UPDATES

BIOLOGICAL EFFECTS

Schwan Lecture... In 1986, Dr. Herman Schwan, professor emeritus at the University of Pennsylvania, delivered the Lauriston S. Taylor Lecture at the annual meeting of the National Council on Radiation Protection and Measurements (NCRP). The NCRP has now published Schwan's talk, *Biological Effects of Non-Ionizing Radiations: Cellular Properties and Interactions* (Lecture No.10), in booklet form. It is available for $12.00 from: NCRP Publications, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814, (301) 657-2652. The lecture will also be published as part of the proceedings of the NCRP's 1986 meeting.

Bioeffects Critique... The U.S. Air Force has released a *Critique of the Literature on Bioeffects of Radiofrequency Radiation: A Comprehensive Review Pertinent to Air Force Operations* (USAFSAM-TR-87-3), by Louis Heynick, who recently retired from SRI International. The 691-page review covers non-ionizing radiation effects in the 10 kHz-300 GHz frequency range and was commissioned as a reference source for environmental impact statements on radiation-emitting USAF systems; it features more than 600 references. For more information, contact: James Merritt, USAF School of Aerospace Medicine, Human Systems Division, Brooks AFB, TX 78235, (512) 536-3583.

COMPATIBILITY & INTERFERENCE

ESD Suspected in MX Explosion... Plaintiffs in a lawsuit filed last September, which alleges that the armed forces have not adequately addressed the issues of hazards of electromagnetic radiation to ordnance (HERO), have asked the Pentagon to produce reports on a recent MX missile fire which killed five technicians (see *MWN*, September/October 1987). The explosion occurred while fuel was being loaded into the first stage of an MX missile at a Morton Thiokol plant in Utah on December 29. Although company officials have not specified the cause of the accident, the plaintiffs suspect that electrostatic discharge (ESD) was to blame. The lawsuit, now in pretrial discovery, also seeks data on more than 50 weapons systems accidents – including six other solid fuel explosions and some of the recent UH-60 Black Hawk Army helicopter crashes (see *MWN*, November/December 1987). In court papers, the plaintiffs – whose number has grown from four to 39 and now includes Physicians for Social Responsibility – allege that there are similarities between the MX accident and a 1985 Pershing II missile explosion in West Germany (see *MWN*, June 1985).

Assorted Notes... In our September/October 1987 issue, we featured a report on the efforts of NBS's François Martzloff to control conducted EMI. For more on this, see Ivars Peterson's article, "In Search of Electrical Surges," in the December 12 *Science News*....The Microwave Filter Co. has issued *The Filter Book*, which covers the company's products in the 1 MHz to 26 GHz frequency range. Copies are available from: Microwave Filter Co., 6743 Kinne St., East Syracuse, NY 13057, (800) 448-1666, or (315) 437-3953 in NY....Two Texas Instruments Inc. researchers have published "Characterization of Metals as EMC Shields" in the September 1987 *IEEE Transactions on Instrumentation and Measurement*.... Comsearch Applied Technology, Inc. of Reston, VA, has won a $5.6 million contract from the Naval Surface Warfare Center in Dahlgren, VA, for below-deck EMI services....In our last issue, we noted the conflict between British radio astronomers and broadcasters over limited frequency space. Now, according to the December 24/31 *New Scientist*, the potential interference problem appears to have been resolved by reallocating spectrum space given to air traffic controllers; broadcasters can now hope for a fifth television channel by 1991, leaving astronomers free to detect pulsars without EMI.

GOVERNMENT

FCC on FM Boosters... The FCC has proposed adding FM booster stations to its list of facilities that must comply with its RF radiation health regulations. The move was prompted by July 1987 FCC rules that lifted the previous 10-watt limit on output power. Now, FM boosters can be much more powerful – up to 20% of the maximum permissible ERP of the primary station. In 1985, the FCC issued regulations requiring applicants for its licenses to either meet the ANSI RF/MW radiation safety standard or complete an environmental impact statement (see *MWN*, April 1985 and March/April 1987). Comments were due by February 8, with reply comments due by February 23. For more information, contact: Dr. Robert Cleveland at the FCC's Office of Engineering and Technology, (202) 653-8169.

...and on Satcom Stations... On December 30, the FCC issued a public notice (No. DS-703) reminding all applicants for transmitting earth stations that they must "include a statement that the station is in compliance with the environmental radiation health standards" codified in the commission's regulations. Those not in compliance must submit an environmental assessment.

MEASUREMENT

Magnetic Field Meter... Electro-Metrics has introduced a new meter that can measure low-level magnetic fields. The MFM-11 unit has a minimum sensitivity level of 1 nT from 20 Hz to 50 kHz – users can select any one of a large number of frequency bands within this range. In addition, filters are available to screen out power line noise. The unit costs $6,995 and is designed primarily for TEMPEST and EMC applications. For more information, contact: Paul Sikora, Marketing Manager, Electro-Metrics, 100 Church St., Amsterdam, NY 12010, (518) 843-2600.

MEETINGS

Hanford ELF Symposium...In October 1984, DOE, EPRI and Battelle Pacific Northwest Labs sponsored the 23rd Hanford Life Sciences Symposium on the *Interaction of Biological Systems with Static and ELF Electric and Magnetic Fields* in Richland, WA, home of the Battelle Labs. The proceedings of the meeting are now available. Because of the long delay in publication, many of the papers are no longer current. Nevertheless some of them are still useful and among these are: Dr. Hans-Arne Hannson's (of Sweden) observations of "lamellar bodies" in cerebral tissue of exposed animals. Dr. Gregory Lotz and Jack Saxton's (both of the Naval Aerospace Medical Research Lab in Pensacola, FL) second study of monkeys chronically exposed to ELF fields (see *MWN*, September 1984), designed to simulate the U.S. Navy's submarine communications system, which operates between 72 Hz and 80 Hz. Lotz and Saxton also reviewed the lab's first monkey study – a final report on that experiment was never published. Also of particular interest is Dr. Don Deno's (of GE) discussion of exposures to weak electric and magnetic fields in the home. In all, there are more than 40 papers by researchers from around the world. A copy of the 553-page paperback volume is available for $25.00 from: Dr. Larry Anderson, Battelle Pacific Northwest Labs, PO Box 999, Richland, WA 99352, (509) 375-2294.

Israeli Meeting Canceled...The *International Symposium on Interaction of Electromagnetic Fields with Biological Systems*, which was scheduled to be held this March in Israel, has been canceled "due to lack of interest" (see *MWN*, November/December 1987).

MILITARY SYSTEMS

Microwave Weapons...If you want to know what a microwave weapon looks like, open the December 7, 1987 issue of *Aviation Week* to page 85 for a picture of the U.S. Air Force's "Gypsy microwave device," which is being used to test the susceptibility of electronics systems. The Gypsy device can produce more than one *gigawatt* of power in short pulses and is tunable over the frequency range 800 MHz to 40 GHz. The Air Force program is based at Kirtland Air Force Base, NM, where a conference on high-power microwave (HPM) technology was held in December 1986 (see *MWN*, January/February 1987)....According to the May 4, 1987 *Aviation Week*, the HPM effort sponsored by the Defense Nuclear Agency (DNA), the U.S. Air Force and the U.S. Navy has a budget of $15 million in fiscal year (FY) 1988....Some of that money will go to the company that successfully responds to a DNA request for proposals (RFP No.DNA001-88-R-0009, issued on November 25) for 45 months worth of studies on the effects of HPMs on weapons systems, on methods to protect such systems and on the feasibility of propagating HPMs through the atmosphere. Among the options listed in the RFP are experiments designed to "determine the maximum microwave power density...that can be propagated through the atmosphere before air breakdown occurs" and tests to determine the HPM susceptibility of orbital satellites. The winning contractor will need a top secret security clearance....The Lawrence Livermore National Lab (LLNL) and the Sandia National Lab are also working to assess the vulnerability of electronics to HPMs. There is a short article on the program in the July 1987 issue of *Energy and Technology Review*, published by LLNL....And in its March 1987 issue, the magazine featured a longer item on LLNL's research on HPMs and pulsed power....Dr. James Benford of Physics International in San Leandro, CA, reviews "High Power Microwave Simulator Development" in an article appearing in the December 1987 issue of the *Microwave Journal*....The U.S. Army has its own product – a radiofrequency (RF) weapon. In the August 24, 1987 *Defense News*, John Rosado of the Harry Diamond Labs in Adelphi, MD, is quoted as saying that "the nature of warfare will be completely changed by the use of [RF] weapons." Rosado also noted that RF radiation could be used over a wide battlefield with phased arrays....Some of the DOD's concern over RF and HPM weapons is reflected in a recent glossy pamphlet, *The Soviet Space Challenge* (issued in November 1987), in which the DOD notes that, "The Soviets could test a ground-based [RF] weapon capable of damaging satellites in the 1990s."...Watch for the review of "Tactical Microwave Weapons" by Dr. H. Keith Florig of Carnegie-Mellon University in the March 1988 issue of *IEEE Spectrum*.

OVENS

CU Ratings and Warning...In its January 1988 issue, *Consumer Reports* rates microwave ovens. At the top of the list are units by Litton, GE, Whirlpool and KitchenAid, with prices ranging from $328 to $385. As for safety, Consumers Union (CU) found that all the ovens tested were "well within" the FDA's leakage standard and notes that, "A door seal on all recent models minimizes leakage even when slight gaps develop between the door and the oven."...In its February 1988 issue, CU issues a warning concerning what appears to be the use of scare tactics to sell an oven radiation meter. CU cites an ad by American Health Products of Houston, TX, which quotes the bulletin of the "National Microwave Safety Council" as urging that all ovens be immediately checked for leaks and which also quotes *Business Week* as warning that CU found many leaking ovens. The trouble is that the CU quote is 15 years old, and CU could find no trace of the council. And the Houston outfit, which sells its meter for $29.95 is not listed in the Houston telephone book. The FDA is now trying to track down both the Houston company and the council – so far, without success.

Assorted Notes...The sales of microwave ovens continue to shatter all records. The Association of Home Appliance

Manufacturers, based in Chicago, IL, reports that more than a quarter of *all* appliances shipped in 1987 were microwave ovens – the largest annual shipment of any major appliance in history....On a more somber note, three physicians from the University of Iowa in Iowa City describe two cases in which infants suffered burns from microwave ovens. "Microwave Oven Burns to Children: An Unusual Manifestation of Child Abuse" appears in *Pediatrics*, *79*, pp.255-260, 1987.

PEOPLE

Sheldon Meyers, director of the EPA's Office of Radiation Programs since August 1984, is leaving his post to become the agency's associate administrator for international activities. **Richard Guimond,** the head of the EPA's radon division, is taking over for Meyers....**Thomas Keller** has been appointed chief scientist at the National Association of Broadcasters (NAB). Keller will work out of the NAB's new Broadcast Technology Center, which seeks to encourage the development of high-definition television. **Michael Rau,** a staff engineer, is taking over many of Keller's former duties. Rau has been named a vice president and the acting head of the NAB's Science and Technology Department....**Jules Cohen** will receive the NAB's Engineering Achievement Award at this year's convention in Las Vegas on April 9. Cohen is the president of Jules Cohen & Associates, a consulting firm in Washington, DC....Dr. **Forrest Lee Carter** of the Naval Research Lab in Washington, DC, died of cancer on December 20. Among Carter's many interests were the emerging fields of molecular electronics and solitons....The Bioelectromagnetics Society (BEMS) has decided not to present its D'Arsonval Award this year. The prize is given in recognition of outstanding research achievement. (Sources say that the BEMS board was divided between two candidates.)

ETC...

Radio Radio Everywhere... Anne Scully lives in Hull, MA, near WBZ's 50 kW transmitter, and she can pick up the station from her radiator and from her telephone. She told *The New York Times* (January 17) that her neighbors can pick up WBZ from their microwave ovens and their toilets. NPR's *All Things Considered* also aired a light-hearted piece on Mrs. Scully's troubles the same week.

McFarland Cancer Cluster *(continued from p.1)*

compatibility consulting firm in Los Angeles, told *Microwave News* that, although he had not made any measurements in McFarland, he thinks that a "substantial" field would impinge on a town as close to the VOA transmitter as McFarland. The engineer, who has nearly fifty years of experience in electromagnetic field measurements – much of it in southern California, said that he has received numerous inquiries about the possible impact of the VOA radiation on McFarland. "It is far more significant than parts-per-million chemicals," he said. The engineer asked that his name not be used.

Other experts have raised the possibility that some kind of synergy between toxic chemicals and non-ionizing radiation may be at work in McFarland. Laboratory studies indicate that microwaves can enhance the carcinogenicity of benzopyrene and the teratogenicity of cytosine arabinoside (see *MWN*, May 1981 and January/February 1987). Microwaves can also act synergistically with drugs (see *MWN*, February 1981).

Indeed, new experimental evidence points to the efficacy of the combined action of RF radiation and chemicals. Adey explained that, "Work in our laboratory by Dr. William Fletcher has shown that weak modulated RF fields can significantly enhance chemical cancer promoters. Together they disrupt communications between cells through gap junctions. These findings are consistent with modern cancer models, which emphasize that this type of disruption leads to unregulated cell growth."

In addition, some of those interviewed said that the intermittent nature of the VOA broadcasts could pose a greater health risk than constant exposures, because on-and-off stimuli prevent biological systems from adapting.

Since 1975, at least 12 children have developed cancer in McFarland, which has a population of approximately 6,000. Six of the children have died. Eight of the cases were diagnosed in the 1982-1985 time period, which constitutes a much rarer cluster. Two of the cases were identified before 1982 and two after 1985.

Many different types of cancer have been diagnosed among the McFarland children, including leukemia and brain and kidney cancer.

In a telephone interview from McFarland, Connie Rosales, a mother of one of the cancer victims, said that she thinks at least two additional cases should be counted as part of the cluster. In addition, as we go to press in early February, there are news reports of the diagnosis of the 13th childhood cancer case in McFarland – a seven-year-old with a brain tumor.

According to Dr. Matthew Zack of the Chronic Disease Control Division at the Centers for Disease Control in Atlanta, GA, cancer clusters occur "fairly frequently," but eight cases in four years is "exceptional." Zack is a member of the newly-established McFarland Advisory Committee, chaired by Dr. Kenneth Kizer, the head of the California health department.

In addition to the cancer cluster, McFarland had "relatively high rates" of infant deaths in 1982-1983 and of fetal deaths and low birth weights in 1981-1983.

Because of the grouping of cancer cases in 1982-1985, ESSS officials, who wrote the new report, placed particular emphasis on the period from January 1980 to January 1982 as the time when McFarland would most likely have been exposed to a toxic agent. They call this period the "window of vulnerability." McFarland's Rosales said she is skeptical about the window theory. A previous study by the county failed to identify any cause for the cluster based on then existing (1986)

conditions.

In numerous interviews with *Microwave News*, ESSS officials said that they had been advised by the VOA and by the Environmental Protection Agency (EPA) that the non-ionizing radiation levels in McFarland were "well below all existing standards." The ESSS report states that the EPA reviewed the VOA data and concluded that "any adverse health effects" in McFarland citizens were "unlikely to be related to RF radiation." ESSS adds, "We agree with this conclusion."

ESSS staffers are also skeptical about a possible link between VOA radiation and the cluster because they have been unable to document any changes in broadcasting from the Delano station during 1980-1983.

The state report also finds that it was unlikely that water contamination by nitrates and arsenic triggered the cancers. After reviewing existing records of pesticide use, the study found nothing abnormal in the types or amounts of pesticides applied in McFarland. "What we saw were commonly used pesticides in usual amounts," the report concludes. Nevertheless, four pesticides – dimethoate, fenbutatin oxide, dinoseb and dinitrophenol – have been targeted for further study.

The only partially suggestive finding in the state study is that 80 percent of the fathers of the cancer cases, compared to 45 percent of the fathers in a control group, worked in the crop fields in the time interval between three months before pregnancy and the date of diagnosis of the child's cancer. According to the report, "This is of borderline significance." The state plans to study this finding further in the next phase of its investigation.

Only one set of RF measurements has ever been carried out in McFarland. On February 6, 1986, a team of VOA engineers measured a level of 10 $\mu W/cm^2$ under a local power line and concluded that, "This implies that any health problems encountered in McFarland city were not directly linked to the VOA facility in Delano."

One of the engineers who took the measurements in McFarland and who no longer works at the VOA, told *Microwave News* that all their measurements were keyed to the levels specified in the 1982 American National Standards Institute (ANSI) standard: "We did not expect to find anything and we didn't."

The VOA did begin negotiations with the EPA to measure RF radiation levels at Delano and at other VOA stations. Due to lack of funds, however, no interagency agreement was ever completed and no additional measurements were taken.

Many non-ionizing radiation bioeffects experts agree that more detailed measurements are needed. In a telephone interview, Dr. Sam Milham of the Washington state Department of Social and Health Services said that, "It would be a good idea to do some measurements." Milham recently published a study showing that amateur radio operators have an increased rate of cancer mortality (see *MWN*, November/December 1987).

At the first meeting of the new advisory committee on January 29 in McFarland, a Kern County resident raised the issue of the need for more non-ionizing radiation measurements. At this time, the state has made no commitment to additional radiation measurements.

Very few studies of low-level exposures have ever been completed. In one landmark study carried out at the University of Washington in Seattle, rats exposed for their lifetime to the equivalent of the levels allowed by the ANSI standard showed a statistically significant increase in cancer (see *MWN*, July/August 1984 and March 1985).

In 1986, a group of Italian researchers showed that rats exposed to RF levels that were 4,000 times below the ANSI guidelines experienced developmental ill effects (see *MWN*, November/December 1986).

Until recently, the proposition that low levels of non-ionizing radiation could be biologically active or play a role in the development of cancer has been dismissed. In the last two years, however, a large body of evidence has accumulated indicating that extremely small (50/60 Hz) power line magnetic fields – as low as 2-3 mG – may promote cancer (see *MWN*, November/December 1987). The California study did investigate the distribution of power lines in McFarland but found no "significant changes" during 1980-1982.

The emerging link between a cancer risk and magnetic field exposures may be important in McFarland. Engineers explain that at shortwave frequencies, the ground-level magnetic field is stronger than the electric field component. Indeed, the VOA's own 1986 field survey at the Delano station shows that the measured magnetic field at 1,535 feet from one of the antennas was often greater than at 935 feet.

Also, last year, a preliminary epidemiological study by the Hawaii Department of Health indicated that people living near broadcast radio and television stations had a statistically significant higher rate of cancer than those whose homes were not near broadcast towers (see *MWN*, May/June 1987). In addition, the Cancer Research Center in Hawaii has identified a leukemia cluster among children living near a U.S. Navy communications complex at Lualualei on the island of Oahu (see *MWN*, May/June 1987).

A retrospective and an ongoing prospective epidemiological study of members of the Polish military exposed to RF and microwave radiation indicate a threefold increased risk of developing cancer; for some types of cancer, the risk is seven times greater than for controls (see *MWN*, March 1985 and JanuaryFebruary 1987).

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New Listings

NCI Set To Begin Childhood Cancer-EMF Study

Role of NCI Scientists Questioned

The National Cancer Institute's (NCI) study of the possible association between childhood leukemia and electromagnetic fields (EMFs) is scheduled to begin in the fall. The four-year study, which will be part of a larger effort to understand the causes of childhood leukemia, will assess residential exposures from power lines and appliances.

In December, NCI announced that requests for proposals (RFPs) would be issued by the end of the month. They were not available by February 1, however, but an NCI spokeswoman said that they would be released very soon (see box on p.15 for a description of the study). The estimated cost of the EMF study is $2.5 million. NCI anticipates that awards will made by September 30, 1989.

The announcement comes as a storm is brewing over possible ethics violations by NCI staff members who have testified on behalf of utilities that there is no evidence of adverse biological effects from exposure to power frequency EMFs. Questions have also been raised as to whether such testimony might prejudice the NCI study.

"I think we have a very open mind going into this study," Dr. Martha Linet told *Microwave News*. Linet, the co-director of the NCI study along with Dr. John Boice, added that she had been unaware of her colleagues' testimony.

Last year, Drs. Stuart Aaronson, Lucius Sinks and Margaret Tucker, all

(continued on p.15)

Vernon Down's Syndrome Study Is Abandoned; Critics Voice Outrage

The New Jersey Department of Health (NJDOH) has dropped its study of the incidence of Down's Syndrome and other birth defects among babies born in Vernon Township, NJ, primarily because of the lack of evidence of a continuing problem and the "apparent impossibility" of estimating past microwave exposures.

Many observers contest both of these arguments. A leader of the citizens' group, Citizens Against the Towers (CAT), which first prompted the study, said that NJDOH's action "borders on criminal neglect. It's one big cover-up." CAT has long maintained that the large number of uplink antennas at three satellite complexes in the town may be in some way responsible for the health problems in the community.

(continued on p.14)

HIGHLIGHTS

Epidemiology Roundup

Support for Radio Operator Cancer Risk

Dr. Samuel Milham, Jr., has uncovered new evidence to support his epidemiological study which found that amateur radio operators had a significant excess mortality rate due to acute myeloid leukemia, multiple myeloma and certain types of malignant lymphoma. The original study, published last year, was based on data compiled by the Federal Communications Commission (FCC) (see *MWN*, N/D87).

Using radio operator license class as a "crude measure of duration of licensing," Milham found that members of the FCC's novice class did not show the increase in cancer mortality observed in the other, more experienced classes. Novices, who are limited as to transmitter power and restricted to certain transmission frequencies, may not have "been exposed long enough to fulfill a cancer latency period" or may have been less exposed to "whatever carcinogenic agents may be operating," Milham explained in a letter to the *American Journal of Epidemiology*. The novice class, in a sense, "provides an internal control group," he said.

The new analysis "adds a lot of credibility to the other findings and fits exactly with what you would expect in an occupational cohort in terms of latency parameters," Milham told *Microwave News*.

Milham proposed that it should now be possible to study the effect of license duration on mortality and to determine the interval between initial licensing and development of disease by tracking "individual license holders through successive [FCC] registration files."

Milham's letter was published in the November 1988 issue of the *American Journal of Epidemiology (128*, pp.1175-1176); the original study appeared in the journal's January 1988 issue *(127*, pp.50-54). Milham's first report of a link between radio operators and cancer based on an analysis of mortality records of members of the American Radio Relay League was published as "Silent Keys" in the league's monthly magazine *QST* (see *The Lancet*, April 6, 1985, and *MWN*, My85).

Also, in a letter to the editor which appeared in the following issue of the journal (December 1988), Dr. Thomas Kurt, a Dallas, TX, researcher, pointed out that the onset of AIDS, as well as the nationwide increase in non-Hodgkin's lymphoma over the past 40 years, may have contributed to Milham's original findings. Milham, using data from his new study on license class, discounted these assertions.

