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Wertheimer and Leeper Reaffirm ELF-Fetal Loss Link

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

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

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

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RTCA Seeks To Limit Computer Use During Takeoffs and Landings

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

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

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

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Beyond "Henhouse": Early PMF Exposure Most Effective

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

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

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

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

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

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

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

Leal told *Microwave News* that the results indicate that the PMFs "arrest development at a very early stage, before the beginning of the organogenetic process." She presented her findings at the 8th Annual Meeting of the Bioelectrical Repair

and Growth Society on October 10 in Washington, DC.

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

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

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

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

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

FCC Asks EPA To Reconsider RF Guidance Decision

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

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

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

NICHD Workshop on VDT Pregnancy Risks

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

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

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

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

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

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

Only one proposal is now before NICHD—a prospective epidemiological study by researchers at the Mount Sinai

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

HPM Pulses Suppress Startle Reflex in Mice

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

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

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

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

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

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

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

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

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

Call for a National EMP Cancer Study

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

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

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

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

"60 Minutes" To Tackle EMP

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

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

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

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

New Lawsuit Seeks To Block EMPRESS II Again

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

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

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

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

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

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

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

USAF Admits PAVE PAWS EED Hazard at Robins AFB

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

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

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

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

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

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

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

Among other restrictions cited by the Georgia papers is a new hazard zone—military planes are now prohibited from

flying within one nautical mile of the PAVE PAWS radar, resulting in a shorter landing approach; in addition, all aircraft carrying EEDs are required to obtain permission to land and must use the runway farthest from the radar.

AM Levels in NJ Meadowlands Among Highest in Country

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

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

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

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

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

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

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

The Talk of Phoenix

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

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

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

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

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

Because Savitz's elevated cancer risks with measured magnetic field exposure are short of statistical significance (at the 5% confidence level), Tenforde contended that the link is less than reliable. When asked to respond, Savitz said that, "Statistical significance is not a critically important issue to me....It does not negate that the association was found—it

says that a bigger study is needed to produce a more precise estimate of the association." Neutra had a similar view: statistical significance is not crucial, especially for a risk that has "such public health significance."

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

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

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

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

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

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

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

Graves maintained that the Adey-Byus papers "are not indicative of cancer promotion," which in turn prompted

Byus to clarify his position: "The fact that ODC is changing does not indicate transformation into a neoplastic state, it means we should be studying further to find out if the cell is becoming transformed and neoplastic."

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

Planning Underway for California Health Research

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

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

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

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

the status of the research program, detailing—if deemed necessary—additional funding needs and legislation to limit exposures to EMFs.

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

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

Epi Study of Telephone Workers: No EMF-Cancer Risk

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

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

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

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Appraiser Devalues Land Near Marcy-South Power Line

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

Gurda, of Gurda, McBride, Isseks & Smith in Middletown, NY, is representing 58 landowners who are seeking \$66.5 million in damages from the New York Power Author-

ity (NYPA) (see *MWN*, M/J88, J/A88 and S/O88).

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

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

Marcy-South Expert Witness Fees

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

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

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

† As of November 23; NYPA anticipates further billings.

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

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

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

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

If ELF EMFs do cause leukemia or other malignancies, then a general increase in these malignancies in the general population might be expected as the use of electric power for each head of the population increases. Also children with leukemia exposed to ELF fields might be expected to be younger than those without such exposure. Neither of these propositions seems to be true. At the most, the carcinogenic potential of ELF EMFs must be weak. It may be that as the wavelength of electromagnetic radiation lengthens and the frequency decreases, the carcinogenic effect diminishes.

Further studies to evaluate the health hazards from ELF EMFs should take into account the complexities of measuring the strength of magnetic fields separately from that of electric fields. A comprehensive, relevant and valid method for assessing exposure is needed. Standards on limiting exposure to magnetic fields have been developed in several countries, and it would be useful to make these standards uniform by basing them on sound scientific data.

