UPDATES

BIOLOGICAL EFFECTS

Interest in UV-A Growing...A new FDA study indicates that UV-A radiation used by many commercial suntanning salons and often claimed to be "safer than the sun" may, in fact, lead to skin cancer and premature skin aging. The study, by Dr. Victoria Hitchins at the FDA's Center for Devices and Radiological Health (CDRH), found that UV-A at levels comparable to those emitted by standard tanning devices produced a three-to-fourfold increase in the mutation rate of exposed mouse cells—indicating potential cancer-causing effects. Although UV-A, with longer wavelengths than UV-B radiation used in older tanning devices, may be less likely to cause severe sunburn and corneal burns, its greater skin-penetrating ability may induce serious long-term damage, warned Dr. C. David Lytle, acting director of the center's biophysics division. Lytle added that repeated UV-A exposure may also cause cumulative and permanent eye damage, including cataracts and retinal lesions, and urged the use of protective goggles, even when eyes are closed, during tanning sessions. These new findings are consistent with those of Drs. Meyrick Peak and Jennifer Peak, of the Argonne National Lab, who showed that UV-A can cause breaks and cross-links in cellular DNA (see *MWN,* January/February 1986). For more information about the CDRH findings, contact: Dr. Victoria Hitchins at (301) 443-7110 for research inquiries and Ms. Diana Woods at (301) 443-4190 for consumer questions....Also, watch for the forthcoming paper, "Artificial Suntanning: Spectral Irradiance and Hazard Evaluation of Ultraviolet Sources" by H.P. Gies, C.R. Roy and G. Elliot in the June issue of *Health Physics*....On Saturday, May 10, 1986, *The New York Times* reported on independent studies of Nepalese villagers and Australian aborigines indicating that excessive exposure to sunlight can cause cataracts, and therefore suggesting that wearing sunglasses with dark lenses could protect the eyes from UV radiation. However, in a letter to the *Times* (May 26), Dr. Robert Sekuler, of the Neurobiology-Physiology and Ophthalmology Department at Northwestern University in Evanston, IL, warns that many dark sunglasses not only do not block UV, but place the wearer at increased risk by allowing the pupils to open wider, exposing the eyes to higher doses of invisible, yet harmful radiation. "Instead of rules of thumb," Sekuler recommends, "consumers should get reliable industry-wide labeling."...See also *Newsweek's* June 9 cover story: "Danger in the Sun: A Good Tan May Be Hazardous to Your Health."

COMMUNICATIONS

All Clear on Vashon Island... Washington state epidemiologists have found no evidence that a satellite communications complex is causing cancer among residents of Vashon Island near Seattle. In a May 14 letter, Dr. Samuel Milham and Steve Norsted informed island residents that there is no excess cancer among people living near the Alascom earth station in Paradise Valley. Residents there had reported a cluster of nine cancer cases, including five among women under forty. The satcom station handles telephone traffic between the mainland U.S. and Alaska (see *MWN,* March/April 1986). A cancer registry at the Fred Hutchinson Cancer Research Center listed the same number of cancer cases before and after the Alascom station became operational in 1983. (Milham and Norsted emphasized that the latency period for solid tumors is ten years.) Jay Becker, the editor of the *Vashon-Maury Island Beachcomber,* told *Microwave News* that he is satisfied that there is no cancer cluster but said he is not sure that all the island residents agree.

COMPATIBILITY & INTERFERENCE

Power Surge Downs Rocket... The loss of a NASA Delta rocket and a $57.5 million weather satellite on May 3 has been blamed on two power surges in the rocket engine's electrical system. The May 12 *Aviation Week* reports that telemetry data show that that there were two 150 amp spikes, one lasting about 6-8 milliseconds, the other about 14-15 milliseconds; these spikes caused the main engine to shut down after the voltage in its battery dropped from 28 to 11 volts. Following the loss of power, the Delta rocket began to tumble and was destroyed by ground controllers. There was immediate speculation that a stray radio signal might have been responsible for the engine malfunction, but this possibility was later discounted. On May 10, the *Washington Post* disclosed that after a 1974 accident the electrical system of the second and third stages of the Delta rocket were modified to protect against short circuits, but that, on the advice of Rockwell International, NASA decided not to modify the first stage — the one that malfunctioned in May....See also the timely paper by Boeing's George Ketterling and the Air Force's Major Raymond Vogel and Shirley Briggs, "EM Transient Protection Requirements for Avionics LRUs" (LRUs are electronic line replacement units), in the April 1986 issue of the *IEEE AES Magazine,* published by the Aerospace and Electronic Systems Society.

Open Door Policy... President Reagan's E-4B emergency command plane, a Boeing 747 electronically equipped to serve as a control center in the event of nuclear war, can be an EMI menace. Residents of San Bernardino, CA, not far from March Air Force Base where the E-4B is parked when the President is at his ranch, have had sporadic difficulties with their remote-control garage door openers over the last several years. "It had us buffaloed for a long time," Dr. Larry Murdock of Genie Garage Doors told the Associated Press (April 4), but then he noticed that the problems always accompanied the President's visits. Although the White House press office refused to confirm or deny the allegations, *The Sun,* a San Bernardino paper, reported on April 8 that the Air Force had acknowledged that the E-4B might be responsible. Murdock, who has a doctorate in physics, told *The Sun* that the garage doors returned to normal when the President went back to Washington, DC.

EMI-RFI Market... Frost & Sullivan, Inc., is forecasting an upward trend through the end of the decade for the EMI test equipment industry, due to both the virtual "omnipresence" of electronic and digital devices and the need to comply with FCC rules. The firm's 239-page report, *Electromagnetic and Radiofrequency Interference Test Equipment* (No.1521), predicts a compound annual industry growth rate of 12%, from sales of more than $180 million

in 1984 to nearly $320 million by 1989. Shielded screen rooms, the number one seller, are expected to account for 50% of the market. The largest annual percentage increases are expected in the computer industry (15%) and in the U.S. government (14%). A copy of the report is available for $1,800 from Frost & Sullivan, Inc., 106 Fulton Street, New York, NY 10038, (212) 233-1080.

GOVERNMENT

Gearing Up for Star Wars... Research on the "Star Wars" missile defense system is intensifying, prompting growing interest in health effects associated with exposure to weapon systems that use high-power, pulsed microwave or millimeter-wave radiation. As Dr. Jim Toler of the Georgia Institute of Technology in Atlanta noted at last year's Bioelectromagnetics Society (BEMS) meeting in San Francisco, CA, there are virtually no data on which to base a safety standard for these types of radiation. Now the Army and the Air Force are coming to the rescue. The Walter Reed Army Institute of Research (WRAIR), with labs in Washington, DC, and Forest Glen, MD, will soon begin experimental studies using two different high-power pulsed sources: two 200 million watt (MW) peak power units operating in the 2.5-3.0 GHz frequency range, produced and tested by the Sandia National Labs, and a 10 MW peak power unit (10 GHz) designed by the Naval Research Labs. The WRAIR also has several large anechoic chambers and other pulsed and continuous wave generators in the 0.9-35 GHz range. The WRAIR's interdisciplinary research team is headed by Lt. Col. Edward Elson, MD. In the months ahead, the Walter Reed group will explore the possibility of collaborating with other researchers who wish to make use of the lab's unique equipment. Meanwhile, the Air Force School of Aerospace Medicine (AFSAM) at Brooks Air Force Base, TX, has put the word out that it is looking for a contractor to do research on the "behavioral effects of ultrashort, high peak power pulsed microwave radiation." According to a notice published in the May 21 *Commerce Business Daily* by the AFSAM, those who wish to do this work must have security clearances. In fact, they will need a clearance just to apply. One AFSAM staffer told *Microwave News* that the biological studies themselves will not be classified, but that the principal investigator will need clearance to attend classified briefings. For more information, contact AFSAM's James Merritt at (512) 536-3583. The AFSAM has already sponsored a number of research contracts: Toler and his associates at Georgia Tech prepared a report on "The Effects of High Peak Power Pulsed Millimeter Waves," which includes a literature review – the basis for Toler's 1985 BEMS paper – and they have also designed a millimeter-wave (35 GHz) exposure system for future biological studies. Toler's report to the Air Force is in press and should be ready for distribution at the end of the summer. In addition, the Air Force sponsored research at the University of Utah, which yielded a paper, "Absorption of Millimeter Waves by Human Beings and Its Biological Implications," by Drs. Om Gandhi and Abbas Riazi. Writing in the February 1986 *IEEE Transactions on Microwave Theory and Techniques,* Gandhi and Riazi conclude that there are "potential problems" associated with irradiation in the millimeter-wave frequency band, including "extremely high superficial SARs even for incident power densities of 5-10 mW/cm^2 recommended in safety guidelines. They also urge continued study of occular effects due to energy deposited in the cornea and of the differences in thresholds for perception between millimeter waves and infrared radiation. How exactly might microwaves be used in the Star Wars program? *Microwave Systems News and Communications Technology* gives some hints in a special report, "SDI Offers Challenges and Advances in Technology," in its March 1986 issue. It is doubtful that anyone sees high-power microwaves as a "hard-kill" directed energy weapon, more likely are their potential as a "soft-kill" or "hard-jam" weapon, according to the authors of the report: These systems either burn out the electronics of missiles, aircraft and radars or irreversibly upset their operation.

Radio Marti Compensation... The FCC has approved five new compensation claims to Florida AM radio stations for expenses incurred in offsetting Cuban interference. On January 22, Miami's WNWS was awarded $113,271 and, on February 5, WIOD, also of Miami, was granted $84,027. Then, on February 25, the FCC awarded WVCG of Coral Gables $245,751 for anticipated expenses for increasing nighttime power. More recently, on April 4, WEAT of West Palm Beach was granted $14,397 and, on April 11, WINZ in Miami was awarded $31,460. The first and only previous FCC award ($12,265) was made to WSUN of St. Petersburg in March 1985 (see *MWN,* April 1985). All of the awards to date are for costs incurred *before* Radio Marti went on the air at 1180 kHz on the AM band. Interestingly, despite all the fears, Cuba has not jammed Radio Marti; in fact it has hardly retaliated at all. Compensation is authorized under the law that set up Radio Marti. In 1984, the FCC scrapped the original $250,000 ceiling on claims and ruled that the cost of protective equipment was also reimbursable. Despite the FCC's approval of the six awards, none of the stations has actually received any money, at least partly because the United States Information Agency (USIA), Radio Marti's parent agency, has yet to ask Congress for the funds.

MEASUREMENT

Infrared Radiation (IR)... Barnes Engineering Co. has published the *Handbook of Infrared Radiation Measurement* to help others find solutions to industrial problems involving the measurements of temperature and heat flow. The well-illustrated, typescript, 82-page volume covers the fundamentals of IR and the instruments necessary to measure it. The handbook is available for $6.95 from Barnes Engineering Co., 44 Commerce Rd., PO Box 53, Stamford, CT 06904, (203) 348-5381.

MEETINGS

Wroclaw EMC... Researchers from Bulgaria, England, Japan and the U.S.S.R. will participate in a session on "EM Emissions Related to Earthquakes" at the *8th International Wroclaw Symposium on EMC,* which will be held June 24-26 in Poland. In other sessions, papers will address EMC standards in Czechoslovakia, mechanisms of millimeter

wave bioeffects, EMI problems related to TV transmitters, suggested human exposure guidelines in Italy and RFI in shipboard power lines. For more information, contact: EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland.

Biomedicine and EM Fields... Last December, the Institution of Electrical Engineers (IEE) in London, England, held an *International Conference on Electric and Magnetic Fields in Medicine and Biology*. Thirty-three papers from the meeting have now been published, covering childhood cancer and power lines, electrical stimulation and bone healing, a magnetic nerve stimulator, effects associated with a 750 kV power line and many other topics. A copy of the paperback volume is available in the U.S. for $56.00 from PPL Dept., IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060, ext.382. Credit card orders are accepted. If you do not prepay, add $2.25 for postage and handling. *Non-U.S. residents should contact the IEE, Savoy Place,* London WC2R 0BL, U.K., (01) 240-1871, ext.222.

DOE-EPRI Contractors Meeting... The 1986 review of research by contractors to the Department of Energy (DOE) and to the Electric Power Research Institute (EPRI) will be held at the Sheraton Denver Tech Center in Colorado, November 17-20. The number of presentations will be smaller this year because the New York State Power Line Project has come to an end. A block of rooms has been reserved at the special rate of $50/night, plus tax; call (303) 779-1100 for reservations. For more information, contact Dr. William Wisecup, W/L Associates, 600 S. Frederick Ave., *Gaithersburg, MD 20877, (301) 948-0642.*

POWER LINES

Texas Developments...A consortium of utilities has decided to abandon the proposed 153-mile Walker-Matagorda, TX, DC power line and has petitioned the Federal Energy Regulatory Commission (FERC) for permission to do so. The utilities plan to use existing AC lines in lieu of the planned ±400 kV line. Central Power & Light Co., Houston Lighting & Power Co. and Southwestern Electric Power Co. gave up on the project on May 1, almost two years after a state Public Utilities Commission (PUC) administrative law judge recommended against construction of the line because of potential public health risks. The PUC then remanded the case for further hearings (see *MWN,* November 1984), but the utilities filed suit in District Court in Austin challenging the PUC's jurisdiction in questions of public health. The utilities were initially victorious but then suffered a reversal that would have required a new trial. As a result, they decided to make do with their AC lines....Meanwhile, Houston Lighting & Power Co. is preparing its appeal of the $25 million decision it lost last November (see *MWN,* November/December 1985). The judgment, which cited the utility for "reckless disregard" of *children's health in siting a 345 kV power line across school* property, was based primarily on potential health risks.

Funds for Bioeffects Research... When should government officials stop paying for studies on a particular risk? Professor Granger Morgan of Carnegie Mellon University in Pittsburgh, PA, poses this question with respect to 60 Hz health effects in an editorial in *Science* magazine (May 23). Citing the $25 million award for punitive damages against Houston Lighting and Power Co. over the siting of a power line and the trend toward slashing ELF research budgets (see *MWN, November/December 1985 and above*), Morgan writes, "We have invested enough to produce a body of science that, in its current state, will support vigorous adversarial debate and rancor for years to come and are now truncating government research funding before producing enough science to resolve the question of risk." In a telephone interview, Morgan explained that much more work must be done on ELF bioeffects since we are still formulating the questions to be answered – a far cry from devising the appropriate stopping rules. Morgan's editorial was much discussed at the June Bioelectromagnetics Society meeting in Madison, WI. Indeed, at the opening session, Dr. Ross Adey of the VA Hospital in Loma Linda, CA, called it "irresponsible." Criticisms centered on the fact that Morgan did not distinguish between risk-related studies and pure or fundamental research on the biological action of electromagnetic fields. And while the amounts already spent on ELF research studies might appear to be large they are minuscule when contrasted with the size of the utilities that build and operate the power lines. (Note that there is a typographical error in the fifth line of the first paragraph of Morgan's editorial: the word "effect" should be replaced with "effort.")

Interference... Three recent papers from the IEEE Power Engineering Society: (1) "Carrier Frequency Interference from HVDC Systems" by Neal Patterson of Montreal Engineering Co. in Canada, in the November 1985 *IEEE Transactions on Power Apparatus and Systems;* (2) "Effect of Power Lines on AM Radio Broadcast Radiation Patterns" by R.C. Madge and D.E. Jones of Ontario Hydro in Toronto, Canada; and (3) "Electromagnetic Interference Measurements at 900 MHz on 230 kV and 500 kV Transmission Lines" by the BPA's V.L. Chartier in Vancouver, WA, R. Sheridan and J.N. DiPlacido, of Chas. T. Main, Inc. in Boston, MA, and M.O. Loftness, a consultant in Olympia, WA. The latter two papers appeared in the April 1986 *IEEE Transactions on Power Systems.*

STANDARDS

Computer EMI in Canada... The Canadian Department of Communications has proposed amending its EMI rules for digital equipment. The March 8 proposal would make the Canadian regulations essentially the same as those adopted by the FCC in the U.S. – the limits for conducted and radiated emissions, for both Class A and B devices, are identical. Copies of the Canadian standard are available from the Standards Code and Information Center, NBS, Admin. Bldg. A629, Gaithersburg, MD 20899, (301) 921-2092. Ask for No. TBT 86.45. Or write directly to S.N. Ahmed, Engineering Programs, Dept. of Communications, 300 Slater St., Ottawa, Ontario K1A 0C8, Canada.

Satcom Antennas... The Electronics Industries Association (EIA) has issued a proposed revision of its 1973 recommended standard, EIA-411, *Electrical and Mechanical Characteristics of Earth Station Antennas for Satellite Earth*

Communications. The detailed proposal has a chapter on on-site antenna measurements, including specifics on protection against radiation hazards. For more information, contact Standards Sales Dept., EIA, 2001 Eye St., NW, Washington, DC 20036, (202) 457-4900. Refer to proposal No.1661.

IEC on Short-Circuit Currents... The International Electrotechnical Commission's (IEC) Technical Committee No.73 has issued a new standard for the calculation of the effects of short-circuit currents for AC systems with rated voltages up to 72.5 kV. The 49-page standard covers the electromagnetic effect on rigid and slack conductors as well as the thermal effect on bare conductors. A copy of IEC Publication No.865 (1986) will soon be available for $47.00, plus $5.00 postage and handling, from the International Sales Dept., American National Standards Institute, 1430 Broadway, New York, NY 10018.

VDTs

NIOSH Pregnancy Study...NIOSH has moved a step closer to starting its planned epidemiological study of reproductive risks among VDT operators. The federal Office of Management and Budget (OMB), which rejected NIOSH's study protocol last December, conditionally approved virtually the same study plan on appeal in June. The decision came just weeks after witnesses at two separate congressional hearings suggested that the OMB was blocking the study because of pressure from Bell South, one of the companies that agreed to participate in the project but objected to the protocol (see *MWN,* January/February 1986).

Resources...A Swedish research team has found a possible association between VDT use and operators' skin problems. The 13-member team from the National Board of Occupational Safety and Health (NBOSH), in conjunction with the Karolinska Institute and the Huddinge Hospital, found that "there may be a relation between VDT work and an aggravation of seborrheic dermatitis, acne and rosacea, and possibly also the provocation of poikiloderma of Civatte." The results are included in a five-part study published in the *Scandinavian Journal of Work and Environmental Health, 11,* pp.457-493, 1985: "Subjective Symptoms and Discomfort" (Part I), "Physical Exposure Factors" (Part II), "Ophthalmologic Factors" (Part III), "Refraction, Accommodation, Convergence and Binocular Vision" (Part IV) and "Dermatologic Factors" (Part V). The authors caution that the skin problems may have resulted from either physical or psychological factors and note that none of the observed skin disorders resembled VDT-related rashes reported in Finland in 1982. The study also found that VDT operators reported vision-related problems more often than other office workers, although ophthalmologic and optometric tests failed to identify the causes of the high rate of complaints....Australian researcher Dr. Michael Repacholi dismisses radiation emissions as potential health risks for VDT operators. In "Video Display Terminals — Should Operators be Concerned?" Repacholi states that, "The answer to the question on VDTs posed by the title of this paper...is a categorical NO in relation to radiation exposure" (emphasis in original). The paper appeared in *Australasian Physical & Engineering Sciences in Medicine, 8,* pp.51-61, 1985. Following a review of selected published radiation research, Repacholi questions whether the Delgado effect — fetal damage due to low-level magnetic fields — can be confirmed. "There is no current theory that predicts [that] developmental or other effects could occur from exposure to magnetic field strengths so much lower than the Earth's magnetic field," he writes. "If the effects were found to occur at these low fields, all electronic devices used in the home or workplace would be called into question." Repacholi is chief scientist at the Royal Adelaide Hospital....In a second review article, Dr. Kenneth Foster of the University of Pennsylvania in Philadelphia concludes that ambiguous and incomplete data have fueled concern about possible reproductive risks for VDT operators. Writing in the March-April issue of the *American Scientist* on "The VDT Debate," Foster states that the available evidence does not establish an association between VDT use and reproductive problems or even the likelihood that such a connection might exist. He criticizes the research to date on reproductive clusters among VDT workers and challenges the view that VDT radiation emissions might be capable of causing damage.

ETC...

Debating the Debate... Dr. Ross Adey's extended review of Dr. Robert Becker's *The Body Electric* and Dr. Nicholas Steneck's *The Microwave Debate,* (see *MWN,* June 1985) — much discussed in the non-ionizing radiation community — has now been answered by both authors. Adey's piece appeared in the January/February 1986 issue of *The Sciences*, the magazine of The New York Academy of Sciences. Becker's response is in the magazine's May/June issue, and Steneck's is in the July/August issue.

PEMFs and Chick Eggs

(continued from p.11)

Rooze and Hinsenkamp in Belgium

Drs. M. Rooze and M. Hinsenkamp have found that the 5 msec, 15 Hz EBI pulses can increase the lengths of the bones in chick embryos. Their studies indicate that PEMF stimulation initiates, as well as accelerates, bone formation earlier than in controls.

Writing in *Reconstruction Surgery and Traumatology (19,* pp.87-92, 1985), they also report that PEMF stimulation increases embryonic weights, with more pronounced gains the longer the exposure. Rooze and Hinsenkamp are at the Erasmus University Hospital in Brussels, Belgium.

In an earlier study with quail eggs, also using an EBI signal (though they do not specify which one), the researchers found evidence that it is the electric field, not the magnetic field, that is biologically active. (See their paper in *Interactions Between Electromagnetic Fields and Cells,* A. Chiabrera, et al., eds., New York, NY: Plenum, 1985.)

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Of related interest, see Dr. W.C. Parkinson's paper, "Comments on the Use of Electromagnetic Fields in Biological Studies," *Calcified Tissue International, 37,* pp.198-207, 1985. ●

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HAWAIIAN HOT SPOTS

Cancer Rates Higher Near Honolulu Broadcast Towers

The cancer incidence in eight out of nine census tracts with broadcast towers in Honolulu, HI, is "significantly higher" than in nearby tracts without sources of radiofrequency (RF) radiation, according to a study by the Hawaii Department of Health.

Dr. Bruce Anderson and Alden Henderson, the authors of the report prepared for the Honolulu City Council, conclude that their study design "does not allow for drawing a cause-and-effect relationship between cancer incidence and RF radiation." They recommend additional research and the adoption of an "interim" standard for public exposures to RF radiation "until more information is available on possible long-term effects."

In a telephone interview, Henderson told *Microwave News* that the study points to a "potential problem" but that there is little chance of a follow-up: "The RF problem has low priority – there are only two of us and there are many other pressing environmental issues."

Marilyn Bornhorst, the Honolulu Councilwoman who requested the study, said that, "Our goal is to try to get the towers out of the city." Until recently, broadcast antennas were sited in down-

(continued on p.14)

Lualualei Leukemia Cluster

Between 1979 and 1985, there were nine cases of leukemia – more than four times the expected number (2.1) – among children living within five miles of the U.S. Navy's communications complex at Lualualei, on the island of Oahu in Hawaii, according to the Cancer Research Center of Hawaii (CRCH). Since 1986 no cases have been reported, however.

A full-scale study of the leukemia cluster was never carried out. "We wanted to get funding to take measurements in the homes of the leukemia cases as well as in those of controls," Dr. Loic LeMarchand of CRCH told *Microwave News*, but "unfortunately we did not get the money and then the rates were back to normal."