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Leukemia in Sweden

Male Swedish electrical line workers had nearly double the expected incidence of chronic lymphocytic leukemia (CLL), according to a study by a group of U.S. and Swedish researchers led by Dr. Martha Linet of the National Cancer Institute in Bethesda, MD. This finding was statistically significant.

The U.S.–Swedish team also reported that electrical line workers did not show a significantly increased incidence of other types of leukemia, including acute non-lymphocytic leukemia (ANLL), and that, "No excess [ANLL] was seen in other occupational groups potentially exposed to electromagnetic fields" (EMFs).

When asked about the significance of the line worker-CLL association, Linet told *Microwave News* that, "It's one finding, one study. It needs to be followed up with more research."

A previous Swedish epidemiological study had identified a non-significant increase in total leukemia—though not in any subtype—among power linemen (see *MWN*, M/J86). Linet and coworkers suggested that, since the risk of CLL is highest among older people, the previous study by Dr. S. Tornqvist and associates may have missed this finding because, unlike Linet, Tornqvist did not include males over 64 years old.

Using the Swedish Cancer-Environment Registry, which links national cancer data from 1961 through 1979 with employment information, the researchers observed a number of new leukemia-occupation associations, including chronic myelogenous leukemia among brewery workers and motor mechanics and CLL among cloth and pattern cutters. The registry does not contain data on employment duration or on specific exposures, such as radiation, benzene or other potential carcinogens.

Linet's study appeared in the *American Journal of Industrial Medicine, 14*, pp.319-330, 1988.

Parental Occupational Exposures

A case-control study of children with central nervous system (CNS) tumors showed no consistent association with parental occupational exposures to EMFs. Dr. Philip Nasca and coworkers at the New York State Department of Health pointed out that their study does not rule out a link between EMF exposures and tumors of the peripheral nerves.

The study did reveal an increased risk of cancer among the children of fathers with jobs associated with exposures to ion-

izing radiation. (This association was apparent when exposure was based on industrial codes, but not on occupational titles.)

The researchers investigated 338 children under the age of 15 diagnosed with CNS tumors between 1968 and 1977 in New York state. The study appeared in the December 1988 issue of the *American Journal of Epidemiology (128*, pp.1256-1265).

Emphasize Science, Not Statistics

The public is being unduly alarmed by epidemiological studies that are scientifically flawed, an epidemiologist at the Yale University School of Medicine charged in the December 2, 1988 issue of *Science*. Dr. Alvan Feinstein based his view on studies which implicated a "common entity of daily life"—not infectious diseases; some of these studies passed peer review and received wide publicity only to be discredited later.

Using as examples three recent studies linking reserpine (a medication for hypertension) with breast cancer, coffee with pancreatic cancer and alcohol with breast cancer, Feinstein argued that the epidemiologists overlooked fundamental scientific standards. Since their publication, the reserpine and coffee risk studies have both been refuted.

Feinstein recommended that, in the future, epidemiologists should place more emphasis on the scientific quality of the evidence, and less on the statistical methods of analysis and adjustment.

OTA on EMPRESS II: More EMI Testing Is Needed

The U.S. Navy's electromagnetic pulse (EMP) simulator, EMPRESS II, presents "no significant health effects" threat to humans and wildlife on land or to marine life when operating in the Atlantic Ocean, 15 miles off the coast of North Carolina, according to a new analysis by the Congressional Office of Technology Assessment (OTA). The report does recommend additional testing to gauge EMPRESS II's threat of electromagnetic interference (EMI) to avionics.

The OTA's Dr. Anthony Fainberg, the author of *The Potential Biological and Electronic Effects of EMPRESS II*, does recommend that it would be "imprudent" to have Navy personnel aboard the ships exposed to 50 kV/m electromagnetic fields (EMFs), given the uncertainties in knowledge and "particularly since simple shielding could reduce the field strengths to far lower values." He notes that the rate of cancer among Boeing workers exposed to EMP, though not "definitive," might be "a cause for concern and an indication for further study." Since the OTA report was issued, Dr. Sam Milham, Jr., has called for a national EMP health study (see *MWN*, N/D88).

Fainberg highlights research needs related to EMI. He points out that the Navy has neither examined the effect of EMPRESS II on flight electronics nor determined the EMF levels at the boundary of the 6,000-foot-high exclusion zone. "Both of these issues should be resolved by appropriate testing," he recommends, calling the present uncertain situation "somewhat disturbing." Marine traffic will be excluded from approaching within two miles of EMPRESS II.

Of special concern, according to Fainberg, is EMI to "fly-by-wire" aircraft—those, such as the Boeing 757 and 767 and the Airbus 320, which are controlled electronically instead of mechanically. He notes that the Boeing 767 is designed to withstand peak EMFs of only 100 or 1,000 V/m, depending on frequency. Fainberg advises that, "It would be vital to assure that no unhardened 'fly-by-wire' aircraft come within the 100 V/m range, which might be as far as 25 nautical miles away. Over the site, the 100 V/m altitude might be around 60,000 feet, beyond the limit of commercial aircraft."

Fainberg notes that the U.S. Army's Harry Diamond Labs is considering operating a similar EMP tester (VEMPS II) at its Woodbridge facility in Virginia, 15 miles from Washington's National Airport and only a little further from Andrews Air Force Base and Dulles International Airport. "Given the presence of [VEMPS II] near three large airports in the Washington, DC, metropolitan area, a solid understanding of EMP on commercial aircraft seems vital," he warns.

While "EMPRESS II levels appeared to cause no damage to tested marine electronics at levels equivalent to those at the edge of the two-mile exclusion zone," Fainberg adds that, "Momentary upsets of depth-finding equipment were noted," and that, "Within the zone, a LORAN-C receiver suffered upsets that could be difficult to detect." The LORAN-C was affected by levels above 4.3 kV/m. Fainberg advises that an examination of the susceptibility of "a wider variety of equipment than has already been tested" is needed.

The OTA report was requested by Congressman Walter B. Jones (D-NC), the chairman of the House Committee on Merchant Marine and Fisheries. Jones's district includes Curri-

U.S. Army To Prepare EMP EIS

On January 11, the U.S. Army announced that it will prepare an environmental impact statement (EIS) on its EMP simulators at its Woodbridge, VA, facility. The EIS will cover health and environmental effects, as well as EMI to medical, aviation and marine electronics. Public meetings were held on January 30 and 31.

The Army has targeted the completion of the EIS for September 1989, according to Dave Davison of the U.S. Army Laboratory Command's Public Affairs Office.

The EMP testers at Woodbridge have been shut down since April 1988, as part of a settlement of a lawsuit which sought EISs for most military EMP facilities (see *MWN*, M/J88). For more information, contact: Marian Singleton, Army Laboratory Command, Attn: AMSLC-PA, 2800 Powder Mill Rd., Adelphi, MD 20783.

tuck County, which borders on EMPRESS II's ocean site. Jones sought this independent OTA review to calm fears and concerns among his constituents.

Edmund Welch, chief counsel to the committee, told *Microwave News* that no follow-up was planned by the committee, but that Congressman Jones "will continue to monitor" EMPRESS II activities.

EMPRESS II, an acronym for the second Electromagnetic Pulse Radiation Environment Simulator for Ships, has been at the center of a controversy for many years (see *MWN*, O84, N84, J/F87 and M/J88). The Navy had originally planned to use the simulator in the Chesapeake Bay but finally selected the Atlantic Ocean site when faced with intense opposition from elected officials in Maryland and Virginia.

Among Fainberg's other findings are:

- "There appears to be a lack of hard data to justify the [U.S. Air Force's 100 kV/m personnel] standard."
- Residents of Corolla, NC, the closest land-based population, are exposed to 80 V/m from EMPRESS II, according to Navy measurements.
- "Tests on birds show that homing is still accomplished after exposure to EMP, although some disorientation may occur," and "It is unlikely that the effect of EMP on migration is greater than the effect of natural lightning."
- Exposure to test EMPs—not simply computer simulations or sub-scale modeling—is "necessary" to verify the hardness of ship electronics.

For more information, contact: Dr. Anthony Fainberg, International Security and Commerce Program, OTA, U.S. Congress, 600 Pennsylvania Ave., SE, Washington, DC 20510, (202) 228-6429.

Professor Saul Rosenthal 1918-1989

After a period of declining health, Dr. Saul Rosenthal suffered a cerebral hemorrhage and died on January 15.

An associate professor of electrical engineering at Polytechnic University in Brooklyn, NY, Rosenthal was a leading member of the bioelectromagnetics community. From 1968 to 1988, he was the chairman of what is now called the American National Standards Committee C95 on Non-Ionizing Radiation Hazards—and he played a key role in shepherding the 1982 ANSI standard through its lengthy approval process. Rosenthal was one of the original board members of the Bioelectromagnetics Society (BEMS) and was an active participant in the IEEE and URSI.

Much of Rosenthal's research was on the biological effects of microwaves and millimeter waves—specifically, on the potential damage of microwaves to the eye and on the attempted replication of Soviet cellular studies on low-level millimeter waves.

Rosenthal was an early and enthusiastic supporter of *Microwave News*. When the newsletter was still in the planning stages, he encouraged us to go forward and, during the crucial first years of publication, he was always ready and willing to help. Saul Rosenthal was most generous to us, and we will miss him.

Picking the Right RF Meter

Power densities measured with broadband radiofrequency (RF) meters can be incorrect by as much as a factor of 50, according to tests by Ed Mantiply of the U.S. Environmental Protection Agency's (EPA) Office of Radiation Programs.

Mantiply recommends the use of specific types of meters for different types of sources. For single FM stations, any meter designed for this frequency range (88-108 MHz) will yield "good results." In areas where there are multiple FM and/or TV stations, a meter with a thermocouple (e.g., a General Microwave Raham 3 or a Narda 8621/8631 probe) or a square-law diode-based instrument (e.g., a General Microwave Raham 4A or a Narda 8652/8662 probe) should be used. If an electric field is to be measured in the presence of significant AM broadcast fields, a meter which is immune to RF potential sensitivity (e.g., Instruments for Industry EFS-1) is desirable.

In a paper presented at the *10th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, held in New Orleans, LA, last November, Mantiply outlined the types of problems which can lead to spurious readings: RF potential sensitivity, non-sinusoidal and out-of-band responses, zero instability and non-isotropy.

RF potential sensitivity can come into play at frequencies below 10 MHz when the meter responds to the RF potential difference between the probe and the meter instead of to the electric field in the vicinity of the probe. And non-sinusoidal fields can lead to measurements which are 1-2 dB too high.

If an RF meter is used in the presence of fields outside its specified frequency range, "unpredictable" responses may result. For instance, Mantiply indicates that some meters will be influenced by 60 Hz electric fields. Zero stability can also be tricky because the zero point may only drift when the field is applied—otherwise, it appears to be stable.

For more information, contact: Ed Mantiply, Office of Radiation Programs, EPA, PO Box 98517, Las Vegas, NV 89193, (702) 798-2476.

Canada Adopts New Computer EMI Standards

On February 1, new rules governing electromagnetic emissions from computers went into effect in Canada. The regulations parallel—and were in fact prompted by—those already adopted in the U.S. by the Federal Communications Commission (FCC).

"There are a few minor differences between the two sets

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The **New York Power Authority (NYPA)** went on an early December field trip to Sandspoint and East Williston, both in NY, to take magnetic field measurements next to an **underground 345 kV line**—similar to a proposed 25-mile power line to run under Long Island Sound. The fields measured directly above the buried line in Sandspoint were less than 1 mG; in contrast, measurements taken under a nearby overhead distribution line showed levels of 2.5 mG. Officials from East Williston, one of the towns opposing the new line, accompanied NYPA on what it described as a "demonstration." In May 1988, the state PSC approved the route, which, according to a NYPA spokesman, now only needs a permit from the U.S. Army Corps of Engineers before construction can begin. Meanwhile, a group of Westchester residents who are protesting the line are disappointed over NY Governor **Mario Cuomo**'s last-minute veto of a bill which would have required NY utilities to consider siting power lines along state highways rather than along local streets—including those in their own neighborhood (see *MWN*, M/J88). Undaunted, the group is now pressing state legislators to re-introduce the bill in the new session.

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Electrical World offered some advice in its November issue concerning "What Utilities Can Do About the EMF Threat." First, the magazine noted that, "Scant evidence exists to prove" claims that EMFs contribute to cancer and other health effects: "The outlook for utilities planning critical new transmission projects is not bright at this time for, as in acid rain and greenhouse issues, perception seems to be more powerful than reality. In other words, whether or not EMFs are harmful is irrelevant. What is relevant is the fear that they are harmful." Then it endorsed the approach taken by the New York Power Authority in the Marcy-South lawsuit—lining up experts who conclude that EMFs do not cause cancer and showing that land next to power lines has not been devalued.

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In January, the Sandpiper Shores Elementary School in suburban **Boca Raton, FL**, opened on schedule, despite a last-minute class action suit filed against the Palm Beach County school board (see *MWN*, S/O88). Three of the children's parents are seeking a permanent injunction against the opening of the school, which is located within 230 feet of five power lines. At a preliminary courtroom hearing on December 13, Dr. **Andrew Marino** testified that opening the school would "constitute a human research experiment on the children." A different view was offered by Dr. **Morton Miller**, testifying for the school board: There is no scientific evidence that EMFs cause any deleterious biological effects, he said, even though he did recommend further research. A trial date has been set for May 8. Phyllis Atler, president of Citizens Endorsing a Safer Environment (**CEASE**), a parents group which continues to oppose the school's opening, told *Microwave News* that most CEASE members are not sending their children to the school, and that others are sending their children for the remainder of the semester only and will make other arrangements for the next school year if the court does not take action. Some of the parents believe that the school board relied on misleading and biased information from scientists on utility payrolls in making its decision to open the school. At an October 26 informational hearing, experts told the school board that the magnetic field levels surrounding the school are within "safe" limits. But Atler claims that the experts—Drs. Philip Cole, Paul Leaverton, Samuel Milham, Jr., and Harrison Mehn—were supplied with an outdated maximum field measurement of 1.4 mG; the highest levels measured were closer to 2.8 mG (45 feet from the school). In addition, the lines are only being used at 48% capacity, she said.

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In the October/November issue of the ***EPRI Journal***, James Hall looks at ways to improve power lines to meet a number of objectives, including **reducing EMFs**. Using the ENVIRO software, developed at EPRI's High-Voltage Transmission Research Center in Lenox, MA, Hall compared the electric and magnetic fields from a standard double-circuit 230 kV line and from a compact six-phase 230 kV line. The electric fields were roughly the same in each case, but the magnetic fields associated with the six-phase line were approximately half of those from the double-circuit line.

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Central Maine Power Co.'s (CMP) plans to purchase 300 MW of electricity from **Hydro-Québec** for $4 billion over the next 29 years have been put on hold. On January 9, the Maine Public Utilities Commission (PUC) voted 2-1 to deny CMP permission to build a power line composed of two segments —42 miles at 345 kV AC and 92 miles at 450 kV DC—across western Maine. According to the PUC, the utility did not show that the proposed contract was the "least cost energy plan," and failed to adequately assess in-state production and conservation. The decision was not based on health or environmental concerns—the power line would have required cutting down 2,000 acres of trees and would have crossed the Appalachian Trail. Pamela Prodan, a member of **No Thank Q Hydro-Québec**, a citizens group opposing the project, told *Microwave News*, "In this particular case, the PUC wasn't ready to look at the economic impacts of health effects."

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On April 4, Dr. **Bill Feero** of Electric Research & Management will chair a panel on power line EMFs at the ***11th IEEE/PES Transmission & Distribution Conference and Exposition*** in New Orleans, LA. Among the panelists will be Robert Black and James Mitsche, both of EPRI, Dr. Lee Rosen of W/L Associates and James Vick of Gulf Power Co. The T&D expo is the largest meeting of its kind—the last one, held in 1986, attracted more than 10,000 participants.

Sheppard to Seattle City Light: Consider Epidemiological Data

"It is now reasonable to consider epidemiological evidence in making public policy" on power lines, Dr. Asher Sheppard advises in a report to Seattle City Light (SCL), a Washington state utility. Sheppard adds, however, that, "It would be wrong to treat the evidence as if a cause and effect relation had been proven" and that, "It will not be possible to confirm or rule out an association between 60 Hz fields and cancer for some time."

When asked by *Microwave News* whether he would recommend a magnetic field exposure limit based on the Wertheimer-Leeper and Savitz epidemiological studies, Sheppard replied that, "I can't recommend a number that would serve as a 'standard' for magnetic field exposures but what I do recommend is that on the basis of the epidemiological data, milliGauss (mG) fields may influence cancer incidence."

Sheppard did suggest that in planning new power lines, SCL should take a close look at the routing to see who is at risk and what the economic impact may be. Then the utility should let the ratepayers decide the preferred course of action. Sheppard, who is on the research staff at the Veterans Administration Hospital in Loma Linda, CA, prepared his report as a consultant to SCL.

Laurie Geissinger of SCL's Environmental Affairs Division told *Microwave News* that, "The Sheppard report will indeed influence the way SCL presents any new proposals for facility upgrades, including power lines." Like Sheppard, Geissinger shied away from a specific magnetic field standard: "The next logical step is not trying to impose specific standards when we don't know if we are purchasing any increased benefits with respect to public health. Instead, we are getting ready to make changes in design that may be warranted in the future." She added that the utility is now also investigating whether there are areas of high exposure.

In a critique of Sheppard's report, Dr. Robert Becker, a consultant based in Lowville, NY, argues that the evidence of harmful effects is "sufficiently compelling to require that any new transmission line be constructed in such a fashion as not to expose any residence or school building...to any 60 Hz magnetic field in excess of 3 [mG]." However, he does add that, "I do not advocate that this standard be immediately placed on all existing facilities" because "such an action would result in the failure of our electric power system with unacceptable risks to the general population."

In his comments, Becker dismisses as "patent nonsense" the NY Public Service Commission's decision—following the release of the NY Power Lines Project final report—to set a field strength limit of 100 mG at the edge of 345 kV rights-of-way (see *MWN*, M/A88 and N/D88). Becker prepared his comments at the request of Citizens Against Overhead Power Lines (CAOPL), a Seattle citizens group organized to fight a

SCL Policy Statement on EMFs and Human Health

Seattle City Light (SCL) is committed to providing safe, reliable and environmentally sound electric service for its customers and a safe work environment for its employees. The Utility adheres to the Washington State Standards for Electrical Construction Code and Electrical Workers Safety Rules (WAC Chapter 296-44 and 45) and complies with other applicable regulations governing installation of electrical facilities. Additionally, the Utility is committed to public involvement in determining where electrical facilities should be located.

The utility is aware of the ongoing research effort to identify the biological effects of power frequency (50-60 Hertz) electric and magnetic fields (EMFs) and to determine if such effects have any implications for human health. Research on EMFs covers a wide range of subjects, such as studies concerning reproduction, cancer and behavior. Studies of humans include both workers and people without work-related exposure.

Exposure of people to electric and magnetic fields from electrical transmission, distribution, and appliances may or may not be found to affect health. At this time, whether such fields can produce or promote change that impairs or otherwise compromises health is a matter of great scientific uncertainty. However, the fact that some studies even suggest a link between electric and magnetic fields and health requires assertive steps by the utility industry and government agencies to answer questions pertaining to possible health effects. SCL acknowledges the scientific uncertainty and public concern about possible health effects. Any potential risk to health is viewed as a serious concern by the utility. SCL's policy on this topic will be used to guide decision-making of the utility that involves consideration of electric and magnetic field effects.

Statement of Policy

It is the policy of SCL to share its knowledge of the available information on the biological and possible health effects of electric and magnetic fields in open internal and public communications about research and regulatory developments, and to ready the utility for operational changes that could be warranted in the future. This will be accomplished by establishing an interdisciplinary work group with responsibility for:

- Monitoring research and regulatory developments
- Registering concerns about possible health effects and responding in a coordinated manner to requests for information on electric and magnetic fields from the public and SCL employees
- Initiating the conveyance of information to enhance understanding of electric and magnetic field effects as dictated by milestones in the research and/or heightened sensitivity of the public and employees
- Identifying and proposing means by which SCL may work with other electric utilities to advance and support research in this field
- Making recommendations concerning changes to design standards and/or system operating practices that may be warranted.

230 kV line first proposed by SCL in 1984.

In his report, Sheppard proposes that SCL expand its 1986 final Environmental Impact Statement (EIS) on the 230 kV Highline power line project to include magnetic—as well as electric—field concerns. SCL's Geissinger said that the Highline project has been "shelved" for at least three to five years.

Among Sheppard's other recommendations are that SCL prepare a supplemental EIS with an emphasis on risk assessment, taking into account recent epidemiological studies; set up an EMF task force; evaluate potential risks associated with power lines and substations; assess existing facilities to estimate potential health hazards; and consider delaying new power line projects until more information has come in.

CAOPL calls for the creation of an oversight group made up of experts not affiliated with utilities, to be independently funded and administered by a public health agency. In the meantime, CAOPL wants SCL to "stop all construction of proposed...lines and substations" and to take "accurate 24-hour measurements of existing 'hot spots' of chronic exposure levels."

SCL recently adopted a policy statement on human health and electric and magnetic fields (see p.7) and will soon finalize a work plan for the next few years.

Update on the Scientific Literature Concerning Health Effects of 60-Hz Electric and Magnetic Fields of Power Transmission and Distribution Facilities, which was released in September 1988, was prepared at the order of Seattle City Council Resolution 27741. The report is available from: Laurie Geissinger, Seattle City Light, 1015 Third Ave., Seattle, WA 98104, (206) 684-3462.

NAS-NRC ELF Workshop

The National Academy of Sciences-National Research Council (NAS-NRC) will host a one-day workshop on extremely low frequency (ELF) fields in Washington, DC, on March 14. The purpose of the workshop is to see how this field of study has developed over the last few years and to determine whether the NAS-NRC should devote more attention to it, according to Dr. Ray Cooper of the NAS-NRC's Board on Radiation Effects Research.

An ad hoc panel, chaired by Dr. Richard Setlow of Brookhaven National Lab, has been assembled to review the ELF data. The panel will hear from six experts: Drs. Martin Blank of Columbia University; Craig Byus of the University of California, Riverside; David Carpenter of the NY State Department of Health; Russell Reiter of the University of Texas Health Science Center; David Savitz of the University of North Carolina, Chapel Hill; and Tom Tenforde of Battelle.

The NAS-NRC held similar workshops in 1983 and 1985 (see *MWN*, D83 and N/D85). In a report, *Non-Thermal Effects of Non-Ionizing Radiation*, issued following the 1985 meeting, the NAS-NRC panel concluded that, "Abundant fragmentary evidence has been presented in support of possible biological effects from non-ionizing radiation, at both transmission line and microwave frequencies. These effects often appear to be unaccompanied by macroscopic thermal changes" (see *MWN*, M/J86).

