

# MICRO WAVE NEWS

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## INSIDE...

### ELF NEWS pp.2-3

*Major Cancer-ELF Studies Planned in Sweden*

*Leukemia Among Finnish Electrical Workers-Canadian Committee Gets to Work*

*Ambient Distribution Line Fields Measured Assorted Power Line Notes*

### HIGHLIGHTS pp.4-7

*Diapulse Back on Market*

*Treating Spinal Cord Injuries with Diapulse*

*FM Station Accepts 10  $\mu$ W/cm<sup>2</sup> Limit*

*Faulty Anti-Static VDT Screens*

*Difficult Times for EBI*

*Military Systems: A Review*

### FROM THE FIELD pp.7-10

*An Exchange on Epidemiological Studies Related to an EMF-Cancer Link: Drs. Philip Cole, Nancy Wertheimer and David Savitz*

### UPDATES pp.11-14

*Copper-Microwave Synergy • Poor Turnout at EEPA Meeting • AM Interference • FCC Again Denies EMP Petition • CISPR on EMI Measurements • Mt. Sinai VDT Study Redesigned • Revising FCC Computer Measurements • NMRI Bioeffects • The AMA on VDTs • "Awesome" MW Weapons • TEMPEST Market Strong and Growing • EIA on TV and VCR Immunity • MW Ovens More Common than Dishwashers • Dowsers' Magnetic Senses • Radar Detectors to the Rescue • People in the News • and more...*

### CONFERENCES p.14

*New Listings*

*Lack of Funds Stymies Follow-Ups*

## 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.

## 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,

### 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.

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 ask 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

## 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  $\mu$ T (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  $\mu$ T vs. 0.15-1  $\mu$ T.

Based on measurements over 223 km of roads, the magnetic fields were greater than 0.04  $\mu$ T 90% of the time, greater than 0.16  $\mu$ T 50% of the time, greater than 0.51  $\mu$ T 10% of the time and greater than 1.08  $\mu$ T 1% of the time. See Héroux's paper in *Bioelectromagnetics*, 8, pp.135-148, 1987.

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.

# 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.

## 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.

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.

## 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 makeup 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 $\mu$ W 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<sup>2</sup>.

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<sup>2</sup>." 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<sup>2</sup> in the commissary and up to 300  $\mu$ W/cm<sup>2</sup> 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-

## HIGHLIGHTS

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 Bioelectron 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, Bioelectron 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  $0.139 \mu\text{W}/\text{cm}^2$ , 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  $0.03 \mu\text{W}/\text{cm}^2$  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  $3.7 \text{ mW}/\text{cm}^2$  atop one of 17 lampposts (38 feet high) and readings of over  $1 \text{ mW}/\text{cm}^2$  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  $745 \mu\text{W}/\text{cm}^2$  was measured. At 6 feet above ground level near the lampposts and the security cameras, EIG measured a maximum  $1.85 \text{ mW}/\text{cm}^2$  field, with many of the measurements below  $1 \text{ mW}/\text{cm}^2$ .

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  $\pm 2$  dB, are reported in *Radiofrequency Radiation Survey for the AN/FPS-115 PAVE PAWS Radar, Cape Cod AFB, 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  $\mu\text{W}/\text{cm}^2$  for a six-foot-tall human 20 feet from the transmitting antenna, inside the public exclusion area – or 1  $\mu\text{W}/\text{cm}^2$  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  $\text{mW}/\text{cm}^2$  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 RR's, 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

## FROM THE FIELD

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 be-

tween 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), Barregård (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), Tommenius (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<sup>+</sup>), but not cupric (Cu<sup>++</sup>), 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 be 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.

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### 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.

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### 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.

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### 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.

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#### 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.

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#### 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  $\mu\text{W}/\text{cm}^2$ . 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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