There were two leukemia cases in 1982 and three in 1983, and one in every other year between 1979 and 1985, except for 1981, when none were reported.

The study would have been difficult to execute, LeMarchand ex-

(continued on p.15)

Major Cancer-ELF Studies Planned in Sweden

Swedish health officials are planning one of the most ambitious epidemiological studies ever undertaken on the possible relationship between power line magnetic fields and cancer. Dr. Anders Ahlbom of the National Institute of Environmental Medicine in Stockholm will direct the case-control study.

The study will include those who lived within 300 meters of a 220 kV or 400 kV power line for at least one year between 1960 and 1983 and who developed any type of childhood cancer, adult brain tumor or leukemia and some of those who developed breast cancer – a total of approximately 1,200 cancer cases, according to preliminary estimates. The study is expected to cost approximately $500,000 and is tentatively scheduled to be completed in 1991.

The epidemiological study is only one of five 50 Hz projects that are now regarded as high priorities by the Swedish Minister of Energy. (The Swedish electrical distribution system operates at 50 Hz, compared to 60 Hz in North America). The total cost of the five projects will be about $1 million.

The other projects will include: an investigation of cancer promotion in cell cultures; a lifetime exposure study (with cancer as the end point) of experimental animals exposed to 50 Hz magnetic fields; an occupational cancer registry study of electrical workers; and an effort to estimate the electric and magnetic field exposures in a number of different occupations. The tissue culture study will be headed by Dr. Kjell Hansson Mild; the other three will be run by Professor Bengt Knave. Mild and Knave are both with the Swedish National Board of Occupational Safety and Health (NBOSH). Mild is based in Umea, and Knave is in Solna (near Stockholm).

In a telephone interview from Stockholm, Ahlbom said that given current gaps in knowledge, it is important to carry out both well-designed epidemiological studies and basic science research on mechanisms.

Mild will also be responsible for the assessment of exposures in Ahlbom's epidemiological study. The magnetic fields inside homes will be measured, as well as estimated, based on the distance from, and the loadings of, the power lines. Dr. David Savitz of the University of North Carolina in Chapel Hill, and Dr. John Bonnell, who recently retired from the Central Electricity Generating Board in London, U.K., will serve as consultants to Ahlbom's research team, as will Knave.

Ahlbom and coworkers are planning to test the study protocol at one 220 kV power line near Stockholm and then at all the major lines in Stockholm county. Once the feasibility phase is completed, they will take on all the major lines in the country.

On his return from Sweden, where he attended a planning meeting in early May, Savitz told *Microwave News* that he was "very impressed" with what he learned. He said that the Swedish researchers should be able to get a good handle on dosimetry because they have a historical record of the loadings on the lines.

Leukemia Among Finnish Electrical Workers

The incidence of leukemia among Finnish electrical linemen and cable joiners was more than three times the expected rate, according to the preliminary results of an epidemiological study by Jukka Juutilainen of the University of Kuopio, E. Pukkala of the Finnish Cancer Registry and E. Läärä of the University of Oulu.

In an abstract scheduled for presentation at the *2nd Hungarian Symposium on Magnetotherapy*, held in May (see *MWN*, March/April 1987), Juutilainen reported that the cancer incidence was highest among linemen and cable joiners, relative to all types of electrical employees, and that these workers "probably had the strongest electromagnetic exposure[s]." He warned against drawing any conclusions, given the small number of cases.

The three researchers will report results on other types of cancer at a later date. Their data were collected by the Finnish Cancer Registry and Central Statistical Office of Finland.

Juutilainen, who also has been studying the effects of pulsed magnetic fields on chick embryos (see *MWN*, May/June 1986), was unable to attend the Hungarian symposium.

Canadian EMF Committee Gets to Work

The newly-organized Canadian Working Group on Electric and Magnetic Fields (EMFs) is in the process of identifying key research areas and gaps in knowledge related to recent reports linking EMFs to health problems, especially cancer.

At its first meeting, held in Ottawa on March 23, the working group adopted the following statement of goals:

> The purpose of the group is to assess the existence and scope of health effects of electric and magnetic fields related to the generation and use of electricity in order to identify knowledge gaps, to foster research to fill these gaps and to educate the Canadian public on the state of scientific understanding.

Also, staffers from the Canadian Electrical Association,

Health and Welfare Canada, Hydro Quebec and Ontario Hydro briefed the group about their ongoing EMF projects. Chairwoman Dr. Maria Stuchly asked members to assemble a list of possible funding sources.

The EMF group was set up last year, after union officials became concerned about the health risks associated with exposure to EMFs (see *MWN*, November/December 1986). Its next meeting is scheduled for July 6 in Toronto.

Members of the working group are: Jim Bolan, Canadian Union of Public Employees; Gary Cwitco, Communication Workers of Canada; Raymond Del Bianco, Canadian Electrical Association; Dr. Yang Mao, Health and Welfare Canada; Dr. A.M. Muc, Ontario Ministry of Labour; Dr. Robert Phillips, Hospital for Sick Children; Dr. Michel Plante, Hydro Quebec; Dr. Sol Sax, Ontario Hydro; Dr. Maria Stuchly (Chairwoman), Health and Welfare Canada; and Dr. Gilles Thériault, McGill University.

For more information, contact: Dr. Maria Stuchly, Bureau of Radiation and Medical Devices, Room 233, Health and Welfare Canada, Environmental Health Center, Tunney's Pasture, Ottawa, Ontario K1A 0L2, Canada, (613) 954-0306.

Assorted Notes

• On April 29, the Texas Public Utilities Commission granted Houston Lighting & Power Co.'s (HL&P) request to reroute its 345 kV power line. In late 1985, a jury awarded a school district $25 million in punitive damages for HL&P's having put the line on school property without proper permission (see *MWN*, November/December 1985), and last year the Texas Supreme Court refused to grant the utility permission to use the line pending its appeal (see *MWN*, November/December 1986). According to court papers HL&P filed in May, the rerouting around the school is costing $4.26 million and will be completed by August or early September.

• At its May 11 meeting in Tampa, the chairman of the Florida Electric and Magnetic Fields Advisory Committee, Dr. Jack Parker, raised a question about how to deal with power intensity windows: Do you ignore them because of the absence of a clear dose-response relationship or do you set a rule to cover the lowest window? The committee plans to asks its consultants about this problem (see *MWN*, March/April 1987).

• In our last issue, we cited skeptical comments on *Science News*'s coverage of the power line-cancer risk. In its April 25 edition, the science weekly published two responses to the letters. After noting his initial skepticism about a cancer link, USC's Dr. Joseph Bowman went on to write, "The epidemiologists have given the physicist's paradigm a resounding kick in the butt, so now is the time for biophysical scientists to get to work. ...Whatever the eventual outcome of the issue, the physicist's arrogance is no longer justified, and must be replaced with some humble research." Dr. Ross Adey cited the ability of some marine vertebrates to detect electric fields as weak as nanovolts/meter and concluded that, "It is truly the miracle of living matter that extremely weak environmental and intrinsic electromagnetic fields exercise powerful influences on intracellular enzyme systems that govern signaling within cells, cellular metabolism and cell growth."

• The IEEE Power Engineering Society is set to meet in San Francisco, July 12-17. Not a single paper will address bioeffects of AC power line fields. There will, however, be one session on "The Effect of Color on the Acceptance of Transmission Lines," chaired by G.A. Davidson of Stone & Webster Engineering Corp.

Ambient Power Distribution Line Fields Measured

The 60 Hz electric and magnetic fields from 2-14.4 kV power distribution lines in the streets of Montreal, Canada, are "relatively strong," according to a survey by Dr. Paul Héroux of the Institut de Recherche d'Hydro-Québec. Typical values are 32 V/m and 0.16 μT (1.6 mG), respectively, for the electric and magnetic fields.

By comparison, Héroux notes that his data indicate that "a person walking the streets would be above the threshold determined by Liboff et al. between [20% and 77%] of the time" – referring to a study by Dr. Abraham Liboff, which showed that 15 Hz-4 kHz sinusoidal magnetic fields could enhance DNA synthesis in human fibroblasts (see *MWN*, October 1983, and *Science, 223*, pp.818-820, 1984). Héroux cautions that ambient – in contrast to *in vitro* – exposures "vary considerably."

Héroux observes that the magnetic fields vary much less than the electric fields. Also, measured at a height of 1 m, the magnetic fields from underground cables can exceed those from overhead lines – 0.5-1.9 μT vs. 0.15-1 μT.

Based on measurements over 223 km of roads, the magnetic fields were greater than 0.04 μT 90% of the time, greater than 0.16 μT 50% of the time, greater than 0.51 μT 10% of the time and greater than 1.08 μT 1% of the time. See Héroux's paper in *Bioelectromagnetics, 8*, pp.135-148, 1987.

HIGHLIGHTS

Diapulse Back on Market

Fifteen years after the Food and Drug Administration (FDA) ordered Diapulse® – a medical device using pulsed high frequency electromagnetic fields – off the market, the agency has agreed to its use for the treatment of post-operative swelling and pain.

At the end of March, a New York federal court approved a joint FDA-Diapulse Corporation of America proposal to allow the company to market its device for "adjunctive use in the palliative treatment of post-operative edema and pain in superficial soft tissue."

The Diapulse unit uses pulsed 27.12 MHz radiation with 80-600 pulses per second, each having a width of 65 usec. Its peak power is 293-975 watts, with an average power of 1.5-38 watts.

Diapulse was developed by Dr. A.J. Ginsberg in the 1940s and was first marketed in the early 1960s. Following years of acrimonious disputes, the FDA forced it off the market in 1972.

"We got caught in the thermal vs. non-thermal effects controversy," Diapulse Corp. Vice-President Bern Siler told *Microwave News,* "because the device causes no significant temperature rise."

The FDA's Roger Schneider agrees that was part of the problem. "Back in the early days, the agency's compliance staff and its medical advisors were simply not prepared to believe that electromagnetic energy could bring about non-thermal, beneficial effects," he said in a telephone interview. Schneider, the associate director for science at the FDA's Center for Devices and Radiological Health in Rockville, MD, added that Diapulse officials did not appreciate the kinds of medical data needed to satisfy the FDA. "They should have had better-designed experiments to argue their case because in those days anybody who claimed non-thermal effects was thought to be a quack."

Under the settlement, Diapulse Corp. can only market its unit for a small fraction of its original treatment claims. Because the unit was first sold before the 1976 medical device amendments, which codified the FDA's rigorous premarket approval (PMA) process, the company did not have to pass PMA review for any of its original claims – including the now-approved treatment of post-surgery swelling and pain.

The FDA's recent decision was based, in part, on an oral surgeon's "quite dramatic results," in which Diapulse therapy reduced edema and pain, Schneider said. These data were collected some time ago but only convinced the FDA after they were recently supplemented and reanalyzed.

Diapulse Corp. plans to ask the FDA's permission to expand the device's applications, according to Siler. Among its possible future uses are for healing soft tissue wounds and spinal cord injuries (see box).

The Diapulse unit costs $10,500; it can also be leased. Siler said that the company had survived for the last 15 years through sales in European countries, including Austria, England, France and Switzerland. The company is based in Great Neck, NY.

Treating Spinal Cord Injuries with Diapulse

Dr. Wise Young of the New York University (NYU) Medical Center in New York City has successfully used Diapulse radiation to treat cats with acute spinal cord injuries. In functional studies, up to half the cats that received Diapulse therapy shortly after injury recovered within two months, while none of the controls significantly improved.

"The phenomenon is real," Young told *Microwave News* in a telephone interview. "The major problem now is how it works."

Young has found one important clue: Diapulse therapy reduces the amount of calcium accumulating at the site of injury. He speculated that because blood clotting is a calcium-dependent process, Diapulse could affect the clotting mechanism.

The FDA's Roger Schneider, who coordinated the FDA's recent review of Diapulse, called the Young results "impressive."

Young, the director of the NYU Medical Center's Neurosurgery Laboratories, said that he is in the process of preparing papers for publication on his research with cats. He is presently working with tissue culture, he explained, in an effort to try to understand the mechanism of interaction.

Faulty VDT Screens

Certain types of commonly used anti-static VDT screens stop working after six months, according to a Swedish survey of over 100 carbon-treated nylon mesh electrostatic shields. Dr. Mats Berg of the Karolinska Hospital and Ingvar Langlet of the National Institute of Radiation Protection reported this "remarkable" finding in a letter to *The Lancet* (April 4, 1987), England's leading medical journal.

"After some months the carbon film seems to be transformed into a non-conducting state," they concluded. Screens with metal nets or metallized plastic do not deteriorate.

In a telephone interview from his office in Stockholm, Langlet, a physicist, said that the only way one can be certain a shield is still effective is by measuring the static charge: "You cannot say anything about the quality of a screen without testing it in the workplace." When asked whether his results might apply in the U.S.,

Langlet replied, "It could be the same situation as in Sweden."

Berg and Langlet tested the screens as part of an investigation of VDT-related skin rashes. In a letter to *Microwave News*, Berg, who is in the Department of Dermatology, wrote that they are in the midst of a study of 4,000 office workers – 2,000 VDT operators and 2,000 controls. The results should be published in about a year.

Langlet said that the vast majority of the screens tested were the "Power Screens" made by Power System AB, based in Stockholm. Screen Data Corp. of Whippany, NJ, one of the leading sellers of anti-static, carbon-impregnated nylon mesh screens in the U.S., is a subsidiary of Power System, and its screens are the same, according to Screen Data's Mike Kling.

Screen Data and Sun-Flex Inc. of Novato, CA, the other leading U.S. manufacturer of carbon-nylon mesh screens, now use essentially the same carbon-embedded mesh for their monochrome VDT filters. Tony Gault, president of Sun-Flex, said that the fiber is made in the U.S. and is woven into mesh in Switzerland.

Representatives from Screen Data and Sun-Flex challenged the Swedish findings. "We have not had any complaints about our screens; they should last indefinitely," Ed Thomson, Sun-Flex's manager of communications, said.

Langlet recommended that VDTs be retrofitted to guarantee anti-static protection. He said that, in Sweden, the cost of retrofitting a VDT is about the same as two anti-static filters – $150.00.

The reason for the deterioration of the screens is unclear. Langlet suggested that it may have something to do with the action of electrical forces, possibly from air pollutants in the office environment. But he did say that the loss of the anti-static properties is not simply due to age: "We found some unused, old screens and, when tested, they still worked." Another, different problem, he added, is that some of the screens are not properly grounded.

Herman Kappel, president of Kantek Inc. in New York City, another maker of carbon mesh screens, offered a simple test to identify whether an anti-static screen is still working: "If dust is accumulating on the screen, you know something is wrong." Indeed, *The Lancet* letter noted, "Female operators often report that eye make-up is deposited on the VDT screen at the end of the working day."

VDT screens are a $70-million-a-year market in the U.S., industry sources estimate – though there are no reliable statistics available. While some screens exclusively protect against glare, others add an anti-static component and still others also claim to shield very low frequency radiation.

FM Station Accepts 10 μW Limit

A Denver, Colorado FM station, KYGO, has agreed to a set of stringent precautions to limit radiation levels at a camp on whose land its radio tower is located, according to the camp's lawyers.

Attorneys Bruce DeBoskey and Joe Silver, who negotiated the settlement for Beryl and Maelma Main, owners of the Lighted Lantern Square Dance Camp, said that under an agreement signed on June 12, KYGO has reduced power from 100 kW to 1 kW and will operate from an alternate antenna during the camp's summer season. If the radio station opts to use the tower in the fall, it will continue to broadcast at only 1 kW and will erect a fence around all areas of camp property where fields exceed 10 $\mu W/cm^2$.

A recent Environmental Protection Agency (EPA) and Federal Communications Commission (FCC) survey of the radiation levels near the KYGO tower revealed that, "Many people could... visit areas where power densities exceed 1,000 $\mu W/cm^2$." The main camp building is within 100 feet of the tower, and the EPA-FCC team found radiation levels of approximately 100 $\mu W/cm^2$ in the commissary and up to 300 $\mu W/cm^2$ on the patio/deck (see *MWN*, March/ April 1987).

After the EPA-FCC measurements were released earlier this year, Wayne Phillips, KYGO's general manager, told the *Denver Post* that the station plans to relocate. Phillips did not return calls from *Microwave News*. KYGO is owned and operated by Jefferson-Pilot Broadcasting Inc.

Beryl Main has developed non-Hodgkin's lymphoma and intends to pursue a claim that his cancer was caused by the FM antenna. If he does, his suit will be another in a series seeking to link radiofrequency (RF) radiation with cancer (see *MWN*, May/June and September/October 1986).

Last year a California FM station closed down rather than comply with the FCC's RF rules (see *MWN*, March/April 1986).

Difficult Times for EBI

A Food and Drug Administration (FDA) advisory panel has recommended the removal of Electro-Biology Inc.'s (EBI) bone growth stimulator from the market. After reviewing data on patients who had been treated with the device, the Orthopedic and Rehabilitation Devices Panel questioned the efficacy of the EBI stimulator, which uses pulsed electromagnetic fields.

The panel's recommendation, made at a May 7-8 meet-

ing, is not binding; FDA regulators must decide whether to stop the use of the device, which has been on the market since 1979. An FDA spokesman said that the panel members did not find any safety problems with the device; they only questioned its efficacy. The chairman of the panel is Dr. Michael Mayor of the Dartmouth-Hitchcock Medical Center in Hanover, NH.

The FDA spokesman added that only EBI's device is under review at the moment, but that other stimulators will undergo a similar long-term assessment.

In its response, EBI charged that the panel's decision "was based on very limited data," and that the company "will vigorously attempt to rebut the panel's conclusions." Nevertheless, one FDA official told *Microwave News* that the agency is taking the panel's recommendation "very seriously." The FDA could take two to six months to decide the fate of the EBI device.

In some ways, the panel's May decision flows directly out of its discussions at an October 31, 1986 meeting. At that time, panel members voiced the need for double blind studies with concurrent controls to demonstrate the efficacy of electromagnetic bone growth stimulators. As Dr. Randall Lewis, an orthopedic surgeon based in Washington, DC, argued, "I cannot envision any circumstance under which historical control[s] would be adequate." Lewis also stated that "double blind studies are not unethical." Trying to show efficacy without double blind studies has long been controversial (see *MWN*, May 1981).

In other developments, American Medical Electronics Inc. (AME) and Biolectron Inc. petitioned the FDA in March to limit the use of EBI's stimulator for non-union fractures of greater than nine months duration. (AME, Biolectron and EBI are the only three FDA-approved bone growth stimulators.) The two competitors complained that some doctors were using the EBI device for "fresh" fractures and argued that, since the data for the three devices are comparable, they should all be used in the same way – only for fractures nine months or older. EBI said that it will contest the petition, which it regards as "anti-competitive."

And in early June came news that EBI has won a favorable ruling on its long-running patent infringement lawsuit against AME. Official details were not available at press time, but there is speculation that, if the ruling holds, AME may discontinue operations.

Military Systems: A Review

Outlined below is a system-by-system update of recent developments in several major military radar and communications projects.

PAVE PAWS

The maximum time-averaged radiation level in the communities near the Air Force's PAVE PAWS 420-450 MHz radar on Cape Cod was 0.139 $\mu W/cm^2$, according to a survey by the Air Force's Engineering Installation Group (EIG) from Keesler Air Force Base (AFB), MS. The highest reading was taken at a height of 86 feet, atop a fire tower 3.2 miles from – and in direct line-of-sight to – the radar. At all other sites the power densities were significantly less; none exceeded 0.03 $\mu W/cm^2$ at a height of 6 feet.

The survey was prompted in part by a need to monitor exposures of maintenance and construction personnel and in part to assist the Massachusetts Department of Public Health in its investigation of an abnormally high cancer incidence in the Cape Cod area.

On the base, EIG found a maximum field of 3.7 mW/cm^2 atop one of 17 lampposts (38 feet high) and readings of over 1 mW/cm^2 atop 6 others. EIG recommended that the radar be turned off when workers are on these lampposts. At one of 7 security camera locations, each approximately 15 feet high, a level of 745 $\mu W/cm^2$ was measured. At 6 feet above ground level near the lampposts and the security cameras, EIG measured a maximum 1.85 mW/cm^2 field, with many of the measurements below 1 mW/cm^2.

According to *Aviation Week* (May 18), the Air Force had been planning to increase power at the Cape Cod PAVE PAWS radar by 6 dB – a factor of four – but is now holding off. A 6 dB increase at Beale AFB, CA, may occur first, however, if the Air Force receives the necessary funding for fiscal 1989. Meanwhile, the fourth PAVE PAWS radar – at Eldorado Air Force Station, TX – was completed in May.

The EIG's measurements, which have an uncertainty of ±2 dB, are reported in *Radiofrequency Radiation Survey for the AN/FPS-115 PAVE PAWS Radar, Cape Cod AFS, MA: 18-30 September 1986* (Report No.86-33), which was obtained by *Microwave News* under the Freedom of Information Act. For further information, contact: Kevin Gilmartin, USAF Electronic Systems Division, Hanscom AFB, MA 01731, (617) 377-4064.

GWEN DEIS

The Air Force recently issued a draft environmental impact statement (DEIS) for the Ground Wave Emergency Network (GWEN), a 150-175 kHz communications system designed to survive a nuclear electromagnetic pulse (EMP).

In the DEIS, the Air Force concludes that electric fields from the "relay nodes" would be 50 V/m or less – a safety level recommended by John Mitchell of the AF School of Aerospace Medicine at Brooks AFB, TX (see *MWN*, January/February and November/December 1986). Magnetic fields at the fence would be approximately 30 mA/m.

For continuous UHF transmissions, the Air Force estimates that there would be a maximum exposure of

2.9 μW/cm² for a six-foot-tall human 20 feet from the transmitting antenna, inside the public exclusion area – or 1 μW/cm² allowing for the transmitter's 40% duty cycle.

The GWEN DEIS is also available from Hanscom AFB. The Air Force plans to issue a final EIS in August.

OTH-B

The Air Force has released EISs for two planned Over-the-Horizon-Backscatter (OTH-B) radar systems. In an August 1986 DEIS for the proposed central OTH-B radar, to be located in North and South Dakota and/or in Minnesota, the Air Force concludes that power levels in accessible areas would be below the 1982 ANSI limits – 36-1.15 mW/cm² at the OTH-B's operating frequencies of 5-28 MHz.

The Air Force has developed an "Operational Plan for [RF] Interference Avoidance" to limit potential interference to other users of the OTH-B frequencies and its harmonics, including TVs, CB radios, amateur radios and air-to-ground communications, according to the DEIS.

Similar analyses accompany the Air Force's final EIS for the proposed OTH-B radar in south-central Alaska, released in January 1987.

Both EISs are available from Lt. V.G. Brown, ESD/SCO, Hanscom AFB, MA 01731, (617) 271-5364.

The only completed OTH-B, in Maine, is undergoing trials, but delays in computer software development are slowing the process. General Electric, which built the Maine radar, recently received the contract for the Alaska facility.

In other OTH-B news, the Navy has announced plans to seal off a small wilderness island off the coast of Alaska as the initial site for a new, relocatable OTH radar (ROTHR), *Defense Week* reported (November 24, 1986). The Navy hopes to begin operating the ROTHR by 1989. Finally, Australia has announced plans to build a three-station OTH-B radar system; and Japan will send a delegation to the U.S. to study the OTH-B radar, and may build its own.