"Things have changed quite a lot since the earlier workshop," Cooper told *Microwave News*, "but I am not sure that there is enough information to say anything definitive [about ELF mechanisms]." Academy members and federal officials have been invited to the workshop. Those wishing to attend should contact Cooper directly at the NAS-NRC, 2101 Constitution Ave., NW, Washington, DC 20418, (202) 334-2743.

FROM THE FIELD

On March 27-31, the Maryland Public Service Commission will hold hearings on the health effects associated with exposure to extremely low frequency (ELF) electromagnetic fields (EMFs). The hearings are the latest stage in the Potomac Electric Power Company's (PEPCO) 12-year struggle to build the 10-mile 500 kV Brighton-High Ridge power line—the only unbuilt piece of a 243-mile loop around Washington, DC (see MWN, *M/A88 and S/O88). The following is excerpted from expert testimony filed by some of the parties and intervenors in the case.*

For PEPCO

Dr. Edwin Carstensen, Professor of Electrical Engineering and Biophysics, University of Rochester, NY.

Q. What is the scientific consensus on the effects of transmission line EMFs on health and safety?

A. Over the past decade, there have been in excess of 15 reviews of this subject by consensus groups throughout the world. These scientific and governmental bodies have identified three potentially adverse effects from exposure to transmission line fields—shock from contact with conducting objects, the related effects on productivity in honeybees, and inhibition in a limited subset of implanted cardiac pacemakers. The National Electrical Safety Code contains a 5 mA standard to address the potential for adverse shock effects. That standard appears to have been 100% effective in eliminating shock-related accidents. As I noted before, the effect on honeybees can be eliminated by shielding the hives. With respect to pacemaker inhibition, the consensus is that this is a manufacturing defect and that the solution to the problem lies with the manufacturer.

Dr. Mark Israel, Chief of the Molecular Genetics Section of the Pediatric Branch, Division of Cancer Treatment, National Cancer Institute (NCI), Bethesda, MD.

Q. Based upon your experience and research as a pediatric oncologist and cancer researcher, is there any scientific evidence that would lead you to believe that exposure to power frequency EMFs causes, promotes, or otherwise leads to the development of cancer?

A. No.

Q. In your opinion, is there any scientific basis to believe that exposure to the EMFs from the Brighton-High Ridge 500 kV transmission line would cause, promote, or otherwise lead to the develop-

ment of cancer?
A. No.
Q. Dr. Israel, let us assume that the magnetic field levels at the edge of the right-of-way [ROW] for the Brighton-High Ridge line would be as high as 200 mG. Based upon that assumption, is there any scientific evidence that would lead you to believe that exposure to magnetic fields from the Brighton-High Ridge line would cause, promote, or otherwise lead to the development of cancer?
A. No.

Dr. Margaret Tucker, Chief of the Family Studies Section of the Environmental Epidemiology Branch, NCI, Bethesda, MD.
Q. What do you conclude based upon your review of the occupational and residential epidemiological studies of EMFs?
A. I find no consistent pattern of risk of cancer in children or adults, no indication of a dose/response relationship, and in certain studies, an inadequate assessment of the impact of probable confounders.
Q. In your opinion, do the occupational and residential studies fail to show a consistent pattern of risk because the research has not advanced far enough?
A. No. The epidemiology research is fairly far advanced. For example, at the same stage in the cigarette/cancer research, one could make a conclusion about the relationship between cigarettes and cancer, because there was a consistent pattern of risk within and across the studies.
Q. What is your opinion on the risk of cancer from exposure to EMFs?
A. The research in epidemiology in this area has yielded no persuasive scientific evidence of an increased risk of cancer in children or adults from exposure to power frequency EMFs.
Q. Dr. Tucker, let us assume that the magnetic field levels at the edge of the ROW for the Brighton-High Ridge line would be as high as 200 mG. Based upon that assumption, is there any scientific evidence that would lead you to believe that exposure to magnetic fields from the Brighton-High Ridge line would increase the risk of cancer in children or adults?
A. No.

For Maryland People's Counsel

Dr. Charles Polk, Professor of Electrical Engineering, University of Rhode Island, Kingston, RI.
Q. Were you aware of the work of Wertheimer and Leeper before the results of the Savitz study were published and what was your opinion concerning their findings?
A. Yes, they are discussed in...the *Handbook of Biological Effects of Electromagnetic Fields*, which I edited. In 1984 or 1985 I was very skeptical concerning the validity of their findings, primarily because I did not believe at that time that the "wire configuration code," which they used, was really a valid measure of long-term magnetic field exposure. I also discounted the results, because the classification of residences into wire codes was not done "blind"; that is, the classifier was aware of whether or not the particular residence corresponded to a cancer case.
Q. Have you changed your opinion concerning the Wertheimer-Leeper studies?
A. Yes, because the much more elaborate study by Savitz and coworkers gave results very similar to the earlier findings. Also, measurements over 24-hour periods by Kaune and coworkers (*Bioelectromagnetics, 8*, p.315, 1987) in 43 homes indicated that the Wertheimer-Leeper wire codes predicted reasonably, although imperfectly, average magnetic field levels. Finally, I concur now with the suggestion by Savitz that the Wertheimer-Leeper wire codes may be a better indication of *long-term, historical* magnetic field exposure of *former* residents of a home (who died of cancer) than current short-time (hour or less) field measurements which are affected by such variables as recent home wiring changes or purchase of new appliances.
Q. What do you believe are the implications of the New York power lines study and of the laboratory investigations which you described for the construction of the proposed 500 kV transmission line in Maryland?
A. While it is probably impossible to wait several years for the availability of further research results, I believe that caution is in order. Since the Savitz and Wertheimer-Leeper and Tomenius studies suggest a possible association of cancer with long-term exposure to magnetic fields above 2.5 or 3.0 mG, it is clearly desirable to reduce the magnetic fields from the line as much as possible in areas where dwellings are located.

For Howard County, Maryland

Dr. Jerry Phillips, Cancer Therapy and Research Foundation, San Antonio, TX.
Q. Do the results of your studies provide any explanation of a manner in which EMF exposure might be associated with an increased incidence of cancer or other illness or disease?
A. Yes. Cancer is a disease that appears to develop in stages. The first stage, known as initiation, is irreversible and involves at least one heritable change in the structure of the cell's genetic information, its DNA. The second stage, known as promotion, involves a series of reversible changes during which this initiated cell that was produced undergoes continued growth and further change that ultimately results in the production of a cell that is recognizable as a cancer cell. During the final stage, which is known as progression and is irreversible, certain more cancerous variants become dominant and have selective growth advances and survival advances over other cells in the tumor. Therefore during this phase of progression, one sees the emergence of increasingly diverse cancer cells with enhanced survival and growth characteristics. In lay terms, this stage of progression has been defined as that stage during which tumors go from bad to worse. Within this framework then, one can see a relationship between the work performed in my laboratory and those events that are characteristic of the stage of progression in tumor development. As stated above, human cancer cells exposed to EMFs demonstrated an increased capacity to grow, as well as an increased resistance to destruction by natural killer cells, which are cells that are part of the body's normal defense system. These cells, then, after exposure to EMFs, have demonstrated enhanced properties of growth and survival. It would appear that EMF exposure has taken a bad situation and made it worse....
Q. Dr. Phillips, do you have an opinion, based upon your individual research and your review of studies conducted by other scientists and physicians, whether there are biological or adverse health-related effects from exposure to EMFs?
A. Yes, I do.
Q. What is your opinion?
A. It is incontrovertible that exposure of biological systems to EMFs produces changes in those systems. Furthermore, it is my opinion that it is probable that the observed changes in biological structure and function are related to adverse effects on human health and development. I have stated in the past that I believe there is indeed a problem associated with human exposure to EMFs and that the only way to properly define the nature and magnitude of that problem is through continued research. Until we can define whether or not there is a problem, in what areas a problem exists and how big that problem might be, I believe it is imperative to minimize exposure of the general public as much as possible.

For Maryland Department of Natural Resources

Dr. William Bailey, Vice President, Environmental Research Information, Inc., New York, NY.

Q. Is there any evidence that there may be a health hazard associated with the EMFs generated by transmission lines?

A. Several epidemiological studies have reported that some types of electric utility wiring configurations (primarily relating to the number and thickness of distribution lines and their distance from residences) are found more frequently outside the residences of cancer cases than outside the residences of individuals without cancer....This has led to the hypothesis that this association reflects a low but increased risk of cancer from exposure to power line magnetic fields. If the hypothesis were true, then possibly all sources of magnetic fields, including household wiring and electrical appliances, would be associated with increased risk, as well as transmission lines.

Q. Do these studies prove that power lines cause cancer?

A. No. These studies are open to other interpretations and none has proved that the reported associations are causal. In addition, a larger number of other similar epidemiological studies have not observed any such association. An important consideration that also argues against a causal relationship is the fact that such associations (between wiring configurations and cancer) are not confirmed in those studies in which exposure to magnetic fields in the residence was determined by actual measurement.

Q. What about epidemiological studies of workers in "electrical" occupations?

A. There have been about 30 epidemiological studies which have looked for associations between job titles in "electrical" occupations and cause of death. These descriptive studies do not include measurement-based estimates of exposure to EMFs or to known or suspected chemical carcinogens that are widely prevalent in "electrical" occupations. Therefore, it is difficult to determine what field exposure might have contributed to mortality, independent of other factors. Without such information, these studies are of little help in documenting health risks. The studies also are not consistent in their findings....

Q. Have laboratory studies of animals or cells isolated from animals and humans, exposed to EMFs produced findings that would indicate that these fields cause cancer?

A. The evidence clearly weighs against this possibility....Neither has the behavior of normal or cancerous cells been shown to be affected by field exposures in ways that would characterize fields as having tumor-promoting properties.

Q. Is the evidence which suggests there might possibly be a health hazard from EMFs adequate to cause changes in public policies regarding the routing of transmission lines?

A. Not on the basis of the evidence that is now available....The results of currently available epidemiological and laboratory research on EMFs together do not support the conclusion that the operation of a 500 kV transmission line would produce cancer or other health hazards in adjacent populations.

Thomas Magette, Manager, Nuclear Programs for the Maryland Power Plant and Environmental Review (MPPER) Division; Department of Natural Resources.

Q. What are MPPER Division's conclusions?

A. Based upon our evaluation of the existing research, we do not believe that the operation of the 500 kV Brighton-High Ridge transmission line will result in any adverse health effects.

Q. Would you then say that there is no risk of a health effect from the operation of this line?

A. If there is any risk of a health effect, it is extremely low, and is easily outweighed by the benefits of the electrical transmission system, including the Brighton-High Ridge line.

J. Patrick Reilly, Johns Hopkins University Applied Physics Laboratory, Laurel, MD.

Q. What are the calculated maximum field levels within the ROW for the existing 230 kV lines?

A. The maximum field level for the existing four-circuit 230 kV lines is calculated as 95 mG under conditions described by PEPCO as "normal loading." Under "heavy loading" conditions, the calculated maximum level is 125 mG....

Q. What are the calculated maximum field levels within the ROW with the addition of the 500 kV line?

A. The calculated fields depend on which configuration is being considered. For configuration A, the maximum field level within the ROW is 77.3 mG under conditions described by PEPCO as "normal loading" and 101.0 [mG] under conditions described as "heavy loading." For configuration B, the maximum field level is 83.8 mG for "normal loading" and 118.4 mG for "heavy loading."

Q. Could you please explain how these fields could be lower following the addition of the 500 kV circuit?

A. The addition of an additional transmission line alongside existing lines can cause the total field to either increase or decrease at specific locations. The total field level is affected by several factors, among them the specific line designs, the current loads, and the interaction of the fields from each transmission line....

Q. What exactly do you mean by interaction of the fields?

A. Each wire in the transmission line circuit will produce its own magnetic field. The magnetic field at a distant point will be due to the combined effects of all the wires, but these effects are not necessarily additive in a simple sense because of the differing electrical phases. As a general rule, the fields from separate sources can combine in either a mutually reinforcing or canceling way, depending on the phases of the separate sources. The magnetic field components from the individual wires of a single transmission lines circuit will partially cancel one another at most locations distant from the lines. The efficiency of this mutual cancellation will depend on the geometric arrangement of the wires. As a rule of thumb, the cancellation becomes more efficient as the wires comprising a simple transmission line circuit are moved closer together, and also as the measurement point is moved more distant from the lines. If there is more than one transmission circuit in a ROW, the combination may be one of addition or cancellation depending on the relative phases of the wires in the different circuits and the location of the measurement point.

Q. What are the calculated field levels distant from the ROW?

A. ...the calculated fields are below a level of 0.5 mG somewhere between 400 and 1,000 feet from the centerline of the ROW. The precise distance depends on which configuration is being considered, the current load that is assumed, and the degree of electrical imbalance.

Q. What is the significance of a level of 0.5 mG?

A. 0.5 mG is a typical level found in many residences that are not located near high voltage transmission lines. Actual ambient residential levels depend upon a host of factors and could be higher or lower than that value.

Q. Is it possible that the magnetic fields might actually be greater than the ones you have calculated?

A. Yes, it is.

Q. What factors could cause the magnetic fields to be greater than the calculated levels?

A. Two major factors could result in magnetic field levels that are substantially greater than the calculated levels. One is higher current levels, the other is electrical imbalance.

UPDATES

BIOLOGICAL EFFECTS

PMF-Rat Study Shows Some Effects...PMFs had some adverse effects on pregnant rats and their offspring, but the Canadian researchers who ran the study generally discounted the significance of the effects. Dr. Maria Stuchly of Health and Welfare Canada in Ottawa, Ontario, first presented the results at the power line contractors' review in Kansas City, MO, in November 1987 (see *MWN*, N/D87). Female rats were exposed to PMFs at intensities of 5.7, 23 or 66 μT seven hours per day starting two weeks prior to impregnation and lasting throughout pregnancy. The fetuses exposed to 66 μT PMFs had a highly significant ($P<0.001$) increase in minor skeletal anomalies. One type of skeletal variation was also elevated in the 23 μT group. Stuchly and coworkers discounted these findings as "common 'noise' that appears in every teratological evaluation." The team also found statistically significant decreases in red and white blood cell counts among the rats exposed to 66 μT, as well as a small but significant change in one blood chemistry index among those exposed to 23 μT. Stuchly called this latter finding "incidental," but noted that the changes observed at 66 μT "could represent a toxic response to the magnetic field." These hematological findings were not reported in 1987. The results appear in *Teratology, 38*, pp.461 -466, 1988.

COMPATIBILITY & INTERFERENCE

"ENR" Changes Hands... The *Electromagnetic News Report (ENR)* has a new owner. The bimonthly newsletter, started 17 years ago by Robert Goldblum of R&B Enterprises, has been sold to Michael Howard, the president of Liberty Labs, Inc., which until now has been best known for its engineers' log books. In a telephone interview from his office in Cedar Rapids, IA, Howard told *Microwave News* that he plans to continue the current format, but will add new features and columns. For instance, in the first issue edited by Howard (January 1989), William Kimmel of Kimmel Gerke Associates Ltd., an EMI consulting firm based in St. Paul, MN, inaugurates an "EMC Notebook." Howard will also send his subscribers special bulletins—*ENR Express*—to highlight news that cannot wait until the newsletter's next issue. "We intend to provide up-to-date information to the EMC community," he said. When asked to compare *ENR* to both Don White's bimonthly *EMC Technology* and Dash, Straus & Goodhue's quarterly *Compliance Engineering*, Howard said that while *EMC Technology* is directed to the design engineer and *Compliance Engineering* emphasizes regulations and standards, "*ENR* will provide general news to the EMC community." *ENR* has a circulation of approximately 500, with a readership of 2,100, according to Howard. Subscriptions are $53.00/year in the U.S. and Canada and $68.00/year elsewhere. For more information, contact: Michael Howard, Liberty Labs, Inc., 4920 Johnson Ave., NW, Cedar Rapids, IA 52405, (319) 390-3646 or (800) 728-7081.

Louis Slesin, the editor of *Microwave News*, takes a look at the implications of the demise of EPA's non-ionizing radiation program and its decision not to issue federal exposure rules in "The Danger of Ignoring Non-Ionizing Radiation," which appears in the January 1989 issue of *Technology Review*, an MIT publication. Subscribers can get a complimentary copy by sending a self-addressed stamped envelope to: *Microwave News*, PO Box 1799, Grand Central Station, New York, NY 10163.

TEMPEST Industry Hurting... In our last issue, we noted that Frost & Sullivan, Inc. (F&S), was predicting a slower rate of growth for the TEMPEST products market. More recently, the January 23 *Washington Post* reported that the industry is struggling through hard times—and may therefore be in worse shape than was suggested by F&S. The *Post* quoted representatives from Washington, DC, area TEMPEST firms: "The industry in general is having a bad year," said John Innocenti of Atlantic Research Corp., who predicted "some tough times ahead" for the smaller companies. David Lucien, president of Tempest Technologies, Inc., said that "TEMPEST is leveling off" and that future growth will be more like 9 percent a year compared to the 30-40 percent levels of the past. The turnabout was blamed on a combination of a slowdown in the computer industry and a government spending freeze on data processing equipment.

EMP

FCC Petitioned Once More... Two Washington, DC, area residents are again trying to convince the FCC to open a notice of inquiry (NOI) on how best to protect civilian communications against an EMP. On November 28, Nickolaus Leggett and Donald Schellhardt filed a new petition asking the commission to reconsider its position that the NOI is unnecessary because other efforts are in progress—the basis for the FCC's refusal to act favorably on similar petitions in 1986 and in 1987 (see *MWN*, S/O86, J/F87 and M/J87). Leggett, a "technology analyst," and Schellhardt, an attorney, argue that, contrary to the commission's expectations, EMP protection standards are not expected from the National Security Telecommunications Advisory Committee (NSTAC) or from the American National Standards Institute (ANSI) in the foreseeable future. They cite a letter from the president of ANSI, stating that EMP standards are "not a priority" and that, "We have no idea when to expect their development."

GOVERNMENT

EPA Meets EEPA... The Board of Directors of the Electromagnetic Energy Policy Alliance (EEPA) met with Richard Guimond and Dave Janes, both of EPA's Office of Radiation Programs (ORP), in early December to try to convince them to change their minds and issue federal RF/MW radiation limits. The EPA staffers held their ground. Guimond, the head of

the ORP, explained, as he has in the past (see *MWN*, S/O88 and N/D88), that non-ionizing radiation is not a high priority at EPA or in Congress and that the agency had decided to tackle more important issues, according to Richard Ekfelt, EEPA's executive director. Ekfelt said that, as far as EEPA is concerned, the costs of *not* implementing the guidance are greater than the costs of doing so. In a telephone interview with *Microwave News*, Guimond explained that issuing the RF/MW guidance would not be enough in itself and that the agency would also have to implement it. He said that the agency would have to spend a million dollars and assign five members of the ORP staff during the current fiscal year to complete the rules and then would have to earmark the same resources for each of the next few years to educate industry and the public. When asked at the end of January if his prognosis for the guidance had changed, Guimond replied, "I don't see it in the cards at this time." EEPA has not given up the fight and is waiting for the new EPA Administrator, William Reilly, to take office to see if he is more responsive to its interests. Whatever Reilly's outlook may be, Guimond said that he expects to be staying on as the head of the ORP. Meanwhile, Ekfelt said that EEPA will continue to look for a receptive ear in Congress.

FCC and FM Boosters... The FCC has added FM booster stations to its list of facilities that require environmental analyses of RF/MW radiation levels before permits can be issued or renewed. The final action comes a year after the commission first proposed applying its rules governing the preparation of environmental impact statements to FM boosters, which are used to reach listeners who otherwise could not receive FM signals due to terrain obstructions (see *MWN*, J/F88). The FCC had originally exempted FM boosters because of their low-power transmission (see *MWN*, A85 and M/A87). The FCC changed its mind after the boosters were allowed to operate at powers of up to 20 kW. For more information, contact: Dr. Robert Cleveland, Office of Engineering and Technology, FCC, 1919 M St., NW, Washington, DC 20554, (202) 653-8169.

MEDICAL APPLICATIONS

FDA Faults Magnetrode... The FDA withdrew its approval of the Magnetrode hyperthermia unit last fall, according to a front-page story in the November 25 *Los Angeles Times*. The agency ordered that patients should no longer be treated with the unit, which was developed by Dr. Kristian Storm, formerly at UCLA and now at the University of Wisconsin, and which is manufactured by Henry Medical Electronics, Inc., in Los Angeles. The unit heats the body using 13.56 MHz radiation (see *MWN*, My81). The *Times* cited an October 6 letter from the FDA's Office of Device Evaluation which claims that researchers using the Magnetrode unit at nine medical centers have failed to prove its efficacy and safety. The *Times* also reported that the FDA was worried about the Magnetrode's potential for significant leakage, thereby exposing medical personnel to undesirable levels of radiation. Until his resignation in December 1987, Storm was the chairman of the ANSI subcommittee charged with revising the 1982 ANSI RF/MW safety standard (see *MWN*, M/A88).

MEETINGS

Electrical Potpourri...EPRI is sponsoring seminars on various aspects of power line design and analysis in Palo Alto, CA, during the first five days of May. One day each will be devoted to radio noise, lightning and EMF calculations; two days are reserved for power line EMC with railroads and pipelines. You can register for each topic separately or for all four together. For more information, including costs, contact: Valerie Kakaio, EPRI, PO Box 10412, Palo Alto, CA 94303, (415) 855-2798.

MW Susceptors and Migration... There will be a special session on microwave susceptors at *MW Foods '89*, to be held at the Drake Hotel in Chicago, IL, on March 15. Among the topics to be covered are susceptor safety, package migration, food product/package interaction, consumer safety, fires and hot spots. Jerome Heckman of Keller & Heckman, a Washington, DC, law firm, will chair the panel discussion; joining him will be Robert Schiffmann, a consultant based in New York City, and Dr. Lester Borodinsky of the FDA, among others. For more information, contact: The Packaging Group, PO Box 345, Milltown, NJ 08850, (201) 636-0885.

Bioelectricity Meeting Canceled... The *2nd Meeting of the International Society for Bioelectricity*, scheduled for March 10-12 in Denton, TX, has been canceled. According to Dr. Andrew Marino, the president of the society, the move was prompted by a lack of "quality abstracts."

MILITARY SYSTEMS

Nunn Seeks PAVE PAWS Evaluation... On January 4, Senator Sam Nunn (D-GA), chairman of the Senate Armed Services Committee, asked the USAF for an "official evaluation of the potential hazards of the PAVE PAWS radar emissions to aircraft flight safety and the long-term adequacy of the current operational procedures" at Robins AFB, GA. Nunn also requested a report on how the phased array radar can perform its space tracking mission with minimal risk to aircraft operations. "We may need to have an independent assessment," Nunn warned. In a January 27 letter to Nunn, USAF Brigadier General Burton Moore said that the USAF has "convened a General Officer Group to review the potential safety problems and make recommendations by June 1989." Over the past year, the Robins PAVE PAWS radar has been at the center of an EMI controversy over whether electro-explosive devices (EEDs) aboard aircraft flying through the radar's main beam are in danger of detonating (see *MWN*, J/A88). The USAF considered relocating the radar at a cost of $37.7 million because of this risk—but later rejected the proposal. In the meantime, a number of safety precautions for air traffic

have been instituted at the base and plans to upgrade the radar's power have been scrapped (see *MWN*, N/D88). These precautions include shutting down a portion of the radar whenever fighter planes carrying EEDs land at the base runway, according to the January 7 *Macon Telegraph and News*. Also on January 27, the director of the USAF Space Command office of public affairs wrote to the editor of the *Macon Telegraph and News* explaining that the original EED EMI hazard assessment was based on the average power of the radar but that a later review had indicated that "peak power was, in fact, a more accurate parameter to use."

