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within the RF exposure causes an effect other than simply heating," predicts a report released by the National Academy of Sciences–National Research Council (NAS–NRC) on November 4. Potential effects include "stun, seizure, startle and decreased spontaneous activity," it continues, calling for research on "useful susceptibilities" to ultrashort, ultrawideband and very high peak power signals. The NAS–NRC panel, commissioned by the Joint Nonlethal Weapons Directorate, is chaired by Dr. Miriam John of Sandia National Labs in Livermore, CA, and includes Dr. Clay Easterly of Oak Ridge National Lab in Tennessee. The report also addresses existing applications, including the "active denial" millimeter-wave weapon officially introduced last year by the U.S. Air Force for crowd control (see *MWN*, M/A01). The panel points to the danger of eye injury and "inadvertent exposure of targets at close range" leading to "severe burns or other injuries" as an "area of concern" with the technology. The full text of *An Assessment of Nonlethal Weapons Science and Technology* is available free of charge at <www.nap.edu/catalog/10538.html>. Print copies of the 158-page report are not yet available, but can be ordered for $50 each, or $60 outside the U.S., from the National Academies Press, 500 Fifth St., NW, Lockbox 285, Washington, DC 20055, (800) 624-6242, or on the Web at <www.nap.edu>.

OCCUPATIONAL EXPOSURES

NRPB Measurements... Levels of non-ionizing radiation in many U.K. workplaces exceed the ICNIRP limits, according to a new report from the National Radiological Protection Board (NRPB). In response to a request from the Health and Safety Executive, the NRPB analyzed data from previous surveys and found that "reference levels or basic restrictions may be approached or exceeded" near power-generation equipment, magnetic tape erasers, antitheft systems, and telecommunications antennas, among other sources. "Further work may be required to investigate compliance with the guidelines," the NRPB added in an October 28 announcement accompanying the report. The NRPB is currently considering whether to revise its exposure limits — among the world's highest—to bring them in line with those of ICNIRP. The 60-page report, *Occupational Exposure to Electric and Magnetic Fields in the Context of the ICNIRP Guidelines*, is available free on the Internet at <www.nrpb.org/publications/w_series_reports/index.htm>. Print copies may be purchased for £15 each (US$23), not including shipping, from the NRPB, Chilton, Didcot, Oxon OX11 0RQ, U.K., (44+1235) 822742, Fax: (44+1235) 822746, E-mail: <information@nrpb.org>.

PEOPLE

Prof. **Zhengping Xu** is the new director of the Bioelectromagnetics Lab at Zhejiang University in Hangzhou, China. Prof. **Huai Chiang**, the previous director, will continue to direct two research projects at the lab until they are completed in 2005. Xu, who was trained at Harvard medical school, uses genomic and proteomic techniques to study the biological effects of ELF EMFs and modulated high-frequency radiation. He is also the director

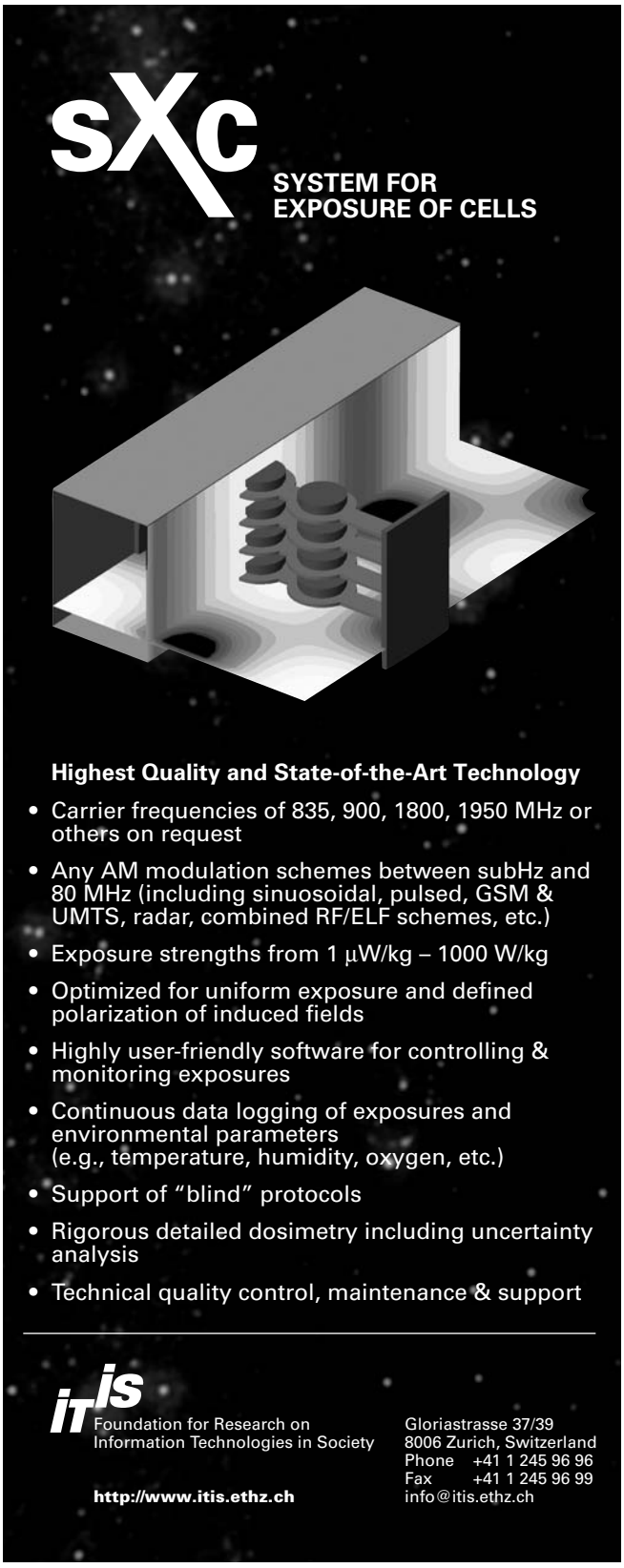
of the Bioelectromagnetics Commission of the Chinese Biomedical Engineering Association.

PRECAUTIONARY PRINCIPLE

The Decline and Fall of Modern Society... Two longtime members of the RF community have written a scalding attack on the precautionary principle, predicting that unless reformulated it will lead to nothing less than the end of Western civilization. Drs. Q. Balzano and Asher Sheppard characterize the precautionary principle as "illogical, irrational and rife with arbitrariness" and describe its application by the U.K. panel on mobile phones chaired by Sir William Stewart as an "egregious" example of how policy decisions can go awry "in a stormy sea of choices." Balzano and Sheppard, who are both consultants to Motorola, are especially distressed that the Stewart committee advised that children should be discouraged from using cell phones. "Because the [panel] misunderstood key scientific knowledge and lacked definitive research data on outstanding questions, fears of unknown risks were amplified unrealistically to generate speculations about the health of children," they write. Balzano and Sheppard call the application of ALARA-like rules to RF exposures from wireless technology an "absurdity," and argue that "ALARA is likely to fan public fears without demonstrable effects on disease risks." (ALARA stands for "as low as reasonably achievable.") Instead, they favor the creation of "scientific fire brigades" that would respond to public concerns under the guidance of government science agencies and funded by the involved industry. They cite with approval the example of the cooperative agreement, or CRADA, between the CTIA and FDA to investigate mobile phone health effects (see *MWN*, N/D99 and M/J01). Balzano and Sheppard conclude their argument, which appears in the *Journal of Risk Research (5*, pp.351-369, 2002), with this dire warning: "Unless current efforts lead to its successful reformulation, the precautionary principle could institutionalize excessive caution and thus deepen rather than alleviate alarm from the doom-laden hypothetical risks called 'perceived threats.' The resulting suppression of innovation and technological progress would inevitably have disastrous effects on society, leaving it susceptible to the decay that over time turns great civilizations into antique ruins."

RISK MANAGEMENT

WHO on Establishing a Dialog... How do you talk about EMF risks? To whom? When? And what do you say? In a new booklet, available free on the Internet, the WHO International EMF project offers some practical advice "to improve the decision-making process by reducing misunderstandings and improving trust through better dialog." It predicts that, "Community dialog, if implemented successfully, helps to establish a decision-making process that is open, consistent, fair and predictable. It can also help achieve the timely approval of new facilities while protecting the health and safety of the community." The project describes possible risks as small, if they exist at all. For instance: "The balance of evidence to date suggests that exposure to low-level RF fields (such as those emitted by mobile phones and



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Sacramento Bee (California), October 18, 2002

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their base stations) does not cause adverse health effects. Some scientists have reported minor effects of mobile phone use, including changes in brain activity, reaction times and sleep patterns. In so far as these effects have been confirmed, they appear to lie within the normal bounds of human variation." With respect to ELF EMFs, though classified as a possible human carcinogen by IARC last year, the WHO adds the following perspective: "An example of a well-known agent classified in the same category is coffee, which may increase the risk of kidney cancer, while at the same time be protective against bowel cancer." One of the project's goals is to harmonize national exposure standards. The booklet warns that adopting precautionary limits "undermines the credibility of the science and the exposure limits." The 66-page booklet, *Establishing a Dialog on Risks from Electromagnetic Fields,* can be downloaded from the project's Web site, <www.who.int/emf>. Copies may also be ordered from: Marketing and Dissemination, WHO, 20 Ave. Appia, 1211 Geneva 27, Switzerland, (41+22) 791-2476, Fax: (41+22) 791-4857, E-mail: <bookorders@who.int>.