EMPRESS II

Congressional opposition to the Navy's plan to site its Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS II) on Chesapeake Bay continues to increase (see *MWN*, January/February and March/April 1987). Republican Senator John Warner of Virginia, a former Secretary of the Navy, has introduced an amendment to the Defense Department's fiscal 1988 authorization bill to block *permanently* the Navy's Chesapeake Bay siting recommendation. Democratic Representative Roy Dyson of Maryland, who has in the past led efforts to block siting on a yearly basis, has offered a similar amendment in the House and predicts he has enough votes to pass the measure.

Project ELF

The Navy has suspended further development of the Satellite Laser Communications (SLC) system, which would use blue-green lasers to communicate with submerged submarines, supplementing or replacing Project ELF (see *MWN*, May 1985). The Navy has refused to fund the SLC at $100 million over the next two to three years, a decision which Defense Advanced Research Projects Agency officials complain will kill the project, according to the March 2 *Defense News*.

Meanwhile, Project ELF is "moving toward operational capability," a Defense Department official told *Aviation Week* (March 9): The long-contested transmitter antenna sites in Wisconsin and Michigan are almost completed and submarine receivers are in production.

FROM THE FIELD

Epidemiological Evidence for an EMF-Cancer Link: An Exchange

Excerpted below is an edited and shortened version of An Epidemiologic Perspective on Electromagnetic Fields (EMFs) and Cancer *by Professor Philip Cole, chairman of the Department of Epidemiology at the University of Alabama in Birmingham, which was prepared for the state of Florida's Electric and Magnetic Field Advisory Panel (see* MWN, *March/April 1987). Drs. Nancy Wertheimer and David Savitz's responses to Cole have also been edited and shortened. Savitz revised his comments before making them available to* Microwave News.

Cole's Perspective

Wertheimer and Leeper (1979)...The paper...brought to the fore the question of EMF and cancer among children. The paper represents that all forms of childhood cancer, but especially leukemia, are increased about two- to three-fold among children who are exposed to "high current" configurations in their household wiring....

I was most struck by two aspects of the paper which I do not believe have been mentioned by others and which cause me to be unable to place confidence in it. The first is the complete absence of the analytic methods of epidemiology. Even the primary associations are described only in terms of statistical significance. There are no relative risks (RRs)....

The second problem is what I can only term the paper's "inordinate consistency." There are about 30 (not necessarily independent) comparisons made. When these comparisons are expressed in terms of RRs, they can be seen all (but one) to lie in the range of 2.0 to 3.0....

Finally, the paper represents that the positive results pertain to leukemia, to lymphoma and to nervous system and other cancers of childhood. And...Wertheimer has represented that similar findings pertain to most forms of cancers of adults. In short, it appears that Wertheimer proposes that she has provided evidence that EMF increases considerably the risk of

all forms of cancer, both of children and of adults. This stretches credulity....

With regard to interpretation of the Wertheimer and Leeper 1979 report, there can be little doubt about the possibilities of chance and confounding. Neither of these two factors can explain the results at all. The consistency of the results obviates chance....Thus, we are left with the question, "Is the study biased or does it reflect causality or is there an element of both?" The answer is that it is biased. No other study approaches this one in strength or consistency of findings, despite better methodology....[T]he Savitz study must be regarded as generally superior and, perhaps, much superior. This is especially so for exposure assessment. This, in turn, should cause the Savitz study to be more strongly positive and the more consistent of the two. It is, unarguably, neither.

The Savitz Study (1986)...The [draft] Savitz study must be viewed as the definitive work, to date, on the question of EMF and cancer among children. Its only limitations are those put forward by Dr. Savitz himself: 1) it is somewhat small; 2) cooperation, especially of the controls, was deficient; and 3) results may pertain uniquely to the Denver setting. I consider only criticism number (2) to have...[valid] implications. I also believe that the analysis section is thorough...and the interpretation reasonable, even though it is not an interpretation that I wholly share. The further point that Dr. Savitz has advanced – that exposure measurement needs to be improved, perhaps goes without saying, but it is not clear that it could have been done better.

I consider the Savitz study to be an essentially null study and one that is, in any case, very different in its results from the Wertheimer and Leeper (1979) report. My opinion is based on three observations: 1) The amount of data generated and the number of RRs presented are enormous. Yet, there are nearly as many RRs below 1.0 as above.... 2) There is no consistent dose-response.... 3) A crucial age-effect is missing....

This interpretation is offered of the Savitz study: The results presented show a slight but inconsistent trend to the positive. There is no dose-response relationship and no internal consistency in the data. The study may be viewed as only suggestive of a weak effect. It argues strongly against any major or consistent effect. It is consistent with nullness.

Other Epidemiologic Studies...Most of these studies were done in an occupational setting and used industry or job title as an indicator of EMF exposures. However, four of the studies pertain to residential EMF exposures....This is not an exhaustive review....The proportionate mortality studies [PMRS] provide the most limited and potentially flawed data pertaining to cancer and EMFs, while [retrospective follow-up studies (RFUS)] are the most methodologically sound. The case-control studies [CCS] occupy an intermediate position. The residential studies are discussed separately.

PMRS...The six most pertinent studies [are Milham (1982), Wright (1983), Coleman (1983), McDowall (1983), Calle (1985) and Milham (1985)]....A diversity of occupations involving potential EMF exposures were considered in these studies and all subjects were assumed to have experienced such exposures. However, it is probably true that many of these workers were, in fact, exposed little or not at all....

The PMRS provide little or no evidence that EMF exposures are a cause of human leukemia. They are not convincing mainly because of the inherent limitations of a PMR....In summary, the PMRS are interpreted as, essentially, negative.

CCS...[McDowall (1983), Pearce (1985), Lin (1985), Flodin (1986) and Stern (1986)] have a number of methodologic limitations for the purpose of evaluating the relationship between EMFs and cancer. For example, no direct measurements of EMFs were made in any of them and, with the exception of Lin's study, no attempt was made to evaluate dose-response. Furthermore, the men in these studies may have been exposed to other carcinogens which may explain their apparent excess of these cancers. Nonetheless, there is a clear tendency for positive findings in these studies. This is highly unlikely to be due to chance. It is also difficult to imagine how a bias or confounding by some factor could explain the consistent positive findings. However, a possible explanation of these positive findings is a propensity of investigators to report only positive results....

RFUS...None of the [five Swedish RFUS, Vagerö (1983), Vagerö (1985), Olin (1985), Barregard (1985) and Törnqvist (1986)]...found an excess of leukemia and four of the five found no excess of cancer of the nervous system. The fifth study...[did].

The results of the RFUS clearly contradict the CCS. The RFUS also suffer limitations as do the CCS. For example, two of the studies were quite small and so do not provide persuasively negative results....However, on the whole, the methodology of these RFUS is better than that of the CCS. More importantly, these RFUS were designed specifically for the purpose of investigating the role of the EMFs in the etiology of cancer....For these reasons, considerably more weight should be placed on the results of the RFUS, than on the CCS....The occupational RFUS provide moderate or strong evidence that EMFs have no meaningful role in the etiology of cancer.

Residential Studies of EMFs and Cancer...Fulton (1980) conducted a CCS of childhood leukemia and residential wire configurations in Rhode Island. These investigators did not find a positive association....However, the validity of this study was challenged by Wertheimer. She claimed that the control distribution of residences was biased....The result of this bias would be to provide underestimates of the RRs. She re-analyzed a subset of Fulton's data, presumably correcting for this urban bias, and reported a statistically significant positive association. Fulton did not respond to her criticisms of his study. Thus, the findings and interpretation of Fulton's study are unclear and it must be considered a non-persuasive negative study.

Tomenius (1986) conducted a CCS of childhood cancer and EMFs in Sweden....An overall statistically significant RR of 1.4 was reported for all cancers....However...among the exposed, there is an *inverse* trend between distance of dwelling from the relevant electrical configuration and cancer risk. This observation argues against a causal interpretation of the weak overall positive finding.

Wertheimer and Leeper (1982) conducted a CCS of adult cancer in relation to residential wire configurations. They reported a strong and remarkably consistent positive association between overall cancer and EMFs....However, as in her study of childhood cancer, the coding of residential wire configurations was not done blinded and hence the positive findings may reflect observer bias. This study also suffers other limitations similar to those described above for her study of childhood cancer.

McDowall['s] (1986)...RFUS [showed]...no overall excess of all cancer mortality, nor of leukemia....There was a slight, nonsignificant excess of lung cancer mortality. However, this could not be directly attributed to EMFs. A limitation of this study is that some of these people probably moved away from these residences subsequent to 1971, introducing a dilution of the outcome. Nonetheless, this is a sound epidemiologic study which provides additional evidence that exposure to EMFs is unrelated to the occurrence of human cancer.

New Information...[I]f it were true that EMFs cause leukemia

among children...then one might reasonably expect that during this century the childhood leukemia death rate would have risen more or less progressively....It is evident that power consumption has risen strikingly, there having been nearly a 100% increase in every decade. At the same time, leukemia mortality rates have shown a rise of about 40% per decade up to about 1950 and, typically, a *decline* thereafter....

These results for leukemia and CNS neoplasms, taken together, suggest that either there is no causal relationship between exposure to EMFs and these conditions in children or that, if there is any effect, it must be very small....

Conclusions: The collective pattern of results that emerges from the epidemiologic reports is that of a weak, transitory effect that is not supported by consistent dose-response relationships or other internal characteristics of the data. A summation can only be that either there is no relationship between EMFs and cancer in human beings or if there is an effect it must be of very low magnitude even among people who are moderately to heavily exposed.

The above interpretation is fully supported by the absence of a temporal correlation between per capita electric power consumption and mortality rates of leukemia and CNS cancer among children in the United States.

Wertheimer's Response

...Dr. Cole seems to be reaching too hard to find explanations that deny the generally consistent positive findings of the studies. He says, for instance, that our study cannot be wrong because of chance or confounding, so it must be wrong because of bias; then, not believing that the Savitz results have the same problems with bias, he says they must be wrong because of uncooperative controls....Dr. Cole then recognizes that the major flaws of the occupational studies are unlikely to have produced the positive results found, so he concludes that those positive results are wrong because negative results were not published (though one must realize that powerful funding sources exist that welcome the finding and reporting of negative results), etc.

...I agree with Dr. Cole that it is particularly important to perceive the pattern of a number of epidemiological studies in evaluating a field. However, the strength of effect he looks for may be hard to attain for 60 Hz EMFs, because control groups will be universally exposed to this agent, diluting the risk ratios....

Responding to Dr. Cole's criticisms of our 1979 paper...He criticizes our method of data presentation. While our presentation was simple, I believe it was adequate (especially since Dr. Cole seems to have been able to compute the RRs and ARs he wanted from the data provided)....

Dr. Cole is skeptical about the similarity of risks seen for several different analyses. This is less surprising when one considers that the various analyses he refers to are simply different perspectives on the same basic data....

Finally, Dr. Cole suggests that since the Savitz study was superior to ours, Savitz should have gotten stronger, more consistent findings than we did. Actually, the differences between Savitz's results and ours (which are not so great) may have little to do with how well either study was done. The differences could be real: For instance, our work covered an era when young children usually stayed at home, but in the era Savitz covered children more often spent time at day-care centers, away from the home. Further, divorce, with division of the child's time between different homes, was probably more common in the era Dr. Savitz covers. Both of these factors, by decreasing the time the child spent in the coded home, may well have weakened Dr. Savitz's results.

Concerning the Savitz study: Dr. Cole contends that the Savitz data show as many RRs under as over 1.0, and that therefore the study is null and fails to confirm our findings. However, many of the RRs (such as those relating to electric fields) that are under 1.0 were not intended to test our hypotheses. No one claimed they should be over 1.0....I don't myself think that counting RRs from non-independent tables is a very useful way to evaluate a study, but at least the results do seem to show that, no matter how one cuts the data, high-exposure homes generally have a greater cancer risk than low-exposure homes....

Concerning other studies cited by Dr. Cole: Dr. Cole discusses a number of studies linking cancer with occupational EMF exposures (although he omits an interesting study by Swerdlow (1983), linking eye cancer (mostly melanoma) to electrical occupations....

I would agree that, in general, these studies cannot cast much light on our present problem because 50-60 Hz exposure cannot be assessed very well from occupational titles alone, and because, although "something seems to be going on," it may have to do with fumes and solvents rather than EMF exposure. However, my rough attempt to sort out probable exposures on the basis of job titles did not suggest that fumes and solvents are the whole story, or even the major part of the story.

I am concerned that Dr. Cole seems to put the most weight on what he sees as negative results from five RFUS studies [Vagerö (1983), Vagerö (1985), Olin (1985), Barregard (1985) and Törnqvist (1986)]; yet each of these studies has either little convincing evidence of 50-60 Hz exposure, or little convincing evidence that the cancer rates were unaffected, or both....

In Tomenius's study only the 200+ kV lines were shown to produce excess exposure. For these power lines a significantly increased cancer risk of 2.1 was, in fact, seen....When...[I reworked his data], a positive dose-relationship with distance is seen....

The problems of the McDowall (1986) study are severe, for he provides no evidence whatever that his "exposed" homes actually do receive increased 50 Hz EMF exposure. In fact... there is little reason to expect such exposure....

Concerning Dr. Cole's contention that childhood cancer rates should have increased in this century if power lines were responsible for a fair share of childhood cancer: This is a naive assumption....There is actually little reason to suppose that exposure to 60 Hz EMFs has increased over the century simply because use of electricity has increased: High power use need not produce high EMFs.

As both the Savitz study and Kaune's work in Washington state showed, the EMF exposure at a house is not related to the total power use in that house. Furthermore, as power use has increased, technology has changed in a number of ways that *reduce* field exposure....

Perhaps most important is the clear finding of the Savitz study that buried distribution wires – a recent technology – generally produce less field in nearby homes than the old-fashioned overhead wires. In connection with this advent of buried wire construction, Dr. Cole's table of changes in the cancer rate of children from 1920-1980 actually fits nicely with the changes expected in EMFs produced in homes by power lines: The years when the old overhead wires were carrying more and more current (1920 into the 1960s) show increasing cancer rates, but these rates seem to have decreased since buried wires became common in the new suburbs....

Savitz's Response

...I should first acknowledge that the array of available epidemiologic information is sufficiently incomplete and contradictory that further inspection of existing data is unlikely to resolve the issue. That is, the existing data are unfortunately compatible with an array of views, including Dr. Cole's judgement that "there is no relationship between EMFs and cancer in human beings or if there is an effect it must be of very low magnitude."

Because I agree with much of what Dr. Cole has written, I will only focus on areas about which I would raise questions. In regard to my own data, I would question the legitimacy of declaring it negative based on a preponderance of risk ratios around the null value. One of the hazards of generating as many risk estimates as I did is the problem of making sense of the pattern. Although many individual risk estimates (e.g., for measured fields) suggest no effect, there are reasons to argue that the results from the analysis of wire codes reflect the best estimate available of long-term low-level magnetic field exposures in the home. If the "best" measure showed an effect and weaker measures showed weaker effects, this would be compatible with a causal relationship. The merits of the different exposure measures are open to debate, but the absence of effect for electric field measures and possibly even for magnetic field measures does not negate the potential importance of the wiring data.

The absence of a clear dose-response for the wire coding data is also acknowledged, but if one considers the relationship of average magnetic field to wire code, this could explain the lack of distinction among the lowest three levels (buried, VLCC, OLCC) and an increasing risk for OHCC and for VHCC, as was found. Part of the reason for no dose-response gradient might be the absence of a real gradient in exposure across the five wire code categories. The most substantial differences in risk corresponded to the most substantial differences in measured magnetic fields related to the wire codes.

...Dr. Cole's suggestion that even supposedly "positive studies" are not entirely consistent prompted me to try to synthesize the information from just the childhood cancer studies [Wertheimer & Leeper (1979), Fulton et al. (1980), Tomenius (1986), Coleman et al. (1985), Myers et al. (1985) and Savitz (unpublished)]. I fully agree that there are inconsistencies even among the "positive" studies. The type of cancer showing the greatest effect varies markedly and the overall constellation of data does not all point in the same direction. Thus, the imperfect array of available data are consistent with the absence of a causal association as well as being consistent with a true, causal effect which has been clouded by methodological problems and random error.

The temporal trends and other aspects of existing literature are interpreted as indicating that a large effect of EMFs on cancer risk is unlikely, with which I also agree. Each line of evidence has a reasonable competitor to a causal interpretation, including the data from our own study. Nonetheless, the constellation of suggestive data is not easily dismissed in that postulating a true causal effect which has been diluted through poor exposure measurement can account for many (but by no means all) of the observations. The uncertainty in exposure identification pervades the literature, with most studies likely to be biased towards the null. I disagree with the assertion that "an effect must be of very low magnitude even among people who are moderately to heavily exposed" since we have yet to effectively isolate persons who have such levels of the relevant exposure.

It seems the most reasonable, unbiased reviewers of these studies come to the general conclusion that a causal effect of EMFs on human cancer has not been proven but that there are positive suggestions which should not be dismissed. There is less agreement on the more subtle questions of how close are we to proving causality, how compatible are the data with no causal association and how we should react to this uncertainty.

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UPDATES

BIOLOGICAL EFFECTS

Copper-Microwave Synergy... The latest results from the ongoing collaboration between the FDA's Drs. Jose-Luis Sagripanti and Mays Swicord and Dr. Christopher Davis of the University of Maryland in College Park indicate a synergistic reaction between microwaves and copper in damaging plasmid DNA. The researchers exposed purified plasmids – extrachromosomal rings of DNA – to 2.00-8.75 GHz radiation and found that in the presence of small amounts of copper, the radiation can lead to a statistically significant increase in single- and double-strand breaks. The effect is "linearly related to both the power applied and the duration of the exposure to MW," and, unlike the team's previous results, was observed throughout the frequency range and was not correlated with resonant frequencies, though it is possible that "the sensitivity required for detecting any resonant effects may well be out of the range of the technique used...." Microwaves alone did not affect the DNA. The researchers are emphatic that microwave heating played no part in the effect, and that their antenna did not cause any "hot spots." Follow-up studies showed that cuprous (Cu^{+}), but not cupric (Cu^{++}), ions on their own can mimic the microwave effect. The copper-microwave synergy was discovered when the researchers found that their sham-exposed sample of DNA in contact with the antenna, which was not radiating, suffered more damage than the control sample. The group cautions others to be careful in interpreting their experimental results if samples are in contact with a metallic antenna. The mechanism for the synergistic interaction remains "unclear." The team's paper appears in *Radiation Research, 110,* pp.219-231, May 1987 (see also *MWN*, May and November 1984)

COMPATIBILITY & INTERFERENCE

AM Interference...A listener survey conducted by the National Association of Broadcasters (NAB) found that while 60% of the respondents said that at sometime they heard static or interference on their AM stations, *none* of them complained to the FCC. According to the NAB, FCC officials have stated that they don't think interference is a problem because of the lack of complaints they receive from radio listeners. In a statement, NAB Radio Board Chairman Bev Brown argued, "...the public has no concept of how to complain to the FCC and no feeling that complaints will help resolve interference problems." He suggested that the FCC "establish standards to prevent interference from occurring, rather than await degradation of broadcasting that is suddenly recognized by emerging complaints."

TEMPEST Market Strong and Growing... Sales of TEMPEST computer and communications equipment will exceed $1.5 billion this year, $10 billion in 1993 and possibly $19 billion in 1997, according to a new report by International Resource Development Inc. (IRD), a market research firm. Wang has the largest share of the market, followed by IBM and DEC. IRD notes that advances in material and engineering have helped to reduce the price of TEMPEST products, but that a TEMPEST-rated PC is still more than double the unshielded price. *TEMPEST Secure Computing Equipment & Markets* (No.738) is available for $2,100.00 from IRD, 21 Locust Ave., Suite 1C, New Canaan, CT 06840, (203) 966-2525.

EMP

FCC Again Denies Petition... The FCC has dismissed a petition for reconsideration of an earlier ruling refusing to institute a notice of inquiry (NOI) on the effects of EMPs on civilian communications (see *MWN*, September/October 1986 and January/February 1987). In an order released on May 8, the FCC reaffirmed its opinion that the two petitioners, Donald Schellhardt and Nickolaus Leggett, had failed to make a *prima facie* case that an NOI would be in the public interest and that, given other ongoing efforts, an NOI would be premature. The FCC, citing support from DOD, argued that, "The sensitivity of EMPs and its national security implications weigh against a public proceeding." Schellhardt told *Microwave News* that he and Leggett have not yet decided whether to appeal the FCC decision in court.

MEASUREMENT

Revising FCC Computer Guidelines...CBEMA has proposed a "substantial revision" in the current methods of measuring radiated and conducted emissions from computer hardware as detailed in FCC's *Methods of Measurement of Radio Noise [Electromagnetic] Emissions from Computing Devices*, better known simply as *MP-4* (see *MWN*, September 1983). In an April 23 letter to FCC Chief Engineer Dr. Thomas Stanley, attorney Lawrence Movshin of the Washington, DC, firm of Heron, Burchette, Ruckert & Rothwell outlined CBEMA's suggested changes, including: (1) establishing a "method of measurement which will take precedence over other alternatives" because "the flexibility established in the original test procedures has created a number of conflicts between and among manufacturers"; (2) restating the Class A limits on the basis of a measurement distance of 10 meters because of the substantial cost of using a 30-meter test site – and eliminating the existing rules for extrapolating factors; (3) establishing a standard open area test site, which would conform to criteria outlined by CBEMA; (4) replacing the tuned-dipole antennas with linearly-polarized broad-band antennas because the latter are "significantly more efficient to use"; and (5)

deleting "all references to the need for maximizing emanations, including the need to vary cable placement during testing," because it is impossible to establish what the worst case emissions are. The complete CBEMA proposal is contained in Document No. ESC-5/87-29, April 1987, which was developed by a committee chaired by Bill DeVey of Tektronix Inc., in Wilsonville, OR. The proposal is scheduled to be discussed at the August meeting of the C63 Committee on EMC, which will he held in Atlanta, GA. For more information, contact: Charlotte LeGates, Computer and Business Equipment Manufacturers Association (CBEMA), 311 First St., NW, Suite 500, Washington, DC 20001, (202) 737-8888.

MEDICAL APPLICATIONS

NMRI Bioeffects...A group at the University of Western Ontario in London, Canada, has found that rats exposed to NMR imaging (NMRI) magnetic and RF fields experience no behavioral effects. Drs. Klaus-Peter Ossenkopp, Nancy Innis, Frank Prato and Edmund Sestini placed rats, housed in a Plexiglas chamber, inside the coils of a 0.15 T Technicare unit, using 6.25 MHz radiation, for approximately 23 minutes. The rats were tested after one or more exposures – both immediately following exposure and up to three months later. The team found no evidence of any short- or long-term behavioral changes, based on both open-field and passive avoidance learning tests. Studies on the rats' spatial memory were also negative. See the group's two papers, "Behavioral Effects of Exposure to Nuclear Magnetic Resonance Imaging: I. Open-Field Behavior and Passive Avoidance Learning in Rats" and "II. Spatial Memory Tests," in *Magnetic Resonance Imaging, 4*, pp.275-280 and pp.281-284, 1986....Dr. Frank Shellock of the Cedars-Sinai Medical Center in Los Angeles, CA, published "Biological Effects of MRI: A Clean Safety Record So Far" in the February 1987 issue of *Diagnostic Imaging*. He concludes that, "A detectable biological change caused by MRI does not necessarily indicate an adverse effect....It is known that tissue heating may occur as a result of RF power absorption during MRI and that this may be considered a biological effect. It appears, however, that temperature changes are easily tolerated by patients....It is hoped that safe levels of exposure will ultimately be established for pregnant women and operating personnel. ...Unwarranted and unsubstantiated remarks regarding the possible deleterious effects of MRI can cause unnecessary alarm and impede the progress of the technique. It is imperative, however, that appropriate precautions be taken so that the outstanding safety record of MRI can remain intact." Shellock has presented numerous papers on thermal responses to MRI fields (see *MWN*, May/June 1986). Contact: Dr. Frank Shellock, Cedars-Sinai Medical Center, Box 48750, Los Angeles, CA 90048, (213) 855-3940.