...USAF Pays for Change of Channel... Georgia public TV station WDCO, whose signal interferes with the PAVE PAWS radar at Robins, is being reimbursed by the USAF for switching its broadcast frequency, according to the December 10 *Macon Telegraph and News*. Since 1986, when the phased array radar became operational, the USAF has regularly detected minor, low-level EMI caused by WDCO's transmitter located about 20 miles away. After WDCO asked the FCC for permission to upgrade its power output from 300,000 to 5 million watts, the USAF became concerned that the EMI would now compromise the PAVE PAWS mission to monitor sea-launched nuclear missiles and orbiting satellites and offered to pay for the change in frequency.

OCCUPATIONAL HEALTH

Workers To Get NIER Policy... Bath Iron Works (BIW) and the Occupational Health and Safety Administration (OSHA) have reached a settlement regarding BIW's numerous violations—including lax radar testing—at its Portland, ME, shipyard. In 1986, BIW workers claimed that they had been exposed to a U.S. Navy ship's radar and were experiencing health problems ranging from severe headaches and facial burns to raised blood pressure and fever (see *MWN*, J/A86). As part of its agreement with OSHA, BIW will completely restructure and implement a non-ionizing radiation policy and will introduce a "state-of-the-art" safety and health program at all of its plants by April 1, 1989. The company will also pay $650,000 in fines—much less than the record $4.2 million penalty originally proposed in 1987 (see *MWN*, N/D87). One unique part of the settlement calls for BIW to provide "substantial and meaningful financial" support for an "Occupational Health and Training Resource Center," to be located in Auburn, ME, for the benefit of all workers in the state.

STANDARDS

Canada: Power Line EMI... An amendment has been proposed to the Canadian Standards Association's RFI Regulations (standard C108.3.1) to expand protection from high-voltage power lines. The proposal provides for the transfer of responsibility for the investigation and resolution of complaints of power line-induced EMI from the Department of Communications to utilities. It also stipulates minimum performance standards for newly-constructed and modified power lines and for methods of measurement. The amendment was spurred by increasing numbers of power line EMI complaints; rising from 10,949 in 1980 to 16,560 in 1984. The amendment appears in the August 20 issue of *The Canada Gazette, Part 1*, pp.3361-3374. A copy is available from: JoAnne Overman, Office of Standards Code & Information, Admin. Bldg., Rm. A629, NIST, Gaithersburg, MD 20899, (301) 975-4037. Ask for TBT/Notif. 88.188.

New and Reaffirmed ANSI Standards...ANSI has published two new standards, *Recommended Practice for the Measurement of RF Emission from ISM Equipment Installed on User's Premises*, ANSI/IEEE 139-1988 ($45.00) and *EMC Limits—Recommended Practice*, ANSI C63.12-1987 ($49.50). ANSI has also reaffirmed *RF Radiation Hazard Warning Symbol*, ANSI C95.2-1982 (R1988) ($15.00) (see *MWN*, O81). Copies of all three standards are available (prepaid) from: Sales Department, ANSI, 1430 Broadway, New York, NY 10018. Shipping and handling are extra.

VDTs

Newsroom Miscarriage Cluster... Since September 1987, there have been 14 miscarriages among women working at the *USA Today* headquarters in Arlington, VA. The first report of the cluster appeared on the front page of the December 9 *Washington Post*, prompting other newspapers to pick up the story. Although the cause of the cluster has not been identified, employees speculated that VDT use or poor indoor air quality may have played a role. All of the women who miscarried used VDTs and worked in newsrooms that have been under heavy construction for nearly a year, according to the *Post*. About 100 women work in the division. In a December 13 follow-up item, the *Post* reported that air sampling tests failed to reveal any toxic contaminants in the building. NIEHS epidemiologist Dr. Allen Wilcox recommended further investigation of the cluster and told the *Post* that "...it sounds like an unusual number." (See also *MWN*, N/D88).

ETC...

BEMSNET Off the Air... Just before the new year, ONR's electronic mail network for the bioelectromagnetics community suddenly went off the air, leaving messages in limbo and severely curtailing communications among researchers. The system's carrier, DIALCOM, pulled the plug because of "contract complications" with ONR and GSA, according to ONR's Dr. Michael Marron. Apparently, DIALCOM had not been paid for months. As we go to press, negotiations are underway to find a new carrier.

What Is This Product?...A recent Macy's catalogue offers a product, "Finally Free," which removes "hair permanently without shaving, wax or cream. Low frequency radio waves travel to the hair root." Next to the listing is a picture of a woman using it to remove eyebrow hair. The price is $100.

Two members of NJDOH's own scientific advisory panel, set up to monitor the study, expressed surprise and dissatisfaction at the decision to abandon years of work. "It is my belief that the failure to complete the study is a breach of faith with the community, with those who agreed to serve as cases and controls, and with the scientific panel members," Dr. William Morton, an epidemiologist at the Oregon Health Sciences University in Portland, told the NJDOH in an October 26, 1988 letter. Morton added that the "decision to terminate the study before completion of data collection or analysis may have been political and/or economic, but it was not scientific and did not have the approval of the panel."

Similarly, Dr. Maureen Hatch, an epidemiologist at Columbia University in New York City, told the NJDOH that she was more than disappointed by the decision to abandon the study and, in an October 27 letter to the NJDOH, she threatened to resign from the panel.

In a telephone interview, Dr. Leah Ziskin, assistant commissioner of NJDOH's Division of Community Health Services, who is in charge of the study, said, "I respect [the panel members'] opinions, but from a public policy point of view, I feel that the department was justified in its decision."

Other panel members, including Chairman Dr. Nicholas Wright of the Robert Wood Johnson Medical School in Piscataway, NJ, and Ron Petersen, manager of non-ionizing radiation protection at AT&T Bell Labs in Murray Hill, NJ, supported NJDOH's decision.

Dr. Daniel Whartenberg of the Department of Environmental and Community Medicine at the Robert Wood Johnson Medical School, who reviewed the NJDOH report, told *Microwave News* that, "I think that what they did with the data they had was reasonable, but I would not go so far as to say that the problem is gone. I would like to continue surveillance."

The report promises to "continue to monitor the health of babies born to residents of Vernon" through the state Birth Defects Registry. In an interview, Dr. Mark Fulcomer, who wrote the report, said that, "The community deserves to have the work continued." For his part, Whartenberg favors a more detailed effort—a prospective epidemiological study.

The controversy surrounding the study is essentially a repeat of the 1984 dispute that arose when the NJDOH first tried to dismiss local fears of a birth defects problem in Vernon (see *MWN*, S84 and My85). The NJDOH was later forced to admit that its numbers were wrong—that there was a greater than expected incidence of chromosomal abnormalities among Vernon babies. The following year, the Centers for Disease Control confirmed the cluster and recommended that the NJDOH conduct the case-control study which it is now abandoning (see *MWN*, N/D85).

Three or Four Cases in 1987

In its December 1988 report, the NJDOH states that, "There is no continuation of the earlier increased rate of Down's Syndrome in babies born to residents of Vernon Township." Others, including Morton and CAT, disagree, arguing that the cluster continues to grow.

The critical year is 1987, when there were at least three cases—four cases, according to CAT—of babies born with chromosomal defects in Vernon. According to Morton's notes from the May 1988 panel meeting, the NJDOH said that there were two abnormal babies born in the first half of 1987: one case of Down's Syndrome and one case of translocation, another type of genetic abnormality. In addition, the amended minutes of the meeting acknowledged a further case of Down's Syndrome later in 1987. (The NJDOH report does not include a year-by-year breakdown of abnormal births.)

CAT's Elise Kreindler stated that there were three cases of babies born with chromosomal abnormalities in January 1987 alone. The third was a case of Trisomy 13, which is rarer than Down's and which is usually fatal. In addition, the case of gene translocation was extremely unusual—"A country-wide search failed to turn up a similar case," Kreindler said in a telephone interview from her new home in Florida. According to her records, at least two of the mothers were under 30 years of age when their babies were born with defects.

Including NJDOH's Down's Syndrome case from the second part of the year, Kreindler's total for 1987 rises to four.

On the average, there are fewer than 200 live births per year among women under the age of 31 in Vernon, according to NJDOH's statistics, and the expected rate of Down's Syndrome for this age group is approximately one per 1,000 live births. (Two other more serious abnormalities, Trisomies 13 and 18, together have an expected rate of only one in approximately 10,000 live births among women under 30.) Thus, the expected annual incidence of Down's and other serious genetic defects among young women in Vernon is approximately 0.2 cases per year.

"Clearly, if you look at the 1987 data, the cluster is continuing," said Dr. Robert Becker, a consultant to CAT based in Lowville, NY. In fact, Becker argued this very point in a letter to *Microwave News*: These new cases may "represent the beginning of a second peak in incidence" (see *MWN*, M/A88). Morton agrees, pointing out that such periodicity is consistent with reports of other epidemics.

When asked about the 1987 abnormal births, NJDOH's Fulcomer said that he did not want "to discuss the numbers," but added that three or four cases in a year would not be remarkable. Similarly, NJDOH's Ziskin did not respond to repeated requests for comment on the 1987 cases.

In the minutes of the May 1988 panel meeting, the NJDOH, while acknowledging two of the January 1987 cases, noted that it would not include its third recognized case in the study because it fell after the June 1987 cutoff date and the department chose not to "change the study period."

There is also a dispute about whether the NJDOH made a concerted effort to ascertain all of the cases of abnormal births. "The NJDOH did not try hard enough," Kreindler told *Microwave News*. "It's just plain criminal that they can know of this problem, but not do anything for seven years."

One longtime observer decried the way clusters have been

investigated. Dr. David Lilienfeld, an epidemiologist at New York City's Mount Sinai Hospital, told *Microwave News:* "The mishandling of the Vernon and other clusters in which the public is convinced that there is a health problem—whether there is one or not—leads to such suspicion and distrust in the public's mind that the agency is no longer able to fulfill its mandate. It's a major tragedy."

Microwave Radiation Levels

In 1987, the NJDOH asked the National Bureau of Standards (NBS) to evaluate two proposals to measure microwave radiation exposures in Vernon—one from Richard Tell, a consultant based in Las Vegas, NV, and one from Dr. Bill Guy of the University of Washington in Seattle. The NBS replied that the proposed methods would yield power density calculations with large uncertainties (on the order of 10-30 dB) and, thus, the "value of the proposed study [was] questionable."

But some members of NJDOH's advisory panel disagreed. In her comments to the NJDOH, Hatch argued that this conclusion seemed "well beyond the expertise of NBS." She strongly criticized the state for basing its decision to "jettison" the study on the NBS report without giving the panel the opportunity to meet with the NBS and review its findings.

In an October 28 letter to the NJDOH, Petersen pointed out that the accuracy of microwave measurements depends on the amount of money available, but that, "The cost of doing a useful assessment would far outweigh the benefit." He later stated that he was "satisfied with the state's conclusion that you cannot do an accurate assessment at a reasonable cost."

NCI EMF Study Questioned (continued from p.1)

of whom work at NCI, testified on behalf of the New York Power Authority (NYPA) in the $66.5 million Marcy-South power line lawsuit. In prepared statements, each discounted any cancer threat from EMFs (see *MWN*, J/A88 and S/O88). For instance, Sinks wrote that, "After consideration of genetics, hematology, immunology and epidemiology taken as a whole, it is my opinion that there is no causal relationship between exposure to power frequency EMFs and childhood cancer."

For their contributions, Aaronson was paid $70,250.98, Sinks $41,083.42 and Tucker more than $12,978.04 (see *MWN*, N/D88.).

Similarly, NCI's Dr. Mark Israel is testifying on behalf of the Potomac Electric Power Co. (PEPCO) in an ongoing health effects hearing (see p.8).

Some of these NCI staffers are participating in a number of different proceedings across the country. For example, in 1988, Tucker gave evidence on behalf of the Mississippi Power Co., the Public Service Co. of Colorado, the Arizona Public Service Co. and PEPCO (see p.9).

The above-mentioned fees appear to be in violation of NCI rules. According to the National Institutes of Health's (NIH) rules on outside income, "Total compensation from consulting with profit-making organizations, including industry and law firms, and from testimony in private litigation, is limited to $25,000 per year, with no more than $12,500 from any individual company or law firm." (These rules were revised on September 1, 1988.)

In a December 29 letter to NIH Director Dr. James Wyngaarden, Dr. Ross Adey of the Veterans Administration Hospital in Loma Linda, CA, wrote that he and others "are deeply concerned that the RFP from NCI...comes from a source already committed by public statements of its senior scientists to an *a priori* position unequivocally denying the existence of a health problem." Adey raised the question of "excess" compensation and warned that, "At issue...is the safeguarding of an independent, objective and unbiased source of scientific expertise essential for framing wise public policies on highly technical issues that directly impact the public welfare."

Adey also sent copies of his letter to NIH to California Democratic Congressmen George Brown and George Miller.

As of January 25, the NCI had begun looking into Adey's allegations. An NCI spokeswoman told *Microwave News* that the investigation would take at least six weeks and that NCI scientists would not be available for comment.

The NCI EMF Study

The primary objective of the $2.5 million NCI study is to examine the association between specific subtypes of acute lymphocytic leukemia (ALL) among children and EMF exposure from power lines and residential appliances. Dr. John Boice of NCI's Radiation Epidemiology Division and Dr. Martha Linet of NCI's Epidemiology and Statistics Program are directing the study.

They will assess lifetime residential EMF exposure through visits to all current and previous residences of the ALL cases and of the matched controls in six mid-Western and mid-Atlantic states and through measurements taken at approximately 8,000 residences and 1,500 schools throughout the country. (The RFP asks for development of standardized protocols for obtaining and coding field measurements.)

NCI is also seeking proposals for an organization to act as the coordinating center for the study.

The EMF study is piggybacked onto a $2.35 million five-year study by the U.S. Children's Cancer Study Group of risk factors for childhood leukemia, which began in September 1988. The study, which also is being funded by the NCI, is headed by Dr. Leslie Robison of the University of Minnesota in Minneapolis.

For more information on the *Etiology of Childhood Leukemia: Measurement of Low Frequency Electromagnetic Fields*, RFP No.NCI-CP95608-21, and on the *Etiology of Childhood Leukemia: Coordinating Center*, RFP No.NCI-CP95610-21, contact: Barbara Shadrick, Cancer Etiology Contracts Section, NCI, Executive Plaza South, Rm. 620, Bethesda, MD 20892, (301) 496-8611.

CONFERENCES

New Listings

March 7-8: **American National Standards Institute (ANSI) Annual Public Conference on "The Future of the Voluntary Standards System: Challenges and Opportunities in the Post-Reagan Era,"** Grand Hyatt, Washington, DC. Contact: Development Department, ANSI, 1430 Broadway, New York, NY 10018, (212) 354-3300.

March 14-15: **MW Foods '89,** Drake Hotel, Chicago, IL. Contact: The Packaging Group Registrar, PO Box 345, Milltown, NJ 08850, (201) 636-0885.

April 10-14: **2nd International Conference on Frequency Control and Synthesis,** University of Leicester, U.K. Contact: Conference Secretariat, Institution of Electronic and Radio Engineers, Savoy Hill House, Savoy Hill, London WC2R 0JD, U.K., (01) 240-1871, ext. 246.

May 1-5: **Electrical Potpourri,** Electrical Power Research Institute (EPRI) Conference Center, Palo Alto, CA. Contact: Valerie Kakaio, EPRI, PO Box 10412, Palo Alto, CA 94303, (415) 855-2798.

May 8-12: **10th International Conference on Electricity Distribution,** Brighton Centre, Brighton, U.K. Contact: CIRED 1989 Organizing Committee, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

May 21-25: **Annual National Conference on Radiation Control,** Hilton Hotel, Baton Rouge, LA. Contact: Conference of Radiation Control Program Directors, 71 Fountain Place, Frankfort, KY 40601, (502) 227-4543.

June 18-22: **35th Annual International Education Seminar of the International Right-of-Way Association (IRWA),** Dearborn, MI. Contact: IRWA, 9920 La Cienega Blvd., #515, Inglewood, CA 90301, (213) 649-5323.

June 20-23: **4th National Environmental Health Conference,** San Antonio, TX. Contact: Centers for Disease Control, Atlanta, GA 30333, (404) 488-4700 or 488-4682.

August 21-23: **24th Microwave Power Symposium,** Westin Hotel, Stamford, CT. Contact: International Microwave Power Institute, 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

September 4-8: **19th European Microwave Conference,** Wembley Conference Centre, London, U.K. Contact: Microwave Exhibitions and Publishers Ltd., 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (08) 924-4027.

October 5-8: **National Convention of the Society of Broadcast Engineers (SBE),** Kansas City, MO. Contact: SBE, PO Box 16861, St. Louis, MO 63105.

October 20-21: **A Delicate Balance: Technics, Culture and Consequences,** California State University, Los Angeles, CA. A conference sponsored by the L.A. chapter of the IEEE's Society on the Social Implications of Technology. Contact: Dr. Nik Warren, Otis/Parsons Art Institute, 134 Hart Ave., Santa Monica, CA 90405, (213) 392-6595.

October 29-November 2: **Conference on Electrical Insulation and Dielectric Phenomena,** Xerox Conference Center, Leesburg, VA. Contact: Prof. Marshall Pace, Dept. of Electrical & Computer Engineering, University of Tennessee, Knoxville, TN 37996, (615) 974-5419.

November 28-December 1: **34th Annual Conference on Magnetism and Magnetic Materials,** Sheraton Boston Hotel, Boston, MA. Contact: Dr. John Scott, American Institute of Physics, 335 E. 45th St., New York, NY 10017.

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MICRO WAVE NEWS

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New Outlook on Effects of Very Weak Electric Fields

Biological responses due to very weak electric fields "cannot be dismissed" on theoretical grounds, according to Dr. James Weaver of the Massachusetts Institute of Technology (MIT) in Cambridge, MA, and Dr. Dean Astumian of the National Institute of Standards and Technology (NIST) in Gaithersburg, MD.

"We do not explain how the field can have an effect. All we are trying to point out is that the thermal noise limit cannot be used to dismiss the possibility of a real effect being present even at low field strengths," Astumian told *Microwave News*.

In a paper published in the January 26 issue of *Science* (p.459), Weaver and Astumian take aim at the often-used argument that to trigger biological

Special Report: Table of Extremely Low Frequency Magnetic Field Gaussmeters and Dosimeters. See pp.8-9.

changes electric fields must be large enough to overpower random fluctuations. Their simple models indicate that a tiny, but repetitive, electric field concentrated in a narrow band of frequencies (for example, a 10 Hz bandwidth) can trigger transitions in the conformation or shape of macromolecules—especially membrane-bound enzymes.

In a telephone interview, Astumian said that there is "an almost unlimited number of macromolecules whose shape could be influenced by external fields of various frequencies." After all, he pointed out, "proteins,

(continued on p.16)

Florida's Magnetic Field Limits Challenged as Too Lenient

On December 29, Florida's Hillsborough County challenged the state's power line electromagnetic field (EMF) standards—the first magnetic field limits adopted in the U.S.

In its petition, the county charged that the standards disregard studies showing a potential link between increased cancer risks and magnetic field exposures at levels significantly lower than the specified limits. According to the county, they "do not further the statutorily mandated goal of protecting public health and welfare," because they are "approximately 100 times greater than the intensity of magnetic fields, which are suspected to increase the incidence of all childhood cancer by 30 percent and to double the risk of contracting childhood leukemia."

(continued on p.6)

« Power Line Talk »

It's been a tough few months for those with Department of Energy (**DOE**) contracts. Some of the major labs doing EMF research—including Battelle, Lawrence Berkeley, Loma Linda and Midwest Research Institute—have been caught in a bureaucratic squeeze, with no money coming in since October. Rumors have also been circulating that the DOE might ask **Oak Ridge National Lab** in Tennessee to run the EMF program. December brought the retirement of Dr. **Ken Klein**, who has long shepherded the DOE's EMF effort. On top of all this, the program might be caught up in a bureaucratic reorganization. The researchers have been pushed to the limit: not only can't they pay their bills, but they face losing 10% of their contracts to Oak Ridge as an administrative fee at a time when they don't know if the DOE will be able to keep its EMF research effort afloat. Few of those involved were willing to speak on the record, but one contractor told us that he is doubtful that the Oak Ridge move will ever take place. DOE staffers maintained that the funding snafu was not limited to the EMF program. A new assistant secretary froze funding on all programs until he could be briefed on each one. But meetings with Klein's successor—acting division head **Russ Eaton**—have been repeatedly postponed. At press time, the DOE had begun processing the paperwork to get the EMF money flowing again—though Eaton still hadn't seen the assistant secretary and the contractors still hadn't seen their checks. One contractor speculated that the funding crunch resulted from a combination of Gramm-Rudman budget cuts and a reevaluation of the whole EMF effort. No one knows whether the program will survive in its present state or whether, as one observer put it, it will be "reorganized right out of existence." Meanwhile, the public's concerns about EMF health effects continue to grow. Stay tuned....

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...For instance to power lines on ***Nightline:*** ABC News is planning to air a half-hour segment on its late night news program in late February or early March. Camera crews have already filmed anxious homeowners in Alexandria, VA, who are battling with **Virginia Power** over what they consider to be excessively high magnetic fields in their homes—up to 80 mG, they say. Among others scheduled to be interviewed are Drs. **Keith Florig, Indira Nair, David Savitz** and the New York Power Authority's **James Cunningham.**

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Some physicists are positive that the whole EMF business is a fraud. Dr. **Robert Adair** of Yale University is prominent among them. Here are some of his latest statements: "Anyone who would believe that EMFs could promote cancer would believe in perpetual motion or cold fusion....In my mind, this falls into the realm of aberrant science..." (*Journal of the National Cancer Institute*, November 15). "What I found [at EMF meetings] is there's a lot of very good people who don't believe any of it, and a lot of people who are not well based in science who do experiments that are very difficult to interpret, who then manage to interpret them. It looked like very bad science to me" (*Hartford Courant*, January 25). Adair has been busy studying other issues: Harper & Row recently published his book, *The Physics of Baseball.*

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On the other hand, some physicists *are* willing to consider the possibility of low-level EMF interactions. At this year's **American Physical Society** meeting, there will be a panel on *Health Effects of Non-Ionizing Radiation.* Among those scheduled to speak are Drs. **Ross Adey, Granger Morgan, Tom Tenforde** and **Joe Elder.** The meeting will be held April 16-19 in Washington, DC.