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

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

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

His review of radiofrequency and microwave radiation is brief, addressing only a few cellular and epidemiological

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

NY State Considers a Second Power Lines Project

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

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

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

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

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

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

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

IEEE-PES and APPA Issue Statements on Health Effects

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

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

At present there is no consensus expressed in the reports as to which factor, the electric or magnetic field, is the more biologically important. Similarly, the roles of field strength, duration of exposure, and intermittent versus continuous exposure are also unknown. This uncertainty complicates efforts to develop and implement methods of exposure mitigation. There is no

clear direction concerning whether to reduce fields, and if so by how much, or whether harmonics are a factor. Therefore initiation of mitigation without an adequate scientific base may not be effective. EPRI is beginning to address the question of what is actual human exposure, with plans for a national program of magnetic fields measurements. It is expected, however, that such an effort will take years before useful information is available. It will take additional years for the biological sciences to determine what component, if any, of exposure is a factor in health risks.

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

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

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

CONFERENCES

1989 Conference Calendar

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

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

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

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

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

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

March 29-30: IEEE AESS National Radar Conference, Sheraton Park Central Hotel, Dallas, TX. Contact: IEEE AESS Radar Conference, Attn:

Russell Logan, PO Box 1000-262, McKinney, TX 75069.

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

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

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

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

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

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

- April 25-27: IEEE Instrumentation and Measurement Technology Conference (IMTC), Washington, DC. Contact: Robert Myers, IMTC Conference Coordinator, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024, (213) 475-4571.
- April 29-May 2: 67th Annual Convention of the National Association of Broadcasters (NAB), Convention Center, Las Vegas, NV. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5300.
- April 30-May 3: 10th Annual Meeting of the Canadian Radiation Protection Association, New Victoria Conference Center, Victoria, British Columbia, Canada. Contact: Lutz E. Moritz, TRIUMF, 4004 Wesbrook Mall, Vancouver, B.C. V6T 2A3, Canada, (604) 222-1047.
- April 30-May 5: 6th Annual Magnetic Resonance Imaging National Symposium, Hyatt Orlando, Disney World/EPCOT Center, FL. Contact: Florida Radiological Society, Program Committee, PO Box 17241, Tampa, FL 33682, (813) 873-2090 or (800) 338-5901.
- May 7-12: 175th Meeting of the Electrochemical Society, Los Angeles, CA. Contact: Electrochemical Society, 10 South Main St., Pennington, NJ 08534.
- May 9-12: 2nd Dresden Symposium on Electrostimulation, Dresden, G.D.R. Contact: Dr. K.-J. Schulze, Medical Academy "Carl Gustav Carus," Clinic of Orthopedics, Fetscherstrasse 74, Dresden, 8019 G.D.R.
- May 13-17: 24th Annual Meeting and Exposition of the Association for the Advancement of Medical Instrumentation (AAMI), Cervantes Convention Center, St. Louis, MO. Contact: AAMI, 3330 Washington Blvd., Suite 400, Arlington, VA 22201, (800) 332-2264.
- May 23-25: IEEE National Symposium on Electromagnetic Compatibility, Radisson Hotel, Denver, CO. Contact: Dave Hill, PO Box 4056, Englewood, CO 80155, (303) 497-3472.
- May 31-June 2: 43rd Annual Frequency Control Symposium, Denver Marriott City Center Hotel, Denver, CO. Contact: T.R. Meeker, 2956 Lindberg Ave., Allentown, PA 18103.
- June 4-9: International Symposium on Charge and Field Effects in Biosystems, Virginia Commonwealth University (VCU), Richmond, VA. Contact: Jackie Elston, Conference Coordinator, College of Humanities & Sciences, Box 2019, VCU, Richmond, VA 23284, (804) 367-1674.