MEETINGS

Poor Turnout at EEPA... Only 65 industry officials came to the third annual meeting of the Electromagnetic Energy Policy Alliance (EEPA), April 22-24, in Washington, DC – down from 80 last year. Many of those who attended blamed the poor turnout on apathy – a surprising state of affairs given the troubles and frustrations in trying to site new facilities described by many of the speakers. For instance, Lt. Col. Paul Hanson of the U.S. Air Force said that the "lack of a national standard has significantly impacted the ability to deploy the GWEN system." By far the most rousing presentation was by Dan O'Brien of KONG-TV in Seattle, WA, who has run into opposition in his efforts to start a new television station on Cougar Mountain (see *MWN*, January/February 1986). He first applied for an FCC permit in 1980; the case is still in litigation. O'Brien said that he may appeal a permit denial all the way to the U.S. Supreme Court. He argued that the process is much more of an emotional issue than a scientific or engineering one. At one point, he said, decision makers became so frustrated that they threw up their hands, saying, "To hell with science, cut [the standard] in half." Similarly, in a discussion of EM emissions from electronic products, Dr. Walter Baker, the director of human factors for IBM, said that, "We have chaos today and we need order." Asked about the contrast between the tales of woe and the lack of interest in the meeting, many attendees said that people don't react until they have to face their own siting problems.

MILITARY SYSTEMS

Awesome Weapons..."The military potential of directed microwave beams is...awesome," writes Dr. Theodore Taylor in the April issue of *Scientific American*. In his article on "Third-Generation Nuclear Weapons," Taylor warns that, "Because the atmosphere is virtually transparent to microwaves, either the beam-generating device or the intended target could be based in space, in the atmosphere or on the earth's surface. In any event, the deployment of such weapons is likely to undermine confidence in the wartime reliability of strategic and tactical forces, including those forces that constitute the ultimate deterrent to nuclear war." Taylor also addresses the generation and propagation of EMP radiation.

OVENS

More Common than Dishwashers... In 1986, for the first time, there were more microwave ovens than dishwashers in American homes, according to MRCA Information Services, a market research firm. Nearly 60% of U.S. households now have microwave ovens, compared

to 50% with dishwashers. The spread of the ovens has been explosive: in 1982, only 26% of American homes had microwave ovens. MRCA's special report, *Microwave III*, is based on a survey of 2,000 households. Sales in 1987 continue to be strong: over 4 million ovens were shipped through the end of April, a 10% increase over the same period in 1986, according to the Association of Home Appliance Manufacturers (AHAM) in Chicago, IL. AHAM's statistics show even a larger microwave oven ownership than MRCA's estimates: AHAM projects that nearly 75% of U.S. homes will have them by the end of the year. Not surprisingly, AHAM does not expect the growth trend to continue. Some of the other statistics cited in the MRCA report include: 55 million servings of food pass through microwave ovens each day; the most commonly microwaved food is coffee; and 57% of all home-cooked baked potatoes are prepared in a microwave oven, as are 47% of home-cooked hot dogs. *Microwave III* is available for $2,275.00 from MRCA Information Services, 4 Landmark Square, Stamford, CT 06901, (203) 324-9600.

PEOPLE

Richard Tell, chief of EPA's electromagnetics branch at the Office of Radiation Programs in Las Vegas, NV, will leave the agency in September. During his 20 years with EPA, Tell, a physicist, has become well-known for his non-ionizing radiation measurement surveys, especially the recent series for the FCC in Honolulu, Portland, Seattle and Denver. Tell plans to open a consulting firm.

Dr. **Stanley Sussman** has joined EPRI's non-ionizing radiation sub-program to oversee projects on exposure assessment. **Bob Black**, who took over from Dr. **Bob Patterson** last year, will now monitor EPRI's epidemiological studies on power line electric and magnetic fields. Dr. **Leonard Sagan**, EPRI program manager for radiation studies, told *Microwave News* that a third person will soon be hired to be in charge of basic science projects, including mechanistic studies and whole animal experiments related to both teratology and cancer causation. Dr. **George Hidy**, president of the University of Nevada System's Desert Research Institute, has joined EPRI as a vice-president and director of its environment division. Hidy succeeds **Rene Males**.

After 15 years with the Naval Medical R&D Command, Dr. **Elliot Postow** has joined a Special Study Section of the National Institute of Health. Postow, the former editor of *Bioelectromagnetics*, told *Microwave News* that he plans to try to maintain as much contact with the non-ionizing radiation community as he can.

Two of the organizers of last September's international utility symposium on the effects of power line fields are moving on to new endeavors. **Bette Cantor** is leaving the Edison Electric Institute, where she has been environmental program manager, to join ICS Inc., a large Washington, DC, consulting firm, as a senior research associate. Ontario Hydro's **John O'Grady** has been promoted to a new job in the Health and Safety Division, where he will be responsible for a wide array of issues, including asbestos and PCBs. Both Cantor and O'Grady say they plan to keep up with the power line field.

STANDARDS

EIA on TV and VCR Immunity... The Electronic Industries Association (EIA) has issued a revised version of its Interim Standard (IS), *Immunity of Television Receivers and Video Cassette Recorders (VCRs) to Direct Radiation from Radio Transmissions, 0.5 to 30 MHz*. IS-16-A replaces IS-16, which was published in 1985 (see *MWN*, September/October 1985). The new standard retains the same immunity levels as IS-16: 1 V/m for AM broadcast, amateur radio and CB bands, and 0.3 V/m for other frequencies. The major change is that VCRs in the playback mode must now be immune to these levels between 500 kHz and 7.5 MHz; it applies to new chassis designs for VCRs in production after May 1989 and all VCRs after May 1991. Note that the EIA standard does not apply to miniature TVs or to portable, battery-operated VCRs. IS-16-A, which was developed by the EIA R-2 Committee on Consumer and Electromagnetic Compatibility, chaired by Howard Lester of GE, includes a section on measurement methods. Copies of IS-16-A are available for $7.00 each from the EIA Standards Sales Office, 2001 Eye St., NW, Washington, DC 20006, (202) 457-4966.

CISPR on EMI Measurements... The International Special Committee on Radio Interference (CISPR) has just published the second edition of its international standard, *CISPR Specification for Radio Interference Measuring Apparatus and Measurement Methods*, Publication 16. The 228-page document, written in English and in French, covers both conducted and radiated EMI and includes measurement techniques for domestic appliances, radio and TV receivers and ISM equipment. In addition, it details how to gauge the total radiated power from equipment operating in the microwave frequency range – 300 MHz-18 GHz – using a reverberating chamber and discusses statistical considerations for ensuring that mass-produced appliances meet EMI rules. The publication contains 19 appendices; topics include power line interference, pulse generators, spectrum analyzers and field measurements. The standard is available for $139.10, prepaid, which includes postage and handling, from: ANSI, International Sales Department, 1430 Broadway, New York, NY 10018, (212) 642-4900.

VDTs

AMA on Health Effects...VDT use is not associated with reproductive or radiation risks, according to a report by an American Medical Association (AMA) panel. Citing some of the VDT epidemiological studies, the panel concludes that none of the work "could support an association between exposure and adverse outcome." The paper, "Health Effects of Video Display Terminals," appears in the *Journal of the American Medical Association, 257*, pp.1508-1512, March 20, 1987.

Mt. Sinai Study Design... Researchers at the Mount Sinai School of Medicine in New York City have completely redesigned their proposed prospective epidemiological study of reproductive risks among VDT workers. Their principal objective now is to investigate the miscarriage risks associated with *office work* in general, not just VDTs. According to Dr. Michele Marcus, the coordinator of the study, the planned cost of the project has more than doubled – at least partly because it will no longer rely on volunteers to recruit participants. In addition, an extremely sensitive urine test will be used to detect miscarriages. The Mount Sinai study was first announced two years ago by Dr. Irving Selikoff, a world-renowned expert on occupational health (see *MWN*, June 1985). Soon afterwards, following Selikoff's retirement, Dr. Philip Landrigan took over as head of Mount Sinai's Division of Environmental and Occupational Medicine and became the co-principal investigator. The study has not yet received funding.

ETC...

Magnetic Senses... Can dowsers detect tiny anomalies in the Earth's magnetic field? Tom Williamson outlines the historical record for and against dowsers in the cover story of the March 19 *New Scientist*. Williamson is sympathetic to the proposition that humans, like many other species, have a magnetic sensitivity. He notes that researchers have calculated that the yellowfin tuna's magnetic sensors can detect changes in the magnetic field as small as one nanotesla....Two University of Washington, Seattle, zoologists report that a marine mollusk derives directional information from the Earth's magnetic field. See Drs. Kenneth Lohmann and Dennis Willows's paper in the January 16 *Science*.

Speeding Jets... Whistler Corp.'s police-radar detector was recruited for a special electronic warfare mission in 1979. After the Shah was chased out of Iran, the U.S. Navy had to find a quick way to protect its fighter and attack jets from its own Hawk missiles. The solution, according to the Associated Press (May 5): the Navy purchased about 750 detectors, for approximately $180 each, and had them modified – at a cost of about $2,500 each – at the Naval Weapons Center at China Lake, and then mounted them on the aircraft dash with Velcro. It was supposed to be a stopgap measure, but a Defense Department source conceded that some of the units are still in use. The May 18 *Aviation Week* added that the detectors will be phased out within the next two years.

Conference Calendar

New Listings

September 17-19: **3rd Annual Clinical Hyperthermia Symposium and Workshop**, St. Louis, MO. Contact: Dr. Bahman Emami, Radiation Oncology Center, Mallinckrodt Institute of Radiology, 4939 Audubon, Suite 5500, St. Louis, MO 63110, (314) 362-8500.

September 23-25: **1987 Symposium on Antenna Applications**, Allerton House, Monticello, IL. Contact: Paul Mayes, Dept. of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 244-0543.

September 29-October 1: **9th Annual Meeting and Symposium of the Antenna Measurement Techniques Association**, Stouffer Madison Hotel, Seattle, WA. Contact: James Otey, 6632 South 191st Place, Suite E-105, Kent, WA 98032.

October 23-25: **Magnetic Resonance Imaging**, Marriott Hotel, Washington, DC. Contact: Patrice Rapalus, *Diagnostic Imaging*, 500 Howard St., San Francisco, CA 94105, (415) 397-1881.

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

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

Honolulu (continued from p.1)

town Honolulu because local zoning rules have barred them from the surrounding hills to preserve scenic beauty (see *MWN*, April 1984).

The report has attracted very little interest. Robert Hall, who has actively sought government attention to the RF radiation issue, told *Microwave News* that he had mailed a copy of the report with additional background information to the Governor, to every member of the Hawaiian congressional delegation, to every state representative and to every major radio and television station and newspaper, but that not a single person has responded. Hall, who heads the Hawaii Institute for Biosocial Research, is also calling for "all sources of radiation" to be moved "from where people live and work."

A 1984 radiation survey of Honolulu by the Environmental Protection Agency (EPA) and the Federal Communications Commission (FCC) identified the highest levels of RF radiation ever measured in an urban area (see *MWN*, January/February 1985). Last year, the Honolulu City Council adopted a zoning regulation that bars the construction of new broadcast towers in residential and business districts (see *MWN*, November/December 1986). (continued on p.15)

The age- and race-adjusted cancer rates (1979-1983) among males in eight of nine census tracts with radio and television towers were significantly higher ($p<0.01$) than the rates expected on the basis of state statistics, according to the Anderson-Henderson report. In one tract, the number of reported cases was three times greater than expected. The cancer data were obtained from the Hawaii Tumor Registry.

The overall adjusted rate among women during the same period was also significantly higher than expected – but this only held true for two specific tracts. The rates of leukemia were also higher in tracts with RF sources, though not at the 0.01 level of significance. The number of cases was small.

Anderson and Henderson, who are with the health department's environmental epidemiology program, cited a number of limitations to the study, including the lack of detailed exposure data, possible confounding effects of other carcinogenic agents and the transiency of the study population.

Dr. William Morton, a professor of environmental medicine at the Oregon Health Sciences University in Portland, told *Microwave News* that the Honolulu study is a "reasonable pilot study" and is "definitely an indication that further research should be undertaken." Morton, who uncovered a correlation between cancer incidence and RF broadcast radiation in Portland, said that the Honolulu survey supports his own observations (see *MWN*, January/February and May 1982).

Lualualei *(continued from p.1)*

plained in a telephone interview from his office in Honolulu, because the number of cases was small and because exposures from the radio antennas would have been hard to estimate due to the Navy's frequent changes in frequency and power output. "If the rates had continued to increase, we would have pressed for a study," he said.

LeMarchand pointed out that even though the four cases of acute lymphoid leukemia and the five cases of acute myeloid leukemia were unexpected, small clusters of leukemia do occur by chance.

The Radio Transmitter Facility (RTF) at Lualualei has been a source of friction between local residents and the Navy for many years. In 1982, Citizens Concerned for the Future of Our Children challenged the Navy, raising concerns over the possibility that radiation from the antenna farm – which includes a 1-2 million watt very low frequency (VLF) transmitter – was increasing the incidence of cancer and hyperactivity among the children in the community (see *MWN*, July/August 1982).

In a 1982 letter to U.S. Senator Spark Matsunaga, the group asked that a health study of those living near the Lualualei RTF be carried out by CRCH. The health survey was never done; instead, the radiation levels inside the Navy complex and on its border were measured by Boynton Hagaman of Kershner & Wright, a consulting engineering firm based in Springfield, VA, as well as by Navy personnel.

On the basis of those measurements, the Navy's Bureau of Medicine and Surgery in Washington, DC, 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 a recent telephone interview, Dr. Fred Dodge of the Wai'anae Coast Comprehensive Health Center, one of those who signed the letter to Senator Matsunaga, said that there was less than complete confidence in the Navy's radiation survey because of the Navy's refusal to extend its measurements into the nearby community. In addition, he said, the Navy refused to specify the power levels coming from the antennas at the time of the survey. According to Dodge, the radiation issue in the community next to the Lualualei RTF is "dormant but not dead."

At a Pearl Harbor news conference held in July 1982, Professor Bill Guy of the University of Washington in Seattle reassured local residents that their alarm was "totally unwarranted," according to a report by the *Honolulu Star-Bulletin*.

LeMarchand was not at the cancer center in 1982. He said that a local physician, who suspected that the rates of leukemia were abnormally high, brought the cluster to his attention.

At the time the measurements were made in 1982, the RTF had one VLF antenna consisting of two 1,500-foot towers operating at 22-23 kHz, one low frequency (LF) 450-foot antenna operating at 146.1 kHz and several high frequency (HF) antennas operating at various frequencies in the 3-30 MHz band. There were also a number of microwave (MW) towers. According to the survey, the highest radiation levels at the RTF's boundary fence were: 83 V/m for VLF; 1.35 V/m and 4.16 mA/m for LF; for HF radiation, the levels were at least 16 times (24 dB) less than the ANSI standard (63 V/m at 30 MHz and 632 V/m at 3 MHz); and for MW, less than 10 $\mu W/cm^2$. Inside the base, the maximum measured VLF electric and magnetic fields were 972 V/m and 3.81 A/m, respectively; for LF, they were 114 V/m and 23.4 mA/m, respectively.

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VDT Use Linked to an Increased Miscarriage Risk

Women who used video display terminals (VDTs) more than half the workweek during the first three months of pregnancy were more likely to suffer miscarriages than those doing other types of office work, according to a new epidemiological study from Kaiser Permanente in Oakland, CA. Their offspring also had an increased rate of birth defects, though this finding was not statistically significant.

In the June issue of the *American Journal of Industrial Medicine*, Kaiser's Marilyn Goldhaber, Michael Polen and Dr. Robert Hiatt report that clerical workers who used VDTs more than 20 hours a week had more than twice as many miscarriages as women who performed similar tasks without VDTs. Kaiser provides health care and medical coverage to approximately two million members.

"I don't think these are definitive findings, but we did identify a statistically significant association," Goldhaber told *Microwave News*, "The VDT-pregnancy issue needs more research." She added that her study was not designed to determine the causes of the miscarriages. "Not much is known about low-frequency, low-intensity magnetic fields, so we can't rule them out, nor can we eliminate the possibility that poor working conditions are responsible; and there is always the chance that the association is spurious," she said.

(continued on p.13)

ELF and the Pineal Gland: Cancer and Depression

The pineal gland is at the center of new hypotheses on the role of extremely low frequency (ELF) fields in the development of cancer and depression. Neurochemicals which are associated with the pineal have been linked – either directly or through their metabolites – to tumor formation and suicidal behavior.

To be sure, the links are still far from proven, but as Dr. Bary Wilson of the Battelle Pacific Northwest Labs in Richland, WA, said in a telephone interview, the data are "equivocal, but highly suggestive" of a major role for the pineal gland in a number of electromagnetic field (EMF) effects.

As early as 1981, researchers at Battelle reported that ELF electric fields can affect the hormones secreted from a rat's pineal gland. In June, at the *Annual Meeting of the Bioelectromagnetics Society* (BEMS), Battelle's Dr. Fred Leung will report that rats which *respond* to a cancer-causing chemical develop more mammary tumors when exposed to ELF

(continued on p.14)

ELF NEWS

« Power Line Talk »

Consulting on power line health effects can be very lucrative. Dr. **H.B. Graves,** now chief scientist at Crowell & Moring, a Washington, DC, law firm, and formerly a professor at Pennsylvania State University, made over $75,000 (U.S.) in six months as a consultant to the Health Department of Victoria in **Australia.** Graves reviewed the State Electricity Commission of Victoria's plans for the now-canceled **Brunswick-Richmond** line, paying special attention to the health risks associated with EMF exposure. According to documents released under the local equivalent of our Freedom of Information Act, Graves spent more than 850 hours on the job from October 1985 to March 1986, billing at the rate of $90/hour. During one marathon week in February, Graves made close to $7,000. In addition, he claimed approximately $10,000 in expenses, including $4,124 in airfare for his trip to Australia.

«« »»

It is likely that the **Department of Energy** (DOE) will have more money for research on the biological effects of power line fields in 1989. The **House energy and water development subcommittee** of the Appropriations Committee has increased DOE's budget from the $2.2 million requested by the Reagan Administration to $4 million. The new money is largely due to the efforts of Rep. **George Brown** (D-CA). The Senate has yet to act; any differences would have to be addressed later in a House-Senate conference. Still, one senior DOE official is optimistic. "There's a good chance the increase will pass," he said.

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A September 8 trial date has been set for the $60 million **Marcy-South** power line lawsuit filed in January 1987 against the New York Power Authority (NYPA) (see *MWN*, March/April 1987). Landowners are claiming that the 345 kV line will create a "cancerphobia" corridor which will destroy the market value of their property. They want the NYPA to establish a right-of-way (ROW) of 2,400 feet, thereby limiting magnetic field exposures to a maximum of half a milligauss. **Michael Gurda** of Gurda, Gurda & McBride in Middletown, NY, will be representing many of the plaintiffs. NYPA's attorneys will include **Tom Watson** of Crowell & Moring. In mid-May, the NYPA announced that the entire 207-mile Marcy-South line was being energized for testing.

«« »»

In an April 2 editorial following the March 21 broadcast of the **BBC's** ***Panorama*** program on power line health risks, ***The Lancet,*** one of the world's leading medical journals, chastised the U.K.'s **Central Electricity Generating Board** (CEGB) for not spending enough money on research. The editors wrote that the £500,000 ($940,000) budget is "nowhere near enough to support the studies, in the laboratory and by epidemiologists, that will be needed to resolve the question." Dr. Robin Cox, the CEGB's chief medical officer, issued a prompt reply – published in the journal's April 23 edition – noting that the board's new commitment of £500,000 actually represented a doubling of its budget on EMFs and that it had spent £3.5 million ($6.5 million) on the problem over the past eight years. A commentary by Dr. Neville Goodman in the April 9 issue of the ***British Medical Journal*** called the documentary "well balanced" and praised those interviewed for not being "dogmatic." This appraisal was in stark contrast to accusations in Parliament that the show had engaged in scaremongering. Part of the problem is no doubt related to the fact that a move is underway in the U.K. to take the CEGB private and there are concerns that no one will want to buy the national electrical grid if it is believed to cause cancer. **Tom Mangold,** the reporter for *Panorama's* "Electricity – A Shock in Store," presents an overview of his thinking in an article, "The Killing Fields," in the March 24 issue of *The Listener.*

«« »»

There is continuing comment on Dr. **Ken Foster** and **Bill Pickard's** proposal to put an end to research on hazards associated with non-ionizing radiation (see *MWN*, January/February 1988). Writing in the May 5 issue of ***Nature,*** French researcher Dr. **Janine Perre** endorses their view. Perre, who has collaborated on 50 Hz electric field studies with scientists from Electricité de France, the French utility, wonders if the editors and reviewers of major scientific journals have a tinge of ambivalence "when confronted with a manuscript dealing with possible dangers of industrial agents, an ambivalence arising perhaps from a fear of being accused of selling out to international capitalism." Look for more letters in future issues of *Nature.*

«« »»

The report of the **Canadian Working Group on Electromagnetic Fields,** due to be released in February, is still not out. The group was formed after union officials raised concerns over health risks associated with ELF fields (see *MWN*, November/December 1986 and May/June 1987). The report

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has been held up by a host of procedural and bureaucratic delays, according to the group's chair, Dr. **Maria Stuchly** of the Canadian Radiation Protection Bureau. But she said that the report will be released at the end of the summer.

«« »»

Here is the latest on **Florida's power line siting rules.** Following the April 14-15 meeting of the Environmental Regulation Commission, the state Department of Environmental Regulation (DER) proposed EMF standards at the edges of rights-of-way: 1.5 kV/m for the electric field and 50 mG for the magnetic field, under average load conditions, and 100 mG under maximum loadings. These limits are essentially the same as those recommended by the Florida EMF Advisory Panel last year (see *MWN*, November/December 1987). A public workshop has been scheduled for June 7, and another will be held in July. The standards will apply only to new power lines. "Old lines will operate as they are," DER's **Buck Oven** said. This would save a lot of retrofitting because, as Oven pointed out, the vast majority of the existing 500 kV lines do not now conform to these limits; nor do more than half of the existing 230 kV lines. Even some of the 138 kV lines do not comply. Under the current schedule, final rules could be adopted in October but, as Oven indicated, the date they would take effect is another issue still to be determined.