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Many utility customers have been receiving pamphlets explaining the EMF problem along with their electricity bills. And as we have noted before, as often as not, Dr. **David Savitz**

Panel Calls on DOE for Non-Nuclear Epi Research

The Department of Energy (DOE) should allocate $7.5 million in fiscal year 1991 for "new and important areas of energy-related epidemiologic research"—including electromagnetic field (EMF) effects, according to an independent advisory panel.

In an interim report to the DOE, the Secretarial Panel for the Evaluation of Epidemiologic Research Activities (SPEERA) stated that, "Many questions about toxic chemicals, non-nuclear energy and community radiation risks remain unaddressed." Steve Boedigheimer, SPEERA's executive director, told *Microwave News* that, "Non-ionizing radiation is within the scope of research that the panel has flagged."

Although at least two dozen major epidemiological studies of EMFs are now under way worldwide (see *MWN*, N/D89), none of these is funded by the DOE. The DOE's defense programs and Office of Environmental Safety and Health spend $30 million on ionizing radiation epidemiology.

Overall, the panel cited "ample evidence to confirm weaknesses in the department's epidemiology program" and noted that it remains undecided as to whether the program should be moved out of the DOE.

The nine-member panel, which is made up of health professionals from around the country, will issue a final report in mid-March.

is quoted in these tutorials (see *MWN*, S/O89). In a brochure distributed by Commonwealth Electric in Massachusetts, Savitz says: "Using standard levels for scientific proof, the argument that these [EMFs] cause cancer, reproductive damage or other health effects falls far short of convincing."...The **National Electrical Manufacturers Association** (NEMA), one of the newest entrants in the EMF public information campaign, recently mailed its members a Q&A brochure on the *Biological Effects of Electric & Magnetic Fields*. NEMA concludes that, "Despite considerable evidence that there is no risk, there is a need for continuing research." The association is concerned that fear of the unknown could lead to "irrational and damaging public policy decisions."

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What the public really thinks of the EMF risk is best reflected in the way people evaluate real estate near power lines. On this basis, buyers are worried. This is how Charles Baumbach, a San Francisco appraiser, put it in the latest issue of ***Appraisal Views:*** "While the extent of the EMF influence on our health is in dispute, it is already affecting project planning and surrounding property values. In the future, this issue can be expected to grow in significance in the planning process, the courts and the marketplace." The quarterly newsletter is published by Dominy, Ford & McPherson in Houston, TX, as part of a national appraisers' network.

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Writing in the December 16 issue of the ***British Medical Journal***, Stella Lowry decried the scare stories about EMFs that have appeared in the press and said that there is an "urgent" need for high quality epidemiological studies on the "effects, if any," of EMFs on human health. Dr. **Stephen Perry**, a retired English physician who has long studied the possible link between EMFs and suicide, has responded with a warning about a fundamental problem in human studies on low-level field effects—the absence of an unexposed control population. "Power frequency magnetic fields are pervasive throughout the developed world," Perry noted. "Thus all epidemiological research will tend to compare the bad with the worse."

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The National Association of Regulatory Utility Commissioners (**NARUC**) can't make up its mind. Last year, NARUC's electricity committee asked its subcommittee staff to draft a resolution on EMF research. But when the committee members read it, they decided to put it on hold. One staffer told us that he "got the feeling" that the committee "wasn't interested."

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This year, for the first time, the **Maryland** Department of Natural Resources (DNR) will include EMF bioeffects among its list of proposed research topics. The DNR's Power Plant Topical Research Program—which funds environmental research—has a research budget of $400,000, most of which will be distributed in $50,000-$70,000 grants. For more information, contact: Paul Miller, Research Administrator, Chesapeake Bay Research & Monitoring Division, Tawes State Office Bldg., 580 Taylor Ave., Annapolis, MD 21401, (301) 974-3782. (See also *MWN*, M/A89.)

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Utilities have long complained about how reporters cover the EMF issue. Now they must contend with criticism from the art world. On February 14, a New York City gallery is opening a show called ***Our Cells, Our Selves, Our Homes***, by Paul Ludick. It's about electromagnetism, furniture and appliances and features a "cancerous" sofa and love seat. Ludick, who in the past has taken on ozone depletion, told us that "the show is about tumors and mutations." It runs through March 10 at Art & Industrie, 106 Spring St., New York, NY.

Marcy-South "Cancerphobia" Decision Appealed

The Marcy-South 345 kV power line "cancerphobia" lawsuit is going back to court. On December 11, the New York Power Authority (NYPA) appealed the settlement awarded last fall based on noise and loss of view (see *MWN*, S/O89). Three days later, the landowners' attorneys filed a cross appeal raising the health risks issue.

The NYPA is appealing every part of the decision—*except* for the cancer issue, which was rejected by the court. The plaintiffs are using their appeal to argue once again that their land has been devalued because of the fear of cancer associated with power lines.

On September 29, Judge Peter McCabe, Jr., of the New York State Court of Claims in Goshen ruled that the landowners had failed to prove that there is a "reasonable basis for any fear that power lines cause health problems." However, McCabe did approximately triple the NYPA's original offer to one of the landowners.

The NYPA contends that the $123,260 award conflicts with the opinions of its real estate appraisers and was based solely on the "subjective judgment of the court." Carl Rosenbloom of Bond, Schoeneck & King in Washington, DC, is representing the NYPA in its appeal.

Michael A. Gurda of Gurda, Gurda & McBride in Middletown, NY, who represents the 58 landowners, told *Microwave News* that the court "erred on its burden of proof. We shouldn't have to prove [EMFs] cause cancer, just that there is sufficient cause for concern." He added that they probably would not have appealed had the NYPA not done so first.

A decision on the appeals is not expected for at least a year, according to Gurda. In the meantime, the remaining landown-

ers will continue their claims—the next five are scheduled to be heard some time in April.

The appeals were filed in the Appellate Division of the New York State Supreme Court, Second Department, in Brooklyn. For more on the case, see *MWN*, M/A87, J/A88, S/O88 and N/D88.

"Prudent Avoidance" Is Basis for Maryland Power Line Appeal

On December 21, the Maryland Public Service Commission (PSC) gave the Potomac Electric Power Company (PEPCO) the go-ahead to complete the last segment of a 243-mile 500 kV power line loop around Washington, DC. However, on January 22, one day before the order became final, the state Office of People's Counsel (OPC) appealed the decision.

The OPC called for the PSC to adopt a strategy of "prudent avoidance." In so doing, it invoked the Colorado Public Utilities Commission's (PUC) recent adoption of an identical policy (see *MWN*, N/D89). Prudent avoidance has become a rallying cry since it was first proposed in a Congressional Office of Technology report last summer (see *MWN*, J/A89).

In the 84-page decision, PSC Hearing Examiner Teresa Bay granted PEPCO an unconditional certificate, while ordering the PSC staff to monitor future EMF bioeffects research and to file semi-annual reports with the commission beginning July 1, 1990. Bay accepted the recommendations of the state Department of Natural Resources (DNR) staff that the evidence does not support a conclusion of health effects but that "additional research is warranted."

The OPC challenged Bay's decision, arguing that the "evidence clearly is sufficient to justify the commission's adoption of a 'prudent avoidance' policy in this case, and the imposition of conditions which will reduce the magnetic field exposure levels in a reasonable and prudent manner."

"It is not acceptable for the commission to bury its head in the sand on this issue, because of lack of 'proof' and scientific uncertainty," the OPC maintained.

The OPC proposed that the commission "take reasonable steps to minimize the consequences"—including requiring PEPCO to "investigate the feasibility of design changes" or to widen the right-of-way to ensure levels of 10 mG or less at its edge or to reroute the line through a less developed area. Failure to do so "subjects these residents to a long-term biological experiment, with potential short and long-term health consequences," according to the OPC.

Hearing Examiner Bay had rejected these recommendations as "arbitrary and perhaps counterproductive." Citing the California PUC's recent report (see *MWN*, N/D89), she stated that setting magnetic field limits would be "inappropriate."

Last March, the PSC held a hearing on the sole issue of whether operation of the line would cause adverse health effects. Among the participating parties were PEPCO, the OPC, the DNR and Maryland's Howard County (see *MWN*, M/A88 and S/O88; for excerpts from the testimony by the parties' expert witnesses, see *MWN*, J/F89).

Epidemiology Roundup

• While Dr. Michel Coleman and coworkers failed to find a "clear association" between leukemia and residence near electricity transmission and distribution equipment in south London, U.K., they did make some positive observations. For instance, they found a nonsignificant 50% increased risk of leukemia among those under the age of 18 who lived within 50 m of a substation—which is similar to the risk observed in the Savitz study. They also found that people of all ages who lived within 50 m and within 100 m of high-voltage power lines had a 100% and a 45% increased risk of leukemia, respectively. Here again, neither was statistically significant, nor was the trend of increasing risk with proximity to the line. Residents within 25 m of a substation had a 30% increased risk of leukemia, but those within 100 m showed no such elevation. See "Leukaemia and Residence Near Electricity Transmission Equipment: A Case-Control Study," *British Journal of Cancer (BJC), 60*, pp.793-798, 1989. Coleman is at the International Agency for Research on Cancer in Lyon, France.

• In a guest editorial in the same issue of the *BJC*, Dr. Ray Cartwright concluded that, "Present scientific knowledge points at the very best to a minute [leukemia] risk of EMF verging on the point of non-existence." Cartwright, of the U.K.'s Leukaemia Research Fund Centre for Clinical Epidemiology at the University of Leeds, is currently working on a study of leukemia and residential EMF exposures (see *MWN*, N/D89). See "Low Frequency Alternating Electromagnetic Fields and Leukaemia: The Saga So Far," *BJC, 60*, pp.649-651, 1989.

• Preliminary results from a Swiss study of railroad engine drivers indicate increased risks of hematopoietic and lymphatic cancer on the order of 50%, according to Drs. Christoph Minder and Dominik Pfluger of the University of Bern's Department of Social and Preventive Medicine (see *MWN*, N/D89). The researchers estimated the workers' exposures to be several hundred A/m (>1 G). They are planning more detailed measurements.

• It appears "that an association is present between high traffic density and childhood cancer," although the "data do not strongly implicate traffic-related air pollution," Dr. David Savitz and Lisa Feingold concluded in a recent study. The findings were particularly striking for children under the age of five—fivefold increases in leukemias and in brain tumors and a threefold increase in all cancers. Savitz had investi-

gated, and rejected, traffic density as a possible confounder in his landmark Denver childhood cancer-EMF study. See "Association of Childhood Cancer with Residential Traffic Density," *Scandinavian Journal of Work and Environmental Health, 15*, pp.360-363, 1989.

• David Savitz, New Zealand's Neil Pearce and Charles Poole of Epidemiology Resources in Chestnut Hill, MA, explore the ins and outs of EMF studies in "Methodological Issues in the Epidemiology of Electromagnetic Fields and Cancer," *Epidemiologic Reviews, 11*, pp.59-78, 1989.

• Linemen who worked on a 400 kV power line (with average daily exposures of 233 mG and 2.8 kV/m) for one day and on an identical—but unenergized—line the following day showed "no statistically significant" differences in blood chemistry, EEGs and behavioral indices which could be attributed to EMF exposures, according to a study from the Swedish National Institute of Occupational Health. See F. Gamberale et al., "Acute Effects of ELF Electromagnetic Fields: A Field Study of Linemen Working with 400 kV Power Lines," *British Journal of Industrial Medicine, 46*, pp.729-737, 1989.

• A number of epidemiological studies have linked EMFs with brain cancer. And so it was noteworthy that in 1988, Drs. Devra Lee Davis and Joel Schwartz reported an almost threefold increase in brain cancer among white men and women aged 75-84 (*The Lancet, i*, pp.633-636, March 19, 1988). In a November 25, 1989 letter to *The Lancet*, Drs. Anders Ahlbom and Ylva Rodvall of Sweden's Karolinska Institute noted that a Norwegian study had found a similar trend but that in Sweden there was an increase among men, but not among women. They concluded that conflicting results from recent studies "raise the issue of whether or not the increase in brain tumor rates reported by others is real. If it were it would be of considerable importance, both from the public health point of view and scientifically." Ahlbom was a member of the NY Power Lines Project scientific advisory panel. (See also a letter from Italy's F. Levi and C. La Vecchia in the October 14, 1989 *Lancet*.)

• Since electrical technicians and engineers had higher mortality rates due to leukemia than linemen and power station operators who had "presumably" higher EMF exposures, there is probably another agent at work. So argue Dr. Richard Gallagher and colleagues at the Cancer Control Agency of British Columbia, Canada, in a letter to the *Journal of Occupational Medicine, 32*, p.64-65, January 1990. They recommend that, in future studies, researchers consider exposures to chemicals and solvents, as well as to EMFs.

• In a study of varied occupational exposures and cancers, a team of Italian researchers observed no significant association with exposures to electricity and radar. The team did find increased risks for agricultural occupations and for those involving exposures to benzene and other solvents. See C. La Vecchia et al., "Occupation and Lymphoid Neoplasms," *British Journal of Cancer, 60*, pp.385-388, 1989.

Washington State ELF Literature Review Issued

Current research is "inconclusive, but the findings nonetheless are cause for concern." This is how Thomas Sykes and Ping Li of the Washington State Institute for Public Policy (WSIPP) sum up the EMF bioeffects literature in a new survey. Among the report's other findings are that epidemiological studies, for the most part, have shown a "consistent relationship between exposure to electric or magnetic fields and the promotion of cancers," but that the "evidence is not strong enough to validate [this] hypothetical relationship...."

The 41-page January 1990 report, *Possible Health Effects of Electric and Magnetic Fields from Electric Power Lines: A Summary of Scientific Studies*, was ordered by a 1989 state law (see *MWN*, M/A89 and M/J89). For more information, contact: Thomas Sykes, WSIPP, Evergreen State College, Seminar 3162, MS: TA-00, Olympia, WA 98505, (206) 866-6000, ext. 6380.

Project ELF Fully Operational

After more than a quarter century of plans, studies, protests and litigation, the U.S. Navy's Project ELF is operating at full power. With the official opening on October 6 of the second of two extremely low frequency (ELF) transmitters, the Navy now has a communications system capable of reaching submarines at great depths.

The transmitters—one near Clam Lake in northwestern Wisconsin and another near Sawyer Air Force Base south of Marquette, Michigan—are broadcasting at powers up to 2.3 megawatts. The Navy believes this system will provide continuous contact with submarines around the globe in the event of a nuclear weapons attack.

The 28-mile-long transmitter in Wisconsin and the 56-mile-long transmitter in Michigan are considerably smaller than the 6,200 miles of cable and 100 transmitters first proposed in the late 1950s, when the system was known as Project Sanguine. For a short time, it was called Project Seafarer.

Controversy has plagued Project ELF. Opponents, led by John Stauber and Jennifer Speicher of Stop Project ELF, have for years questioned its biological and environmental impacts. In 1984, the state of Wisconsin won a court order forcing the Navy to stop work until it completed a supplement to the environmental impact statement it had filed in 1977. Before that study was completed, however, a federal court

overturned the order—permitting construction to continue—and Supreme Court Justice John Paul Stevens refused to consider an appeal (see *MWN*, S84). Under a contract with the Navy, the American Institute of Biological Sciences completed a literature review on ELF effects in March 1985 (see *MWN*, Mr85).

Magnetic Field Limits Challenged (continued from p.1)

"The primary goal is to invalidate the rule," Edward de la Parte, Jr., who is representing the county, said in an interview. "Beyond that, the county is wrestling with what numbers to suggest to the state Department of Environmental Regulation [DER] if the challenge is successful." De la Parte, of de la Parte & Gilbert in Tampa, FL, is working with County Attorney Frederick Karl, also based in Tampa.

The DER's Buck Oven, who developed the standards, told *Microwave News* that the challenge may be "legally inappropriate and moot," because it is not certain whether the county has standing to oppose the rule.

The Division of Administrative Hearings will hold a two-week hearing on the petition starting May 21. The participating parties are the DER, Florida Electric Coordinating Group (a utility lobby), Florida Power Corporation and Hillsborough County.

The magnetic field limits (and electric field limits) which took effect last March are for new power lines only: they specify a maximum of 150 mG for lines of 230 kV or less, 200 mG for 500 kV lines and 250 mG for certain double-circuit 500 kV lines. The rule exempts existing lines and new lines of 69 kV or less.

The county contended that the DER improperly exempted existing electrical facilities and smaller lines. Magnetic field exposures of 2.5 mG may increase the incidence of childhood cancer, according to the county, yet existing lines and those of less than 69 kV (as well as new lines) "commonly produce fields of greater than 2.5 mG at the boundary of the right-of-way [ROW]."

The standards are significantly weaker than those first proposed by the DER in June 1988, which specified *daily average* and *maximum* limits of 50 mG and 100 mG, respectively (see *MWN*, M/J88). Last year, Oven said that the adopted standards were based on levels that are "technologically achievable" (see *MWN*, M/A89).

Hillsborough County charged that the limits were "increased by the DER in order to accommodate the concerns of the electrical power industry."

The DER's Assistant General Counsel Betsy Hewitt maintained that the DER "considered all the scientific evidence and came up with a rule that reasonably does what it is supposed to do—protect the health and welfare of the public—by preserving the status quo."

The county also charged that, "Florida statutes require that the DER establish magnetic field standards to protect public health and welfare," but, "By the DER's own admission, the magnetic field standards are not reasonably related to either goal."

In addition, it challenged the limits specified for the 500 kV Lake Tarpon-Kathleen line (see *MWN*, M/A89), arguing that although they are more stringent than those set for other new 500 kV lines, they are still higher than fields "now occurring at the edge of similar 500 kV ROWs throughout the state" —contrary to the rule's status quo objective. The county fought against the yet-to-be-built Lake Tarpon line for four years before losing the certification battle last August.

Even if the rule is withdrawn, the Lake Tarpon limits will remain in effect because they were set by the siting board during the certification process, according to Oven.

With regard to the economic issues, the county claimed that the DER's economic impact statement is inadequate because it "fails to address the cost to the public and health care providers of exposing the population of this state to magnetic fields approximately 100 times more intense" than fields suspected of increasing the cancer risk.

On this point, Oven said that, "The economic impact issue should have been raised at the DER hearing a year ago."

Last March, the county issued a challenge to the rule one day after its effective date (see *MWN*, M/A89). The petition was withdrawn in April (see *MWN*, M/J89).

Hillsborough County, FL, v. Dept. of Environmental Regulation, Case No.90-0001R. For more on the Florida standards, see *MWN*, J/A83, J/A84, M/A86 and N/D87.

IRPA Issues Exposure Limits

The International Radiation Protection Association (IRPA) has published its *Interim Guidelines on Limits of Exposure to 50/60 Hz Electric and Magnetic Fields*. The guidelines, which were developed by IRPA's International Non-Ionizing Radiation Committee (INIRC), specify public exposure limits for magnetic and electric fields of 0.1 mT (1,000 mG) and 5 kV/m, respectively.

The interim occupational exposure limits for magnetic fields and electric fields are 0.5 mT (5,000 mG) and 10 kV/m, respectively.

The IRPA committee based its guidelines on "established or predicted effects of exposure to 50/60 Hz fields." With regard to the potential association with cancer, it noted that, "Not only is this association not proven, but present data do not provide any basis for health risk assessment useful for the development of exposure limits."

The IRPA/INIRC guidelines, together with explanatory text, were first published in the May/June 1989 issue of *Microwave News*. The complete IRPA/INIRC statement appears in *Health Physics, 58*, pp.113-122, January 1990.

NEW BOOKS

Brief Reviews

Robert O. Becker, **Cross Currents: The Perils of Electropollution, The Promise of Electromedicine,** Los Angeles, CA: Jeremy P. Tarcher, Inc., 1990, 336 pp., $19.95.

In this sequel to *The Body Electric,* Becker explores the two sides of electrobiology: on the one hand, its application in nontraditional healing techniques and, on the other, the cause for concern over the proliferation of radiation-emitting devices in the modern environment.

Richard B. Borgens et al., **Electric Fields in Vertebrate Repair,** New York, NY: Alan R. Liss, Inc., 1989, 334 pp., $69.50.

Six well-referenced chapters provide an introduction to the biology of endogenous and applied electrical fields and their role in regeneration and healing. The emphasis is on DC fields. The authors are with Purdue University.

Paul Brodeur, **Currents of Death: Power Lines, Computer Terminals and the Attempt To Cover Up Their Threat to Your Health,** New York, NY: Simon & Schuster, 1989, 333 pp., $19.95.

This is the book that everybody is writing and talking about. Excerpts first appeared in *The New Yorker* last June.

James C. Lin, editor, **Electromagnetic Interaction with Biological Systems,** New York, NY: Plenum Press, 1989, 300 pp., $62.50.

The 15 papers assembled by Lin, of the University of Illinois in Chicago, were first presented at the 1987 URSI meeting held in Israel. Of particular interest are contributions by China's Huai Chiang and Binjie Shao on microwave effects on reproduction, development and immunology and by Poland's Stanislaw Szmigielski on Polish and Soviet safety standards.

Shizuo Mizushina, editor, **Non-Invasive Temperature Measurement,** New York, NY: Harwood Academic Publishers, 1989, 144 pp., $70.00.

Four of the eight papers in this collection—from France, Japan and the U.S.—deal with microwave radiometry. The use of ultrasound is also covered.

Eberhard Neumann, Arthur E. Sowers and Carol A. Jordan, editors, **Electroporation and Electrofusion in Cell Biology,** New York, NY: Plenum Press, 1989, 436 pp., $85.00.

In the words of the editors, this volume "covers basic, applied, and instrumentation aspects of electroporation and electrofusion and presents discussions of biological and biophysical model systems." Many of the 27 papers are from West Germany; two are from the U.S.S.R.

Bertil R.R. Persson and Freddy Ståhlberg, **Health and Safety of Clinical NMR Examinations,** Boca Raton, FL: CRC Press, 1989, 175 pp., $110.00.

The Swedish authors have provided the most complete discussion of this subject now available—they cover static, ELF and RF fields, as well as EMI and site-planning issues. One chapter is devoted to safety standards.

Cyril W. Smith and Simon Best, **Electromagnetic Man: Health & Hazard in the Electrical Environment,** London, U.K.: J.M. Dent & Sons, Ltd., 1989, 344 pp., £17.95. [Available in the U.S. for $29.95 from: St. Martin's Press, New York, NY, (212) 674-5151, ext. 661.]

Smith, a physicist at the University of Salford, and Best, a science journalist, give a comprehensive overview of the health effects of EMFs—with a special emphasis on the role of homeopathic medicine (in, for example, the treatment of electrical allergies). Other topics covered include the military's use of NIER, the effects of chronic EMF exposures and international safety standards.