TOWERS

Planning Rules... The U.K. government has issued a new set of planning rules for the siting of mobile phone base stations. The *Code of Practice* is designed to balance environmental protection and public concerns with the need for increased network capacity, according to a November 11 statement from the deputy prime minister. It noted the Stewart report's call for a precautionary approach but not its recommendation that base station radiation be kept to "the lowest practical levels" in public areas (see *MWN,* M/J00; also M/A01). The new code is available at <www.planning.odpm.gov.uk/telecomms/index.htm>.

Keeping Current: Follow-Up on the News

◆ In her presentation at the London MTHR meeting (see p.5 and p.9) Dr. Leeka Kheifets left no doubt that the WHO EMF project—run by Dr. Michael Repacholi—shares the already widespread skepticism over the recent Australian results that are purported to refute Repacholi's own cancer study (see *MWN,* M/J97 and S/O02). Instead of beginning with the expected overview of the project, Kheifets flashed a slide challenging the reliability of the new results reported by Drs. Tammy Utteridge and Tim Kuchel in *Radiation Research*. Later, Kheifets told *Microwave News* that the project had been no more successful than anyone else in getting the Australian researchers to clarify any of the many outstanding questions and inconsistencies.

◆ The French parliament has issued a report from its Office of Technology Assessment that analyzes the potential health risks associated with mobile phones and towers. The full text of the report, which is only available in French, is at <www.senat.fr/rap/r02-052/r02-052.html>.

◆ On November 18, the U.S. FCC proposed fining A-O Broadcasting Inc. $28,000 for allowing its radio station, KTMN, in Cloudcroft, NM, to violate its RF exposure limits. KTMN's FM antenna is mounted on an observation tower used by the U.S. Forest Service to watch for wildfires. A survey showed that when operating at only 40% of its authorized power, the antenna caused the RF levels on the tower to exceed the FCC limits by 300%. This is the first time the commission has proposed a monetary fine for a violation of its RF rules. A-O has 30 days to appeal.

◆ Prosecutors in Kiel, Germany, have indicted the former head of Hagenuk, the first company to market low-SAR mobile phones, the German Press Agency reported on November 8 (see *MWN,* S/O97 and N/D97). Manfred Schmitt is charged with accounting fraud and other crimes. The company, which he bought in 1995, declared bankruptcy in 1997—and again two years later. Schmitt, now a fugitive, is believed to have left Germany.

◆ *IEEE Transactions on Electromagnetic Compatibility* has issued a call for papers for a special issue on intentional EMI from high-power sources. For more information, contact Dr. William Radasky of Metatech Corp. at <wradasky@aol.com>. The papers are due next June and the issue will be out in May 2004.

VIEWS ON THE NEWS

The Coffee Manifesto

Being exposed to EMFs is no more hazardous to your health than drinking a cup of coffee. That's the message from the World Health Organization (WHO).

After the International Agency for Research on Cancer (IARC) classified power-frequency EMFs as possible human carcinogens last summer, we began to wonder how this ratcheting up of the health risk would play among the skeptics.

We found the answer in a new booklet on communicating EMF risks (see p.17). Inside, the WHO EMF project cites only one other agent designated as a possible carcinogen by IARC — coffee.

WHO's Mike Repacholi and Leeka Kheifets could pick from among 232 IARC possible carcinogens, including carbon tetrachloride, DDT and lead. But most of these appear less benign than coffee and might have prompted some public alarm.

To further cushion the blow, the WHO adds that coffee may be good for you: While acknowledging that it might increase the risk of kidney cancer, the WHO also tells the reader that coffee might protect against colon cancer. And, of course, many of us could not start the day without a good jolt of coffee.

EMFs are famously linked to childhood leukemia. But we had never before considered the possibility that EMF exposure could actually benefit children. Yet, soon afterwards, we came across a fact sheet from the Catholic school system in Edmonton that said just that. Children exposed to EMFs have *lower* rates of cancer, according to the fact sheet. (For the record, that is not our added emphasis.) This is the same school system that reported, "Every expert we talked with and studies we researched did *not* find a link to EMFs and childhood leukemia."

Who on earth have these Canadian Catholics been talking to? The most likely source is Mary McBride (see p.3). She says that the plan to site a new school next to a power line — which she endorses — is consistent with WHO's recommendations.

In its own newly revised EMF booklet, the National Institute of Environmental Health Sciences (NIEHS) thankfully steers clear of the coffee paradigm but still takes a dismissive view of the potential health risks (see p.2).

Four years ago, a panel convened by the NIEHS also designated EMFs as possible carcinogens. Rather than seeing the IARC decision as reaffirmation, the institute's resolve appears to have weakened and it is no longer promoting strategies that would reduce unnecessary EMF exposures.

Chris Portier, who helped draft both the NIEHS and the WHO booklets, seems to have changed his outlook. At last summer's IARC meeting, he was the one who forcefully argued that the animal data, not just the epidemiology, suggest a cancer association (see *MWN*, J/A01). Had he convinced three more of the 21 panel members to join him, IARC would have classified EMFs as *probable* human carcinogens, putting them in a class with benzopyrene, PCBs and UV radiation.

Portier, the associate director of the U.S. National Toxicology Program and the director of NIEHS' Environmental Toxicology Program, has a lot of clout. We wonder why he changed his mind — clearly, he is not impressed by the new California report (see p.2) — and why he now chooses not to give the American public fair warning about EMF health risks.

In the past, both the WHO and the NIEHS have endorsed prudent avoidance, or taking low-cost steps to reduce EMF exposures. That now seems to be history. Today's message is "Don't worry, be happy, have another espresso."

Our Wish List for 2003

Next year, we would like to see:

• A commitment from the U.S. federal government to sponsor ELF EMF and RF/MW radiation research.

• A new editor for papers on non-ionizing radiation at *Radiation Research* — someone who is not a consultant for the electric utility and cell phone industries.

• A moratorium on claims that the Utteridge–Kuchel mouse study is a replication or a refutation of the Repacholi cancer experiment. A little icing on this cake would be an investigation on how the study passed peer review at *Radiation Research*.

• Another moratorium on the well-worn arguments that the epidemiology linking childhood leukemia and power-frequency EMFs has no support from laboratory studies — after all, we now have six labs showing DNA breaks at 50/60 Hz and six others have shown that these fields can inhibit the cancer-controlling action of melatonin. And while we are at it, we should also ask for —

• A commitment by the Edison Electric Institute, American Public Power Association and EPRI, as well as the rest of the electric utility industry, that they will no longer dismiss and ignore the existence of EMF health risks.

• A serious attempt to settle the controversy over microwave-induced leakage through the blood-brain barrier. This is the third year in a row for this particular wish. *Hello!* Is anyone paying attention?

• And under our Christmas tree, we hope Santa will leave us a taste of whatever Q. Balzano and Asher Sheppard were smoking when they penned their over-the-top assault on the precautionary principle (see p.17).

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Cancer Risk Cited in $25 Million Power Line Award in Texas

A Texas jury has ordered Houston Lighting & Power Co. (HL&P) to pay more than $25 million in punitive damages to a local school district for "reckless disregard" of children's health in siting a 345 kV power line across school property. The decision, handed down on November 27, was "based almost entirely" on potential effects of electromagnetic radiation, according to H. Dixon Montague, the school district's attorney.

Montague, who is with the Houston firm of Vinson & Elkins, told *Microwave News* that the jury was "amazed" that HL&P would put such a large facility on school property and "shocked" that HL&P would do so when there was a question as to whether electromagnetic radiation causes, or has any relation to, cancer.

Martha Medina, a spokeswoman for HL&P, the nation's fifth largest electric utility, said the company will appeal the decision.

The six-member jury in the County Civil Court At Law No.1 of Harris County found that the utility had abused its discretion in condemning approximately eight acres of the Klein Independent School District's property to build the transmission line. The jury told HL&P to pay approximately $105,000 in damages for trespassing and $25 million in punitive damages — $1 million more than the school district had requested.

The jury also ruled that if the utility does not remove the power line, it will have to pay $42 million to relocate the three school buildings on the property. According to Montague, the $42 million figure is based on 1981 dollars and today amounts to more than $64 million.

(continued on p.11)

Soviet Bioelectromagnetics Research Blossoming

The Soviet Union is stepping up its research program on the biological effects of electromagnetic fields. Two American scientists just back from a tour of Soviet labs reported that Soviet research teams are pulling ahead of their American counterparts at a time when many U.S. labs are closing down or cutting back.

In interviews with *Microwave News* following their return from a three-week tour of Pushchino, Moscow and Leningrad in October, Dr. Bill Guy of the University of Washington at Seattle and Dr. Don Justesen of the VA Hospital in Kansas City, MO, said that they are convinced that the Soviets are making research on electric and magnetic fields a top priority.

(continued on p.9)

GAO Blames Felec and Air Force for Clear Radar Accident

The General Accounting Office (GAO) has concluded that Felec Services, Inc. (FSI) and the Air Force were responsible for the radiation accident at Clear Air Force Station in September 1983 in which six workers were overexposed to radiofrequency radiation.

The GAO, a congressional investigatory bureau, found that any of several actions by either FSI or the Air Force could have prevented — or at least minimized — the accident. "While the actions of one employee did initiate the accident," the GAO explains in its 65-page report, "this simple explanation does not consider the basic problems that allowed the accident to happen and to go undetected for eight minutes. In our opinion, the basic causes are varied, but relate primarily to contractor noncompliance with operational and safety specifications in the contract and systemic problems in Air Force contract management practices."