- June 13-15: 1989 IEEE MTT-S International Microwave Symposium, Long Beach, CA. Contact: Reynold Kagiwada, c/o LRW Associates, 1218 Balfour Dr., Arnold, MD 21012, (800) MICROWAVE.
- June 18-22: 11th Annual Meeting of the Bioelectromagnetics Society (BEMS), Sheraton El Conquistador Conference Center, Tucson, AZ. Contact: Dr. W.G. Wisecup, BEMS, 120 West Church St., Frederick, MD 21701, (301) 663-4252.
- June 25-29: 34th Annual Meeting of the Health Physics Society (HPS), Albuquerque, NM. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.
- June 26-29: 14th Annual Conference of the Australian Radiation Protection Society, Perth, Western Australia. Contact: ARPS-14 Conference Convenor, c/o Radiation Protection Office, Queen Elizabeth II Medical Centre, Verdun St., Nedlands, 6009, Western Australia, Australia, (09) 389 2262.
- June 26-30: IEEE AP-S International Symposium & URSI Radio Science Meeting, Red Lion Inn, San Jose, CA. Contact: Dr. Ray King, General Chairman, Lawrence Livermore National Laboratory, L-156, Livermore, CA 94550, (415) 423-2369.
- July 9-14: 1989 IEEE PES Summer Meeting, Hyatt Regency, Long Beach, CA. Contact: IEEE Society Special Services, 345 E. 47th St., New York, NY 10017.
- July 24-27: 1989 SBMO International Microwave Symposium, Maksoud Plaza, São Paulo, Brazil. Contact: Dr. Octavio Andrade, IMT-Escola de Engenharia Mauá, Estrada da Lágrimas, 2035, 09580 - S. Caetano do Sul - São Paulo, Brazil, (011) 442-6944.
- August 1-3: 4th International EMC EXPO-89, Sheraton Hotel, Washington, DC. Contact: Jeff Eckert, PO Box D, State Route 625, Gainesville, VA 22065, (703) 347-0030.
- August 7-11: Non-Ionizing Radiations: Biophysical and Biological Basis, Applications and Hazards in Industry and Medicine, Massachusetts Institute of Technology (MIT), Cambridge, MA. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139.
- August 22-25: International Symposium on Antennas and Propagation, Tokyo, Japan. Contact: Dr. Takashi Katagi, Mitsubishi Electric Corp., 325 Kamimachiya, Kamakura, 247 Japan, (0467) 44-8862.
- August 28-September 1: 6th International Symposium on High Voltage Engineering, Westin Canal Place Hotel, New Orleans, LA. Contact: Professor P.B. Jacob, Electrical Engineering Dept., Mississippi State University, PO Drawer EE, Mississippi State, MS 39762, (601) 325-3912.
- August 29-September 1: 2nd International Symposium on Antennas and EM Theory, Shanghai, People's Republic of China (PRC). Contact: Professor Mao Yukuan, Xidian University, 2 Taibe Rd., Xi'an, PRC.
- September 4-8: 2nd International Conference & Workshop on Electromagnetic Interference & Compatibility (INCEMIC), Bangalore, India. Contact: Dr. G.K. Deb, Electronics and Radar Development Establishment, C V Raman Nagar, Bangalore - 560 093, India.
- September 4-8: 2nd International Symposium on Recent Advances in Microwave Technology, Beijing, People's Republic of China. Contact: Dr. Banmali Rawat, Dept. of Electrical Engineering/Computer Science, University of Nevada, Reno, NV 89557, (702) 784-6927.
- September 8-10: International Symposium on Electromagnetic Compatibility, Trade and Industry Center, Nagoya, Japan. Contact: Professor Y. Miyazaki, Toyohashi University of Technology, Toyohashi, 440 Japan, (0532) 47-0111, ext. 576.
- September 11-14: Work with Display Units 89 (WWDU89), Queen Elizabeth Hotel, Montréal, Québec, Canada. Contact: WWDU89, Institut de Recherche en Santé et en Sécurité du Travail du Québec, 505 boul. de Maisonneuve Ouest, Montréal, Québec H3A 3C2, Canada, (514) 288-1551.
- September 17-20: 9th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS), Cleveland Clinic Hotel, Cleveland, OH. Contact: Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025.
- September 21-23: 10th Conference of the European Society for Hyperthermic Oncology, Amsterdam, The Netherlands. Contact: Congress Office, Bureau PAOG-10th ESHO, Tafelbergweg 25, 1105 BC Amsterdam, The Netherlands, (20) 566-4801.
- September 24-30: 10th International Conference on Bioelectrochemistry and Bioenergetics (BEC X), Centre Culturel des Prémontrés, Pont-à-Mousson, France. Contact: Prof. René Buvet, BEC X, 23, allée de la Toison d'Or, F-94000 Créteil, France; or (in the U.S.) Martin Blank, College of Physicians and Surgeons, Columbia University, 630 W. 168th St., New York, NY 10032, (212) 305-3644.
- September 26-28: 11th Annual Electrical Overstress/Electrostatic Discharge Symposium, Hyatt Regency, New Orleans, LA. Contact: Bob Rountree, Texas Instruments Inc., 12201 Southwest Freeway, MS 631, Houston, TX 77001, (713) 274-2067.
- September 26-28: International Conference on Lightning and Static Electricity, University of Bath, U.K. Contact: Laura Christie, Principal Conference Organizer, ERA Technology, Ltd., Cleeve Rd., Leatherhead, Surrey KT22 7SA, U.K.
- September 26-29: International Conference on High Frequency/Microwave Processing and Heating, Arnhem, The Netherlands. Contact: KEMA, PO Box 9035, 6800 ET Arnhem, The Netherlands.