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As expected, on April 12, the **New York Public Service Commission** (PSC) decided to keep its power line 1.6 kV/m **electric field standard** (see *MWN*, March/April 1988). At the same time, the commission ordered the development of an interim magnetic field standard. The PSC also called for state utilities to participate in a technical conference to help set the magnetic field limit and to determine the magnetic fields generated by 345 kV power lines. (In its January 11 task force report, the PSC recommended setting the limit at 100 mG.) The conference, which will be open to the public, will not consider the bioeffects of magnetic fields. As the PSC argued in an April 12 order: "The interim standard will not be directly related to biological effects," because "magnetic fields have not been shown to be hazardous and...the purpose of any standard would be to ensure that exposures to magnetic fields in future transmission line designs would be no greater than those which now exist for the many 345 kV lines operating for years throughout New York state."

«« »»

The opening plenary session at the **July Power Engineering Society meeting** in Portland, OR, will be an update on EMFs. Among those scheduled to speak are the VA's Dr. Ross Adey, HHS's Dr. John Bailar, DOE's Ken Klein and EPRI's Dr. Leonard Sagan. And this year's annual **DOE-EPRI EMF research review** will be held October 30-November 3 in **Phoenix, AZ.** The meeting is open to all and there is no registration fee. A special room rate of $46.00 is available to attendees. For additional information on both meetings, see the conference calendar on p.15.

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The transcript from last October's **Congressional hearings** on ***Health Effects of Transmission Lines*** is back from the printer and can now be ordered. The hearing record includes both the testimony of the expert witnesses and their answers to questions posed by Rep. **George Miller** (D-CA), the chairman of the House subcommittee on water and power resources (see *MWN*, September/October 1987 and January/February 1988). The transcript also includes a number of interesting papers, articles and letters concerning EMF effects. Lauri Sonken, the staff aide who organized the hearings, recently left the subcommittee to return home to Los Angeles. Copies of the transcript are available for $11.00 each from: the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Specify stock No.052-070-06461-7. Visa and Mastercard orders are also accepted; call (202) 783-3238.

Wertheimer & Leeper: Adult Study Links EMFs and Cancer

A major epidemiological study does link adult leukemia and exposure to extremely low frequency (ELF) electric and magnetic fields (EMFs) at home, according to a new analysis by Dr. Nancy Wertheimer and Ed Leeper. Researchers at the Battelle Pacific Northwest Labs in Richland, WA, originally reported no association in their study, which, like the Savitz childhood study, was supported by the New York Power Lines Project (NYPLP).

Battelle's Dr. Richard Stevens found no significant increased risk of acute non-lymphocytic leukemia (ANLL) among those exposed to the greatest EMFs, as compared to controls (see *MWN*, November/December 1986). Wertheimer and Leeper believe that, in fact, the study supports their hypothesis that magnetic fields are cancer promoters.

Wertheimer and Leeper have refined the Battelle analysis by taking into account the chronic use of electrically-heated beds – electric blankets, waterbed heaters and electric mattress pads – which are common sources of magnetic fields in the home. "Because Stevens's group collected extensive data on the use of these appliances, we were able to assemble a better control population – one that was unexposed to EMFs from either power lines or electrically-heated beds," Wertheimer told *Microwave News*.

Using this new control group and making other refinements, Wertheimer and Leeper reworked the Battelle data and found that the risk of leukemia increases 50-90% if an individ-

ual has been exposed to EMFs from *either* power lines or electrically-heated beds, and up to 110-260% if exposed to EMFs from *both*. When a comparison is made with those exposed to neither source of EMFs, the estimates are either borderline or fully statistically significant at the 95% confidence limit.

Wertheimer, a professor in the Department of Preventive Medicine at the University of Colorado in Denver, and Leeper, a freelance consultant based in Boulder, CO, also argue that the number of cases in Battelle's highest exposure group was too small to allow for meaningful comparisons. "When we collapsed the study's four exposure categories into 'high' and 'low' exposure groups, a positive trend emerged," Wertheimer said.

Indeed, in his report to the NYPLP, Stevens pointed out the study's limitations due to both the small sample size and the possible misclassification of exposures. "I would not rule out an association between adult leukemia and residential exposure to ELF fields on the basis of our study," he said in a recent telephone interview.

Dr. David Carpenter of the New York Department of Health, who served as the executive secretary of the NYPLP, agreed that the issue is not closed. "There is no reason to believe that, if magnetic fields are linked to cancer, the effect is limited to children," he told *Microwave News*.

Wertheimer, Leeper, Stevens and Carpenter all support further research. "We've got to do more studies on adult residential exposures," Stevens said.

Wertheimer and Leeper argue that, if magnetic fields and cancer are causally linked, well over 25% of the ANLL cases in the Battelle study may be attributable to EMFs from high-current power lines, especially electrically-heated beds. They emphasize that exposures from appliances like electric blankets are avoidable: "*Individuals* can mitigate any cancer risk inherent in EMF exposure by altering their use."

A copy of Wertheimer and Leeper's comments is available for $3.75 from: Charlene McAuliffe, NYS Department of Health, School of Public Health, Corning Tower, Room 2517, Empire State Plaza, Albany, NY 12237, (518) 474-7888. Make the check payable to Health Research, Inc.

States Seek Power Line Rules in Face of Federal Inaction

Interest in power line safety is heating up in state houses around the country. Eight months after Representative George Miller (D-CA) held hearings, the U.S. Congress appears reluctant to tackle the power line issue. As a result, the regulation of power line extremely low frequency (ELF) fields may follow the same path as that of radiofrequency and microwave radiation; that is, in the absence of federal rules, state and local governments will adopt their own exposure standards.

Although only one bill has made it into law – James Seward's measure in New York State – a number of proposals have been introduced in state legislatures. Here is a state-by-state review.

New York

The most specific proposal to regulate electromagnetic fields (EMFs) was introduced by Assemblyman Richard Brodsky on March 29. His bill, No.10427, would require that:

- No new residential building be built within 25 feet of an above-ground power line, or within 50 feet of a 23 kV or greater line;
- No new above-ground power line be built within 25 feet of a residential building;
- No new 23 kV or greater above-ground power line be built within 50 feet of a residential building;
- No new power line or residential building be built such that a power line magnetic field of 2.5 mG or greater is present anywhere in the residence.

The exposure levels were derived from the Savitz study, according to Mike Ettlinger, a legal advisor to Brodsky. "There's enough science there to create a strong suspicion that a real problem [exists]; in the meantime, we shouldn't be building new facilities that are likely to prove harmful," Ettlinger told *Microwave News*.

The bill has been forwarded to the Assembly's Corporations Committee, where it awaits a hearing.

Under a law passed in July 1987, the Public Service Commission cannot grant a certificate of construction or operation to a major utility transmission facility unless it determines that the facility has the minimum environmental impact on agricultural lands, wetlands, parklands and river corridors. The bill, No.1947-A, was sponsored by Senator James Seward.

Rules to limit workers' access to within ten feet of high-voltage power lines were proposed by Senator James Lack. As of early May, Lack's bill, No.7782, which would exempt power line construction and maintenance work, was on hold pending "additional amendments."

Under a bill, No.8831, introduced by Assemblyman Gordon Burrows, whenever possible, utilities would have to locate high-voltage power lines on state-owned lands – specifically, highway rights-of-way. The bill has passed the Assembly's Energy Committee and is now before the Rules Committee. A companion measure has been introduced by Senator Guy Vellela.

California

The Public Utilities Commission (PUC) and the Department of Health Services would conduct a joint study of cancer and any other health risks associated with EMF exposure from power lines, under a proposal introduced by Senator Herschel Rosenthal.

A spokesman for Rosenthal said that the purpose of the

proposal, No.2519, is to "make sure that the state has an independent evaluation of EMF health risks," and that it does not have to rely on studies sponsored by power companies. The bill would require all state utilities with operating revenues of $25 million or more to contribute to a newly created EMF study fund – the total collected could not exceed $2 million. A status report would have to be filed by December 1, 1989.

The bill was prompted by the report from the New York Power Lines Project. The legislature felt that, in light of the Savitz study, it should take some action to establish whether exposure to EMFs produced by power lines presents an "unreasonable cancer risk," and whether regulations are needed to curb that danger, an aide to Rosenthal told *Microwave News*.

Supporters of the bill include the American Cancer Society, the International Brotherhood of Electrical Workers and the Parent Teachers Association. The PUC is also in favor of the proposal, arguing that more evidence – refuting or confirming the health risk – is needed before imposing the costs associated with implementing EMF rules.

The senate's Committee on Energy and Public Utilities approved the bill unanimously on May 3 and forwarded it to the Appropriations Committee.

The PUC is getting ready to start a survey of the status of current EMF research and future research needs. The governor has allocated $100,000 in his 1988-1989 budget for this effort, which is scheduled to begin this summer.

Washington State

Municipally-owned utilities would have to bury those parts of power lines of 200 kV or more that extend beyond city limits, if the population density is at least 100 people per square mile and if the lines pass within 2,000 feet of any residence, according to bill No.6110, introduced in January by Republican Senator Eleanor Lee. The bill was prompted by complaints from residents living outside city limits, who currently have little control over municipal utilities.

The bill received a public hearing in the Senate Energy and Utilities Committee but, as a result of the cancellation of a local utility's plans for a 230 kV line, did not come up for a vote. Instead, the committee called for an interim study on ELF health risks. Lee told *Microwave News* that she plans to introduce a revised version of her bill in the next session, which begins in January 1989.

Another proposal, which also did not emerge from committee, would have prohibited state utilities from erecting high-voltage (in excess of 200 kV) electric transmission lines unless there was "no reasonable doubt that the health and safety of the persons working or residing in the area...are adequately protected." This bill, No.6421, was introduced by Democratic Senator Phil Talmadge.

Fran Raney, an aide to Senator Lee, said that Lee's and Talmadge's bills may be combined in the future.

Virginia

Since 1985, the Virginia legislature has required an annual report on the health effects of high-voltage transmission lines (see *MWN*, May 1985 and January/February 1986). The reports, prepared by the Department of Health and the State Corporation Commission, summarize recent studies on power line safety. The third annual report, issued in October 1987, concludes that, "There is a paucity of data to indicate that...

State Guidelines for Siting Power Lines and Schools

The Klein (Texas) School District lawsuit against Houston Lighting & Power Co. has focused much attention on the siting of schools near power lines and vice versa. Now, the California Department of Education has proposed what may be the first state guidelines addressing this issue.

The interim policy of the department's School Facilities Planning Division was prompted by studies on both electromagnetic fields (EMFs) and corona effects. It calls for a minimum distance – which varies according to a line's voltage – between the edge of a school's property and the edge of a right-of-way (ROW):

100 feet from a 100-110 kV ROW
150 feet from a 220-230 kV ROW
250 feet from a 345 kV ROW

Other factors that are considered include the possibility that a utility might later increase the voltage or expand a line, as well as non-power line issues.

According to Dr. Bruce Lowrey, a consultant to the planning division, the separation distance used to be a minimum of 400 feet, but the policy was relaxed after reviewing data from the Electric Power Research Institute and from the IEEE Power Engineering Society.

Meanwhile, in Florida, Senator Don Childers has introduced a bill which would stipulate a minimum distance of 400 feet between a school and the edge of a power line ROW. The bill, No.1165, which is patterned after California's original policy, has passed the Education Committee and is now before the Natural Resources Committee.

An aide to Childers told *Microwave News* that the senator is pushing hard to get the measure approved. CEASE (Citizens Endorsing A Safer Environment), a Boca Raton-based action group opposing the siting of a local school within 230 feet of two existing 230 kV power lines as well as one 138 kV line, is also pressing for the bill's passage.

electromagnetic fields...can propagate an adverse pathological effect...in humans."

For a copy of the 1987 annual report, contact: Dr. Khizar Wasti, Bureau of Toxic Substances, Department of Health, James Madison Bldg., 109 Governor St., Room 918-922, Richmond, VA 23219.

Measurement Roundup

• The Magnetic Fields Task Force associated with the IEEE Power Engineering Society (PES) released its report, *Magnetic Fields from Electric Power Lines Theory and Comparison to Measurements*, at the society's annual meeting the first week of February.

Among the conclusions of the report are:

> The location of the return current (not if it exists but where it exists) is the most crucial influence on the magnitude of the magnetic field of the power system in areas where human exposure is most likely. The closer physically that this current is to the power line, the less the magnetic field at ground level.
>
> Buried pipes often carry sufficient 60 Hz current to substantially change the ground level magnetic field.
>
> The magnetic fields near distribution lines may be comparable to *or even larger* than the magnetic fields near overhead transmission lines. [emphasis added]
>
> The magnetic fields of buried cables may exceed those of an overhead power line carrying the same currents. This is because the earth is not a good magnetic field shield at 60 Hz.

The principal authors of the report are: Rod Baishiki of Pacific Gas and Electric Co., Dr. Don Deno of General Electric (GE) and Dr. Robert Olsen of Washington State University in Pullman. The task force is an offshoot of the AC Fields Working Group, which in turn is part of the Corona and Field Effects Subcommittee of the Transmission and Distribution Committee.

A copy of the report (88 WM 078-8) is available for $3.00 (IEEE members), $6.00 (nonmembers), prepaid, from: Single Publication Sales Dept., IEEE Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855.

• A team of Swedish researchers has found that the 50 Hz magnetic fields in Swedish residential housing agree with the results found by U.S. teams in Colorado and Washington state and by English studies. Dr. Kjell Hansson Mild of Sweden's National Institute of Occupational Health in Umea told *Microwave News* that his results, based on both short-term measurements in 54 homes and 24-hour readings in 20 residences, are consistent with the previous work.

According to a report in the institute's newsletter (dated 3/87), the measurement project found that "in most residences" the magnetic field is less than 0.1 μT and that fields greater than 1 μT are "found only in exceptional cases" – and that, "In cases where the residence is close (<50 m) to a power line carrying a high current, the externally-generated magnetic field will be the dominant contribution to the general magnetic field levels in the residence."

• The International Electrotechnical Commission (IEC) has issued a new standard, *Measurement of Power-Frequency Electric Fields*, which covers instrumentation, calibration and field strength determination.

Written by the IEC High-Voltage Testing Techniques Committee (No.42), the document includes an appendix on "Parameters Affecting Accuracy of Field Strength Measurements."

Copies of the 45-page standard (IEC 833: 1987), which is in English and in French, are available for $38.00 each from: Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018, (212) 642-4900. All orders must be prepaid.

• The electric fields from different types of 345 kV power lines can vary considerably. "Each type has its own footprint," Dr. David Bruening of the Omaha Public Power District told *Microwave News*. In general, he said, "The higher the conductors, the lower the ground-level electric field."

In a paper in the October 1987 issue of *Right of Way*, Bruening compared the measured and calculated fields from four types of 345 kV structures: lattice towers, tubular H-frames, wooden H-frames and single steel poles. And he found that the maximum fields for a wooden H-frame are approximately 40 feet from the center of the structure, but that they are at the center of the line for the lattice tower and for the single steel pole.

In general, there was good agreement between the measured and calculated values – usually within 5%, with a maximum difference of 15-20%, Bruening said. The electric fields were calculated with a program devised by the Bonneville Power Administration. Bruening added that the calculations were in the process of being repeated using EXPOCALC, developed by the Electric Power Research Institute (EPRI).

Right of Way is published by the International Right of Way Association, 9920 La Cienga Blvd., Suite 515, Inglewood, CA 90301, (213) 649-5323.

• EPRI has released an expanded version (2.1) of EXPOCALC – which allows users to predict exposures to magnetic, as well as electric, fields.

The program operates on IBM PC-compatible microcomputers. EPRI is already planning the next version of the program, which will permit analysis of multiple AC lines in the same right-of-way.

For more information, contact: EPRI's Office of Special Projects, (415) 855-2974.

EPRI's Dr. Stanley Sussman, who is the project manager for the development of EXPOCALC, has written an article in the March 1988 *EPRI Journal* on "Electric and Magnetic Field Exposure Assessment," which provides information on the EXPOCALC software as well as on Emdex, a small instrument worn on the body that measures and records field strengths and

then displays the data on a PC.

• GE's Don Deno, who designed and built the prototype of the Emdex measurement system and originated the leading 60 Hz meter (the "Deno Meter"), has just started marketing an inexpensive 60 Hz magnetic field sensor.

The Model 116 can be plugged into any standard digital multimeter – such as the 3.5 digit Fluke 8020 or the 4.5 digit Fluke 8060. It can also be used to measure magnetic fields from 0.01 milligauss to 25 gauss.

The Model 116 costs $77.00 (including shipping and handling). Contact: Electric Field Measurements, PO Box 326, Rt. 183, W. Stockbridge, MA 01266.

• Integrity Electronics & Research Co. is marketing a 60 Hz magnetic field dosimeter. The portable battery-powered 3"x4"x7" unit can measure fields from 1 microgauss to 2 gauss – on four scales – with a ±2% accuracy in any range. It has an LCD digital readout, with an 11 Hz bandwidth from 55-66 Hz.

Tom Valone, Integrity's president, told *Microwave News* that demand for the new unit, No.IER-109, is surpassing production and that the company has over $10,000 in backlogged orders – without any advertising. He added that Integrity is in the midst of planning a large-scale marketing effort in North America and in Europe.

The dosimeter costs $350.00 and is available from: Integrity Electronics & Research Co., 558 Breckenridge St., Buffalo, NY 14222, (716) 886-6985. The company also markets an ELF spectrum analyzer ($2,700.00) and a charge amplifier/ion current meter ($275.00).

• EPRI is sponsoring a seminar on *Power-Frequency Electric and Magnetic Field Exposure Assessment*, October 12-14 at the Red Lion Inn in Colorado Springs, CO. The current seminar fees are $125.00 for EPRI members and $600.00 for non-members. Fees go up on August 1 and no registrations will be accepted after September 15.

The seminar will feature technical sessions, panel discussions and exhibits. For more information, contact: Robert S. Banks & Associates, PO Box 14574, University Station, Minneapolis, MN 55414, (612) 623-4646.

• Virginia Electric Power Co. (VEPCO) has turned a 27-foot recreation van into a mobile electromagnetic compatibility (EMC) lab for dealing with power line interference. The utility outfitted the van, which includes a 30-foot telescopic rooftop mast, with $200,000 worth of equipment from Electro-Metrics of Amsterdam, NY.

The van will help the utility address interference to television reception. VEPCO will be able to measure power line fields before, during and after the construction of a transmission line. The equipment can even record television programs in specific locations to document the quality of reception.

According to a spokesman for Electro-Metrics, 25 utilities have bought similar equipment – without the van. .

HIGHLIGHTS

DOD Shuts Down EMP Simulators

The Department of Defense (DOD) has shut down many of its electromagnetic pulse (EMP) simulators pending the completion of environmental assessments. The move was dictated by a legal agreement to settle a year-old suit filed by the Foundation on Economic Trends, an environmental group based in Washington, DC, under the leadership of Jeremy Rifkin.

Under the May 13 agreement, approved by U.S. District Court Judge John Garrett Penn, the U.S. Navy will stop using its first EMP simulator for ships (EMPRESS I) and the U.S. Army will stop using its EMP simulators at the Harry Diamond Labs in Virginia, at the Redstone Arsenal in Alabama and at the White Sands Missile Range in New Mexico until they meet the requirements of the National Environmental Policy Act (NEPA). NEPA dictates the preparation of environmental impact statements (EISs) for "major federal actions."

In addition, while the Navy assesses the environmental impact of its TACAMO EMP (TES) and NAVES II simulators at the Naval Air Station in Patuxent River, MD, the electromagnetic fields (EMFs) from their operation must be less than 1 kV/m at the boundaries of the facilities.

The 1 kV/m limit is a compromise that neither Rifkin nor the DOD endorses: The agreement states that Rifkin does not accept it "as a verified standard adequate to protect either public health or the human environment," while the DOD holds that the 1 kV/m limit is "extremely conservative and has been used only as a settlement tool."

The agreement also stipulates that the Army will no longer simultaneously operate its Repetitive EMP Simulator (REPS) and the Army EMP Simulator Operations (AESOP) units at the Harry Diamond Labs in Woodbridge, VA.

Negotiations toward the settlement of Rifkin's suit (see *MWN*, March/April 1987) began in April after motions were filed to interview two civilian employees of the Diamond labs. Sources told the *Washington Post* (May 10) that the two environmental specialists would have testified that they had repeatedly warned their Army superiors that an environmental assessment was needed and that important documents had

been suppressed.

The *Post* also reported that, according to three unreleased reports prepared for the Army by the BDM Corp. of McLean, VA, EMPs can knock out the electronic landing systems on commercial airliners and can cause human health problems.

Under the agreement, the DOD will pay Rifkin's group more than $31,000 in attorneys' fees.

In other EMP-related news:

• Patricia Axelrod is expected to appeal an April 29 decision dismissing her contention that EMFs from EMPRESS II pose a detonation risk to ordnance. Axelrod had earlier filed a separate suit seeking the preparation of an EIS on hazards of electromagnetic radiation to ordnance or "HERO" from all types of EMFs (see *MWN*, September/October 1987). That suit is pending.

• The Navy has released the final EIS for EMPRESS II. For more information, contact: Ronald Dudley, Installations Planning Division, Naval Facilities Engineering Command, Norfolk, VA 23511, (804) 445-2306.

• Under the DOD's fiscal year (FY) 1988 appropriations, the Navy is barred from using EMPRESS II in the Chesapeake Bay until the Secretary of Defense certifies that its use is "essential to the national security" and that its economic, environmental and social costs in the bay are "far less" than elsewhere. On May 10, the U.S. Senate approved an amendment to the DOD's FY89 budget which would extend this prohibition. A similar bill will be introduced in the House.

Broadcasters' Compliance Costs for RF Rules Revised

The Tax Reform Act of 1986 has increased the broadcast industry's potential costs for compliance with a radiofrequency (RF) exposure standard by 30-40%, according to an analysis for the Environmental Protection Agency (EPA).

The revised cost for television and FM radio broadcasters to meet a 100 $\mu W/cm^2$ standard and for AM stations to meet an 87 V/m limit would be $47.6 million. With standards of 200 $\mu W/cm^2$ and 275 V/m, the cost would be $30.9 million, while with limits of 1,000 $\mu W/cm^2$ and 614 V/m (the American National Standards Institute guidelines), the cost would be only $16.1 million. The three sets of options were proposed by the EPA in 1986, together with a fourth option – not to regulate RF radiation (see *MWN*, July/August 1986).

The revised estimates were requested by the National Association of Broadcasters at a 1986 hearing on the EPA options. The analysis was done for the EPA by Jack Faucett Associates of Bethesda, MD. The original analysis was performed by the Lawrence Livermore National Laboratory (see *MWN*, September/October 1985).

The two principal reasons for the increased costs are the tax law's devaluation of corporate business deductions due to the reduced corporate tax rates and the elimination of the investment tax credit, according to the Faucett report.

For more information on *An Estimate of the Potential Costs of Guidelines Limiting Public Exposure to RF Radiation from Broadcast Sources: Amendments Following the Tax Reform Act of 1986*, contact: EPA's Norbert Hankin, Office of Radiation Programs (ANR-461), 401 M Street, SW, Washington, DC 20460, (202) 475-9630.

Ailing FAA Technician Fights for Workers' Compensation

Eugene Shrouf, a former Federal Aviation Administration (FAA) technician who alleges that prolonged exposure to microwave (MW) radiation is responsible for his brain tumors and endocrine problems, is fighting a drawn-out battle with the Department of Labor (DOL) for workers' compensation.

In August 1986, the DOL's Office of Workers' Compensation Programs ruled that Shrouf had failed to prove that microwave exposure caused his health problems. Shrouf, now 66 years old, is seeking a review of the decision based on more recent data.