The accident occurred at the Alaskan base on September 14, 1983, when an FSI technician unknowingly switched on a transmitter that activated Clear's tracking radar, part of the U.S. Ballistic Missile Early Warning System, while eight workers were making repairs on and near the radar dish. The six workers on the dish were later found to have been exposed to levels in excess of safety standards — the highest exposure may have reached 390 mW/cm^2 (see *MWN*, November 1983 and December 1984).

Felec and DOD Responses

FSI challenged the GAO's conclusions in comments it submitted on a review draft of the report, charging that the report "misrepresents the true facts of the case and the circumstances surrounding" the accident. The company argued that the operating procedures on the day of the accident were in conformance with "Clear site instructions" and explained that the procedures had been modified to adapt to specific situations and conditions at Clear.

The Department of Defense (DOD) accepted the GAO's findings, however, and has agreed to make virtually all of the changes called for in the report. The earlier draft was also circulated to the Alaska Department of Labor, which supported the GAO, and the U.S. Department of Labor, which did not respond. The final report is virtually unchanged from the draft.

Democratic Alaska Congressman Don Young, who asked the GAO to investigate the accident, released the report on November 13. In a prepared statement, Young observed that, "It is now up to the courts to review the circumstances of the accident to determine if compensation is due" to the exposed workers. Four of the workers have filed suits against FSI and RCA (see *MWN*, September/October 1985), which was responsible for Clear for many years before FSI took over. (The Clear facility has been operated by the RCA Service Co., the ITT Arctic Services, Co., the RCA OMS Co. and FSI during its 23 years of operation. FSI, an ITT subsidiary, has had the operating contract since 1975.)

Interlock Bypass

According to the GAO, the accident would not have occurred if FSI had properly used the key interlock system that was designed to deactivate the radar system before workers entered the radome (radar housing). In fact, the GAO concluded that FSI routinely bypassed the system. Used properly, the interlock system would have made it virtually impossible to turn on the radar while anyone was in the radome.

The GAO also found that FSI failed to correct errors in the configuration of the waveguides and in the wiring of the four transmitters used to power the tracking and three detection radars at Clear — a mistake which contributed directly to the accident. The system had been improperly set up since its installation in 1961: contrary to the original design of the Clear facility, detection radar transmitters were used to power the tracking radar.

On the day of the accident, while performing a preventive maintenance routine, an FSI technician opened the waveguides to the inactive tracking radar — the interlock system would have prevented this, had it been used properly — and failed to close them before continuing his work. Soon afterward, the power to a detection radar was accidentally interrupted, deactivating the automatic transmitter selection function. When the technician manually switched the system back to its "normal" operating mode, power was mistakenly transferred from the detection to the tracking radar, where the eight repairmen were working.

The GAO criticized both FSI and the Air Force for their failure to correct the configuration problem: "...the accident would not have happened if either the contractor or the Air Force had corrected the transmitter layout design as required by contract provisions and regulations governing technical orders."

The GAO also said that FSI had understaffed the facility and had permitted unqualified personnel to operate the radar on the day of the accident. The report notes that FSI had given a qualified worker the day off.

FSI and the Air Force both issued reports soon after the accident, charging that the FSI technician's actions alone had caused the accident (see *MWN*, January/February 1984).

Oversight and Enforcement

The GAO found that the Air Force's Quality Assurance Evaluators (QAEs) responsible for contract compliance were not "technically trained in radar operation and maintenance" and had no "prior training or experience in contract law and procurement procedures or general contract administration requirements." QAEs serve one-year terms, which do not permit them to become sufficiently familiar with radar system contract compliance, the GAO charged. In addition, the Air Force failed to verify and validate technical orders before awarding the Clear contract to FSI, allowing the configuration errors to go uncorrected.

The medical care given to the exposed workers was ade-

quate overall, according to the GAO, although initial examinations of the men were delayed when an FSI manager required some of the workers to complete the repairs on the radar before permitting them to go to a nearby aid station. FSI then waited 24 hours before sending them to the Fairbanks Memorial Hospital Emergency Room, which is approximately 80 miles northeast of Clear. The report cautions, however, that "[The GAO] cannot determine whether this delay aggravated any existing biological problems or created other symptoms related to the radiation accident." It also notes that the men have received "extensive medical examinations" by Air Force and private physicians.

The GAO report, *Radiation Accident: Incident at Clear Air Force Station, Alaska* (GAO/NSIAD-86-9), recommends that the flaws it identified be corrected and that the Air Force survey other radar sites for similar violations. The title of the final report was changed from the draft's title, *Electromagnetic Radiation Hazards: Ballistic Missile Early Warning System (BMEWS), Site II, Clear A.F.S., Alaska.*

Single copies of the report are available at no cost from the GAO, 441 G St., NW, Washington, D.C. 20548.

Medical Devices Susceptible to EMI

Many computerized medical devices are susceptible to spurious electromagnetic signals and are unable to reject power line transients, according to the Food and Drug Administration (FDA). An FDA task force has identified problems in the way these devices are produced, installed and operated.

Speaking at the *IEEE Engineering in Medicine and Biology Society Conference* in Chicago, IL, in September, the FDA's Howard Bassen reported that "software quality assurance, the quality of the AC power and electromagnetic interference are the primary factors causing problems in computerized medical devices."

Bassen, who is the acting deputy director of the Division of Physical Sciences at the FDA's Center for Device and Radiological Health (CDRH) and chaired the task force, cited an example from the FDA's "Recall" data base: The pacer of an implantable cardiac pacemaker was reprogrammed by an electromagnetic field from an anti-theft device.

AAMSI and ECRI Reports

A study by the American Association for Medical Systems and Informatics (AAMSI), a Washington, DC-based group cited by Bassen, concluded that "the most common computerized device problems were caused by AC power line disturbances and electromagnetic interference (EMI) in clinical settings." AAMSI cited the following examples:

- AC power spikes can upset microprocessors, causing them to malfunction and to lose data.
- Electrosurgical units can cause both radiated and conducted EMI.
- The algorithm of pacemakers can be changed by EMI, without the user noticing.

Bassen also quoted data from the Emergency Care Research Institute (ECRI) of Plymouth Meeting, PA, which showed that electrocardiographs were susceptible to EMI from electrosurgical units, fluorescent lights, AC distribution systems and static on operators' hands.

In most cases, Bassen said, the problems can be resolved by shielding. He advocated transferring EMC techniques developed in the defense and aerospace industries to medical device manufacturers.

In a telephone interview with *Microwave News* after the conference, Bassen said that the FDA's Office of Device Evaluation would now put more emphasis on the EMC of medical devices.

Bassen can be contacted at HFZ-130, CDRH, FDA, Rockville, MD 20857, (301) 443-6536.

ELF Research Budgets: Mostly Bad News

Budgets for research on the bioeffects of extremely low frequency (ELF) power line radiation are being cut to the bone, stranding many laboratories just as they are ready to begin important new experiments. Only utility-sponsored research will get a boost in 1986.

At a meeting of contractors working on the bioeffects of electric and magnetic fields for the Department of Energy, the Electric Power Research Institute (EPRI) and New York State held in Alexandria, VA, in early November, speaker after speaker said that their labs would soon close down unless new funds were found (see also following story on neurologic changes).

Interviews with the leading funding agencies indicated:

- **DOE:** The Electric Field Effects Research program's budget has been reduced to $3 million in fiscal year (FY) 1986 from $4.7 million in FY85. The decrease was requested in President Reagan's proposed budget and Congress agreed to the cut. (The 1986 Energy and Water Development Appropriations Bill was signed into law on November 1.) Ken Klein, the director of the Office of Energy Storage and Distribution, said that "everybody will be hurt" by the cut and that there would probably be no new projects funded next year.
- **New York State Power Line Project:** The project's $5 million research budget has been spent or allocated. "There is almost no hope for any more money," according to Dr. David Carpenter, the director of the New York State Department of Health's Division of Laboratories and Research.
- **EPA:** As reported in our last issue, the Environmental Protection Agency (EPA) has moved to disband its research group on non-ionizing radiation. If this occurs, Dr. Carl Blackman's work on ELF fields will end, even though there has been mounting interest in his recent findings on the role of the Earth's magnetic field in turning certain biological processes on and off.

• **Navy:** Last year, the Navy stopped working on ELF bioeffects at its Aerospace Medical Research Lab in Pensacola, FL (see *MWN*, September 1984). The Office of Naval Research still has a few ongoing projects, however.

• **EPRI:** This is the one exception. EPRI expects to increase its funding level by 40 percent: from $1.7 million in 1985 to $2.4 million in 1986. Dr. Bob Patterson, project manager for EPRI's studies on the bioeffects of electric and magnetic fields, said that he planned to start a National Science Foundation-type program for "less directed and more creative" research with some of the new money.

Brookhaven Lab

Dr. Arland Carsten's plight at Brookhaven National Laboratory is a microcosm of the whole non-ionizing radiation research community. He and his coworkers have completed a study of reproductive and multi-generational effects of 60 Hz electric and magnetic fields on mice at Brookhaven's Medical Department in Upton, NY. (They found no significant effects on a large number of end points in results reported to date.) Carsten's experiment cost $585,000 — over ten percent of the total NY project's funds. Unless he can find a new source of money, however, Carsten will soon have to give up the specially equipped lab he built for the study, due to keen competition for space. "The lab would be perfect for a study of ELF and leukemia and cancer, an issue on a lot of people's minds," he told *Microwave News*. He said he has gone everywhere for research grants but has come up empty-handed.