Gustav Freiherr von Pohl, **Earth Currents: Causative Factor of Cancer and Other Diseases,** Stuttgart, F.R.G.: Frech-Verlag, 1987, 159 pp., $14.00 (approximate).

An exploration of Pohl's hypothesis that "negative electrical earth currents" cause cancer and a variety of other ailments in humans, animals and plants. Most of the book is devoted to case studies. It was first published in German in 1932.

Bary Wilson, Richard Stevens and Larry Anderson, editors, **Extremely Low Frequency Electromagnetic Fields: The Question of Cancer,** Columbus, OH: Battelle Press, 1990, 382 pp., $57.50. [Order from: (800) 451-3543.]

The three editors, from the Battelle Pacific Northwest Lab in Richland, WA, also wrote much of this timely book. For the rest, they enlisted some of the best-known names in the EMF community: Adey, Blackman, Groh, Liboff and Tenforde. Other leading researchers—including Blask, Hammond and Reiter—also contributed chapters.

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ELF Gaussmeters and Dosimeters

Company, Address, Contact	Meter Name	Price	Bandwidth (other bands)	Min-Max/ No. of Scales	Accuracy†	Size/Weight (in/lbs)	Options/Comments
F.W. Bell, Inc. 6120 Hanging Moss Rd., Orlando, FL 32807 (407) 678-6900 Contact: Steve Dakel	Model 4048 Model 9200 Model 9500 Model 9903	$650.00 $1,500.00 $2,800.00 $5,800.00	0-12 kHz 10 Hz-10 kHz 20 Hz-10 kHz 20 Hz-50 kHz	0.1 G-20 kG/3 10 mG-20 kG/4 1 mG-300 kG/6 1 mG-3 MG/7	± 2.5%‡ ± 2.5%‡ ± 1%‡ ± 1%‡	4x7x1.8/1 8.8x4.5x11/8 14x7.5x14/19 18x7.5x16/36	All models are Hall Effect devices. All can measure DC fields. All except the 4048 can output to an oscilloscope.
Combinova AB[1], c/o Ergonomics, Inc. PO Box 964, Southampton, PA 18966 (215) 357-5124; FAX (215) 364-7582 Contact: Frances George	MFM10	$6,700.00	5 Hz-1 kHz	0.1 mG-10 G/4	<± 2%	15.2x4.6x10 /6.6	Data can be stored and transferred to computer.
Electric Field Measurements Box 326, W. Stockbridge, MA 01266 (413) 637-1929; FAX (413) 637-2826 Contact: Dr. Don Deno	Model 116 Model 116+ EMDEX-C[2]	$75.00 $250.00 $2,000.00	60 Hz 60 Hz# 40-400 Hz#	0.1 mG-200 G/4 0.1 mG-200 G/4 0.1 mG-25 G/4	± 3% ± 3% ± 3%	1.5x1.5x2/0.4 4.75x2.5x9/2 1.8x4.8x6.5/1.3	116 sensor plugs into std. digital multimeter. 116+ includes multimeter. EMDEX stores data. Waveform capture device.*
Electric Power Research Institute (EPRI) PO Box 10412, Palo Alto, CA 94303 (415) 855-2581; FAX (415) 855-1069 Contact: Dr. Stan Sussman	3D-AMEX*	To be determined	40-800 Hz	0.35-150 mG/ (not applicable)	± 5%	1x2x4/0.3	Fits in shirt pocket. Requires separate readout unit.
Electro-Magnetics Design, Inc. 9100 W. Bloomington Freeway, Bloomington, MN 55431, (612) 888-7473 Contact: Roger Hastings	ACGM-1 ACGM-2	$450.00 $990.00	20-150 Hz 20-150 Hz	0.1 mG-9 G/2 0.1 µG-9 G/3	± 1% ± 1%	2x4x7/1 2x4x7/1	Autoranging. LCD readout.
Holaday Industries, Inc. 14825 Martin Dr., Eden Prairie, MN 55344 (612) 934-4920; FAX (612) 934-3604 Contact: Burton Gran	HI-3600-02	$1,195.00	50/60 Hz#	0.1 mG-20 G/5	± 5%	1.8x3.5x17/2.8 (with 8" diameter sensor)	Remote readout. Signal output for dB/dt measurements. VDT/ VLF version available.
Integrity Electronics and Research, Inc. 558 Breckenridge St., Buffalo, NY 14222 (716) 886-7283 Contact: Tom Valone	IER-109	$595.00	55-65 Hz	1 µG-2G/4	± 2%	3x4x7/0.9	LCD display. E-field module and 3-access probe available. IER-119 available for 50 Hz.
MacIntyre Electronics Design Associates, Inc. 11260 Roger Bacon Dr., Reston, VA 22090 (703) 471-1445 Contact: Barbara Vayda	µMAG	$495.00	0-100 Hz	10 µG-2 G/3	± 0.5 %	4x7.5x2/0.9	Model with earth field neutralization available for $649.00.

Company, Address, Contact	Meter Name	Price	Bandwidth (other bands)	Min-Max/ No. of Scales	Accuracy†	Size/Weight (in/lbs)	Options/Comments
Monitor Industries 6112 Fourmile Canyon, Boulder, CO 80302 (303) 442-3773 Contact: Ed Leeper	Model 42B	$350.00	40 Hz-1 kHz	0.01 mG-2.5 G/ 12	± 7-10%	2.1x3.1x7.8/ 1.8	Audio speaker. Model 42B-1 with linear frequency response available for $425.00.
Positron Industries, Inc. 5101 Buchan St., Montréal, Quebec H4P 2R9, Canada, (514) 345-2200; FAX (514) 731-8662 Contact: Silvo Frank	"Dosimeter" 378101	$1,650.00†	60 Hz# (5-20 MHz)	60 µG-4 G/ automatic	± 5%	6x3x1/0.5	Output to computer. Stores 18 days of data. Model 378102 available for 50 Hz.
Safe Computing Co. 368 Hillside Ave., Needham, MA 02194 (617) 444-7778, (800) 222-3003 Contact: George Lechter	Safe Meter	$145.00	20 Hz-30 kHz (5-70 kHz)	1 µG-230 mG/7	± 5%	6x3x4/0.7	Safe meter readings must be converted to mG with hand-held table. Both meters rent for $29.95/wk.
	Professional Meter	$175.00	5 Hz-1 kHz (1-40 kHz)	0.1-200 mG/1	± 3%	5.5x3.3x1.5/0.8	
Schaefer Applied Technology 200 Milton St., Unit 8R, Dedham, MA 02026 (617) 320-9900, (800) 366-5500 Contact: John Schaefer	Model EM1	$89.95 (Rents for $40.00/wk)	10 Hz-1 kHz	0.45-10+ mG/1	± 5%	5.5x3x1.5/0.8	Specifies level in 1 of 10 ranges between 0.45 and 10 mG, or greater than 10 mG. Model EM10 has large remote display.
Shoden Corp. 2-23, Ojima 1-chome, koto-ku, Tokyo 136, Japan (03) 637-7711; FAX (03) 637-7724 Contact: Massy Fujiwara	MFM-12A	$1,700.00†	60 Hz (25 Hz-10 kHz)	0.1 mG-20 G/3	± 5%	6x4x2/3	50 Hz meter available. Outputs to oscilloscope and recorder are standard.
Sydkraft AB Carl Gustafs Väg 4, S-217 01 Malmö, Sweden (40) 25 58 96; FAX (40) 97 47 74 Contact: Bo Wiberg	MFDM	$1,850.00	50/60 Hz	10 µG-20 G/5	± 5%	16x12x5/2	150/180 Hz included. The program can be made to suit different requirements.
	3D MFDM	$9,500.00	50/60 Hz	10 µG-2 G/ automatic	± 2%	24x17x8/24	
Walker Scientific, Inc. Rockdale St., Worcester, MA 01606 (508) 852-3674, (800) 962-4638; FAX: (508) 856-9931 Contact: Joe Nowlan	ELF-50 Field Monitor	$179.95	50/60 Hz	1 mG-51.2 G/2	± 1%	6x3.3x1.5/0.5	ELF-50 digital display available for $225.00. For MF-5D, probes designed for specific applications are available.
	MF-5D Fluxmeter	$1,665.00	0-100 kHz	0.1 mG-200 kG /3	± 1%	2.8x8.5x9.3/5	

† Approximate.
§ Accurancy decreases as frequency rises.
# Also measures electric fields.
* Under development. Available later in 1990.

1. The address in Sweden is: PO Box 20050, S-161 20 Bromma, Sweden, (08) 733-9310.

2. Sold under license from EPRI.

HIGHLIGHTS

PMFs and Pregnancy: Clues Emerge, Conflicts Persist

A coherent picture of the effects of pulsed magnetic fields (PMFs) on pregnancy continues to elude researchers, though some clues on the interaction are beginning to emerge. Specifically, the timing of the exposure and the genetic makeup of the target species appear to be key variables.

In his latest series of experiments—in which pregnant mice were exposed to a sawtooth 20 kHz magnetic field with a peak field strength of 15 μT—Dr. Hakon Frölen of the Swedish Agricultural University in Uppsala found that delaying PMF exposure until the ninth day after conception resulted in no harm to the embryos. This differs from his previous findings, reported over the last few years, in which he consistently saw increases in fetal deaths and resorptions with early exposure (see *MWN*, J/A87 and S/O88).

Last September, at a conference on video display terminal (VDT) work and health, held in Montreal, Canada, Frölen explained that he continued to see ill effects when he started PMF exposure on the first, second or fifth day of pregnancy—but not if he waited until the ninth day.

This early pregnancy effect agrees with the results of experiments using chick embryos carried out by Dr. Alexander Martin of the University of Western Ontario in London, Canada, and by Dr. Jocelyne Leal of the Ramón y Cajal Hospital in Madrid, Spain (see *MWN*, N/D88). In a recent paper, Martin reported that the first 24 hours of development were the critical period for the chick's susceptibility to PMFs. Exposure on the second day after fertilization caused no effect.

The second/third day of development for the chick is approximately equivalent to the eighth/ninth day for the mouse, Martin told *Microwave News*. "The cell processes in the chick and the mouse are basically the same as far as cell proliferation and differentiation are concerned," he said. At the November Department of Energy-Electric Power Research Institute (DOE-EPRI) review in Portland, OR, Martin reported that 60 Hz sinusoidal fields did not increase the malformation rate among chick embryos.

Also at the DOE-EPRI meeting, Murray Walsh of Ontario Hydro reported that the mouse pregnancies were totally unaffected by 20 kHz PMFs at 3.6 μT, 17 μT and 200 μT. There were no increases in malformations, resorptions, fetal deaths or any other indices. The study was led by Dr. Michael Wiley of the University of Toronto and was sponsored by the Canadian utility and IBM.

Essentially the same mouse study has now been carried out in three different labs in Sweden and Canada. Dr. Bernhard Tribukait of the Karolinska Institute in Stockholm, Sweden, was the first to report that weak 20 kHz sawtooth fields are biologically active—he reported an increase in serious malformations (see *MWN*, M/A86 and M/J86). Each laboratory used a different strain of mice, however, leading Frölen and Martin to hypothesize that genetics may be the reason for the variation in results.

This view is supported by the results of Project Henhouse, in which six different labs used the same protocol to test the effects of PMFs on chick embryos (see *MWN*, M/A88). The one lab which failed to find any effect used a different strain of eggs from the others. "The genetics of the egg could help explain the inconsistent results reported by several labs," Martin said at the Portland meeting.

Sweden's Dr. Ingrid Nordenson of the University of Umeå and Dr. Kjell Hansson Mild of the National Institute of Occupational Health in Umeå have documented a nearly threefold increase in chromosomal aberrations in human amniotic cells exposed to 30 μT sinusoidal 50 Hz magnetic fields. This result was highly significant ($p<0.001$). There was also an increase following exposure to 16 μT 20 kHz sawtooth PMFs, but this effect was only significant at the $p=0.06$ level. At last summer's Bioelectromagnetics Society meeting, they reported that neither waveform affected protein synthesis, but that the sawtooth PMF did affect DNA synthesis.

EPA RF Survey in McFarland

The Environmental Protection Agency (EPA) found only nanowatt levels of radiofrequency (RF) radiation in McFarland, CA, the site of a well-publicized childhood cancer cluster (see *MWN*, J/F88, J/A88 and M/A89).

The strongest fields, 3-19 nW/cm^2, were associated with UHF television transmissions—levels "commonly found in most urban areas," according to EPA. AM radio signals contributed 2-8 nW/cm^2. Voice of America shortwave broadcasts from a facility in nearby Delano produced much lower levels—0.2-1.3 nW/cm^2. FM radio fields were 0.001-0.006 nW/cm^2. These data are consistent with informal measurements taken in 1988 (see *MWN*, S/O88).

The cause of the cluster remains unexplained. "Many of the avenues of investigation have been exhausted," Dr. Rick Kreutzer of the Epidemiological Studies and Surveillance Branch of the California Department of Health Services told *Microwave News*. He said the state previously had failed to uncover anything unexpected in the air, water or soil—the same now holds true for the RF environment.

The investigation is now focusing on determining the cancer rates—from 1980 to 1989—in four counties in the region. Kreutzer explained that if the elevated cancer rates are related to agricultural pesticides, then the whole area—not just McFarland—would probably be affected. Some preliminary results are due in the spring.

EPA's report, *Radiofrequency Radiation Survey in the McFarland, California Area* (EPA/520/6-89/022, November 1989), was prepared by Edwin Mantiply of EPA's Las Vegas, NV, office and Norbert Hankin of EPA's Washington, DC, office. Copies are available from: Lynne Keeton, Office of Radiation Programs, EPA, PO Box 98517, Las Vegas, NV 89193, (702) 798-2476.

FCC Sets Rules for Multiple RF Sources and "Hot Spots"

The Federal Communications Commission (FCC) has adopted final regulations that exempt some low-level radio-frequency (RF) sources located among other more powerful sources from having to comply with its environmental regulations. The new rules were released on January 18 and will take effect on April 18.

The FCC also provided guidelines for measuring RF "hot spots" to determine compliance with safety limits.

The rules will have the most direct effect on low-power transmitters in antenna "farms" where the combined RF levels may exceed the 1982 American National Standards Institute (ANSI) guidelines for human exposures.

The FCC will now automatically exempt all sources which contribute 1% or less of the ANSI limits from conducting environmental assessments. Low-power transmitters also will be excused from measures needed to comply with the exposure standard.

Hammett & Edison, a San Francisco consulting engineering firm, petitioned the FCC to address these issues in 1987 (see *MWN*, S/O87). The commission responded with a proposed rule in September 1988 (see *MWN*, S/O88). The final rule is essentially the same as the proposal.

Hammett & Edison had recommended a 5% threshold, but the FCC concluded that, "It is better to err on the side of caution" and that, "in this case, the difference between 1% and 5% appears to be significant." The FCC's Dr. Robert Cleveland told *Microwave News* that information provided by the Environmental Protection Agency showed that a 5% threshold is "too lenient and difficult to justify."

In its new rules, the FCC also advises license holders on the proper distance at which to measure "hot spots" caused by the reradiation of RF fields from metal objects. Electing not to set fixed rules, the FCC suggests a guideline of 20 cm for the separation distance between a reradiating object and a meter's sensing device. But the commission adds that measurements at 10-20 cm are "acceptable," particularly in determining partial-body exposures, while cautioning that measurements at less than 20 cm "can exaggerate and inaccurately reflect" whole-body exposures. The commission recommends posting warning signs in "any area where there is an indication of excessive fields" measured at 10-20 cm.

Some observers are concerned that the commission is sending mixed signals on the hot spots issue. Dane Ericksen of Hammett & Edison is disappointed that the FCC has adopted "ambiguous wording on the minimum spacing." And Ric Tell, a consultant based in Las Vegas, told *Microwave News* that, "It's appalling that the FCC has been wishy-washy in specifying the measurement distance."

For more information, contact: Dr. Robert Cleveland, FCC, 1919 M St., NW, Washington, DC 20554, (202) 653-8169.

FROM THE FIELD

Low-Level EMFs: Replies to the Royal Swedish Academy of Sciences

In our last issue, we published the concluding statement of the Royal Swedish Academy of Sciences' workshop on Interaction Mechanisms of Low-Level Electromagnetic Fields (EMFs) in Living Systems—Resonant Phenomena, *held in Stockholm May 25-27, 1989. The statement, which was sent to us by Dr. Bengt Nordén of the Chalmers University of Technology in Göteborg and Dr. Claes Ramel of Stockholm University, prompted the following replies:*

Dear Sir:

As a participant in the workshop, I am surprised that the academy would publish this summary without offering participants the usual courtesy of reviewing its accuracy and scientific perspective or an opportunity to reach an expert consensus.

I was first made aware of this document in November 1989, through the courtesy of the editor of *Microwave News*. My inquiries of four other U.S.—and some Swedish—participants indicate that they were unaware of the document's existence prior to its submission for publication.

The following remarks reflect a deep collegial desire to communicate certain concerns shared by other participants. Because Swedish science holds a preeminent world position in the field of bioelectromagnetics—as in so many other areas of science—it is of great importance that a public statement from the workshop should accurately reflect the current state of knowledge.

I respectfully plead that this statement is an eclectic selection of virtually unrelated topics. It fails to acknowledge that there is a body of connected cell biology on mechanisms of interactions, pointing to the cell membrane as the locus of EMF activity. EMF effects on inward signals act on ionic mechanisms, on intramembranous proteins including specific receptor proteins and on signal coupling to a spectrum of intracellular enzymes. EMFs interact with outward signals in gap-junction mechanisms mediating intercellular communication and regulating cell growth.

I am concerned that readers may be convinced that all that lies between epidemiology and cyclotron resonance models "shows no clear or reproducible pattern of results" because the document fails to address the very existence of significant bioeffects at athermal field exposure levels, as well as their marked frequency and amplitude dependencies. These findings strongly point to long-range, nonlinear physical interactions at the atomic level, rather than to chemical reactions in the fabric of biomolecules.

This summary appears to trivialize as a vast wasteland all research except epidemiology and cyclotron resonance models. This view contrasts with that of the U.S. Congressional Office of Technology Assessment, which, in a June 1989 report, singled out cell membrane studies as of special significance and characterized research on biological effects of power frequency EMFs as being, for the most part, "of very high quality."

Nor should the epidemiological findings be dismissed as indicating only "a slight overall increase in the relative risk of cancer." Recent reports of a tenfold increase in brain cancer risks among certain electronics workers (Thomas, 1987) and a sevenfold higher risk of leukemia among telephone cable splicers (Matanoski, 1989) argue otherwise.

It would seem inappropriate to single out the cyclotron resonance model as the pivotal theory capable of experimental evaluation. Low-frequency sensitivities have also been described in models that bridge from high-frequency coherent oscillations (millimeter microwave) to low-frequency manifestations in Lotka-Volterra models (Fröhlich, 1975, 1977); in similar bridges between high- and low-frequency oscillations in limit cycle behavior of calcium ions (Kaczmarek, 1976); in local superconductivity (Achimowicz et al., 1977); in chaotic behavior of molecular oscillations (Kaiser, 1984); and in microwave effects on red cell membrane enzyme activity consistent with coherent oscillations at 10^{11} Hz (Blinowska et al., 1985). Lednev (1989) offers an exciting new vista on cyclotron-like resonances in coordination compounds between calcium ions and proteins in the presence of fixed and oscillating EMFs.

Is it not in the realm of fantasy to recommend that future research focus on possible effects "on well-characterized systems at the lowest possible levels of complexity"? This belies the challenging evidence that observed sensitivities to low-frequency EMFs are intrinsic to complex ordering of proteins and lipids in membrane structures.

Though sensitive and even painful, some final questions may be raised. Since Professors Nordén and Ramel have no apparent records of published bioelectromagnetic research, and since many participants were excluded from preparation of the summary, were they assisted in its preparation by others, and if so, by whom? In view of the international importance attaching to the academy's conclusions in a matter of such great public interest and scientific importance, is it not unusual to arrange publication in a newsletter that circulates within a narrow segment of the scientific and engineering communities?

We earnestly hope that the academy will offer a sorely-needed forum for continuing scrutiny of the evolving science of bioelectromagnetics. It was indeed a privilege to present our findings in the great halls of the Royal Swedish Academy of Sciences, founded 250 years ago, with its proud traditions of pioneering support in many areas of the physical and biological sciences.

The workshop papers, now in Professor Ramel's hands for publication, contain detailed analyses and critical syntheses that may lead to a somewhat different emergent overview.

Sincerely,
W. Ross Adey, MD
VA Medical Center, Loma Linda, CA

Dear Sir:

During the Royal Swedish Academy of Sciences' workshop, one entire day was devoted to a brisk discussion of mechanisms that might account for the variety of cellular and epidemiological results presented by the speakers. Much of this centered around the cyclotron resonance ideas of Liboff and coworkers.

As the discussion unfolded, led in large part by Herman Schwan, it became clear that if mechanisms of interaction could not be devised to account for the many interesting and puzzling results presented at the meeting, then perhaps the results were of little interest or were maybe even spurious. As I listened, I realized that the physicists were the stumbling blocks. They argued that results like ours did not fit with their reading of the laws of physics. Our findings were therefore not considered "real." It was my impression that these conclusions were based on a preconceived notion that the electric field is responsible for the cellular effects. No one was much interested in considering the possibility that the magnetic field could in fact be causing these highly specific and statistically significant observations.

As a biologist, I don't understand why biological effects such as those observed in my and Ann Henderson's laboratory are received with such skepticism by physical scientists. When we present these data to other biologists, they are not astounded, nor do they call upon us to swear up and down that we have indeed stimulated an increase in specific transcripts. After all, biologists who study responses to stress, such as heat shock, see similar, but different, kinds of changes. Yet when our findings were presented at the workshop, the physicists and engineers greeted them with disbelief. In contrast, the biologists in Stockholm were most receptive—unfortunately, there were only a handful present.

At the end of the meeting I was one of six or seven people involved in the preparation of a summary statement. We all agreed that understanding the mechanism of EMF interaction is important and that it will come as more data appeared. It was *never* considered that, in the absence of a mechanism, what we had reported was a *non-effect*.

It has become clear that the academy has shifted its position on its decision to publish the proceedings. Soon after I returned home, I was asked by Professor Ramel to provide the academy with a manuscript of my talk. I immediately did so with considerable care and effort. I never heard from the academy again and my manuscript seems to be in limbo somewhere.

At least some members of the academy appear to have changed their minds—without the courtesy of telling us. They have judged our scientific research and found us guilty of not being able to explain our results with a mechanism that meets their approval. By implication, our data are suspect or may not even be real.

Professors Ramel and Nordén have selectively chosen unrepresentative examples out of three very exciting days of presentations. In so doing, they have trashed highly interesting results because they found the suggested models wanting.