In a February 17 letter of support for Shrouf's claim, Dr. Samuel Milham, an epidemiologist at the Washington State Department of Social and Health Services, states that, "It is my opinion that [Shrouf's] present status is a result of exposure to [VHF, UHF and MW] radiation received while in the employ of the FAA." Milham cites the long-term exposure study at the University of Washington in Seattle as an indication that endocrine tumors are associated with long-term exposure to microwave radiation, and he refers to his own research showing that brain tumors are "more common than expected in the electrical trades."

For more than a decade, Shrouf and two other technicians, Andrew Loesch and Ervin Kreischer, worked together at an FAA facility in Albuquerque, NM, repairing, adjusting and maintaining VOR, TACAN and ILS equipment (see *MWN*, May 1985). According to Shrouf, all three came very close to radiating antennas, often taking readings from less than 12 inches away. (TACAN stands for "tactical air navigation" and operates at 0.962-1.024 GHz and 1.151-1.213 GHz. VOR and ILS are short for "very high frequency omni-range" and "instrument landing system," respectively.)

Loesch and Kreischer also suffered from cancer and endocrine problems. Like Shrouf, they too were denied workers' compensation. Both are now dead.

Kreischer was diagnosed as having prostate cancer. After surgery and radiation therapy, he developed cardiac problems and ultimately bone cancer. Loesch had brain tumors, among many other ailments.

Of the three, Shrouf considers himself to be "the lucky one." After surgery to remove a benign brain tumor – a pituitary adenoma – he now suffers from hypothyroidism and adrenal damage. He requires daily doses of steroids.

During his 14 years as an FAA technician, Shrouf estimates that he was exposed to over 25,000 hours of microwave and other types of radiation. He told *Microwave News* that neither he nor his coworkers were ever informed about potential radiation hazards. In 1983, however, after the three had retired, the FAA issued a "safety memo" which warned personnel to "avoid direct contact with the TACAN radome and limit the duration of maintenance work in close proximity to the antenna while the TACAN is transmitting." Shrouf insists that although the agency claims to have issued previous safety memos, this was the first warning he had ever received and that the FAA has failed to come up with any indication that such memos ever existed.

Dr. Ira Kaplan, a board certified internist who reviewed Shrouf's claim for the FAA, states "unequivocally" that Shrouf's condition was not related to his employment – contrary to a report by a family practitioner, Dr. Karl Robinson, who told the FAA that he was "convinced" that Shrouf's tumor was caused by occupational radiation exposure.

In the 1970s, two TACAN technicians working at the Naval Air Rework Station at Quonset Point, RI, developed pancreatic cancer and other endocrine disorders. One of the men, Robert Engell, filed a $4.5 million lawsuit against a number of electronics companies. The suit was later settled out of court (see *MWN*, January/February 1983).

Cape Cod Cancer Study Will Include EMFs

The Boston University (BU) School of Public Health will study the possible association between environmental factors – including high- and low-frequency radiation from PAVE PAWS radar and power lines – and elevated cancer rates on Cape Cod, under a $500,000, two-year grant from the state of Massachusetts.

The announcement of the study closely follows the April 21 release of an exploratory survey, *Analysis of Lung Cancer Mortality in Females and Leukemia Mortality in Males and Females for the Towns of Barnstable, Bourne, Falmouth, Mashpee, and Sandwich, 1969-1985*, by the Massachusetts Department of Public Health, which documents a higher death rate among long-term (15 years or more) Upper Cape residents and a possible link to environmental exposures. BU's "Phase II" study is intended as a comprehensive follow-up.

Dr. Ann Aschengrau of the Department of Epidemiology and Biostatistics at BU's School of Public Health, one of the study's principal investigators, told *Microwave News* that her group will look at water and air pollution, radiofrequency radiation from the U.S. Air Force's PAVE PAWS radar and extremely low frequency (ELF) fields from power lines. The study, which will include a 25-year residential history of 3,000 local inhabitants, will also consider data on "confounders," such as diet and alcohol and tobacco use.

FROM THE FIELD

Henhouse PMF Project: Communiqué from Madrid

Reprinted below is a communiqué released following a meeting of the Henhouse Project researchers, who are investigating the effects of weak pulsed magnetic fields (PMFs). They met in Madrid, Spain, April 25-29 (see MWN, *March/April 1988). In addition to Dr. Jocelyne Leal and her collaborators – Drs. L. Chacon, K. Shamsaifar, M. Trillo and A. Ubeda – at the Ramon y Cajal Hospital in Madrid, those in attendance included: Dr. Ezra Berman of the Environmental Protection Agency (EPA), Research Triangle Park, NC; Dr. Barbara Koch of the University of North Carolina, Chapel Hill; Dr. Alexander Martin of the University of Western Ontario, London, Canada; Dr. Kjell Hansson Mild of the National Institute of Occupational Health, Umea, Sweden; Jack Monahan of the Food and Drug Administration, Rockville, MD; Dr. Tom Rozzell of the National Research Council, Washington, DC (and formerly with the Office of Naval Research); and Richard Tell of Richard Tell Associates, Inc., Las Vegas, NV.*

A group of investigators from six laboratories in Canada, Spain, Sweden and the United States met in Madrid from April 25-29 (sponsored by the Spanish Ministry of Health) to discuss the results of their recently completed investigations. The purpose of this set of experiments known as Project Henhouse was to examine the effects of weak low frequency, pulsed magnetic fields (PMFs) on early embryonic development of the fertile chicken egg. The project was initiated in 1984 under the auspices of the U.S. Office of Naval Research to further examine the reports from the laboratory of Dr. Leal at the Ramon y Cajal Hospital in Madrid that exposure to pulsed magnetic fields could cause developmental abnormalities.

Each of the six laboratories participating in Project Henhouse was equipped with identical exposure and incubation equipment that had been specially designed and subsequently calibrated by the U.S. Environmental Protection Agency for these studies. Each laboratory then conducted a series of replicate exposures of 20 eggs (10 treated/10 control) for the first 48 hours of incubation. The treated eggs were exposed to a PMF having a repetition frequency of 100 pulses per second. Following the 48-hour exposure, all embryos were evaluated for maturity and morphology.

Two of the six laboratories demonstrated a significant increase in the incidence of developmental abnormalities. Three of the remaining four laboratories had more abnormal embryos in the treated than in the sham group. When the data from all laboratories were combined, a significant increase in developmental abnormalities from

exposure to low-level PMFs was found. While every attempt was made to have identical conditions in each laboratory, some variables could not be controlled, and differences in the results between laboratories were observed. On the basis of all their results, the investigators in Project Henhouse have concluded that exposure to weak PMFs, under certain conditions as yet undefined, can cause significant developmental abnormalities in the chicken embryo.

Using different PMFs, previous studies have reported similar findings, but several other studies have not observed this effect. There is now substantial evidence that the effect is real, but may be influenced by uncontrolled variables in addition to the PMF.

It is important to note that extrapolation of the results of Project Henhouse beyond the chicken embryo and the exposure parameters of this study is very difficult at the present time. However, there are reports about biological effects of exposure to weak alternating magnetic fields with various waveforms, thus indicating that it might not be the pulse form as such that is the most important parameter. Other parameters such as intensity, pulse repetition frequency, fluctuations in intensity, or other variables may be more significant for production of these biological effects. Therefore, dose-response relationships which are normally used for extrapolation cannot be used until the critical parameters are known. The question the scientific community should now focus on is not whether weak electromagnetic fields affect development but rather, how they affect it. On the basis of the findings of this and other studies, further research is warranted.

During the meeting in Madrid, a draft manuscript of Project Henhouse was prepared and will be submitted for publication in the near future. The results of these studies will be presented at a scientific meeting in June. In addition, preliminary protocols for future work of the group were developed. These protocols will be finalized over the coming months and submitted to potential sponsors for funding.

UPDATES

BIOLOGICAL EFFECTS

EPA's RF/MW Report... Dr. Joe Elder, who, with Dr. Dan Cahill, edited the 1984 EPA report on the *Biological Effects of Radiofrequency Radiation*, has prepared an update based on the literature available through May 1987. The 1984 report was designed to be the basis for the agency's long-delayed RF/MW radiation guidance. Elder does not cover cancer in this new review. The 1987 conclusion differs little from the earlier one: the threshold for bioeffects is about 1 W/Kg (see *MWN*, January/February and December 1984). Here is how Elder sums it all up: "Exposure to RF radiation causes biological effects at SARs above and below 1 W/Kg; some of the effects which occur at about 1 W/Kg may be significant under certain environmental conditions. The biological significance of the effects which occur at SARs below 1 W/Kg, including those which occur at specific temperatures different from the physiological temperature range, specific frequencies or at specific amplitude-modulation conditions, is not established." For a copy of *A Reassessment of the Biological Effects of RF Radiation: Non-Cancer Effects*, contact: Dr. Joe Elder, MD-74, Health Effects Research Lab, EPA, Research Triangle Park, NC 27711.

Sunlight Activates HIV...A number of chemicals and viral agents can enhance the gene expression of HIV, the virus responsible for AIDS. Now, an international group of researchers has found that UV and even ordinary sunlight can also enhance HIV activity. In the May 5 issue of *Nature* (pp.78-81), the team goes further, concluding that their work "raises the possibility that the virus can be activated by direct sunlight."

COMMUNICATIONS

FM and TV Radiation...A researcher at the Finnish Center for Radiation and Nuclear Safety in Helsinki has devised a simple model for predicting the power density near television and FM radio transmitters and has verified it with measurements. Dr. Kari Jokela estimates that the power density is typically less than 1 mW/cm^2 at about 40 meters from 10 kW (input power) UHF-TV antennas, 30 meters from 20 kW FM radio antennas and 15 meters from 4 kW VHF-TV antennas. For details, see Jokela's paper in the May 1988 issue of *Health Physics*.

COMPATIBILITY & INTERFERENCE

Ambulance Strobe EMI... An ambulance's flashing light can interfere with the operation of an onboard cardiac-monitor, according to a letter in *The New England Journal of Medicine* (March 3, 1988). It seems that on the way to the hospital, a 65-year-old woman with heart palpitations began to show abnormal "flutters," although her vital signs were unaffected. The paramedic team noted that the monitor showed an abnormal rhythm only when the ambulance's Opticon strobe, which can turn traffic lights from red to green, was turned on and the woman's hands were touching the metal railings of the patient cart. They soon found that the flutters occurred at the same rate at which the strobe flashed, 9-11 beats per second, as opposed to the five-per-second rate for a typical atrial flutter. The explanation that evolved is that the Opticon induces an EMF large enough to be picked up by the leads of the monitor; alternatively, the cardiac-monitor can pick up the signal from the paramedic vehicle through the cart. The local service department eliminated the EMI by insulating the patient cart.

TV Interference... The FCC's Harry Wong has developed a model to calculate EMI to TV channels 4 and 5 from other communications sources – for instance, private radio and land mobile transmitters. A copy of Wong's report, *Potential Interference from Operational Fixed Stations in the 72-76 MHz Band to Television Channels 4 and 5*, Office of Engineering and Technology Bulletin No.67, is available from

International Transcription Services, 2100 M Street, NW, Washington, DC 20037, (202) 857-3800. For further information, contact Wong at (202) 653-8159.

Protecting Ms. Liberty... Even though she is over 100 years old and has been struck by lightning thousands of times, the Statue of Liberty has suffered no significant damage. She has been protected by the natural conductivity of her copper "skin" and by the efficiency of her original protection system. During her recent restoration, JLN Violette & Associates of McLean, VA, assessed the system and found that, for the most part, only minor repairs and alterations were necessary. In the March/April 1988 *EMC Technology & Interference Control News*, a controlled circulation magazine based in Gainesville, VA, two members of the firm describe the statue's grounding system and the minor improvements they recommended, which included installing copper lightning rods on her torch.

Canceling EMI... Researchers at the California Institute of Technology in Pasadena, CA, have devised a way to measure emissions from a device, even in the presence of a relatively strong interfering signal. The technique uses two receiving antennas to set up destructive interference and thereby cancel out the corrupting EMI. NASA's Jet Propulsion Lab (JPL) sponsored the work and has applied for a patent. For more information, contact: Norman Chalfin, Manager, Technology Utilization, JPL, 4800 Oak Grove Drive, Pasadena, CA 91109. Ask for a copy of JPL Invention Report NPO-17132, dated April 1988.

MEETINGS

Gordon Conference... With all the new developments on bioeffects and mechanisms over the last two years, this summer's *Gordon Research Conference on Bioelectrochemistry* promises some lively discussions. The meeting is always very informal: everything said is off-the-record and no proceedings are published. Sessions are held in the mornings and in the evenings, leaving the afternoons free for recreation or whatever seems appropriate at the time. Dr. Betty Sisken, who is chairing the conference, has assembled an international lineup of speakers. The meeting will be held at Plymouth State College in New Hampshire, August 15-19. For more information, contact: Dr. Betty Sisken, Dept. of Anatomy, University of Kentucky, Lexington, KY 40506, (606) 257-5796.

MILITARY SYSTEMS

Burning a Hole in the Atmosphere... The use of high-power EM radiation in the upper atmosphere is raising concerns over its potential environmental impact. On August 11, 1987, Dr. Bernard Eastlund of Spring, TX, was granted a patent (No.4,686,605) for a way of heating charged particles in the earth's atmosphere with radiation in the 20-1800 kHz frequency band, which he says could result in the "total disruption of communications over a large portion of the earth." Alternatively, the system could be used to modify weather. Eastlund points out that his system "would have significant military implications, particularly as a barrier to, or confusing factor for, hostile missiles or airplanes." The patent has been assigned to APTI, Inc., a subsidiary of Atlantic Richfield. Writing in the April issue of *Physics and Society*, Dr. Richard Williams, a physicist based in Princeton, NJ, warns that Eastlund's invention "might become a serious threat to the earth's atmosphere" and that it is not known how Eastlund's ideas might be applied because two other patents concerning this same invention are classified secret. In his unclassified patent, Eastlund notes that a phased array antenna would be ideal for generating the desired signal and that the North Slope of Alaska would be a good place to test the weapon. Although a lot of energy – 10^9-10^{11} watts – would be needed, the capability is within the state-of-the-art. Indeed, Eastlund told Williams that "a secret project is already underway to study and implement the invention."

OVENS

Is It Dinner Yet?...3M is marketing a product which, it claims, takes the "guesswork" out of microwave cooking. The "MonitorMark Microwave Doneness Indicator" is a time- and temperature-sensitive strip which turns blue when microwaved food is "optimally" ready to serve. Each strip is customized to a given food product, taking into account variations in oven size, cooking instructions and storage temperature – all of which can affect cooking time. Originally developed to help preserve and transport temperature-sensitive vaccines, the 3M strip is currently on Armour frozen dinners. 3M foresees a huge market for the strip – the company estimates that retail sales of "microwave-able" foods already top $21 billion a year. The company also anticipates further uses for the MonitorMark, including monitoring the temperature of products maintained in refrigerated storage, as in a supermarket or at a deli counter. For more information, contact: Colleen Foster, Packaging Systems Division, Bldg. 220-8W-01, 3M Center, St. Paul, MN 55144.

Beyond Food... Chemists at Canada's Laurentian University are using a microwave oven to speed up chemical reactions – by a factor of up to 1,000. They found that some mixtures exploded on irradiation and so they are now putting their reagents in Teflon bottles, which are transparent to the microwaves. The team's experiments are described in the May 19 *New Scientist*....Once you have finished warming up your chemicals, you can put your microwave oven to a more frivolous use: tie-dying t-shirts and scarves. With Micro Dye, Dylon International Ltd. of London, U.K., hopes to corner the market for the do-it-yourself Beau Brummell set. There are eight different colors and the whole process takes only four minutes. Stahlwood Mfg. Co. of Maspeth, NY, is the U.S. distributor.

PEOPLE

The Electromagnetic Energy Policy Alliance (EEPA) has a new president, Dr. **Jay Brandinger** of the David Sarnoff Research Center – formerly part of RCA and now a subsidiary of SRI International. He replaces **Barry Umansky** of the National Association of Broadcasters. Other EEPA officers include **George Wilkening,** a vice president of AT&T Bell Labs, and **Donald Walker,** a vice president of Motorola. **James Carter, Jr.** of Rockwell International is the treasurer and Dr. **John Osepchuk** of Raytheon is the secretary....**Paul Wagner** has transferred from EPA's Office of Radiation Programs in Las Vegas, NV, to the agency's regional office in Atlanta, GA. Wagner had taken over from **Ric Tell,** who left EPA to open his own consulting firm. **Ed Mantiply** is now the only remaining staffer working in Las Vegas on non-ionizing radiation.

STANDARDS

Finnish NIER Rules... On December 4, 1987, the Finnish Ministry of Health and Social Affairs issued a decree regulating products and installations that emit non-ionizing radiation – that is, any electromagnetic field with a frequency of less than 3,000 GHz. The Finnish Center for Radiation Safety is charged with setting safety standards. Among the devices covered by the new rules are UV lamps used for skin treatment, diathermy and hyperthermia equipment, certain types of lasers and other radiation devices designed to be used in the home. Radio and television transmitters and radars, with an average power of less than 1 kW (or a peak pulse of 100 kW), must also be inspected before being put into service. The rules became effective on January 1, 1988. An English translation of the Finnish regulations is available from: JoAnne Overman, Office of Standards Code and Information, Administration Bldg., Room A629, NBS, Gaithersburg, MD 20899, (301) 975-4037. Ask for regulation TBT/Notif.88.36.

IRPA Updates Laser Exposure Limits...IRPA's International Non-Ionizing Radiation Committee has issued some "minor" updates to its 1985 guidelines for human exposures to laser radiation. The changes appear in the May 1988 issue of *Health Physics*, pp.573-574.

TECHNOLOGY

Competing with Japan... Fusion Systems Corp., a small Rockville, MD, high-technology company, is battling with the Japanese conglomerate Mitsubishi over its patented microwave lamp system. In 1977, Fusion sold Mitsubishi Electric its system, which employs MWs to drive high-power UV lamps and is used in the production of semiconductor chips, optical fibers and many other items. Soon after, according to Fusion, Mitsubishi reverse-engineered the system and began filing numerous patents – nearly 200 over the next ten years – in an effort to overpower its smaller U.S. competitor. Fusion says its repeated attempts at a negotiated settlement have been spurned by Mitsubishi, which demanded a worldwide, royalty-free license for all of Fusion's technology, plus substantial cash and royalty payments. Fusion, which believes that its case is not unique, claims to seek only "the right to continue marketing its own technology." On April 26, PBS ran a "Frontline" documentary which included a segment on the Fusion-Mitsubishi dispute.

VDTs

Radiation Shield... An independent Canadian researcher plans to market a device to contain radiation emissions from any standard VDT. The Ancile Protective Screen and Shroud System – essentially a Faraday cage which can hold a VDT – is designed to reduce ELF and VLF emissions and to control the buildup of electrostatic charges. Al Orr, the shield's developer, has already built ten prototypes of the unit and is now seeking venture capital for its production. He anticipates that the device will cost $400-450 (U.S.). For more information, contact: Al Orr, Ancile Radiation Protective Systems, 3024 Countryside Drive, R.R.#4, Brampton, Ontario L6T 3S1, Canada, (416) 840-1859.

County Legislation... On May 10, legislators in Suffolk County on NY's Long Island approved a bill mandating eye care, ergonomic standards and rest breaks for VDT workers. The bill, introduced by Suffolk County Legislator John Foley, applies to businesses using 20 or more VDTs and to operators working at terminals for more than 26 hours a week. If signed into law by County Executive Patrick Halpin, beginning in January 1990, employers will have to pay 80% of the cost of employee eye exams and glasses and provide 15-minute rest breaks every three hours. In addition, the legislature will have to set up a five-member review committee to issue biennial reports on ergonomic and technological developments. Halpin, who has favored VDT rules in the past, must decide by June 9. Last year, a similar bill was vetoed by the previous county executive. Under a compromise, the legislators passed a bill which applies only to county workers.

ETC...

EM Energy News... Dr. Geoffrey Voss, who recently stepped down as the editor of IMPI's *Journal of Microwave Power*, has started his own publication, *Electromagnetic Energy Reviews*. In an editorial in the first issue, dated May 1988, Voss and coeditor Paul Fisher announce that, "Our objective is to provide you with current information, educational material and ideas in the applications of electromagnetic energy." The newsletter will address non-communication, non-military topics in the frequency range of 1 MHz to 1 PHz (10^{15} Hz). Subscriptions are $32.00 (U.S.), $40.00 (Canada) and £18 (U.K., by air mail). Contact: Voss Associates Engineering, Suite 401, 1011 Fort Street, Victoria, BC V8V 3K5, Canada, (604) 384-1021.

Dr. Irving Selikoff, the editor-in-chief of the peer-reviewed journal and a world-renowned specialist in occupational health, called the Goldhaber findings "worrisome." He said that, "There have been warnings that we now live in a world flooded with non-ionizing radiation, the long-term effects of which are largely unstudied. Some of the most serious potential effects are reproductive hazards; the last ten years have seen hints that these may occur with VDT radiation." Selikoff is at the Mount Sinai School of Medicine in New York City and has been seeking funds for a VDT-pregnancy study (see *MWN*, June 1985 and May/June and September/October 1987).

Dr. Michele Marcus, also at Mount Sinai, who is collaborating with Selikoff, said that the Kaiser study is "important" and that it "makes it clear that this issue needs further investigation."

Over the last few years a number of other epidemiological studies have suggested a link between VDT work and adverse pregnancy outcomes. In each case, the results were not clear-cut and the authors dismissed the pregnancy risk:

- Sweden's Drs. Anders Ericson of the National Board of Health and Social Welfare and Bengt Kallen of the University of Lund uncovered a statistically significant, dose-dependent association between VDT work and birth defects, but they cautioned that they were unable to separate VDT exposure from other variables, such as smoking and stress (see *MWN*, July/August 1986).
- Dr. Peter Westerholm of the Swedish Trade Union Confederation reported an increase in congenital malformations – especially of the heart – among the offspring of some VDT operators, but the trend did not follow a dose-response relationship (see *MWN*, July/August 1986).
- Dr. Kari Kurppa of the Finnish Institute of Occupational Health in Helsinki also reported an increase in cardiovascular abnormalities among the children of part-time VDT workers (see *MWN*, January/February 1985 and March/April 1986).
- Dr. Alison MacDonald of the Institut de Recherche en Santé et en Sécurité du Travail du Québec in Montreal, Canada, found an increased risk of spontaneous abortions among part-time – but not full-time – operators. She attributed the finding to recall bias (see *MWN*, July/August 1986).
- Drs. Bill Butler and Kelley Brix, formerly of the University of Michigan in Ann Arbor, found a slight but not significant number of spontaneous abortions among women who used VDTs more than 20 hours a week (see *MWN*, September/October 1986).

After reviewing most of these studies, the Kaiser team concludes that even though the increased risks of adverse pregnancy outcomes were small, "consistent evidence across studies provides some basis to suspect that an excess risk could be real."

Goldhaber and coworkers' survey of 1,583 pregnant women indicates that the risk for both early (less than 12 weeks) and late (12 weeks or more) miscarriages increased approximately 80% for all women who worked on VDTs more than 20 hours a week, as compared to women who did similar work without VDTs. There was a 100% increase in miscarriages when the VDT operators were compared to non-working women. There was no statistically significant increase in risk for women who used VDTs less than 20 hours a week.