"The replacement cost of the exposure facility would likely be more than $500,000. Many Brookhaven staffers supported me to get the lab and equipment ready for this study, otherwise I could never have built it within the budget. It's a pity to dismantle it when there are so many unanswered questions," he said.

The predicament faced by ELF researchers is similar to that of those who work at higher frequencies (see *MWN*, March 1985).

60 Hz Fields Induce Neurologic Changes in Monkeys

Power line frequency electric and magnetic fields can alter the balance of neurotransmitters in monkeys. This finding by researchers at the New York State Department of Health Laboratories in Albany is the first to implicate 60 Hz electromagnetic fields with changes in neurologic function.

Speaking at a meeting of contractors working on the effects of power line radiation held in Alexandria, VA, on November 6, Dr. Richard Seegal reported that monkeys exposed to a varied schedule of electric and magnetic fields for 63 days showed significant and replicable reductions in the concentrations of homovanillic acid (HVA) and 5-hydroxyindoleacetic acid (5-HIAA) in their cerebrospinal fluid (CSF). HVA and 5-HIAA are metabolites of dopamine and serotonin, respectively, two important neurotransmitters which are linked to motor activity, mood, emotion and sleep.

Decreases in HVA and 5-HIAA may indicate decreases in the firing activity of neurons and changes in circadian rhythms, according to Seegal. Changes in the concentration of HVA in the CSF mirror alterations in the brain, and, while the same may be true for 5-HIAA, it is possible that 5-HIAA concentrations in the CSF reflect changes in spinal cord metabolism.

Seegal and his coworkers, Drs. Robert Dowman and Jon Wolpaw, found that the decreases in HVA appeared to be dose-dependent and reversible. Although the decreases in 5-HIAA also appeared to depend on the dose, they did not appear to be reversible.

No Excess Leukemia Among Wisconsin Electrical Workers

Wisconsin electrical workers had a normal rate of leukemia mortality between 1963 amd 1978, according to a letter in the December 5 *New England Journal of Medicine*.

The finding by Drs. Eugenia Calle of the Centers for Disease Control in Atlanta, GA, and David Savitz of the University of Colorado Medical School in Boulder, CO, appears to contradict earlier reports by Drs. Samuel Milham and William Wright (see *MWN*, July/August and December 1982, respectively). The new study used the same occupational groupings as these previous studies.

Calle and Savitz advised that the current practice of combining various occupations into one group of "electrical workers" to test hypotheses is not supportable either by considerations of exposure or by consistent patterns of elevated risk. They wrote: "We believe that the available evidence concerning the possible association between occupational field exposure and leukemia risk should be viewed with caution until workplace exposures are more realistically considered and adequate epidemiologic studies are conducted on particular cohorts of interest."

Savitz is currently working on an attempted replication study of Nancy Wertheimer's epidemiological study that linked electromagnetic fields with childhood cancer (see *MWN*, September 1983). Results are due this summer. Savitz is moving to the Department of Epidemiology at the University of North Carolina School of Public Health in Chapel Hill at the beginning of the year.

Six monkeys were exposed to the field, and four acted as controls. Three sets of exposure conditions were used, each lasting 18 hours a day for 21 days: 3 kV/m and 0.1 gauss (G), 10 kV/m and 0.33 G, and 30 kV/m and 0.9 G in random order. Samples of CSF were collected after each 21-day exposure.

Seegal believes his findings may apply to humans because of their similarities to monkeys. In addition, he noted that the field strengths used in the study are "comparable to those found in the environment."

The team had hoped to run another pair of control monkeys to complete the experiment, as well as to attempt to determine the thresholds for the observed effects and to find out whether the electric or the magnetic field was the active agent, but the group's funding has run out. The studies were paid for by the New York State Power Line Project, whose $5 million research budget has now been depleted.

Seegal told *Microwave News* that he is seeking new sources of funding — so far without success.

CDC Confirms Down's Cluster in Vernon; MW Levels Minimal

The Centers for Disease Control (CDC) has confirmed that there is an elevated incidence of Down's Syndrome in Vernon, New Jersey, but found normal rates of other birth defects and cancer. The cluster remains unexplained, however, as preliminary reports of measurements made by the Environmental Protection Agency (EPA) indicate that radiation levels in Vernon Valley are extremely low. (Seven cases of Down's were identified in Vernon, as compared to the 1.43 expected cases.)

In a consultation report released on November 12, the CDC recommended an "intensive examination" of the Down's cases, but ruled out a "comprehensive" health survey of Vernon residents. The CDC advised that a scientific review advisory panel be set up to help the state Department of Health in its future work in Vernon. (See the full text of the CDC recommendations in "From the Field" on p.8.)

"The NJ Department of Health has accepted the CDC recommendations," Assistant Commissioner Dr. Leah Ziskin told *Microwave News*. She said that she is now putting together the panel and hopes to hold the first meeting in January.

Vernon has the largest concentration of satellite communications stations and point-to-point microwave towers in the U.S. Some local residents blame microwave radiation for the Down's cases and other ailments (see *MWN*, May 1985).

No Cause Found

The CDC could not explain what caused the Down's cluster. It dismissed as "unlikely" the possibility that some of the cases were misdiagnosed and/or that the cluster was a random event — the odds of the cluster occurring by chance were calculated as less than 1 in 1000. Nor could the CDC attribute the increase to maternal age: of the seven observed cases of Down's, five were among women under 30 years old. The CDC said it could not rule out the possibility of an environmental cause and therefore recommended that the cluster be studied further.

According to the CDC, birth weights and birth defect rates (other than Down's) in Vernon were normal and the rates for most cancers were lower than expected.

In mid-November, Richard Tell, chief of the EPA's Electromagnetics Branch in Las Vegas, NV, measured microwave radiation levels in Vernon. According to Dr. Gerald Nicholls, acting chief of the NJ Bureau of Radiation Protection, Tell found levels of 10^{-4} to 10^{-10} uW/cm^2 in residential areas.

In a telephone interview, Nicholls said that the EPA measurement report would be released by the NJ Department of Health in January or February.

Citizens Against the Tower (CAT), a local residents' group, criticized the CDC for making no attempt to check whether there were any additional cases of Down's Syndrome in Vernon and for not acknowledging that the cases already identified are clustered within specific areas in the town. "They just want to bury the whole thing," CAT's Elise Kreindler contended.

When asked about these criticisms, Larry Edmonds of the CDC's Center for Environmental Health, the principal author of the CDC report, told *Microwave News* that the New Jersey study team would check to see if there are any other cases of Down's and any special clustering in Ver-

Avon Siting Dispute

Residents of Avon, Connecticut, are continuing to spar with Avon Mountain broadcasters.

On November 19, the town zoning commission approved Astroline Communications' plan to erect a new 750-foot tower for station WHCT (Channel 18) across the street from an antenna farm, but placed eleven conditions on it, including a non-ionizing radiation limit of 10 uW/cm^2 at the boundary of the tower property and a 90-day restriction on the dismantling of WHCT's nearby 279-foot tower following activation of the new tower.

The residents have appealed the decision in the Connecticut Superior Court in Hartford.

The 10 uW/cm^2 exposure standard is similar to the one recommended earlier this year by Avon's Director of Health, Hudson Birden, Jr., though he had recommended that the limit apply at the nearest residence, 300 feet from the tower's property line (see *MWN*, September/October 1985).

On November 22, another broadcaster, Channel 13, filed an application to reactivate an unused tower on Avon Mountain, further angering the town residents.

non. "I would be very surprised if they came up with anything new," he said.

Kreindler suspects that the satellite stations turned down the power when the EPA came to town. "Usually TV reception in the valley is awful, but two days before the EPA arrived, it cleared up. Then a few days after they left, it returned to normal," she said.

Congresswoman Marge Roukema, who represents the Vernon area, has been monitoring the CDC and EPA studies and has notified CAT that she is looking into the federal government's efforts to set national exposure guidelines for non-ionizing radiation.

EMC Society Meeting

Outlined below are some of the highlights from the papers presented at the *1985 IEEE International Symposium on Electromagnetic Compatibility (EMC)*, held in Wakefield, MA, August 20-22.

• Isidor Straus gave a detailed overview of the German EMC bureaucracy, explaining how it is governed by directives from the EEC (the Common Market). In "Meeting the VDE Requirements," he explained that the German rules have been "extensively reworked" in the last six months. Straus, of Dash, Straus & Goodhue in Boxborough, MA, described the legislative background of the rules and the groups that actually write the standards — for instance, he noted that the German DKE Subcommittee 761 is the approximate counterpart of the U.S. ANS Committee C63 — and he went into considerable depth on the specific rules and measurement procedures.

• With respect to U.S. standards, Edwin Bronaugh of Electro-Metrics in Amsterdam, NY, reviewed the forthcoming SAE J1507 report on testing the susceptibility of motor vehicles to radiated signals in the frequency range 20 MHz to 18 GHz. He explained how the facilities and procedures described by the SAE can be applied to the testing of the immunity of other large and complex electronic systems....Julius Knapp and Frank Rose of the Federal Communications Commission (FCC) examined ways of simplifying and streamlining the commission's Part 15 rules on RF devices — including low power transmitters and computers. One change they advocated is to divide the rules into those that apply to intentional and to unintentional radiators. They also suggested the possibility of combining rules for unintentional radiators with the noise limits for industrial, scientific and medical (ISM) equipment under Part 18. They noted that the commission has not yet scheduled action for an overall revision of Part 15, but that a proposal could be issued in early 1986....And Richard Fabina and Joseph Husnay, both of the FCC, described some of the practical problems of testing computer devices with the commission's MP-4 measurement procedures. They emphasized the importance of cable placement and the configuration of the equipment for maximizing conducted and radiated signal levels — the configuration for maximum emissions also varies with frequency.