Sincerely,
Reba Goodman, PhD
Columbia University Health Sciences, New York, NY

Dear Sir:

I have mixed feelings about the conclusions reached by the Royal Swedish Academy of Sciences following the May workshop. As a participant I was moved by the abundant hospitality shown by the hosts, particularly Dr. Claes Ramel. It says worlds about Swedish science that I have never attended an American conference in this area—whether sponsored by BEMS, DOE, DOD or EPRI—that even came close to matching this Stockholm meeting. I had the feeling that at long last I was attending a scientific meeting, and not one of the dog-and-pony shows that we attend regularly in the U.S.

Nevertheless, despite its excellent planning and quality, there are some disturbing aspects to what has happened since this meeting:

(a) Manuscripts were submitted by the participants with the understanding that these would be formally published in either journal or book form. To the best of my knowledge, there has been little or no movement to date to publish the proceedings. One hopes that this delay has more to do with simple human inertia and that there are no hidden, constraining forces at work—objections perhaps to the content of the various presentations.

(b) One can honestly criticize the way in which the meeting was summarized. I am not sure that any scientific gathering at which diverse points of view are hotly contested can be neatly summarized in a completely objective manner, and perhaps the organizers should have been wise enough not to try. If the manuscripts had been promptly moved toward publication, then the sense of the meeting would have been properly judged by the scientific community. Instead, the organizers chose to delay the proceedings and give us the benefit of *their* conclusions. It is a little disturbing that we have now seen two versions of these conclusions. It is very disturbing to recall the efforts towards the end of the workshop to assemble a group charged with issuing a consensus statement. I am not sure how this group was chosen, but I think it had something to do with who caught the first metro train back from the meeting site.

(c) The statement by Nordén and Ramel might have been more representative of the tone of the workshop if they had seen fit to emphasize the positive instead of the negative. No one denies the lack of an acceptable "physical-chemical" model to explain the ELF interaction but how many still doubt the influence of weak ELF magnetic fields? It may have escaped Nordén's attention that the acceptance of effects per se by the larger scientific community is itself noteworthy and remarkable, quite independent of the poor physical understanding of the underlying mechanism. Science is as much *observing* as it is *understanding*. In physics, especially, one finds wide gaps between experiment and theory. Unfortunately, in the present area, there is a small cadre of theorists who reject the experimental data simply because they cannot frame a proper explanation for the results. Nordén and Ramel have unwittingly acted to reinforce this position by emphasizing the negative, or "controversial" aspects. However, the careful, painstaking efforts of Adey, Blackman, Goodman, etc. should not be forced to suffer the sins of theorists who fail to keep pace.

(d) The conclusions suggest a number of research strategies. Because of concern over the "widely different nature and level of complexity" of the ELF studies, a more "systematic approach" is proposed in which different groups "coordinate their work." It seems to me that the one major previous attempt along these lines, the New York State Power Lines Project (NYPLP), turned into a near fiasco. I recall, in particular, the well-meaning consultants who set up exposure systems and left them in the hands of well-meaning life scientists who didn't have the foggiest notion of what happened when they switched the systems on or off. My opinion is that the most reliable NYPLP experiments were the ones that were *less* coordinated. Good science is done by good scientists, not by good scientific committees.

It is indeed a pity that Nordén and Ramel neglected the meeting's *lengthy discussion on the role of epidemiology. Now that the epi*demiologists have convinced most of us that ELF hazards exist (the Matanoski data persuaded me), is it prudent to spend limited funding on more and more epi studies without comparable expenditures on basic research? There are now 22 epi studies under way worldwide. Are there half as many basic science studies funded? Judging from the little we know of the mechanisms involved, it is unrealistic to assume that epidemiology alone will ever help us untangle what is happening at the *physical, biochemical and physiological levels of inter*action. If we ever hope to do more for the public and the power industry other than suggest "prudent avoidance," a lot more laboratory work has to be done.

Sincerely,
Abraham R. Liboff, PhD
Oakland University, Rochester, MI

Conference Reports from France and Bulgaria

Dr. Charles Polk, professor of electrical engineering at the University of Rhode Island in Kingston, filed the following reports after attending the Bioelectrochemical Society's 10th International Conference on Bioelectrochemistry and Bioenergetics *in Pont-à-Mousson, France, September 24-29, 1989, and the* International School on Electromagnetic Fields and Biomembranes *in Pleven, Bulgaria, October 2-8, 1989.*

Bioelectrochemistry and Bioenergetics–France

A substantial part of this meeting was devoted to the discussion of cell electroporation and closely related topics. The increasing interest in this area has been stimulated by the use of very large electric (E) fields (hundreds of kV/m) to temporarily fuse cells for the transfer of genetic material in preparations where cells are surrounded by a low conductivity fluid.

Efforts directed towards optimizing this technique have led to very active research on membrane behavior. The objective of this research is to understand what happens when porosity is increased substantially—but only for a very brief period—so that the cell remains viable. Some of this work deals with membrane structure and basic membrane processes and is of interest also to those who normally work with the comparatively very low intensity E-fields used in tissue repair. For example, Eberhard Neumann and coworkers at the University of Bielefeld, F.R.G., pointed out that the DNA-counterion system is rapidly polarizable.

J. Teissié of the Center for Biochemistry and Cellular Genetics in Toulouse, France, argued that cell fusion following electroporation is a consequence of a decrease of repulsive hydration forces by the E-field which disturbs the regular organization of water molecules. He indicated that it is normally hydration forces which prevent contact between cell membranes and that these forces, as well as electrostatic repulsion, are opposed by van der Waals forces.

In the context of electroporation and cell fusion, Sianette Kwee of the University of Aarhus, Denmark, identified effects of "low E-fields" as those caused by fields of 20-40 kV/m! In a paper which does not appear in the abstract bulletin, Yuri Chizmadzhev of the A.N. Frumkin Institute of Electrochemistry at the U.S.S.R. Academy of Sciences in Moscow reported that the average time required to change the ion conductivity by an E-field pulse is less than one μsec, while the time necessary to change the average pore diameter is about 10 msec. He indicated that the resealing time (i.e., time required for pore disappearance) is highly variable for different lipid membranes, but is generally above 10 sec.

Several papers addressed photosynthesis, electroluminescence and other effects of visible light in biomembranes. For example, Vlad Brumfeld and Israel Miller of Israel's Weizmann Institute of Science inferred the electrophoretic mobility of rhodopsin molecules inside vesicle membranes from differences in photoluminescence in the presence and absence of "low amplitude" (8 kV/m) msec pulses. Michael Drain and coworkers at Rockefeller University in New York City discussed photogating of ionic currents across a lipid bilayer and showed that currents of large hydrophobic ions depend upon photoinduced charge generation inside the membrane.

The discussion of electrical and electromagnetic stimulation of bone and tissue repair by Heinrich Berg, Martin Blank, Reba Goodman, Ann Henderson, Charles Polk, Sol Pollack, Joseph Spadaro,

Mays Swicord, Tom Tenforde and Bernard Veyret identified two regions of E-field amplitude where effects have been observed. E-fields at frequencies from a few Hz to 100 kHz with amplitudes between 0.01 V/m and 10 V/m have been shown to produce various biological responses. These results are considered non-controversial because the corresponding current densities are well above the endogenous levels (~10^{-3} A/m^2).

Effects at lower field intensities, down to 10^{-6} V/m, such as the calcium efflux "window effects" observed by Ross Adey and Carl Blackman and some of the Goodman-Henderson observations showing modification of cellular protein synthesis, are difficult to explain because they correspond to levels below thermal noise. Probably non-equilibrium thermodynamic processes and processes involving considerable amplification via field effects on enzymes play a role in these "ultra-low" field intensity effects, most of which seem to appear only in the presence of an alternating magnetic (B) field.

Veyret, of the University of Bordeaux, France, reported on experiments designed to explain results obtained with the "Priore apparatus" which produced considerable public discussion in France a few years ago. Apparently, a series of well-controlled experiments by reputable biologists confirmed that this apparatus did stimulate parts of the vertebrate immune system. When Priore died in 1983, detailed information on the electrical and magnetic characteristics of his apparatus was lost—although it is known that the device simultaneously used a steady (DC) B-field and a 9.4 GHz microwave (MW) carrier modulated at various frequencies in the MHz range. Veyret's group now studies only the effects of modulated MWs on the immune system of mice at a power level of 30 μW/cm^2, corresponding to a specific absorption rate (SAR) of 0.015 W/Kg—well below the threshold of 0.4 W/Kg for thermal effects. Veyret's laboratory uses 1 μsec pulses at 1 msec intervals with a 9.46 GHz carrier modulated at various frequencies in the MHz range. Modulations at 21 and 32 MHz stimulate immune response, while modulations at other frequencies between 14 and 41 MHz depress the immune system.

Electromagnetic Fields and Biomembranes–Bulgaria

At this conference more than half of the papers were devoted to electroporation and electrically stimulated cell fusion, reflecting the substantial interest in biotechnology within the eastern bloc countries. Many of these papers came from various agricultural research institutes.

Among the papers dealing with "low" field intensities (i.e., those less than 1 kV/m), I found the following particularly interesting:
(1) A one-hour lecture by Valeri Lednev, head of the Laboratory of Muscle Biophysics at the U.S.S.R. Academy of Sciences' Institute of Biological Physics in Puschino, on "Parametric Resonance" was possibly the most important paper presented at the Pleven conference. It provided a quantitative explanation of the various experiments by Abe Liboff's group, which appears to be theoretically much more plausible than the cyclotron resonance mechanisms proposed by Liboff and Bruce McLeod. Based on earlier (1960) published Russian work, it showed that E- and B-fields at specified frequencies can affect transitions between vibrational states of an ion within the molecule to which it is bound.
(2) Y.A. Kholodov of the Institute of Higher Nervous Activity, U.S.S.R. Academy of Sciences, Moscow, reported on the response of human volunteers exposed during randomly-spaced 60 sec periods to DC B-fields of up to 120 mT and AC B-fields of 0.1-5 mT. Kholodov recorded the subjects' EEGs and their verbal descriptions of sensations, including pain. He pointed out that the melanin pigment in the substantia nigra (where serotonin is produced) is one of the very few paramagnetic proteins.
(3) Ruggero Cadossi of the University of Modena, Italy, summarized information presented earlier at the U.S. BRAGS meeting on the effect of triangular B-field pulses (20 G, 3 msec rise time, 7 msec decay time) on the immune system. He emphasized that the nature of observed effects (i.e., lymphocyte proliferation) critically depends upon when the signal is applied during the cell cycle.
(4) Igor Varayev and O.V. Betsky, both of the Institute of Radio Engineering and Electronics, U.S.S.R. Academy of Sciences, Moscow, reported on a variety of experiments showing interaction of MWs at non-thermal levels with living systems. They observed "resonances" or "window effects" at 41.2 and 70.45 GHz in E-coli (increased rates of cell division), genetic effects in Drosophila at 46 GHz and blocking of the repair mechanism for DNA after radiation damage at 51.7 GHz. In experiments in which E-coli DNA was exposed to polarized E-fields at 51.78 GHz, they observed changes in conformation, but no breaks. Experiments on cell membranes, employing millimeter waves at power levels of 0.5-10 mW/cm^2, showed "resonant frequency effects" only in living, and never in dead, tissue. They also stated that some observed resonance effects correspond to transitions between rotational energy levels in water.
(5) I. Klavinsh of the Institute of Biology, Latvian Academy of Sciences, Riga, U.S.S.R., described his B-field device, which is in clinical use for bone and tissue healing. The system consists of a pair of semiflexible coils and a very compact signal generator which plugs into the European standard 220 V, 50 Hz power outlet. The device generates 1 mT B-field pulses with a rise time of 0.5 msec and a decay time of 0.6 msec, repeated either at 80 Hz or at a rate which varies between 40 Hz and 120 Hz. Klavinsh claimed that variation of the repetition rate is essential to obtain the desired physiological effects.
(6) Fritz Pliquett of Leipzig, G.D.R., reviewed pulse techniques for measuring the electrical parameters of biological tissue—conductivity and dielectric permittivity.

UPDATES

INTERNATIONAL

The Non-Ionizing Decade... The U.K.'s National Radiological Protection Board (NRPB) has included a new chapter on non-ionizing radiation in the fourth edition of its 62-page booklet, *Living With Radiation* (1989). The NRPB takes a conservative view of NIER risks, explaining that epidemiological data are "equivocal" and that the risks of exposure, "if real, are within the range regarded by society as tolerable." The booklet is available for £3.50 from: Her Majesty's Stationery Office (HMSO), Publications Centre, PO Box 276, London SW8 5DT, U.K. (01) 622-3316....An interesting contrast to the booklet is an editorial that appeared in the NRPB's January 1990 *Radiological Protection Bulletin*. The unsigned commentary welcomes the new decade by suggesting that, "The 1990s might be the decade of non-ionizing radiation." For more information, contact: NRPB Information Services, Chilton, Didcot, Oxon OX11 ORQ, U.K., (0235) 831600.

MEETINGS

EMF Effects, West Germany... An international cast of researchers is expected to speak at the April 1-7 symposium on *Electromagnetic Field Effects on Molecules and Biological Cells*, to be held at the University of Bielefeld, F.R.G. Among the topics to be covered are mechanisms of interaction and weak field effects. Contact: Dr. E. Neumann, Faculty of Chemistry, University of Bielefeld, PO Box 8640, D-4800 Bielefeld 1, F.R.G., (0521) 106-2053.

PEOPLE

Dr. **Herbert Pollack**, 84, died on January 2 of cardiac arrest. A charter member of both the Electromagnetic Radiation Management Advisory Council and the Bioelectromagnetics Society, Pollack is most widely remembered as a consultant to the State Department in the 1970s on the irradiation of the U.S. embassy in Moscow. He also advised NASA, the USAF and the Office of Telecommunications Policy and served on a number of ANSI subcommittees setting standards for RF/MW exposures. A faculty member at the George Washington University medical school from 1964 to 1970, and a professor emeritus thereafter, Pollack also consulted on nutrition and health to the Surgeon General, the World Health Organization and numerous other institutions worldwide. He received an MD from Cornell University and a PhD in Physiology from the University of Minnesota.

Professor **T. Dvoràk**, the longtime organizer of the biennial EMC symposia in Zurich, Switzerland, has retired from the Institute for Communication Technology, where he had worked since 1969. The 1991 symposium will be chaired by Dr. **G. Meyer**. Professor **P. Leuthold** will serve as the president of the symposium and Professor **Ralph Showers** once again will be the technical chairman.

RESOURCES

PEMF Review... Dr. Andrew Bassett of the Bioelectric Research Center in Riverdale, NY, has published a comprehensive review of the "Fundamental and Practical Aspects of Therapeutic Uses of Pulsed Electromagnetic Fields (PEMFs)" in *Critical Reviews in Biomedical Engineering* (*17*, pp.451-529, 1989). The paper, which includes 330 references, was refereed by Dr. Ross Adey of the VA Medical Center in Loma Linda, CA.

Ionizing Radiation... The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) recently issued its fifth report on the health effects of ionizing radiation, which concludes that the risk of developing cancer following exposure to low levels of X-rays and gamma rays is three to four times higher than previously estimated. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, known as *BEIR V*, is available for $35.00 (paperback) or $40.00 (hardcover) from: National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418, (800) 624-6242, or (202) 334-3313....The Senate's Committee on Governmental Affairs has published *Early Health Problems of the U.S. Nuclear Weapons Industry and Their Implications for Today* (Senate Print 101-63). The 16-page report is available from: U.S. Government Printing Office, Washington, DC 20402.

Mind Control... Larry Collins, the author of *Maze*, a roman à clef on the use of ELF to control behavior (see *MWN*, J/A89), has now written a nonfictional version. See the January 1990 issue of *Playboy*.

STANDARDS

New Zealand RF/MW Standard... The New Zealand government has proposed adopting most of the 1985 Australian RF/MW exposure standard. (The Australian standard covers 300 kHz-300 GHz, but the New Zealand proposal apparently covers just 300 kHz-100 GHz.) Along with the exposure standard, New Zealand is seeking comments on adopting Australia's *Principles and Methods of Measurement—300 kHz to 100 GHz*. The Standards Association of New Zealand has asked for comments on *Radio Frequency Radiation, Part 1: Maximum Exposure Levels—300kHz to 100 GHz* (DZ 6609.1) and *Part II: Principles and Methods of Measurement —300 kHz to 100 GHz* (DZ 6609.2). The Australian standard, *Maximum Exposure Levels—Radiofrequency Radiation—300 kHz to 300 GHz* (AS 2772-1985), is "flat" at 1 mW/cm^2 from 30 MHz to 300 GHz (see *MWN*, M/A86). Comments on the New Zealand drafts were due by February 16. For more information, contact: C. Gorman, Standards Association of New Zealand, Private Bag, Wellington, New Zealand, (04) 842-108.

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lipids and DNA are all electrically sensitive and their action depends on their topology."

By assuming that a molecule is sensitive to specific frequencies and that a cellular mechanism exists for the signal to elicit a cumulative effect over time, Weaver and Astumian have devised models which show that thresholds for electric field effects can be lowered by a factor of 100,000 below the thermal noise level—to levels as low as 4×10^{-6} V/m at 100 Hz and 10^{-6} V/m at 1 kHz.

In their paper, they illustrate the action of the field this way: "A reaction that is poorly catalyzed may normally proceed at a negligible rate, but the rate may increase significantly upon a field-induced conformation change of the enzyme. Each cycle produces a 'pulse' of product that may accumulate on one side of the membrane...."

The optimal coupling would occur in the range of 100 Hz to 1 MHz, based on the relaxation times of transitions between different structural arrangements of enzymes, according to Weaver and Astumian. Very little research has been carried out on this part of the electromagnetic spectrum, however. "I have always been surprised that people have not focused more on these frequencies," Astumian, a member of NIST's Bioprocessing Metrology Group, said.

When asked about the model's possible implications for magnetic fields, Weaver, who is affiliated with the Harvard-MIT Division of Health Sciences and Technology, replied, "It's hard to make the case for direct low-level magnetic field effects."

Interestingly, the Weaver-Astumian model implies that one would expect to see frequency windows like those identified by Drs. Ross Adey and Carl Blackman. "Amplitude windows are more puzzling," Astumian pointed out.

"Research has been stymied because people have not accepted that these effects could possibly be real," Astumian said. "Now we need a lot of experiments." The other major part of the problem, added Weaver, is that the funding for research has been very poor.

Science magazine is widely read in the scientific community and the Weaver-Astumian paper has attracted much interest—especially as it was featured on the journal's "This Week in Science" page. The entry began, "Do the electric and magnetic fields that are produced by common household appliances, video displays, electric blankets, utility power lines, radar emitters and other sources pose significant hazards to health?"

(Note that figures 2 and 3 on p.461 of the Weaver-Astumian paper are reversed.)

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MICRO WAVE NEWS

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Epidemiologists Call for Study of EMFs and Female Breast Cancer

Health experts are now placing a high priority on a study of the possible link between female breast cancer and exposures to electromagnetic fields (EMFs). The consensus emerged following the publication of a third report indicating an excess of male breast cancer among EMF-exposed workers.

At a January 30-31 workshop sponsored by the National Institute for Occupational Safety and Health (NIOSH), a panel of epidemiologists added female breast cancer to leukemia, brain tumors and lymphoma as critical targets for future EMF research. NIOSH's *Scientific Workshop on the Health Effects of Electromagnetic Radiation on Workers* was held in Cincinnati, OH.

In a series of interviews with *Microwave News*, workshop panelists and participants expressed almost unanimous support for the new initiative. "I think we should study female breast cancer and EMFs," said Dr. Genevieve Matanoski of the Johns Hopkins University School of Public Health in Baltimore, MD. Similarly, Dr. Samuel Milham of the Washington State Department of Health in Olympia said, "It's time to study female breast cancer vis-à-vis EMFs—absolutely."

Dr. Gilles Thériault of McGill University in Montreal, Canada, the work-

(continued on p.14)

EPA Cancer Report Update: SAB Meets, Congress Keeps Tabs, U.K. Sets Review and Excerpts from Testimony; see pp.6-10.

USC Leukemia Study Supports Denver Wire Code Risks

On February 7, Dr. John Peters of the University of Southern California (USC) presented preliminary results showing a statistically significant association between childhood leukemia in Los Angeles, CA, and wire codes—surrogates for electromagnetic field exposures. The results support previous findings of a wire code–childhood cancer link by Dr. Nancy Wertheimer and Ed Leeper and by Dr. David Savitz.

The data offer "little support" for a link between measured magnetic field exposures and leukemia risk, "some support" for a link to wiring configurations and "considerable support" for a link to children's electrical appliance use, according to a USC statement released by the Electric Power Research Institute (EPRI)—the sponsor of the study. Peters reported the results at an EPRI workshop in Carmel, CA (see p.14).

Peters has declined to comment on the study at this time. The results should be published within four months, according to EPRI. The announcement was made as we go to press; full details in our next issue.

ELF NEWS

« Power Line Talk »

Reports of **soaring cancer rates** are continuing to appear. On January 29, the **American Cancer Society** (ACS) announced that the breast cancer risk for women in the U.S. has risen to one in nine—up from one in ten in 1987. The ACS estimates that this year 175,000 American women will develop breast cancer. *Time* magazine ran an eight-page cover story on breast cancer in its January 14 issue with provocative headlines such as "A Puzzling Plague." The trend is not limited to the U.S: "There is an epidemic of breast cancer, which...appears to be occurring around the globe," Germany's Dr. Lenore Kohlmeier and colleagues conclude in a paper recently published by the New York Academy of Sciences (NYAS) in *Trends in Cancer Mortality in Industrial Countries*. While many researchers suggest that improved detection and the aging of the population may be partly responsible for the higher rates, most agree that there is more to the story. "Something in our environment is contributing," Dr. Marc Lippman of Georgetown University told *Time*. The risk of brain tumors is on the rise as well—and not just among the elderly. Dr. Devra Lee Davis of the National Research Council, one of the editors of the NYAS collection, told the December 11 *New York Times* that the rate of brain cancer among people under 45 increased about 2% each year between 1973 and 1986. Davis noted that some researchers have implicated EMF exposure as a possible brain tumor risk. Davis's results will appear in the April 1991 issue of the *American Journal of Industrial Medicine*. Last August, Davis and colleagues reported a sharp rise in brain and central nervous system cancers among the elderly in the U.S., Japan and four European countries over the past 20 years (see *MWN*, S/O90). And NIH's Dr. Nigel Greig reported in the October 17 issue of the *Journal of the National Cancer Institute* that primary malignant brain tumor incidence among the elderly "increased dramatically" between 1973 and 1985.... All of this appears to have been missed in the executive suites at EPA—hard though it is to imagine after the headline on the front page of the December 10 *Washington Post:* "Cancer Rates in Industrial Countries Rise." Dr. **William Farland**, the EPA official who deleted the "probable human carcinogen" designation from the agency's EMF cancer assessment (see *MWN*, M/J90), told the December 15 *New York Times* that it is clear that an EMF–cancer relationship cannot be too large, because the records of disease in this century do not show notable increases as the country was electrified.