For administrative support and clerical workers, a subgroup of the study population, the miscarriage risk was 240% that of the rate for non-exposed workers in the same category. This finding is statistically significant.

The number of birth defects was too small to support a statistically significant link at any level of exposure, although the Kaiser team did find a 40% increase for both moderate (5-20 hours a week) and heavy (more than 20 hours a week) use.

Goldhaber and coworkers warn that their VDT-miscarriage link may be exaggerated by recall bias – the overestimation by women with adverse pregnancy outcomes of their time spent at terminals. Nor can they fully discount ergonomic factors or job stress. Nevertheless, the researchers are unable to eliminate the possibility that the VDTs were responsible for the increased risk.

Study History

The Kaiser study was originally designed to investigate the possible reproductive impact of malathion, a pesticide which was sprayed in California from 1981 to 1982 to combat medflies. In the fall of 1982, prompted by a rash of reported clusters of adverse pregnancy outcomes among VDT operators, the federal National Institute of Occupational Safety and Health (NIOSH) asked Kaiser to include some questions on VDT use in the pesticide study. After the collaboration was announced, negotiations with Kaiser broke down (see *MWN*, November 1982 and June and July/August 1983).

NIOSH finally launched a separate VDT epidemiological study, which is scheduled to be completed this fall (see *MWN*, May and December 1984, January/February 1985, January/February 1986 and September/October 1987). Meanwhile, Kaiser went ahead and included VDT questions in its malathion study.

The Kaiser epidemiological VDT study is the first seriously to consider low frequency magnetic fields. Because the highest electromagnetic fields are at the sides and at the rear of the sets – not at the front – the number of hours at a terminal may not be a reliable index of exposure and may indeed underestimate an operator's time exposed to the field. The Kaiser researchers acknowledge this and note, "Exposure can be dependent on office seating arrangements and coworkers' use of the machines. This fact, however, would only weaken our ability to detect any effect related to non-ionizing radiation." That is to say, if there is a link between problem pregnancies and VDT electromagnetic fields, then the risk is greater than suggested in this study.

In light of their findings, the Kaiser team emphasizes the need for further investigations and calls for large-scale studies of working women to provide "objective measures of VDT exposure, ergonomic factors and job stress during early pregnancy." Indeed, Mount Sinai's Selikoff stresses that, "There are few research areas that deserve more urgent priority."

fields. Such a synergistic reaction between ELF fields and a carcinogen is in itself a major finding. But for those in search of a mechanism to explain ELF effects, Leung's results – uncertain though they may be – relating melatonin and, therefore, the pineal to the promotion of cancer may be equally important.

The role of the pineal in the development – or, more precisely, in the inhibition – of hormone-dependent cancers has been well established over the last few years. In September 1987, at an *International Workshop on the Pineal Gland and Cancer* in Tübingen, West Germany, scientists reviewed the latest research; "The workshop's take-home lessons were that melatonin can inhibit tumor formation and can have a significant impact on the immune system," Wilson told *Microwave News*.

The pineal synthesizes serotonin, a neurotransmitter, which is metabolized into melatonin, which in turn is secreted into the bloodstream and the cerebrospinal fluid (CSF). Daylight suppresses melatonin production, as do stress, alcohol and EMFs. Lower levels of melatonin, the argument goes, result in an elevated risk of cancer.

EMFs also alter the balance of other neurochemicals. In 1985, Dr. Richard Seegal of the New York State Department of Health reported that 60 Hz electric and magnetic fields can lower the levels of 5-hydroxyindoleactic acid (5-HIAA) in the CSF of primates (see *MWN*, November/December 1985). Reduced concentrations of 5-HIAA, which is a metabolite of serotonin, have been associated with depression and suicidal behavior.

Interestingly, two papers, published in 1979 and 1981, by Drs. Stephen Perry, Robert Becker, Andrew Marino and Maria Reichmanis identified an association between living near 50 Hz power lines and suicide (see *MWN*, December 1981). More recently, Perry extended his work to show that people exposed to ELF fields in high-rise apartments also are more likely to suffer from depression (see *MWN*, November/December 1987).

In the 1970s, reports from the Soviet Union indicated that workers exposed to power line fields had higher than expected rates of fatigue, irritability and headaches.

Earlier this year, a team headed by Dr. David Dowson of the U.K.'s Centre for Complementary Medicine in Southampton reported new support for the link between power line exposures and depression and headaches.

There are still many loose connections in this line of argument. Seegal himself is skeptical that his work supports a link between ELF fields and suicides. "It's a natural connection, but there are enough warning signs that the connection is tenuous at best," he said in a telephone interview from his lab in Albany, NY.

On the other hand, Perry told *Microwave News* that he thinks the link is credible and must be studied further. For his part, Becker said that he is confident that there is a relationship between depressive states and chronic exposure to ELF fields.

EMFs can shift circadian rhythms. This effect appears to be analogous to the now well-established "seasonal affective disorders" (known as "SAD"), which are caused by shifts in pineal rhythms and which can, to a certain extent, be remedied by daily exposure to bright light.

Leung's Experiments

Leung and coworkers ran two similar experiments: Rats exposed to 60 Hz, 40 kV/m electric fields were injected with 7,12-dimethylbenz(a)anthracene (DMBA), a known carcinogen. Rats exposed to both ELF fields and DMBA had more tumors per tumor-bearing animal than those receiving only DMBA. In each case, however, the increase was not statistically significant and last November, Leung reported them as negative. But Leung told *Microwave News* that, when the data from both experiments were later combined, the increase *was* significant. Battelle's research on electric fields and the pineal has been supported by the Department of Energy.

Lee Rosen of W/L Associates in Frederick, MD, agreed that Leung's experiment points to the involvement of the pineal. "This may be the key to understanding how EMFs affect the body," he told *Microwave News*. "We may now have a defined, reproducible biological endpoint for monitoring the development of cancer as well as other effects."

Battelle's Dr. Richard Stevens goes even further, stating that EMF impairment of the pineal may be implicated in the observed increase in breast cancer among women in industrialized countries (see *MWN*, January/February 1987). At the Tübingen workshop, he described how alterations in melatonin rhythm by EMFs and light – among other factors – may provide a framework for interpreting mechanisms of action for hormone-related cancers. Stevens is seeking funds for an epidemiological study of breast cancer and its possible relation to electric power use.

Rosen favors extending current studies by using magnetic, rather than only electric, fields. In addition, he would like to see experiments with longer exposure periods to determine long-term impacts, if any.

The debate will continue July 25-27 in Hong Kong at a symposium on *Melatonin and the Pineal Gland*, which is an offshoot of the *8th International Congress of Endocrinology*.

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Stephen Perry, et al., "Environmental Power-Frequency Magnetic Fields and Suicide," *Health Physics, 41*, pp.267-277, August 1981.

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Bary Wilson, "Chronic Exposure to ELF Fields May Induce Depression," *Bioelectromagnetics, 9*, pp.195-205, 1988.

Jonathan R. Wolpaw, et al. (including Richard Seegal), "Chronic Effects of 60 Hz Electric and Magnetic Fields on Primate Central Nervous System Function," *Final Report to the New York Power Lines Project*, May 12, 1987.

CONFERENCES

New Listings

July 25-27: **Melatonin and the Pineal Gland,** Hong Kong. Contact: Alex Tzang, Executive Director, Symposium on "Melatonin and the Pineal Gland," c/o BDG Management Ltd., East Town Bldg., Suite 705, 41 Lockhart Rd., Hong Kong, (5) 286136.

July 29-31: **1988 International Tesla Symposium,** Colorado Springs, CO. Contact: International Tesla Society, 330A W. Uintah, Suite 215, Colorado Springs, CO 80905, (719) 570-0876.

September 13-16: **6th National Association of Regulatory Utility Commissioners (NARUC) Biennial Regulatory Information Conference,** Hyatt Regency, Columbus, OH. Contact: David Wirick, National Regulatory Research Institute, 1080 Carmack Rd., Columbus, OH 43210, (614) 292-9404.

September 21-23: **1988 Symposium on Antenna Applications,** Allerton Park, Monticello, IL. Contact: Paul Mayes, Department of Electrical and Computer Engineering, University of Illinois, 1406 W. Green St., Urbana, IL 61801, (217) 244-0543.

October 3-6: **5th Annual Electronic Imaging '88,** World Trade Center, Boston, MA. Contact: Ed Martin, MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02115, (617) 232-EXPO.

October 30-November 3: **DOE-EPRI Review of Research on Biological Effects of 50/60 Hz Electric and Magnetic Fields, Air Ions and Ion Currents,** Hyatt Regency, Phoenix, AZ. Contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

1989

May 23-25: **IEEE 1989 National Symposium on Electromagnetic Compatibility,** Radisson Hotel, Denver, CO. Contact: Dave Hill, PO Box 4056, Englewood, CO 80155, (303) 497-3472.

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

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

Upcoming Meetings

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

July 5-7: **Military Microwaves '88: Conference and Exhibition,** Wembley Conference Center, London, U.K. Contact: Patrick Pinches, Microwave Exhibition and Publishers, 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 44027.

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

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

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

August 8-12: **Non-Ionizing Radiations: Biophysical and Biological Basis, Applications and Hazards in Medicine and Industry,** MIT, Cambridge, MA. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139, (617) 253-2101.

August 15-19: **Gordon Research Conference on Bioelectrochemistry,** Plymouth State College, Plymouth, NH. Contact: Dr. Betty Sisken, Department of Anatomy, University of Kentucky, Lexington, KY 40506, (606) 257-5796.

August 20-26: **7th Annual Scientific Meeting and Exhibition of the Society of Magnetic Resonance in Medicine (SMRM),** San Francisco Hilton & Towers, San Francisco, CA. Contact: SMRM, 15 Shattuck Sq., Suite 204, Berkeley, CA 94704, (415) 841-1899.

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

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

September 27-29: **10th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Marriott Hotel, Anaheim, CA. Contact: Michael Martin, 3M/Static Control Systems Division, 2111 W. Braker Lane, Bldg. 501, PO Box 2963, Austin, TX 78769, (512) 834-3117.

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

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New Listings

RCA Pays $250,000 To Settle Yannon Microwave Injury Suit

The widow of a New York Telephone Co. radio technician has settled a 1976 product liability suit against the RCA Corp. for a record $250,000. In the suit, Mrs. Antoinette Yannon charged that RCA was responsible for the wrongful death—due to long-term microwave exposure—of her husband, Samuel Yannon.

"It took me 13 long years. I could write a book about what they put me through," Mrs. Yannon, a resident of Staten Island, NY, told *Microwave News*. "I would have loved to have the story come out in court, but the lawyers advised against it because they said I would not live to collect."

Mrs. Yannon's case, filed in May 1976, was initially thrown out on procedural grounds, but, following two successful appeals, the case was scheduled to go to trial on the merits when a settlement was reached.

In the past, similar cases have been settled with the stipulation that details of the agreement be kept confidential. In this instance, however, no such conditions were enforced, according to Sheridan Albert, one of Mrs. Yannon's attorneys, who is with the New York City firm of Schneider, Kleinick & Weitz. "Nobody puts a gag on me," he said in a telephone interview. Mrs. Yannon was also represented by Jerome Ellis and David Paully of Staten Island.

RCA's insurance company paid Mrs. Yannon and her children $154,688; the remaining $95,361 will cover her legal fees. In addition, expert witness fees and related costs totaling $18,041 will come from Mrs. Yannon's share of the award. RCA's attorneys refused to divulge the name of the insurance company, but, according to the "closing statement" filed with the court, RCA was covered by the Zurich Insurance Group.

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Canadian Utility Offers To Buy Homes Next to Power Line ROW

A Canadian utility has made an unprecedented offer to buy the homes along a power line right-of-way (ROW) on Vancouver Island. British Columbia (BC) Hydro is prepared, upon request, to pay a fair market price to landowners concerned about increased electromagnetic fields (EMFs) from a new 230 kV line. BC Hydro will then put the purchased properties back on the market.

The 90-mile 230 kV Dunsmuir-Gold River power line was built on an existing ROW which already had two 138 kV lines, according to a utility spokesman, who said that all but 20 miles of the line is in an unpopulated area. The new line, which will serve a pulp and paper mill, is scheduled to

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HIGHLIGHTS

Double-Blind Studies Show Efficacy of PEMF Treatment

After years of controversy as to whether the application of pulsed electromagnetic fields (PEMFs) is an effective therapy, new double-blind studies are showing that PEMFs can indeed help mend fresh and nonunion fractures, tighten prostheses, heal skin lesions, ease pain and treat osteoporosis. Eight double-blind studies, each with statistically significant results, were presented at *Electrobiology Today: An International Symposium in Honor of Luigi Galvani*, held in Bologna, Italy, in mid-April.

Professor W.J.W. Sharrard of the University of Sheffield, U.K., reported an improvement of tibial fractures with delayed unions when treated with PEMFs for 12 weeks. Sharrard found clinical and radiological evidence of union in 25% of the 20 patients who received PEMF treatment, compared to only 4% among the 25 controls ($p<0.01$). The patients, who were enrolled between 1981 and 1985, were treated more than 16 weeks—but less than 32 weeks—after injury.

On his return from the Bologna meeting, Dr. Andrew Bassett, professor emeritus of orthopaedic surgery at Columbia University's medical school in New York City, told *Microwave News* that the new results "should wipe out the last vestige of skepticism in the few members of the academic community who have made a profession of denigrating the biological activity of PEMFs." Bassett is well-known for his pioneering studies on the medical uses of PEMFs.

"Double-blind studies are extraordinarily hard to do. Dr. Sharrard must be complimented for completing this study," Dr. Brian Pethica of Electro-Biology, Inc. (EBI), the leading manufacturer of PEMF devices, said in a telephone interview. Pethica, who is the vice president for research at EBI in Parsippany, NJ, was also at the Bologna meeting. "The field has advanced very rapidly over the last few years," he said.

Sharrard's report was particularly welcome news to the PEMF community because, in 1984, he and his coworkers reported interim results that cast doubt on the efficacy of PEMF therapy (see *MWN*, Ju84). Sharrard told *Microwave News* that the way cases were selected in the 1984 trial tended to skew the results "rather considerably." He also pointed out that their fractures did not unite for a year or more. Overall, he called the 1984 paper "inconclusive, rather than negative." Sharrard said that a paper describing his new results is undergoing final editing prior to publication.

Of the seven other double-blind studies reported at the Bologna meeting, one was by an American-Australian group on the use of PEMFs for the treatment of loose cemented hip prostheses.

The other six double-blind studies were by Italian researchers. A group led by Dr. G. Borsalino of the Department of Orthopaedics and Traumatology at Montecchio Hospital reported on 32 patients treated with femoral intertrochanteric osteotomies (a surgical procedure for arthritis of the hip). Those treated with a 75 Hz signal showed a statistically significant improved rate of healing. A paper describing the team's findings appeared in *Clinical Orthopaedics and Related Research*, No.237, pp.256-263, December 1988. Send reprint requests to: Dr. Ruggero Cadossi, University of Modena, Clinica Medica II, Policlinico, Via del Pozzo 71, 41100 Modena, Italy.

The other Italian papers were reports on the use of PEMFs for the treatment of non-cemented knee prostheses, fresh femoral fractures, skin lesions, osteoporosis and pain.

For more information on these studies, contact: Dr. Angelo Gusella or Stefano Nardi, Divisione Ortopedica, Istituti Ortopedici Rizzoli, Via G.C. Pupilli 1, 40136 Bologna, Italy, (051) 63.66.225.

The abstracts of the papers presented at the Bologna symposium will be published in the *Journal of Bioelectricity*, edited by Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport, LA, at the end of the year.

Did EMI Cause a Bomb To Fall from an F-16?

Electromagnetic interference (EMI) may have triggered an electro-explosive device (EED) aboard a U.S. Air Force (USAF) F-16 jet, releasing a 500-pound bomb in western Georgia, the *Macon Telegraph and News* reported on May 11.

During a routine training mission on May 4, an F-16 pilot was unable to release a bomb over the target area. As the pilot circled back over Marion County, the bomb dropped, shaking windows up to 1,000 feet away. There were no casualties, however.

The USAF and the U.S. Army are now investigating a number of potential causes—including radio signals from transmitters and radars at nearby Fort Benning—of the unintentional release. A report should be available by August, a USAF spokeswoman told Stuart Leavenworth of the Macon newspaper. Members of Georgia's Congressional delegation are monitoring the investigation.

EMI-related problems have become a recurring news story in Georgia. For more than a year, the PAVE PAWS radar at Robins Air Force Base (AFB) has been at the center of a controversy over whether EEDs aboard aircraft flying through the radar's main beam are in danger of detonating (see *MWN*, J/A88, N/D88 and J/F89).

A spokesman at Moody AFB, GA, where the F-16 is stationed, told *Microwave News* that the jet was equipped with EEDs which are used to facilitate the release of bombs.

The Department of Defense has become sensitive to the threat posed by EMI and recently initiated a three-year, $30 million study of the compatibility of the electronic weapons used by the different branches of the military (see *MWN*, M/A89).

European Bioelectromagnetics Society To Be Formed

Planning is underway to form a European Bioelectromagnetics Society (EBEMS). Dr. Jocelyne Leal, who is leading the effort to create the new group, believes it is needed to reinforce contacts among European scientists and to facilitate setting up collaborative research projects financed with European funds. EBEMS will address both biomedical applications and health effects of electromagnetic fields.

EBEMS has the blessing of many members of the Bioelectromagnetics Society (BEMS), which is based in the U.S. Dr. Tom Rozzell of the National Research Council in Washington, DC, who was one of the founders of BEMS in 1978, has argued that there are "compelling reasons" for the creation of EBEMS.

How the two societies will coordinate their activities is still unclear. Leal, who is based in Madrid, Spain, told *Microwave News* that she would like to establish a "strong and effective relationship" between EBEMS and BEMS. Specific details about this relationship—for instance, whether they will have joint meetings and share the same journal—are currently under discussion.

In addition to Leal, the members of the EBEMS planning committee are: Drs. Alessandro Chiabrera (Italy), Sylvia Fitton-Jackson (U.K.), Maurice Hinsenkamp (Belgium) and Bernard Veyret (France). BEMS has also set up a committee to act as a liaison between the two societies.

For more information, contact: Dr. Jocelyne Leal, Department of Research, Hospital Ramón y Cajal, Carretera de Colmenar, Km 9, Madrid 28034, Spain, (1) 336-8699.

Nuclear Plant Alert Set Off by RFI from Hand-Held Radios

On the night of April 22, the Nine Mile Point-2 nuclear power plant went on alert when radiofrequency interference (RFI) from workers' hand-held radios created noise in the low-voltage circuitry, causing the plant's turbine control valves to close, *Nucleonics Week*, an industry newsletter, reported in its April 27 issue. The safety system switched on and there was no damage to the 1,165 megawatt (MW) plant, which is operated and partly owned by the Niagara Mohawk Power Corp. The Nine Mile plant is located near Oswego, NY, on Lake Ontario.

"We're going to reidentify those areas of the plant that are especially sensitive to interference and post warning signs," Stephen Brady, a Niagara Mohawk spokesman, told *Microwave News* from his office in Syracuse, NY. He added that the company will redouble its emphasis on training personnel to take the necessary precautions so that similar situations do not occur again.

In a telephone interview, Jon Johnson of the Nuclear Regulatory Commission's (NRC) regional office in King of Prussia, PA, said that this type of RFI does occur, but that, "it has not been a serious safety problem." He said that, "Most plants, if not all, have done surveys on where radios can cause RFI and have published procedures for their use." There are no overall NRC rules governing the use of walkie-talkies in nuclear plants, according to Johnson.

In February 1982, the No.2 reactor at the Three Mile Island nuclear power plant in Middletown, PA, went on alert for eight-and-a-half hours before officials discovered that radio signals from a portable two-way radio were interfering with a combustible gas meter, leading operators to believe that hydrogen gas was accumulating inside the reactor (see *MWN*, Mr82). The plant was the site of a major accident in 1979.

Brodeur on Power Lines, Radar and VDTs in "The New Yorker"

Paul Brodeur, the author of *The Zapping of America*, is publishing a three-part series on the health, scientific and political issues related to power line, radar and video display terminal (VDT) electromagnetic fields in the June 12th, 19th and 26th issues of *The New Yorker*, a national magazine.

A book will follow in the fall: *Currents of Death: Power Lines, Computer Terminals and the Attempt To Cover Up Their Threat to Your Health* will be published by Simon and Schuster.

Brodeur has also written books on asbestos and articles on ozone-depleting chemicals—all of which first appeared in *The New Yorker*. *The Zapping of America* was serialized in the magazine in December 1976.

FCC on Part 15 RF Rules and Measurement Procedures

The Federal Communications Commission (FCC) has made major changes in the way it regulates non-licensed devices that emit electromagnetic energy and has proposed new methods of measuring their radiated and conducted emissions.

On April 18, the commission released the final version of its Part 15 rules, which govern the use of such non-licensed radiofrequency (RF) appliances as remote control units, garage door openers and cordless telephones. The revised rules, first proposed in October 1987, are designed to establish uniform technical standards to replace the previous case-by-case approach (see *MWN*, N/D87).

The FCC argues that the new rules remove "unnecessary regulatory barriers" for new services, such as wireless computers and other high speed data transmission and consumer

video systems. At the same time, they tighten up certain emissions limits, thus avoiding the risk of interference to licensed radio and TV broadcasting.

According to the FCC's John Reed, some of the key changes in the final rules are that: (1) a ban has been imposed against any new devices operating in the TV broadcast band —the FCC notes the importance of not hampering the development of high-definition TV; (2) a number of restricted frequency bands have been added—including those used for LORAN-C, wind shear detection and radio astronomy; and (3) for frequencies above 1 GHz, limits are based on average values, in contrast to the limits on emissions below 1 GHz, which are specified in terms of CISPR quasi-peaks, although a cap here is also specified (20 dB).

The revised rules are under attack from a variety of sources, Reed told *Microwave News*. Linear Corp. and Sensormatic Electronics Corp. have already petitioned the FCC for reconsideration, and Reed expects others will follow.

Indeed, the American Radio Relay League (ARRL) has announced that it too will ask the FCC to reconsider. In the June 1989 issue of *QST*, the ARRL's monthly magazine, the league calls some of the rules "ghastly." For instance, the ARRL believes that the FCC's new "consumer bands" allow a host of different types of equipment to emit too much radiation.

On the other hand, the National Association of Broadcasters (NAB) takes a more positive view. "Overall, we're reasonably satisfied with the rules' protections," NAB staff engineer Kelly Williams said in a telephone interview.

Measurement Methods

On May 17, the FCC's Office of Engineering and Technology (OET) announced three new proposals on how to measure radiated and conducted emissions from devices regulated under Part 15. The proposals cover the following types of devices (the document designations are given in italics):

- Intentional radiators, including wireless microphones, cordless telephones and household intercom systems (*OET TP-3*);
- Unintentional radiators, including radio and TV receivers and cable terminal devices—but excluding digital devices, CB receivers and carrier current systems (*OET TP-4*);
- Intentional radiators which operate periodically, including emergency alarms and door openers (*OET TP-6*).

At press time, the actual proposals had not yet been released.

These proposals follow the recent release of a new procedure (*OET TP-5*) for measuring emissions from digital devices (see *MWN*, M/A89). AT&T and the Computer and Business Equipment Manufacturers Association (CBEMA) have requested an extension of the deadline for filing comments and reply comments. They are now due June 7 and July 7, respectively.