• Jane Clemmensen and John Meloy of SRI International in Menlo Park, CA, and Ralph Ferraro of the Electric Power Research Institute in Palo Alto, CA, presented the results of tests of seven power line conditioners, isolators and purifiers to filter out harmonics and noise generated by consumer electronic equipment. They found that these filters could reduce the high frequency noise but often at the

Intentional Satellite EMI?

What appears to be the first case of intentional electromagnetic interference (EMI) with a commercial satellite was reported to the Federal Communications Commission in November. A complaint filed by Eastern Microwave, Inc., alleged that a transponder leased by the company on Hughes Communications' Galaxy 1 satellite was subjected to 18 hours of EMI from an unknown source in late October, according to Eastern Microwave's attorney, Charles Helein of Dow, Lohnes & Albertson in Washington, DC.

The Home Satellite Newsletter, which broke the story, noted that a home satellite dish can be cheaply turned into an uplink transmitter that can interfere with any domestic satellite — "U.S. satellite communications could be held hostage by jammers," the Arlington, Virginia newsletter warned.

Revenge against broadcasters who scramble television programming is one widely cited motive for wanting to jam satellite signals. For instance, the November issue of *STV Magazine* published a fictitious story about an angry HBO subscriber who uses EMI to blackmail the satellite cable network to stop scrambling.

In a letter to the FCC, Helein wrote: "The nature of the signal (unmodulated), its clean quality, the length of interference, the times at which it occurs and the manipulation between [two transponders] suggest a strong possibility that the signal is being deliberately generated to create interference or some licensee is most negligent in its testing procedures. In either case the matter is of grave concern to Eastern Microwave."

Dan Warren, managing editor of *Satellite Week*, a Washington, D.C. newsletter, said in a telephone interview that "people in the industry are nervous," adding that it is easy to interfere with satellites but very expensive to stop and practically impossible to catch the jammer.

expense of increasing the low frequency components by more than 10 dB. In addition, they reported that some of these devices, which can cost up to $500, do not filter common mode noise because the neutral wire is passed straight through. In a second paper, Clemmensen reported that a small appliance with a variable speed motor can cause havoc to a home computer when both are plugged into the same outlet. She said that in 100 out of 100 tries, ten each with ten different computers, disk read-or-write operations failed due to conducted EMI from a hand drill. Moving the drill to a different outlet or using a 20-foot extension cord stopped the interference, however.

• From the Electromagnetic Fields Division at the National Bureau of Standards in Boulder, CO: Myron Crawford and G.H. Koepke outlined the advantages of using a reverberating chamber compared to an anechoic chamber for susceptibility testing. And P.F. Wilson and M.T. Ma evaluated the use of insertion loss as an indicator of a material's shielding effectiveness. If not done properly, they warned, the data obtained may reflect the measurement procedure more than the material being tested.

• Among the other noteworthy papers were: A description of the "Stanford ELF/VLF Radiometer Project" by Drs. A.C. Fraser-Smith and R.A. Helliwell of Stanford University in Palo Alto, CA, where they are attempting to measure the global distribution of ELF and VLF noise...C.K. Jackson of Hughes Aircraft Co. in Fullerton, CA, addressed how to adapt EMC testing procedures to spread spectrum communication systems....William Rhoades of Xerox Corp. in El Segundo, CA, described how to design equipment to achieve immunity to electrostatic discharge.

The attendance at the symposium's technical sessions was 694; the total attendance, including those visiting the exhibitions, was 1,195. A copy of the proceedings of the symposium is available for $33.00 (IEEE members) and $66.00 (non-members) from the IEEE Service Center, Publication Sales Dept., 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060. Order No. 85CH2116-2.

Portland RF/MW Proposal Changed to 200 uW/cm^2

The City of Portland's (Oregon) Planning Commission has proposed a general population radiofrequency and microwave (RF/MW) radiation standard of 200 uW/cm^2 — twice the level recommended by the city's Bureau of Planning.

In a November report to the City Council, the Planning Commission does not explain why it rejected the bureau's recommendation — indeed, it does not acknowledge the change.

Knowledgeable sources indicated that the 200 uW/cm^2 level was a compromise between the city and local broadcasters who opposed the 100 uW/cm^2 level. Although the radio and television stations have now been appeased, it is not clear how community groups involved in formulating the standard will react.

Steven Gerber, of the Portland Bureau of Planning, who is coordinating the development of the standard, told *Microwave News* that the "200 uW/cm^2 limit is conservative, with a built-in margin of safety over identified thermal effects."

None of the city's broadcasters will be adversely affected by the 200 uW/cm^2 standard, according to Gerber. He estimated that one FM station would have had to make some changes if the city had adopted a 100 uW/cm^2 level.

The Planning Commission recommendation must now be approved by the City Council, the last hurdle in a six-year effort to regulate broadcasters in Portland. The City Council is tentatively scheduled to discuss the RF/MW standard at a meeting on January 26.

The new 200 uW/cm^2 recommendation could bring the city in line with the standard for Multnomah County, in which Portland is located. The Portland proposal is the same as the public exposure standard adopted by the state of Massachusetts in 1983 and five times stricter than the guidelines of the American National Standards Institute (ANSI).

For a copy of the *RF Regulatory Review Project: Planning Commission Report and Recommendations to the City Council,* contact: Steven Gerber, Bureau of Planning, City of Portland, Room 1058, 1120 SW Fifth Ave., Portland, OR 97204, (503) 796-7706.

NAS-NRC Symposium on Non-Thermal Bioeffects

An advisory committee on "Non-Thermal Effects of Non-Ionizing Radiation" of the National Academy of Sciences-National Research Council's (NAS-NRC) Board on Radiation Effects Research held a one-day *Symposium on Biological Effects of Low-Level Exposures to Non-Ionizing Radiation* on October 29. Attendance at the meeting was limited to invited speakers and observers from federal agencies.

The board set up the advisory committee to determine what role the NAS-NRC should play in the field of non-ionizing radiation bioeffects. According to the board's staff officer, Dr. Stephen Brown, the committee will consider whether there is a need for an NAS-NRC study, and, if so, on what topic.

Brown told *Microwave News* that the advisory committee is preparing a detailed letter on its findings for the board — the letter should be ready for presentation at the board's meeting on December 6-7. There are no plans to release the letter and it may remain an internal document, Brown said.

The following experts were invited to speak at the NAS-NRC symposium: Drs. Ross Adey, Glen Edwards, Om Gandhi, Reba Goodman, Sol Michaelson, William Pickard, Maria Stuchly and Nancy Wertheimer.

The chairman of the NAS-NRC's advisory committee is Dr. Robert Hofstadter of the Department of Physics at Stanford University in Palo Alto, CA. The other members

(continued on p.8)

FROM THE FIELD

CDC Recommendations on Vernon, New Jersey

Reprinted below are the recommendations contained in the Report of Centers for Disease Control (CDC) Consultation on Vernon Township, New Jersey *issued on November 12, 1985. The principal author was Larry Edmonds of the Center for Environmental Health in Atlanta, GA. See story on p.5.*

The Center for Environmental Health (CEH) does not find any evidence that rates of all categories of birth defects and cancer are increased in Vernon Township. The rate of one defect, Down's Syndrome, was elevated from 1975 through 1981. The data available for review suggest that the rates of other outcomes are not unusual. On the basis of the available information, CEH does not believe that a comprehensive health study of Vernon Township residents is warranted, but rather an intensive examination of the Down's Syndrome cases as indicated below. After reviewing the existing data from Department of Health (DOH) and Citizens Against the Tower (CAT) and after considering the existing public health concerns, CEH suggests the following plan:

1. Describe the incidence of Down's Syndrome from 1982 to the present;

2. Conduct a case-control study of cytogenetically confirmed infants with Down's Syndrome for the years 1975 through 1985, including an in-depth family interview;

3. Measure the range of radiofrequency/microwave (RF/MW) radiation in Vernon Township;

4. Regularly review cancer and birth defects data from ongoing surveillance programs;

5. Establish an advisory panel to review planned studies.

1. The first priority in Vernon Township is to describe the current incidence of Down's Syndrome and other chromosomal abnormalities. Most of the data CEH reviewed are from 1975 through 1981. Very little is known about the current situation, particularly for Down's Syndrome. CEH suggests identification of all cases of Down's Syndrome and other defects due to chromosomal anomalies born from January 1982 through December 1985. The case definition should be the following: a resident birth of Vernon Township with the diagnosis of a chromosomal abnormality confirmed by karyotype. If needed, the DOH should make cytogenetic testing available. Case ascertainment should be very intensive and should include review of the infants' hospital records, local physicians, area chromosomal laboratories, area pediatric referral hospitals, school systems, fetal deaths, special child services and self reports including those from community groups. Special efforts should be made to ascertain resident cases diagnosed out of state through review of out of state hospital records, vital records, chromosomal registries and cytogenetic laboratories. These same intensive case finding procedures should be applied for births which occurred from 1975 through 1981, to insure as complete an ascertainment of cases for that period as possible. CEH is willing to review any cytogenetic studies that have been conducted on these families.