UPDATES

BIOLOGICAL EFFECTS

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

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

COMPATIBILITY & INTERFERENCE

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

TEMPEST Market...Sales of TEMPEST products continue to grow, albeit at a slower pace than predicted last year. According to Frost & Sullivan (F&S), the market will expand from \$1.01 billion in 1987 to over \$2 billion in 1993—considerably less than the \$2.9 billion by 1992 predicted in a similar report issued last year (see *MWN*, S/O87). A spokeswoman for F&S said that there have been many changes in the in-

dstry, which, in fact, prompted the early revision of the report. F&S estimates that the largest segment of the market is for TEMPEST-rated personal computers: \$253 million in 1987, which is expected to grow to \$389 million by 1993. *The U.S. Military TEMPEST Equipment Market* (No.A1956) is available for \$2,150 from: F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080.

GOVERNMENT

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

MEDICAL APPLICATIONS

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

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

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

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

MEETINGS

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

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

from: Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025.

MILITARY APPLICATIONS

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

OVENS

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

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

UPDATES

PEOPLE

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

STANDARDS

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

TECHNOLOGY

Holding Pattern for MLS...The Federal Aviation Administration (FAA) is backing a 17-month study on the microwave landing system (MLS). The proposed study is part of a three-year FAA program designed to address airline pilot and operations personnel concerns about the need for and the capabilities of the MLS, according to *Aviation Week and Space Technology* (October 10). These actions follow the General Accounting Office's (GAO) recommendation that the FAA halt plans for purchasing additional MLSs until their potential operational and economic benefits have been adequately demonstrated. The MLS was originally intended to replace the Instrument Landing System (ILS), which, like the MLS, helps aircraft land in conditions of limited visibility. Designed to increase airport capacity and reduce flight delays, the MLS was selected to become the primary system for military and civilian use amid concerns over the ILS's reliability. Developmental problems, however, have delayed the installation of

MLSs, while ILS capabilities have been updated and improved. The FAA has asked Congress to appropriate over \$1 billion for MLS conversions, but, in its May 1988 report to the House subcommittee on transportation, the GAO concludes that the FAA has not adequately demonstrated the need for the MLS. (Congress turned down FAA requests for MLS funding in FY87 and FY88 pending operational tests and a strategy review.) For its part, the Air Transport Association (ATA), which represents 21 U.S. airlines, opposes the costly MLS, although ATA officials have acknowledged that ILS limitations—particularly, FM radio band interference on the ILS frequency—may ultimately force its members to accept the MLS. In the meantime, the GAO recommends reserving previously purchased MLSs for airports where ILSs cannot be used and for operational testing, while retaining the ILS as the primary landing system in the U.S. For a copy of the GAO report (No.GAO/RCED-88-118), contact: U.S. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877, (202) 275-6241. Single copies are available free of charge.

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

VDTs

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

ETC...

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

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

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

No In-Flight FM Radio Use

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

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

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

The two-volume report, *Potential Interference to Aircraft Electronic Equipment from Devices Carried Aboard*, is full of test data and EMI incident reports. One appendix lists 29 such cases, of which 19 were instances of suspected interference to OMEGA receivers which came to the attention of the U.K. Civil Aviation Authority; six involved VOR, ILS and glide

slope. The RTCA committee notes that after the manufacturer improved a particular type of OMEGA receiver, no more incidents were reported.

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

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

a physicist, runs Monitor Industries in Boulder, CO.

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

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

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

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

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

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

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