«« »»

The **DOE**'s EMF bioeffects research budget will increase in fiscal year 1992, according to Dr. Imre Gyuk, the agency's program manager. The DOE asked for $5 million, which was approved by the Office of Management and Budget. In the last few years, the budget has been steady at about $3 million (see *MWN*, S/O89). When asked what he would do with the new money, Gyuk replied that he would "flesh out" some of the existing projects which had been "cut to the bone" and also develop some new requests for proposals. The final amount of the increase is now up to Congress.

«« »»

In **Rhode Island**, a local **moratorium on power lines** might soon apply to the whole state. Last October, responding to widespread public concern over the health effects of EMFs, the East Greenwich town council banned all new power lines above 60 kV for three years (see *MWN*, N/D90). In early January, two bills modeled after the East Greenwich ordinance were introduced in the state legislature by Senator Michael Lenihan and by Rep. John Hernandez, both Democrats. If the bills become law, they will impose the three-year moratorium statewide. The Narragansett Electric Company is appealing the East Greenwich action to the Rhode Island Public Utilities Commission (PUC), but this will become moot if the bills are adopted as state law, Amato DeLuca, a Providence-based attorney and the author of the East Greenwich ordinance, told *Microwave News*. According to DeLuca, public opinion in Rhode Island is behind the bills, which have "a decent shot at passing."

«« »»

Wisconsin state legislators are less than eager to go to work since EMFs higher than 100 mG were found in their office building. The levels were detected when workers in one office on the second floor noticed that their video display terminals (VDTs) were behaving erratically. Madison Gas & Electric (MG&E) took measurements in the building and found levels as high as 400 mG near the transformer room directly below on the first floor. MG&E brought the levels down to an average of 25-125 mG in some areas by reconfiguring lines and redesigning the electrical vault, but legislators and their staffs are still concerned, according to Katie McGrath, an aide to state Rep. Tom Seery, who is in charge of the EMF investigation. "People are a little frightened. We've got pregnant women in this building," McGrath told *Microwave News*. Although the initial measurements were taken last spring, most of those working in the building didn't learn about them until a local paper ran the story. Now no one wants to move into the building and those already there have turned down spacious offices with high EMF readings, McGrath said. She added that some legislators have become interested in pursuing state health-based exposure guidelines: "If it hadn't affected the legislative arena, we wouldn't be getting this much attention this fast."

«« »»

The **Northeast Public Power Association** (NPPA) is encouraging member utilities to communicate more with the public about the EMF controversy. "Do not deny the issue," NPPA's EMF task force urges in a list of guidelines for utilities planning to establish EMF policies. The NPPA recommends acknowledging public concerns and sharing information with customers and the media. The guidelines also advise: "Consider proce-

dures for minimizing potential EMF exposure when siting, designing and operating power facilities."

«« »»

On January 15, the **California Public Utilities Commission** (PUC) announced that it will investigate how it should address the issue of EMF health effects. The PUC identified four possible strategies: taking no action, maintaining the status quo while limiting any increase in exposure, instituting "prudent avoidance" and aggressively limiting exposures. Utilities and other interested parties have been requested to submit comments by March 15. Public hearings are also planned. In 1988, the PUC, in conjunction with the state Department of Health Services, launched a state-ordered, $2 million research project on the potential effects of EMFs (see *MWN*, M/J88, S/O88 and J/A89).

EMF Mitigation Projects Gain Momentum

The Electric Power Research Institute (EPRI) has allocated $1 million to study ways of reducing electromagnetic field (EMF) exposures. *Studies of Magnetic Field Management*—one of the most ambitious mitigation efforts planned to date—will identify shielding and grounding systems, as well as the most common sources of EMF exposure, Greg Rauch, who is managing the project for EPRI's Electrical Systems Division, told *Microwave News*.

Other mitigation projects are under way in Sweden and in at least three U.S. states.

Among the mitigation techniques to be investigated by EPRI are:

•*Low-field transmission line configurations:* Including reverse phase, split phase, delta and compact configurations. Tests have already shown that these designs can achieve some field cancellation (see *MWN*, J/F89), but problems, such as increased corona discharge and the need for tower design modifications, remain.

•*Line burial:* Substantial field cancellation can result when the three-phase conductors of transmission lines are very closely spaced within an underground, oil-filled, steel pipe. Cancellation is less efficient for buried, residential, single-phase, primary distribution lines and these lines may cause public exposures.

•*Return current "roundup":* Neutral return currents are often found on water pipes or other conductors in buildings and can cause current imbalances and contribute significantly to background EMF levels.

•*Ferromagnetic shielding:* Ferromagnetic materials can attenuate magnetic fields. Use of this type of shielding would probably be limited to utility workers and others who must spend significant periods of time exposed to high levels of EMFs in the workplace.

•*Robotic equipment:* EPRI has already developed a robotic remote manipulator arm for working on overhead transmission lines and could develop similar equipment for other types of high exposure work.

These approaches have emerged over the last year. For example, utility representatives, EPRI staffers and contractors reviewed them at an April 1990 workshop in Orlando, FL. Much of the research will be conducted at EPRI's High-Voltage Transmission Research Center in Lenox, MA.

A 15-page article in the October/November 1990 *EPRI Journal* illustrates a number of field reduction techniques. In an accompanying editorial, Dr. Narain Hingorani, the vice president of EPRI's Electrical Systems Division, writes that EPRI's mitigation efforts are in response to public concern about possible health effects, which is "creating pressure and expectation for measures to reduce or eliminate such fields before a scientific understanding of the nature and magnitude of the risk is in hand."

EPRI will be coordinating its efforts with the Empire State Electric Energy Research Corporation (ESEERCO), a consortium of New York utilities. In January 1991, ESEERCO announced that it will sponsor two mitigation projects with $200,000 of its own funds and $100,000 from EPRI. A contract has been signed with the IIT Research Institute (IITRI) in Chicago, IL, to compile a catalogue of exposure sources. And negotiations are under way with Professor Stewart Maurer of the New York Institute of Technology in New York City for a ten-month, $95,000 study of ground currents; Maurer would investigate possible changes in grounding regulations and design diagnostic models to identify sources of ground currents and help reduce residential EMF exposures. In the second phase of its effort, ESEERCO will develop the most promising EMF mitigation techniques.

The ESEERCO effort was prompted by the New York Public Service Commission (PSC), which has urged state utilities to conduct a large-scale EMF survey and investigate ways of reducing exposures (see *MWN*, M/A88, M/J88 and J/A89).

Separate mitigation studies are also under way in Florida and in Washington State. Last year, the Florida Environmental Regulatory Commission appointed an independent task force to oversee a two-year, $1 million survey of EMF reduction options (see *MWN*, M/J90). The project, which is being funded by the Florida Electric Power Coordinating Group and administered by the state Department of Environmental Regulation (DER), is an outgrowth of the state's 1989 magnetic field rules proceedings (see *MWN*, M/A89). The DER issued a request for proposals, No.9113, on February 8.

In Washington, the Department of Health is conducting a two-year, $40,000 investigation into the feasibility of mitigation. The project was mandated by a state law enacted in March 1990 (see *MWN*, M/J90).

The Swedish State Power Board (SSPB) is also sponsoring work on mitigation. In a paper, *Reduction of Transmission Line Magnetic Fields—Possibilities and Constraints*, presented at

the August-September 1990 meeting of the Conference Internationale des Grands Réseaux Électriques (CIGRÉ) in Paris, France, SSPB researchers concluded that decreased reliability makes compact configurations impractical over long sections of a line, but that significant field reductions can be achieved using delta and reverse phase configurations. The researchers also investigated the possibility of inducing shield currents on extra wires to cancel fields and found that this type of shielding promises considerable EMF reductions.

NCI EMF Witnesses Get Light Reprimand for Misconduct

Three National Cancer Institute (NCI) staff scientists who were paid to testify at the 1988 Marcy–South power line trial violated National Institutes of Health (NIH) outside income rules, an NIH internal investigation has concluded.

In an October 1989 memo, NIH investigators recommended that the matter be referred to the director of the NCI for "appropriate action." The memo was released to *Microwave News* following a long series of Freedom of Information Act (FOIA) requests first initiated in 1989.

The NIH has repeatedly refused to disclose what action has been taken, citing "a clearly unwarranted invasion of personal privacy." However, a knowledgeable source revealed that the punitive action was "minimal and retroactive"—a temporary ban on outside consulting which was lifted when the investigation was completed.

Recently, rumors have been circulating that the NIH has adopted an unofficial policy barring staff members from receiving income for consulting on electromagnetic field (EMF) issues. The rumors could not be confirmed, however.

In 1987 and 1988, NCI staffers Drs. Stuart Aaronson, Lucius Sinks and Margaret Tucker received $70,250.98, $41,083.42 and $12,978.04, respectively, from Crowell & Moring, a Washington, DC, law firm, for testifying on behalf of the New York Power Authority (see *MWN*, S/O88, N/D88 and J/F89). Crowell & Moring handled the bioeffects portion of the Marcy–South litigation for the New York Power Authority.

According to the memo, the director of the NIH's Division of Management Survey and Review (DMSR) found that Aaronson and Sinks earned more than the amounts stated on their approved requests for outside activity. Tucker and Sinks were found to have been paid for work performed outside the period approved by the NCI—in Sinks's case, the unauthorized fee was substantial. In 1989, Sinks told Jeffrey Mervis of *The Scientist* that NIH rules on outside income are cumbersome and do not serve the public interest (see *MWN*, S/O89).

Aaronson and Tucker refused to comment. Sinks, who left the NCI in August 1989 and is now at Middlesex Memorial Hospital in Middletown, CT, did not return telephone calls.

When asked if the NCI staffers would testify in future power line cases, Crowell & Moring's Tom Watson told *Microwave News*, "I would have no hesitation using them. They're outstanding scientists." Nevertheless, the firm has assembled a new group of expert witnesses who recently spoke on behalf of the Utility Health Sciences Group, which was organized by Crowell & Moring (see p.7 and pp.8-10).

The investigation was handled delicately because Aaronson is one of the top researchers at the NIH. He was listed as one of the institute's ten most-cited scientists of the 1980s in the June 25, 1990 issue of *The Scientist*. At the top of the list was NCI's Dr. Robert Gallo. In December 1989, Representative John Dingell (D-MI), who was investigating alleged misconduct by Gallo in the discovery of the AIDS virus, accused the NIH of repeatedly "[turning] a blind eye to misconduct by senior scientists...." Dingell's investigation was prompted by a November 1989 exposé on Gallo by *Chicago Tribune* reporter John Crewdson. Crewdson has also filed FOIA requests with the NIH

U.K. Study: No EMF–Childhood Cancer Link Below 1 mG

There was no association between the risk of childhood cancer and either the proximity of overhead power lines or calculated magnetic fields, according to a new report by Dr. A.D. Clayden and colleagues at the U.K.'s University of Leeds. "The study reveals little about possible effects of magnetic fields *per se*," the team concluded, however, since more than 95% of the case and control addresses had calculated fields of less than 0.1 mG. Indeed, the assumed background level was 0.1 mG.

The team further noted that, "The study stood no realistic chance of detecting any raised relative risk associated with a field of more than 1 mG, because of the very small numbers of cases and controls in that situation." In fact, only one case and four controls were exposed to over 1 mG.

This is one of the first of the more than 22 major epidemiological studies of EMFs and cancer under way worldwide to report results (see *MWN*, N/D89). Unlike the majority of the other studies, there are no direct measurements of magnetic field strengths, only calculations based on line-network maps and load records. "Weaknesses of the study include the lack of any measurements of magnetic fields at case or control addresses," the team pointed out, adding that direct measurements were ruled out for "ethical reasons."

The study included 374 cases of childhood cancer diagnosed in Yorkshire between 1970 and 1979 and 588 controls.

Preliminary results were first presented by Dr. A. Myers at the International *Conference on Electric and Magnetic Fields in Medicine and Biology* in London, December 4-5, 1985. Among the other authors is Dr. Ray Cartwright who, in an editorial in the *British Journal of Cancer, 60*, pp.649-651, 1989, wrote that EMF exposure risks are "minute...verging on the point of nonexistence" (see *MWN*, J/F90). The new study appeared in the *British Journal of Cancer, 62*, pp.1008-1014, 1990.

for information on Aaronson, Sinks and Tucker concerning outside income violations.

NIH outside income rules revised in September 1988 bar staff members from receiving more than $25,000 a year in outside income from profit-making organizations and from earning more than $12,500 from any one company or law firm. Because the revisions were made when the NCI staffers were already consultants to Crowell & Moring, the DMSR limited the inquiry to whether the staffers had misrepresented the fees they anticipated when requesting approval for outside income.

The following is a brief account of the staff members' violations as related in the NIH memo:

• Aaronson received approval for outside income "not to exceed $25,000" for the period February–December 1988. In 1988, Crowell & Moring paid him $51,875 in fees alone—more than double the approved amount.

• Sinks was paid $10,500 by Crowell & Moring for the last three months of 1987, but he never requested official approval. When asked why he had not submitted a request, he told investigators that it would have taken eight weeks to obtain approval and he was already involved in the case. Sinks did submit a request for "an anticipated fee of $4,000" for the first half of 1988; he earned $29,500 in fees during that period. The DMSR found that, "Sinks clearly violated the conditions governing outside work activities of NIH employees...he received $40,000 in fees even though he received approval to earn $4,000."

• The DMSR concluded that Tucker, for the most part, did not violate outside income rules—except that she began working for Crowell & Moring prior to the period for which she received authorization. The NIH did not investigate the other instances in which Tucker was a Crowell & Moring paid expert witness—in 1988, Tucker testified for at least four other utilities around the country (see *MWN*, J/F89).

The issue of misconduct was originally raised by Dr. Ross Adey of the VA Hospital in Loma Linda, CA, in a December 29, 1988 letter to the director of the NIH following the publication of the Marcy–South expert witness fees in the November/December 1988 issue of *Microwave News*.

New from EPRI

The following reports have been published by the Electric Power Research Institute (EPRI). Copies of the reports marked with an asterisk (*) are available from: Research Reports Center, Box 50490, Palo Alto, CA 94303, (415) 965-4081. Those marked with a dagger (†) can be obtained by calling the EPRI "straight line": (415) 934-4212.

*A.A. Afifi et al., ***Proceedings: Discussion of an EMF Protocol*** (EN-6829, Project 2964-6), July 1990. Price: $25.00 ($50.00 overseas). In this report, prepared by Robert S. Banks Associates, Inc. of Minneapolis, MN, the authors argue that the ambiguous findings of many studies of EMF health effects could be clarified by developing an improved protocol for EMF exposure assessment. They summarize the conclusions of epidemiologists and exposure assessment experts who participated in a three-day forum in early 1989: Though there was extensive examination of EMF exposure measurements, no consensus was reached on a single protocol.

*Dan Bracken, ***The EMDEX Project: Technology Transfer and Occupational Measurements*** (EN-7048), November 1990. Price: Vol.1 $25.00; Vol.2 $32.50; Vol.3 $47.50 ($50.00, $65.00 and $95.00 respectively, overseas). Preliminary results indicate general satisfaction with EPRI's EMDEX EMF measurement system. EMDEX is a microcomputer-based digital meter that monitors and records EMF exposures. The project's 50,000 hours worth of exposure data—the most extensive documentation of exposures among utility employees ever—has not yet been fully analyzed.

*D. Briskin and J.S. Feher, ***Research and Development in the 1980s: An Overview*** (OCSP-6894), June 1990. Price: $25.00 ($50.00 overseas). A summary of trends in overall spending on research and development, both nationally and internationally, with an emphasis on developments in the electric utility industry.

†***The Cyclotron Resonance Hypothesis: An EMF Health Effects Resource Paper*** (EN.3014.3.90), March 1990. Single copies are free. A descriptive and mathematical exploration of cyclotron resonance, which has been advanced—most notably by Dr. Abe Liboff—as a possible mechanism of interaction for observed EMF biological effects. This pamphlet details the physical nature of cyclotron resonance, its effectiveness in explaining laboratory results and the experimental and theoretical problems which impede its general acceptance.

†***Health Effects of High-Voltage Direct Current [HVDC] Transmission Lines: An Environmental Briefing*** (EN.3013.3.90), March 1990. Single copies are free. HVDC power lines are a cost-effective and safe way to transport electricity over long distances, according to EPRI, which argues that biological and behavioral research failed to indicate harm to humans or animals "even when exposure levels were much greater than those found within DC transmission line rights-of-way." The report concludes that further research into this area should be given a low priority, while research into the health effects from alternating current (AC) power lines should continue.

*J. Kadvany and L. Merkhofer, ***A Handbook for Communicating Potential EMF Risks*** (EN-7046), Interim Report, October 1990. Price: $32.50 ($65.00 overseas). Designed to help utility personnel respond to the growing number of public inquiries about EMF health risks. According to the authors, prerequisites for using the handbook include a well-defined utility position on EMFs and one or more individuals with a sound knowledge of the issue. A revised edition with more extensive scientific and risk communication information will be issued later this year.

*R. Kavet and J.M. Silva, ***An Alternative Hypothesis for Association Between Distribution Wiring Configurations and Cancer: Planning Phase*** (EN-6863), June 1990. Price: $25.00 ($50.00 overseas). The authors propose that elevated cancer risk among children living near high-current power lines might be due to an increase in carcinogens in drinking water caused by pipe corrosion, and they suggest that "the same external wire configurations that generate higher magnetic fields also lead to larger currents in water pipes used as grounds and thus result in accelerated pipe corrosion...." The report includes some strategies for testing this hypothesis.

****1989 Annual Report: EMF Health Effects Research Abstracts*** (EN-7066), May 1990. Single copies are free. The first annual report on EPRI's EMF program. It includes a statement on each of the

ongoing research projects.

1990 EPRI Utility Seminar: New EMF Epidemiologic Results & Their Implications, 1991. Price: $50.00 for EPRI utilities, government agencies, universities and nonprofit groups; $250.00 for others (air mail postage extra). Order from: Robert S. Banks Associates, Inc., PO Box 14574, Minneapolis, MN 55414. Proceedings of the EPRI-sponsored seminar, held October 15-19, 1990 in Austin, TX. Includes summaries of EMF research at USC and JHU, as well as transcripts of presentations and panel discussions. Also includes tutorials on epidemiology and exposure assessment.

HIGHLIGHTS

Utility Witnesses Fail To Sway SAB Panel at Public Meeting on EPA Cancer Report

Witnesses representing the utility and electronics industries were sharply critical of the Environmental Protection Agency's (EPA) draft report on the cancer threat from electromagnetic fields (EMFs). The industry testimony, presented at a public meeting in Washington, DC, January 14-16, did not appear to convince EPA's Science Advisory Board (SAB) panel charged with reviewing the report. Citizens' groups, on the other hand, supported the EPA effort and encouraged the SAB to back more research on EMF bioeffects. (Excerpts from the statements to the SAB are on pp.8-10.)

The report, which was released December 14, identified EMFs as "a possible, but not proven, cause of cancer in humans" (see *MWN*, N/D90).

While the members of the SAB's EMF panel were reluctant to give their own assessments—preferring to let the panel's final report speak for itself—many expressed their frustrations at the one-sided nature of the industry statements. Despite these critiques, the panelists had a favorable view of EPA's review of the epidemiological data. They were less impressed with the chapter on mechanisms of interactions, however.

"The epidemiological chapter is very complete with respect to the published papers," Dr. Patricia Buffler of the University of Texas Health Science Center said, but added that she would like to see more discussion of classification of exposures. Dr. Genevieve Matanoski of the Johns Hopkins University School of Public Health, who is chairing the panel, agreed, saying that the chapter was "pretty good."

On the other hand, Drs. Granger Morgan of Carnegie Mellon University and Richard Wilson of Harvard University both criticized EPA's review of mechanisms. "I don't think this is a good enough literature review," Wilson said.

After the meeting, EPA's Dr. Robert McGaughy, the project manager for the report, told *Microwave News* that, "There's a lot of rewriting and explaining to be done. We will be more explicit about the uncertainties and that could change the tone of the report." Overall, he said, "I've not heard anything at the meeting to materially change the conclusions of the report."

The panel focused much of its attention on the testimony of the witnesses assembled by the Utility Health Sciences Group, representing more than 85 utilities. The group is being coordinated by Crowell & Moring, a Washington, DC, law firm. In their prepared statements, each—to a greater or lesser degree—discounted the link between EMFs and cancer, but their credibility suffered under questioning by the SAB panel members.

Dr. David Korn of Stanford University School of Medicine, who is also the chairman of the National Cancer Advisory Board, concluded that the data are "soft and noisy" and that the link between EMFs and cancer is "extraordinarily speculative." Following Korn's prepared statement, Drs. Craig Byus of the University of California, Riverside, and Bary Wilson of the Battelle Pacific Northwest Lab questioned him about specific studies. When Korn did not respond, Morgan asked whether he had read the key 20-30 papers on cellular and animal effects—Korn conceded that he had not.

Similarly, Dr. Mark Mandelkern of the University of California, Irvine, told the SAB panel that all the mechanisms of interaction were "implausible" and that "it's hard to understand this phenomenon," but he admitted under questioning that he was not familiar with the papers on EMF effects on melatonin production, which has emerged as a key focus of research interest. Bary Wilson and Morgan, this time joined by Dr. David Bates, the vice chairman of the panel, asked how he could address low-level effects when he did not know the literature. At one point, Mandelkern started to shuffle through his papers in an effort to respond. "How can you argue [your case] when you have to look up what you have read?" Morgan asked.

The absence of a clear mechanism did not lead the panelists

SAB EMF Panel

The members of the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee are: Dr. Genevieve Matanoski (Chair), Johns Hopkins University, Baltimore, MD; Dr. David Bates (Vice Chair), Vancouver, BC, Canada; Dr. Karim Ahmed, Princeton, NJ; Dr. Patricia Buffler, University of Texas, Houston; Dr. Craig Byus, University of California, Riverside; Dr. Kelly Clifton, University of Wisconsin, Madison; Dr. John DiGiovanni, M.D. Anderson Cancer Center, Smithville, TX; William Feero, Electric Research and Management, State College, PA; Dr. Robert Harris, University of North Carolina, Chapel Hill; Dr. Clark Heath, American Cancer Society, Atlanta, GA; Dr. Nan Laird, Harvard University, Boston, MA; Dr. Granger Morgan, Carnegie Mellon University, Pittsburgh, PA; Dr. Donald Pierce, Oregon State University, Corvallis; Dr. Mary Ellen O'Connor, University of Tulsa, OK; Dr. Charles Susskind, University of California, Berkeley; Dr. Bary Wilson, Battelle Pacific NW Lab, Richland, WA; and Dr. Richard Wilson, Harvard University, Cambridge, MA.