2. For each case of Down's Syndrome identified in recommendation 1 (cases born from 1975 through 1985) CEH suggests a detailed interview be conducted with each family and a set of control families. The interviews should include the following: family reproductive and medical history, residential history, occupational history, environmental exposures and other suspected risk factors. The investigation's success relies on the participation of the families of affected children. CEH is willing to consult on the development of a detailed questionnaire and to review the results of any study.

3. CEH recommends that measurements should be taken to determine the range of RF/MW radiation in Vernon Township. All sources of RF/MW radiation should be considered when estimating the range of potential microwave exposure to residents. CEH recommends that priority be given to sampling around and inside the schools adjacent to the satellite dishes. Samples should also be taken at representative areas in the community. The Mayor's Blue Ribbon Panel and CAT should be asked to develop a priority list of 12 sites to be sampled. CEH recommends that, after measurements have been taken around the earth stations' facility boundaries, around and inside the local schools and in representative areas, measurements should be taken at as many of the sites on the priority list as resources permit. These findings should be reviewed by the advisory panel (see recommendation No.5, below) and it is possible they may want more measurements.

4. CEH recommends that the DOH regularly review data on cancer and birth defects from ongoing surveillance programs. Data from Vernon Township and Sussex County should be routinely reviewed. In 1983, the DOH established a statewide birth defect surveillance system. Using this system, the State will be able to monitor Vernon Township and Sussex County with minimal additional effort, and the level of case ascertainment should be very high and timely. Data from Vernon Township and Sussex County should be reviewed every six months and the results should be reported to an advisory panel (see recommendation No.5, below). The cancer registry for New Jersey offers the opportunity to monitor cancer rates. The results of cancer surveillance should be reported in the same manner as those for birth defects surveillance.

5. CEH recommends that a scientific review advisory panel should be established to advise the State Department of Health on scientific issues. The Public Advocate, the Department of Environmental Protection (DEP), the Mayor's Blue Ribbon Panel from Vernon Township and the Citizens Against the Tower each should appoint a responsible scientist to represent it. The panel should review any planned activities and the results of any studies and make recommendations to the DOH. The DOH should be responsible for conducting any health studies in Vernon Township with the advice of the panel. CEH is willing to consult with this group and the Department of Health as appropriate.

NAS-NRC *(continued from p.7)*

are: Dr. J. Woodland Hastings of the Biology Laboratories at Harvard University in Cambridge, MA; Dr. Sean McGlynn of the Department of Chemistry at Louisiana State University in Baton Rouge; Dr. Michael Shelanski of the Department of Pharmacology at New York University in New York City; and Dr. John Rigden of the Department of Physics at the University of Missouri in Saint Louis.

The members of the Board on Radiation Effects Research are: Dr. Richard Setlow (chairman) of the Biology Department at Brookhaven National Laboratory in Upton, NY; Dr. Jacob Fabrikant of the Donner Laboratory at the University of California in Berkeley; Dr. Oddvar Nygaard of the Department of Radiology at Case Western Reserve University in Cleveland, OH; Dr. Joseph Rall of the National Institutes of Health in Bethesda, MD; Dr. Robert Pound of the Physics Laboratory at Harvard University; and Dr. Eldon Sutton of the Department of Zoology at the University of Texas in Austin.

Soviet Research *(continued from p.1)*

"No one can say they are not doing good science," Guy said, stressing that, "They have brand-new equipment, they have adopted a good scientific approach and they work in large interdisciplinary teams composed of biologists, biophysicists and engineers." He added that Professor Inal Akoev at the Institute of Biological Physics in Pushchino (south of Moscow) has 50 researchers in his lab alone and that all key personnel have their own IBM personal computers.

"I was very jealous of what I saw there," Guy said of his visit to Akoev's lab. "They have equipment that I just can't afford." Guy is the director of the University of Washington's Bioelectromagnetics Laboratory, one of the best-equipped and best-funded research centers in the U.S.

A similarly envious view came from Justesen: "Akoev has the best shop and is doing the most interesting things imaginable." Justesen contrasted the flourishing Soviet bioelectromagnetics program with the American one, which he described as "crashing in flames." He said that, based on their progress, the Soviets will soon begin to export medical devices such as magnetoencephalographs.

The two researchers' appraisal of the Soviet commitment to understanding bioelectromagnetic phenomena is consistent with previous reports by Americans returning from the Soviet Union (see *MWN*, November 1982).

Soviet Occupational Standards

In Moscow, Professor Boris Savin, director of the Institute of Industrial Hygiene and Occupational Diseases, told Guy that the new Soviet occupational standard, which limits worker exposures to 25 uW/cm^2 for an eight-hour day over the frequency range 300 MHz-300 GHz, will become effective on January 1, 1986. (See *MWN*, September 1983 for details of the Soviet occupational standard as it was first proposed.) The standard, which is based on the total amount of energy absorbed, allows higher exposures for shorter periods of time — for instance, 100 uW/cm^2 for two hours.

According to Guy, Savin said that the Soviet occupational standard may be relaxed in the next few years and that he would like to see greater parity between the safety standards in his country and those in the U.S.

In 1984, the Soviet Union relaxed its exposure standard for the general public from 5 uW/cm^2 to 10 uW/cm^2 above 300 MHz (see *MWN*, June 1985).

The U.S. Occupational Safety and Health Administration has a 10 mW/cm^2 (10,000 uW/cm^2) standard, although the courts have ruled it unenforceable. The voluntary ANSI standard limits worker and public exposures to 1-5 mW/cm^2 above 300 MHz. There are no federal standards to protect the general population from overexposure to non-ionizing radiation.

ELF Standards

Savin told Guy that the new Soviet occupational standard for extremely low frequency (ELF) electric fields from power lines is 5 kV/m for a full, eight-hour work day. For a ten-minute period, the limit is 20-25 kV/m. Guy said that the standard does not address ELF magnetic fields (see *MWN*, September 1984). The Soviet electrical distribution system operates at 50 Hz.

While in Moscow, Guy and Justesen also visited Professor Yu. Kholodnov at the Institute of Higher Nervous Activity. Here, too, they noted a marked improvement in the quality of the laboratory equipment for studies on DC and pulsed magnetic fields.

In Leningrad, the two Americans toured the Institute of Experimental Medicine and also met with Dr. T. Kalada, who works on occupational health diseases at an institute similar to Savin's.

Joint Statement

At the end of their visit to the Institute of Biological Physics in Pushchino, Guy and Justesen wrote a joint statement with Akoev on the current scientific basis for electromagnetic radiation (EMR) safety standards. They agreed:

- There is some ambiguity in determination of biological significance of the revealed effects of EMR with respect to signalling, adaptive and pathological reactions. There are very few data about the radiation levels and exposure durations associated with induction of pathological changes and with exhaustion of adaptive systems;
- Quantitative correlations between the effects of EMR at different levels of organization of biological systems, from molecular to organismic levels, have not been clearly established. This void of quantitative information hampers attempts to elucidate the role of regulatory systems in the manifestation of the effects at the organismic level;
- A comparative analysis of the effects of continuous wave and modulated irradiation in the range of "Adey windows" and of natural macrorhythms of organisms is much in need;
- There are no controlled studies of the sensory effects of EMR as one of the possible stress factors upon irradiation.

Akoev, Guy and Justesen endorsed the need for greater collaboration between Soviet and American researchers, with more exchanges of scientists and technical publications, as well as more meetings on key problems.

During their tour, Guy and Justesen were guests of the Soviet Union. Their travel was paid for by the National Institute for Environmental Health Sciences, which coordinates the ongoing U.S.-U.S.S.R. exchange program (see *MWN*, September 1983 and March 1985).

MICROWAVE NEWS is published bimonthly • ISSN 0275-6595 • PO Box 1799, Grand Central Station, New York, NY 10163 • (212) 517-2800 • Editor and Publisher: Louis Slesin, Ph.D.; Senior Editor: Mark Pinsky • Subscriptions: $200 per year ($235 overseas); single copies: $40.00 • Copyright © 1985 by Louis Slesin • Reproduction in any form is forbidden without written permission. • We invite contributions to *From the Field*, our column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

CONFERENCES

1986 Conference Calendar

January 8-10: **Detection of Optical Radiation,** *Americana Dutch Resort* Hotel, Lake Buena Vista, FL. Contact: V. Amico, Professional Engineering Development, University of Central Florida, Orlando, FL 32816, (305) 275-2123.

January 13-14: **Satellite Communications: Applications, Technology & Competition,** Halloran House, New York, NY. Contact: Carol Every, Frost & Sullivan, 106 Fulton St., New York, NY 10038, (212) 233-1080.

January 13-16: **National Radio Science Meeting,** University of Colorado, Boulder, CO. Contact: Professor S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO 80309.

January 21-23: **Electrical Overstress Exposition,** Anaheim Hilton and Towers, Anaheim, CA. Contact: Jim Russell, 2504 North Tamiami Trail, Nokomis, FL 33555, (813) 966-3631.

January 30-February 1: **RF Technology Expo,** Anaheim Hilton and Towers, Anaheim, CA. Contact: Kathy Kriner, *RF Design,* 6530 S. Yosemite St., Englewood, CO 80111, (303) 694-1522.

February 2-7: **Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: Nancy Heitmann, IEEE, 345 East 47th St., New York, NY 10017, (212) 705-7893.