For more information on the final Part 15 rules, contact: John Reed, FCC, 1919 M St., NW, Washington, DC 20554, (202) 653-7313. And for more information on the new measurement procedures, contact the FCC's Paul Marrangoni at (202) 653-8107; to order copies of the procedures, contact: Virginia Cannon, Downtown Copy Center, 1114 21st St., NW, Washington, DC 20036, (800) 541-1194 or (202) 452-1422.

U.K.'s NRPB Issues Guidance

In mid-May, the National Radiological Protection Board (NRPB), based in Didcot, U.K., issued recommendations on public and occupational exposures to all frequencies up to 300 GHz, including power line electromagnetic fields.

Microwave News will feature a complete report in the July/August issue.

ELF NEWS

« Power Line Talk »

Make room on your bookshelves for **four new books** on EMF bioeffects which will be available by the fall. In addition to **Paul Brodeur**'s forthcoming book on power lines and VDTs (see p.3), Dr. **Robert Becker** will come out with the tentatively-titled *Healing the Body Electric*, to be published by Jeremy Tarcher, Inc., of Los Angeles, CA. Becker, the author of *The Body Electric*, covers both the promise and the peril of the human use of EMFs. Becker looks at the role of EMFs in ancient and modern techniques of healing, as well as at the implications of upsetting the natural environmental balance. Battelle's Drs. **Larry Anderson, Richard Stevens** and **Bary Wilson** have edited a collection of papers for a volume called *Extremely Low Frequency Electromagnetic Fields: The Question of Cancer*—they also wrote many of the chapters. The collection, which will be published by Battelle, will feature reviews on such topics as the pineal gland, oncogenes, calcium homeostasis and ion cyclotron resonance. In their preface, the editors note that their book is intended to be "provocative and useful." On the other side of the Atlantic in the U.K., Dr. **Cyril Smith** of the University of Salford, and **Simon Best**, a medical journalist, have written *Electromagnetic Man: Health and Hazard in the Electrical Environment*, which will be published by Dent & Sons of London at the end of July. Smith and Best link EMFs to allergies, depression, pain and some forms of cancer, and provide coherent explanations of homeopathy and parapsychology. They also "show

what action can be taken against the dangerous effects of EMFs, as well as how we can make beneficial use of them."

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The annual tug of war over **DOE**'s ELF research budget is starting again. As in past years, the Administration has proposed $2.2 million for EMF effects research for FY1990. Last year, due to public pressure, the research program ended up with an additional $800,000 (see *MWN*, S/O88). Now the question is whether the DOE program will succeed in getting $3 million again. Dr. **Imre Gyuk**, program manager of the DOE's Office of Energy, Storage and Distribution, told *Microwave News* that the proposed $2.2 million budget would result in "considerable cutbacks" in the program's ongoing projects. Some members of Congress are seeking $4 million—a level that is supported by the **American Public Power Association** (APPA). In an April statement to Congressional appropriations subcommittees, the APPA urged them to increase their support "to keep this important program on track." Research is needed, according to the APPA, because, "Almost every proposed new transmission line is currently being questioned—and some have been entirely blocked—by those concerned about possible health effects and potential decreases in property values because of perceived health effects." The final budget resolution is not expected until October.

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Dr. **Nancy Wertheimer** and **Ed Leeper**'s analysis of the **Battelle** epidemiological study of **adult leukemia** will be published in a letter appearing in the August 1989 issue of the *American Journal of Epidemiology;* they show a link between residential EMF exposures and adult leukemia when magnetic field exposures from electric blankets and water beds are taken into account. Last year, Wertheimer and Leeper reported that the risk of leukemia was 50-90% higher than expected among people exposed to magnetic fields from electrically heated beds or power lines and that the risk increased to 110-260% above controls for those exposed to both (see *MWN*, M/J88). Battelle's Dr. **Richard Stevens** and his collaborators will publish their response in the same issue of the journal. They note that an association between adult leukemia and residential ELF field exposure cannot be ruled out because of their study's small sample size and the potential misclassification of exposures.

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"Why expose ourselves, and our customers, to any risk?" asks a Canadian company which is marketing what it calls a **"field-free" water bed heater**. In its ads, the Toronto-based Halcyon cites the 1986 Wertheimer-Leeper study on electric bed heaters and miscarriage risks, and claims that its product provides "an unquestionably safe alternative"—the company believes that there is "minimal, if any, danger" from exposure to EMFs. Despite repeated requests from *Microwave News*, the company has not provided any additional information.

IRPA Revises ELF Guidelines: Cancer Risk "Not Convincing"

The International Radiation Protection Association (IRPA) has approved new interim guidelines for human exposures to 50/60 Hz electromagnetic fields (EMFs). The guidelines, which were developed by IRPA's International Non-Ionizing Radiation Committee (INIRC), specify public exposure limits for electric and magnetic fields of 5 kV/m and 0.1 mT (1,000 mG), respectively.

The extremely low frequency (ELF) limits seek to protect workers and the public from "established or predicted immediate health effects"; they are not based on cancer risk. "Current evidence from the epidemiological studies suggesting an association between the cancer incidence and residential or workplace exposure to 50/60 Hz EMFs is not convincing," according to the IRPA/INIRC, but "these results raise a hypothesis that needs to be tested."

Dr. Richard Phillips of the Environmental Protection Agency's Health Research Laboratory in Research Triangle Park, NC, criticized the new IRPA limits as too lenient. "It's ridiculous—they are not representative of our state of knowledge." Phillips, who served on the 1984 World Health Organization's (WHO) and IRPA's Task Group on ELF Fields, said that, "The document reflects the views of the members of the committee and the committee does not really represent the overall scientific community. It represents one extreme of the distribution of the various scientific opinions."

The new interim guidelines are based on biological effects due to internal currents induced by external electric and magnetic fields—they are designed to limit induced currents to approximately 10 mA/m^2.

In 1987, the IRPA/INIRC circulated a review draft of the 50/60 Hz guidelines specifying magnetic field exposure limits which, though based on the same 10 mA/m^2 limit, were more lenient—by a factor of ten for workers and by a factor of two for the general public (see Table on p.6 and *MWN*, M/A88). The electric field limits are essentially unchanged from those proposed two years ago.

In an interview with *Microwave News*, Dr. Michael Repacholi, the chairman of the IRPA committee, said that, in developing the new guidelines, the committee sought to set levels for the general public that are five times stricter than those for workers—as IRPA has recommended for exposures to radiofrequency and microwave radiation (see *MWN*, Mr84 and J/F88). He added that, while this could be done for magnetic fields, it would not be possible for electric fields if contact currents and transient discharges were to be taken into account.

Magnetic Field Guidelines

The IRPA residential magnetic field limits are approximately 1,000 times more lax than the levels linked to cancer by the Wertheimer-Leeper, Tomenius and Savitz epidemiological studies. For instance, in an effort to protect against such a risk, an Oregon state legislator proposed a standard of 2 mG earlier this year (see *MWN*, M/A89).

The IRPA guidelines are also much looser than those adopted by the state of Florida earlier this year for power line rights-of-way (see *MWN*, M/A89). The Florida limits are not health-based standards, but are set at a "technologically achievable" level, according to a state official.

The May 1987 draft of the guidelines, which predated the publication of the Savitz study, pointed out that the residential epidemiological studies—specifically those by Wertheimer-Leeper—could not be considered in a health risk evaluation because of their many inherent deficiencies.

"The Savitz study tends to support the earlier studies, but we nevertheless concluded that chronic low-level EMF exposure has not been established to increase the risk of contracting cancer," Repacholi told *Microwave News*. "Similarly, no definitive conclusion can be drawn from the occupational studies," he said. Repacholi is the chief scientist at the Royal Adelaide Hospital in Adelaide, South Australia.

IRPA/INIR Committee

The members of the IRPA/INIRC are as follows (see *MWN*, J/A88):

Drs. Jürgen Bernhardt (F.R.G.); Branko Bosnjakovic (The Netherlands); Przemyslaw Czerski (U.S.); Annette Duchêne, Scientific Secretary (France); Martino Grandolfo (Italy); Dietrich Harder* (F.R.G.); Henri Jammet (France); Bengt Knave (Sweden); John Marshall* (U.K.); Michael Repacholi, Chairman (Australia); David Sliney (U.S.); and Jan Stolwijk (U.S.).

*Retired

IRPA/INIRC Interim ELF Human Exposure Guidelines

	Electric Field kV/m (rms)		Magnetic Field mT* (rms)	
	May 1989	May 1987†	May 1989	May 1987†
Occupational				
Whole Working Day	10	10	0.5	5
Short-Term	30[a]	20-30[b]	5[b]	10[b]
For Limbs	—	—	25	25
General Public				
Up to 24 Hours Per Day	5[c]	5	0.1[c]	0.2
Few Hours Per Day	10[d]	10	1[d]	—

Notes: (a) Short-term occupational exposure to rms electric field strengths between 10 and 30 kV/m is permitted provided the rms electric field strength (kV/m) times the duration of exposure (hours per workday) does not exceed 80 for the whole working day.
(b) Maximum exposure duration is 2 hours per workday.
(c) This restriction applies to open spaces in which members of the general public might reasonably be expected to spend a substantial part of the day, such as recreational areas, meeting grounds and the like.
(d) These values can be exceeded for a few minutes per day provided precautions are taken to prevent indirect effects.

* To convert from mT to G, multiply by ten; to convert to mG, multiply by 10,000.
† Exposure limits specified in an IRPA/INIRC draft dated May 12, 1987 (see *MWN*, M/A88).

Currents Induced by 50/60 Hz Magnetic Fields and Their Bioeffects

- 1-10 mA/m² (induced by magnetic fields above 0.5-5 mT)—minor biological effects have been reported;
- 10-100 mA/m² (above 5-50 mT)—there are well-established effects including visual and nervous system effects;
- 100-1000 mA/m² (above 50-500 mT)—stimulation of excitable tissue is observed and there are possible health hazards; and
- 1000 mA/m² and above (greater than 500 mT)—extra systoles and ventricular fibrillation can occur (acute health hazards).

Electric Field Guidelines

In a report prepared by the IRPA/INIRC for the WHO in 1984, the committee concluded that, "It is not possible from present knowledge to make a definitive statement about the safety or hazard associated with long-term exposure to sinusoidal electric fields in the range of 1-10 kV/m" (see *MWN*, D84). "We are still in the same situation today," Repacholi said.

Nevertheless, the new IRPA guidelines allow continuous public exposures of 5 kV/m for the public and 10 kV/m for workers. "For the general public, the 5 kV/m limit applies to open spaces, like sports grounds, where people might spend a substantial part of the day. When they go indoors, the electric fields would be lower by more than an order of magnitude. For occupational exposure, where the limits apply for the workday only, many lab studies on human volunteers have shown no adverse effects from short-term exposure to electric fields of up to 20 kV/m or magnetic fields of up to 5 mT," Repacholi explained.

The IRPA guidelines, which went through final editing at the INIRC annual meeting, in Sicily, Italy, in mid-May, will be published in *Health Physics* in late 1989 or early 1990. They will also appear in a special book on INIRC guidelines and publications to be released later this year.

The guidelines will not be available until publication. For more information, contact: Mme. A. Duchêne, 32 rue Gambetta, F-92260 Fontenay-aux-Roses, France.

WI PSC Initiative for "Independent" EMF Research

The Wisconsin Public Service Commission (WI PSC) is seeking an independent national research effort on the health effects of electromagnetic fields (EMFs). In a March 13 letter to the 49 other state utility commissions, the three Wisconsin commissioners urged the development of an "adequately funded" program to quickly resolve "what is clearly an important issue that needs to be resolved."

A key goal of the WI PSC plan is to make the research program credible by freeing it of direct utility influence. To that end, the WI PSC proposes two potential approaches: either to persuade the Electric Power Research Institute (EPRI) that all or part of its EMF research funding be managed independently, with advice from utilities and state PSCs, or to set up an interstate body, patterned after the New York State Power Lines Project (NYPLP). The commissioners suggest that the National Association of Regulatory Utility Commissioners (NARUC) or a group of "interested states" should develop the new program.

The Wisconsin initiative comes at a time when many state legislatures, in response to public pressures, are considering or sponsoring their own research (see *MWN*, M/A89). The WI PSC notes that a joint approach would be more productive.

Wisconsin has already received encouragement from some of the more active state utility commissions. In an April 25 response, New York PSC Commissioner Peter Bradford agreed that "one of [the] first steps should be to have NARUC urge EPRI to restructure part of its EMF research to assure independence." He also pointed out that the NY Department of Health had already proposed a number of "independently-managed health studies" as a follow-up to the NYPLP (see *MWN*, N/D88).

The California Public Utilities Commission (CA PUC) has sent a "statement of general support" for state-coordinated research, CA PUC's Clyde Murley told *Microwave News*. "We welcome any approach that would increase efficiency," he said. Murley added that the CA PUC shares the WI PSC's concerns about funding, credibility and timeliness of research results.

The CA PUC is currently working on its own literature review of health effects research, in cooperation with the state Department of Health Services. The report should be out in mid-September (see *MWN*, N/D88 and M/A89).

The WI PSC initiative was developed by Michael John Jaeger. For more information, contact Jaeger at: PSC of Wisconsin, PO Box 7854, Madison, WI 53707, (608) 267-2546.

Seattle City Light (SCL), a Washington state utility, would also like to see more EMF research that is "independent of industry interests." In an April 10 letter to U.S. Representative Norman Dicks (D-WA), SCL Superintendent Randall Hardy called for Congressional support for a national EMF effects program to be developed by an interagency coordinating group, and for a fiscal year 1990 Department of Energy EMF budget of $4 million (see p.5).

Hardy pointed out that although EPRI plans to spend approximately $6 million on EMF effects research this year, "These efforts will never...replace the contribution of an independently run federal research program."

HL&P v. Klein Case Is Over

The Texas Supreme Court has again refused a motion by the Klein Independent School District for a rehearing on the reversal of its $25 million punitive damage award from Houston Lighting and Power (HL&P).

In 1985, Klein won the landmark judgment when a jury found that the utility had built a 345 kV power line across school property without obtaining proper permission (see *MWN*, N/D85). The damages were struck down by the Texas Court of Appeals in 1987 and the state Supreme Court first refused to review the case last summer (see *MWN*, N/D87 and J/A88).

Dixon Montague of Vinson & Elkins, a Houston law firm representing Klein, said the case is over. "There's nothing else we can do," he told *Microwave News*. HL&P had filed its own motion for a rehearing, but the request was conditional on the court's agreeing to hear Klein's motion, according to Harris Leven, an HL&P attorney.

Australians Take Cancer Risk Seriously

Government and industry researchers in Australia are taking the cancer threat associated with electromagnetic fields (EMFs) very seriously, as indicated by the two papers discussed below:

Call for a 15-30 mG Magnetic Field Limit

Until definitive results are in, magnetic fields from new power lines should not exceed the average levels surrounding existing 220 kV lines—15 to 30 mG, Dr. Ken Joyner of Telecom Australia Research Laboratories in Clayton, Victoria, recommends.

Joyner's survey of EMF bioeffects is one of the first reviews by a researcher—especially one working for industry—to call for specific magnetic field limits to protect against cancer risks.

Discussing the epidemiological literature, Joyner points out that, although some studies have been "soundly criticized," an EMF-cancer association "deserves serious consideration given the ubiquitous nature of exposure to the electricity distribution system and to AM/FM radio and TV broadcast signals." He further notes that the levels "implicated" in those studies indicating increased cancer risks are "readily found in our homes and environments."

Having reviewed *in vitro* experiments, including those by Drs. Takuya Akamine, Craig Byus and Jerry Phillips, Joyner observes that extremely low frequency (ELF) fields may be "growth enhancers" of malignant tissue cultures and may cause transitory suppression of cell-mediated immunity.

In his paper, Joyner also considers the role of the earth's geomagnetic field and proposes a model to explain the mechanism for the interaction of ELF EMFs at cell membranes.

Joyner calls for the support of further research: "Certainly the recommendations of the WHO/IRPA [World Health Organization/International Radiation Protection Association] committee concerning the 'urgent need' for studies to resolve the suspected link between ELF magnetic fields and cancer should be fully supported by those agencies responsible for the funds for research" (see *MWN*, M/A87).

"[ELF] Electromagnetic Radiation and Interactions at the Cell Membrane" appears in *Radiation Protection in Australia, 6*, pp.118-125, October 1988. Joyner can be reached at: Telecom Australia Research Laboratories, 770 Blackburn Road, Clayton, Victoria 3168, Australia.

A Critical Evaluation of the Literature

Dr. Vincent Delpizzo, a member of the Australian Radiation Laboratory's Non-Ionizing Radiation Group, will soon publish a critical review of the ELF cancer literature, in which he concludes:

> There is enough evidence at present to justify further investigation of this subject. Although exposure to ELF [fields] is an inevitable part of the lifestyle in any technologically advanced society, the degree of this exposure could be reduced, sometimes simply and inexpensively, if health considerations warranted it. The vagueness of the *in vitro* results is not unprecedented in a complex and little understood area.

Delpizzo finds that the "epidemiological data show a reasonable degree of consistency." With respect to the residential studies, he observes that the "available data indicate that a strong association [between ELF fields and cancer] does not exist, but there is some reason to believe that this is partly due to misclassification of exposure." He also notes that 19 of 23 occupational studies have reported an increase in some form of cancer—in nine cases, leukemia.

Delpizzo provides an unusually frank analysis of the ongoing debate over the latest epidemiological and laboratory results. For instance, he dismisses many of the arguments put forward by Dr. Philip Cole of the University of Alabama in Birmingham as "trivial" and "naive." Delpizzo calls Cole's conclusion that the Wertheimer-Leeper study was biased "unproven and unconvincing."

"An Evaluation of the Existing Evidence on the Carcinogenic Potential of [ELF] Magnetic Fields" will appear in the June 1989 issue (*Vol.12*, No.2) of *Australasian Physical and Engineering Sciences in Medicine*. Delpizzo can be contacted at: Australian Radiation Laboratory, Lower Plenty Road, Yallambie, Victoria 3085, Australia.

Around the United States...

Florida...Three Boca Raton parents went to court on May 15 to shut down the Sandpiper Shores Elementary School, located within 230 feet of five power lines in Palm Beach County (see *MWN*, J/F89). A decision from the judge is expected in the first half of June. The experts who testified for the parents were: Drs. Harris Busch, Andrew Marino, Jerry Phillips and Stephen Smith. Testifying on behalf of the school board were: Drs. Edwin Carstensen, Philip Cole, Fred Dietrich, William Feero, Dwight Mercer and Morton Miller. A number of the experts appeared on videotape.

Florida...The Hillsborough County Attorney's office has temporarily withdrawn its petition challenging the state's new electric and magnetic field limits of 2-10 kV/m and 150-250 mG, respectively (see *MWN*, M/A89). The case is now being handled by outside attorneys, Chief Assistant County Attorney Elliott Dunn told *Microwave News*. Dunn expects the petition to be re-filed "any day now."

Maine...Bill No.1347, which would have imposed interim electric and magnetic field standards of 1 kV/m and 3 mG, re-

spectively, for new power lines and which would have required the Public Utilities Commission (PUC) to consider techniques for reducing power line magnetic fields and to review research on health risks associated with EMF exposure, has been withdrawn by its sponsor, Representative Conrad Heeschen. The PUC is now willing to collect data on health effects and magnetic field mitigation and to serve as a resource center, Heeschen told *Microwave News*—although the PUC's approach is not as "active" as he would have liked. With regard to future legislation, Heeschen said that he will first "monitor what the PUC is doing and then go from there." At a May 10 public hearing prior to the bill's withdrawal, Arthur Adelberg, a Central Maine Power Co. (CMP) vice president and general counsel, testified that the utility supported the research efforts, but was opposed to the interim limits, calling them "unwarranted," "premature" and "severely disruptive to economic development of this state." CMP submitted a new draft of the bill without the standards and with a provision for a PUC-appointed panel of experts to assist the commission. Dr. William Bailey, Dr. Philip Cole and Michael Silva also appeared as expert witnesses for CMP. Silva presented a chart which chronicled the magnetic field levels he encountered on the way to the hearing room through the streets of Augusta, ME. The chart showed that the state legislature's usual hearing room measured magnetic field levels of about 25 mG; the local Burger King measured over 10 mG.

Oregon...Interim electric and magnetic field limits of 1 kV/m and 2 mG, respectively, will most likely be dropped from Bill No.2932 until the results of proposed health studies have come in, according to Marc Overbeck, an aide to Representative Nancy Peterson, the bill's sponsor (see *MWN*, M/A89). In a telephone interview, Overbeck explained that a number of projects proposed by the Department of Health Services are being considered, although Peterson favors a combined research and literature review package which would cost $124,000; Overbeck conceded, however, that budget shortfalls make such an allocation highly unlikely. Overbeck added that the review would cover all forms of non-ionizing electromagnetic radiation, while the research would focus on the lower end of the frequency spectrum—for example, a study involving electric blankets, heating sources and home appliances.

November DOE-EPRI Review Will Be Held in Portland, OR

This year, the annual review of research sponsored by the Department of Energy and the Electric Power Research Institute (DOE-EPRI) on the bioeffects of extremely low frequency electromagnetic fields will be held in Portland, OR, November 12-16.

The meeting, which will feature paper presentations and poster sessions, is open to the public and there is no registration fee. The Westin Benson Hotel is offering special room rates of $50.00 to attendees.

For more information, contact: W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

Texas...On May 25, the Austin City Council adopted a resolution instructing the City Manager: (1) "to develop a transmission plan which meets the long-term needs of the [Lower Colorado River Authority] to maintain reliable service while at the same time [minimizing] the potential health effects of [EMFs] from the proposed transmission lines"; and (2) to make sure that if any lines of greater than 138 kV are proposed, "it must be demonstrated that the [EMFs] generated by said lines are no greater than the fields generated by 138 kV lines with the same capacity." The day after the vote, the *Austin American Statesman* applauded the council's recognition of "physical and fiscal reality." Less than two years ago, the council voted to scrap a proposed 345 kV line.

Washington...State bill No.5275, which would require a literature review of ongoing EMF studies, no longer calls for a $10,000 appropriation (see *MWN*, M/A89). If approved, the Washington State Institute for Public Policy, a state-run organization, will conduct the survey with funding from its own budget.

UPDATES

COMPATIBILITY & INTERFERENCE

Surge Protection... KeyTek Instrument Corp. has issued three resources on surge testing: The eight-page *Application Note 103* describes equipment and methods for surge testing all types of electronic equipment and the various relevant industrial, national and international specifications. *Application Note AN-121* provides detailed information on high-voltage oscilloscope probes and techniques for measuring surge voltages up to 6 kV. And the second edition of the 68-page *Surge Protection Test Handbook* includes instructions on how to test equipment and refers to applicable standards. Single copies of these items are available free from: Mike Hopkins, KeyTek Instrument Corp., 260 Fordham Rd., Wilmington, MA 01887, (508) 658-0880.

EMP

Strom, the Courts and *60 Minutes*...Procedural questions—rather than the substantive issues—are now dominating the case of *Robert Strom v. Boeing*. Strom, a former Boeing EMP technician who developed leukemia, charges that Boeing was aware that EMP exposures can cause cancer, but failed to warn any of its employees or to take precautions to protect them (see *MWN*, J/A88 and S/O88). Most recently, Boeing