March 5-7: **Workshop on Measurement of Electrical Quantities in Pulse Power Systems II,** National Bureau of Standards (NBS), Gaithersburg, MD. Contact: Ron McKnight, B344 Metrology Bldg., NBS, Gaithersburg, MD 20899, (301) 921-3121.

March 12-13: **IEEE 1986 National Radar Conference,** Los Angeles, CA. Contact: Radar Systems Group, Hughes Aircraft Co., R-1, D-428, PO Box 92426, Los Angeles, CA 90009.

March 12-15: **Joint Meeting of the European Workshop on Nuclear Magnetic Resonance and the World Health Organization,** Monte Carlo, Monaco. Contact: Dr. Robert Muller, University of Mons, Faculty of Medicine, B7000 Mons, Belgium.

March 25-27: **IEEE IMTC/86: Instrumentation/Measurement Technology Conference,** University of Colorado, Boulder, CO. Contact: Robert Myers, IMTC/86 Coordinator, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024, (213) 475-4571.

April 2-3: **22nd Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP),** Washington, DC. Contact: NCRP, Suite 1016, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652.

April 2-4: **International Workshop on Physics and Engineering in Computerized Multidimensional Imaging and Processing,** University of California, Irvine, CA. Contact: Dr. O. Nalcioglu, Dept. of Radiological Sciences, University of California, Irvine, CA 92717, (714) 856-5904.

April 8-10: **1986 Test & Measurement World Expo,** Convention Center, *San Jose, CA. Contact: Meg Bowen, 215 Brighton Ave., Boston,* MA 02134, (617) 254-1445.

April 12-16: **21st Annual Meeting & Exhibit of the Association for the Advancement of Medical Instrumentation (AAMI),** Hyatt Regency, Chicago, IL. Contact: AAMI, Suite 602, 1901 N. Fort Myer Dr., Arlington, VA 22209, (703) 525-4890.

April 12-16: **64th Annual Convention of the National Association of Broadcasters (NAB),** Convention Center, Dallas, TX. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5350.

April 13-17: **34th Annual Scientific Meeting of the Radiation Research Society (RRS)** and the **6th Annual Meeting of the North American Hyperthermia Group (NAHG),** Las Vegas, NV. Contact: RRS at 925 Chestnut Street, 7th floor, Philadelphia, PA 19107, (215) 574-3153; and NAHG, c/o Professor John Strohbehn, Thayer School of Engineering, Dartmouth College, Hanover, NH 03755, (603) 646-2609.

April 14-17: **24th International Magnetics Conference,** Hyatt Regency, *Phoenix, AZ. Contact: Ms. Diane Suiters, INTERMAG'86, 655* 15th St., NW, Suite 300, Washington, DC 20005, (202) 639-5088.

May 5-9: **Magnetic Resonance Imaging 1986: National Symposium,** Orlando Hyatt Hotel, Disneyworld, FL. Contact: Sally Lunn, Educational Symposia, Inc., PO Box 17241, Tampa, FL 33682, (813) 873-2090.

May 12-14: **1986 Microwave Power Tube Conference,** Naval Postgraduate School, Monterey, CA. Contact: Ralph Nadell, Palisades Institute for Research Services, 11th floor, 201 Varick St., New York, NY 10014, (212) 620-3341.

May 12-15: **International Scientific Conference: Work with Display Units,** Stockholm, Sweden. Contact: WWDU, c/o Stockholm Conference Bureau, Box 1617, *S-111 86 Stockholm, Sweden.*

May 19-22: **18th Annual Meeting of the Conference of Radiation Control Program Directors (CRCPD),** Charleston, WV. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 19-24: **1986 Nuclear EMP Meeting,** University of New Mexico, Albuquerque, NM. Contact: C.W. Jones, Dikewood Corp., 1613 University Blvd., NE, Albuquerque, NM 87102.

May 25-30: **Symposium on Electrofusion and Electroporation of Cells and Protoplasts at the 1986 Annual Meeting of the AAAS,** Philadelphia, PA. Contact: Dr. Thomas Rozzell, Office of Naval Research, Arlington, VA 22217, (301) 696-4053. For more information on *AAAS meeting, see Science, October 11, 1985, p.162.*

June 1-5: **8th Annual Meeting of the Bioelectromagnetics Society (BEMS),** Madison, WI. Contact: BEMS, 1 Bank St., Gaithersburg, MD 20878, (301) 948-5530.

June 2-4: **1986 IEEE MTT-S International Microwave Symposium,** Baltimore, MD. Contact: Marvin Cohn, c/o LRW Associates, 1218 Balfour Dr., Arnold, MD 21012.

June 4-5: **1986 IEEE Microwave and Millimeter Wave Monolithic Circuits Symposium,** Baltimore, MD. Contact: Octavius Pitzalis, Jr., Hughes Research Lab., 3011 Malibu Canyon Rd., MS RL-61, Malibu, CA 90265, (213) 317-5841.

June 8-13: ***Gordon Conference on Bioelectrochemistry,*** *New Hampshire.* Contact: Professor Howard Wachtel, University of Colorado, Boulder, CO 80309, (303) 492-7327, or Professor Betty Sisken, University of Kentucky, Lexington, KY 40506, (606) 258-5796.

June 9-13: **1986 International IEEE Antennas and Propagation Society Symposium and National Radio Science Meeting,** Wyndham Franklin Plaza Hotel, Philadelphia, PA. Contact: Charles Allen, GE, Valley Forge Space Center, Room U4018, PO Box 8555, Philadelphia, PA 19101.

June 11-13: **International Symposium on Probabilistic Methods Applied to Electric Power Systems,** Toronto, Canada. Contact: Dr. Samy Krishnasamy, Research Division, Ontario Hydro, 800 Kipling Ave., Toronto, Ontario M8Z 5S4, Canada, (416) 231-4111, Ext. 6086.

June 16-19: **EMC Expo 86,** Sheraton Washington Hotel, Washington, DC. Contact: EMC Expo 86, Suite 200, 117 King St., Alexandria, VA 22314, (703) 548-2802.

June 19-21: **5th International Congress Cardiostim 86,** Monaco. The meeting will include symposia on **Cardiostimulation** (Cardiac Pacing and Electrophysiology) and on **Biostimulation** (New Advances in Biostimulation). Contact: Dr. J. Mugica, 16 rue Pasteur, 92211 St-Cloud Cedex, France.

June 23-25: **17th Power Modulator Symposium,** Hyatt Seattle, WA. Contact: Leslie Gallo, Palisades Institute for Research Services, 2011 Crystal Dr., One Crystal Park, Suite 307, Arlington, VA 22202.

June 23-27: **Conference on Precision Electromagnetic Measurements (CPEM'86),** National Bureau of Standards (NBS), Gaithersburg, MD. Contact: Norman Belecki, B146 Metrology Bldg., NBS, Gaithersburg, MD 20899, (301) 921-2715.

June 24-26: **1986 International Conference on Lightning and Static Electricity,** Stouffer Dayton Plaza Hotel, Dayton, OH. Contact: Lawrence Walko, AFWAL/FIESL, Wright-Patterson AFB, Dayton, OH 45433, (513) 257-7718.

June 24-26: **Military Microwaves (MM'86),** Metropole Convention Center, Brighton, UK. Contact: R.C. Marriott, Microwave Exhibitions and Publishers, Convex House, 43 Dudley Rd., Tunbridge Wells, Kent TN1 1LE, U.K., (0892) 44027.

June 24-26: **8th International Wroclaw Symposium on Electromagnetic Compatibility,** Wroclaw, Poland. Contact: EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland.

June 29-July 3: **31st Annual Meeting of the Health Physics Society (HPS),** Hilton Hotel, Pittsburgh, PA. Contact: HPS, Suite 300, 1340 Old Chain Bridge Rd., McLean, VA 22101, (703) 790-1745.

July 26-August 9: **NATO Advanced Study Institute: Physics and Technology of Hyperthermia,** Urbino, Italy. Contact: S.B. Field, MRC Cyclotron Unit, Hammersmith Hospital, Ducane Rd., London W12, UK, (1) 743-4594, or C. Franconi, Medical Physics Institute, University of Rome, Via O. Raimondo, 00173 Rome, Italy, (6) 613-1200.

July 28-30: **21st Annual Microwave Power Symposium,** Crowne Plaza Hotel, Memphis, TN. Contact: International Microwave Power Institute (IMPI), 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

July 30-August 3: **1986 International Tesla Symposium,** Colorado College, Colorado Springs, CO. Contact: IEEE Pikes Peak Section, Suite 115, 330-A West Uintah, PO Box 150, Colorado Springs, CO 80901.

August 13-14: **Symposium with Seminars on Antenna Technology and Applied Electromagnetics,** University of Manitoba, Winnipeg, Manitoba, Canada. Contact: L. Shafai, Dept. of Electrical Engineering, University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada, (204) 474-9603.

August 20-22: **11th Annual Conference of the Australian Radiation Protection Society,** Sydney, Australia. Contact: D.A. Woods, Office of the Supervising Scientist, PO Box 387, Bondi Junction, NSW 2022, Australia, (02) 387-0666.

August 25-29: **URSI International Symposium on Electromagnetic Theory and 8th Colloquium on Microwave Communication,** Budapest, Hungary. Contact: Professor T. Berceli, Research Institute for Telecommunication, 1525 Budapest 114, POB 15, Hungary.

September 14-19: **1986 IEEE/PES Transmission and Distribution Conference and Exposition,** Convention Center, Anaheim, CA. Contact: Charles White, South Carolina Electric and Gas Co., PO Box 764, Columbia, SC 29218, (803) 748-3518.

September 16-18: **IEEE International Symposium on Electromagnetic Compatibility,** Town and Country Hotel, San Diego, CA. Contact: George Ufen, GRU Associates, 1105 East Commonwealth Ave., Fullerton, CA 92631, (714) 738-0903.

September 17-19: **International Utility Symposium on the Health Effects of Electrical and Magnetic Fields: Research, Communication and Regulation,** Constellation Hotel, Toronto, Ontario, Canada. Contact: John O'Grady, Ontario Hydro, Suite H8 D4, 700 University Ave., Toronto, Ontario M5G 1X6, Canada, (416) 592-3395.

September 23-26: **Heating and Processing 1-3000 MHz,** Cambridge, UK. Contact: British National Committee for Electroheat, 30 Millbank, London SW1P 4RD, U.K.

September 28-October 2: **5th International Conference on Electromagnetic Compatibility,** University of York, U.K. Contact: Conference Secretariat, Institution of Electronic and Radio Engineers, 99 Gower St., London WC1E 6AZ, U.K., (01) 388-3071.

October 6-7: **2nd International Conference on Harmonics in Power Systems,** Winnipeg, Manitoba, Canada. Contact: Robert Hamlin, Room 227, Engineering Bldg., University of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada, (204) 261-4412.

October 14-16: **1st Annual Convention of the Society of Broadcast Engineers (SBE),** Convention Center, St. Louis, MO. Contact: SBE, Suite 118, 7002 Graham Rd., Indianapolis, IN 46220, (317) 842-0836.

October 19-22: **6th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS),** Utrecht, Holland. Contact: BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

October 20-24: **11th IEEE International Conference on Infrared and Millimeter Waves,** Hotel Continental, Pisa, Italy. Contact: M. Inguscio, Dept. of Physics, University of Pisa, Piazza Torricelli 2, I-56100 Pisa, Italy, (050) 45222.

November 4-6: **4th International Symposium on Antennas: JINA'86,** Acropolis Convention Center, Nice, France. Contact: J.L. Guiraud, CNET-PAB Centre de La Turbie, 06320 Cap D'Ail, France, (93) 411717.

November 7-10: **8th Annual Conference of the IEEE Engineering in Medicine and Biology Society,** Worthington Hotel, Fort Worth, TX. Contact: Dr. Charles Robinson, Rehabilitation R&D Center, Hines VA Hospital, Box 20, Hines, IL 60141, (312) 343-7200, ext. 2240.

November 30-December 5: **Symposium on Heat and Mass Transfer in Thermally Significant Vessels and the Microcirculation,** Anaheim, CA. Contact: Professor Ken Diller, Biomedical Engineering Center, University of Texas, ENS 612, Austin, TX 78712, (512) 471-7167.

Power Line Award *(continued from p.1)*

Montague further explained that HL&P remains liable for the $64 million condemnation damages even if an appeals court later overturns the jury's verdict on HL&P's abuse of discretion.

The decision followed a four-year legal fight that began when HL&P condemned the school district's land for a 100-foot-wide easement. Before the condemnation proceedings were completed, the utility began work on the power line, prompting the district's claim that HL&P acted "with callous disregard for the safety, health and well-being of the 3,000-plus children who attend the schools."

Cancer Risks Argued

Several prominent bioeffects researchers testified at the trial, and the jury heard about the potential cancer-causing effects of extremely low frequency (ELF) radiation. Dr. Jerry Phillips of the Cancer Therapy and Research Center in San Antonio, TX, Dr. Nancy Wertheimer of the University of Colorado in Boulder and Dr. Harris Busch of the Baylor University Medical School in Waco, TX, appeared on behalf of the school district. HL&P called Dr. Edwin Carstensen of the University of Rochester as an expert witness.

HL&P is represented by Ross Harison of Baker & Botts, another Houston law firm. Harison did not respond to telephone calls for comment but was quoted in the *Houston Chronicle* as having said that the medical evidence introduced by the school district is only a small body of research which says there may be a hazard: "What does that prove? Nothing." ●

UPDATES

BIOLOGICAL EFFECTS

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

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

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

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

COMPATIBILITY & INTERFERENCE

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

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

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

GOVERNMENT

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

INTERNATIONAL

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

MEASUREMENT

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

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

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

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

MEDICAL APPLICATIONS

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

MEETINGS

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

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

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

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

PEOPLE

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

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

POWER LINES

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

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

STANDARDS

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

VDTs

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

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MICRO WAVE NEWS

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1987 Conference Calendar (Part I)

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

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

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

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

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

In the seven years following the publication of their landmark

(continued on p.12)

What's Next?

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

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

(continued on p.12)

HIGHLIGHTS

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

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

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

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

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

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

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

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

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

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

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

OSHA's RF/MW Standard

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

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

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

Mechanisms and Cellular Effects Stressed at BRAGS Meeting

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

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

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

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

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

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

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

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

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

Clash Over Reproducibility of Dixey-Rein 500 Hz Results

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

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

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

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

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

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

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

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

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

Microwave Weapons

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

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

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

EPA on RF/MW Exposures

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

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

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

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

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

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

RF Lighting Rules: Conflicting Views

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

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

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

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

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

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

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

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

The Health Physics of Non-Ionizing Radiation

March 9-13, 1987
Merrimack, New Hampshire

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

FROM THE FIELD

Letter from China

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

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

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

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

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

NRPB on Greenham Common

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

Dear Sir:

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

Yours faithfully,

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

Adey & Sheppard and Milham Respond to Foster & Guy

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

September 25, 1986

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

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

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

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

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

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

Sincerely,

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

Asher R. Sheppard
Research Physicist

August 19, 1986

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

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

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

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

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

Sincerely,

Samuel Milham, Jr., MD
Olympia, WA

UPDATES

BIOLOGICAL EFFECTS

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

COMMUNICATIONS

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

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

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

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

COMPATIBILITY & INTERFERENCE

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

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

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

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

GOVERNMENT

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

INTERNATIONAL

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

MEASUREMENT

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

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

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

MEDICAL APPLICATIONS

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

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

MEETINGS

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

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

MILITARY SYSTEMS

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

STANDARDS

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

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

NEW PUBLICATION

Biological Effects of Electropollution Brain Tumors and Experimental Models

Edited by Sisir K. Dutta and Richard M. Millis

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

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ELF Epi Study (continued from p.1)

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

External Field Sources Most Important

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

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

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

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

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

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

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

A Causal Relationship: Pro and Con

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

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

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

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

New EPRI Epi Study

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

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

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

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

Epidemiology Workshop

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

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

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

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

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

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

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

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

Adult Leukemia: No Link to Residential ELF Fields

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

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

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

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

Canadian Unions Press for Research on ELF Radiation Risks

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

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

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

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

proposing or setting ELF safety standards.

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

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

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

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

Other Developments

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

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CONFERENCES

1987 Conference Calendar [Part I]

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

April 8-9: **23rd Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP),** Washington, DC. Contact: NCRP, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814, (301) 657-2652.

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

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

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

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

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

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

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

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

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

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

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MICRO WAVE NEWS

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1988 Conference Calendar

$25 Million Power Line Award Reversed; Health Issue Affirmed

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

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

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

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

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

(continued on p.14)

Congressional Hearings on Power Lines: Follow-Up Seen

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

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

(continued on p.10)

ELF NEWS

The Talk of Kansas City

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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New and Forthcoming Papers on Bioeffects and Health

Byus & Adey: ODC and Cancer Promotion

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

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

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

Among Byus and Adey's key experimental findings were:

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

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

Craig.V. Byus, Susan E. Pieper and W. Ross Adey, "The Effects of Low-Energy 60 Hz Environmental Electromagnetic Fields Upon the Growth-Related Enzyme Ornithine Decarboxylase," *Carcinogenesis, 8*, pp.1385-1389, October 1987; Craig V. Byus, K. Kartun, S. Pieper and W. Ross Adey, "Increased Ornithine Decarboxylase Activity in Cultured Cells Exposed to Low Energy Modulated Microwave Fields and Phorbol-Ester Tumor Promoters," submitted to *Cancer Research*. See also *MWN*, July/August 1983.

Milham: Cancer Among Radio Operators

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

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

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

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

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

Perry & Pearl: Depression in High-Rise Apts.

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

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

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

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

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

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

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

Rivas: Effects on the Second Generation

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

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

Updated Savitz Study: Cancer Link on Firmer Ground

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

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

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

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

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

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

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

No effects were observed on serum proteins and cholesterol.

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

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

Recently Published

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

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

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

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

Florida Report Out; Court Ruling Makes Standards Moot

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

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

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

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

Florida EMF Panel: Recommendations

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

ABC News Covers Power Lines

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

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

by-case basis.

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

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

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

EPRI News

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

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

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

Utility Survey: ROWs Are No.1

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

Advisory Subcommittees

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

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

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

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

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

Assorted Notes

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

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

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

HIGHLIGHTS

EMI Blamed for U.S. Army Helicopter Crashes

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

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

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

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

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

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

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

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

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

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

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

Record OSHA Fine Cites Lax Radar Testing

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

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

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

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

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

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

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

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

FCC Proposes Major Changes to Part 15 RF Rules

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

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

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

Emission Limits for Intentional Radiators

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

*Limits are identical for unintentional radiators.

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

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

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

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

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

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

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

RF Lighting: FCC Drops Radiated Limits Below 30 MHz

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

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

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

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

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

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

Canadian General Population & Occupational RF/MW Exposure Limits

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

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