

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 co-workers 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.

FROM THE FIELD

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.

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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 μ T seven hours per day starting two weeks prior to impregnation and lasting throughout pregnancy. The fetuses exposed to 66 μ T PMFs had a highly significant ($P < 0.001$) increase in minor skeletal anomalies. One type of skeletal variation was also elevated in the 23 μ T 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 μ T, as well as a small but significant change in one blood chemistry index among those exposed to 23 μ T. Stuchly called this latter finding "incidental," but noted that the changes observed at 66 μ T "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

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.

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.

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

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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 Magnetrotode... The FDA withdrew its approval of the Magnetrotode 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 Magnetrotode unit at nine medical centers have failed to prove its efficacy and safety. The *Times* also reported that the FDA was worried about the Magnetrotode'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 in-

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 Shadrack, Cancer Etiology Contracts Section, NCI, Executive Plaza South, Rm. 620, Bethesda, MD 20892, (301) 496-8611.

dustry 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.

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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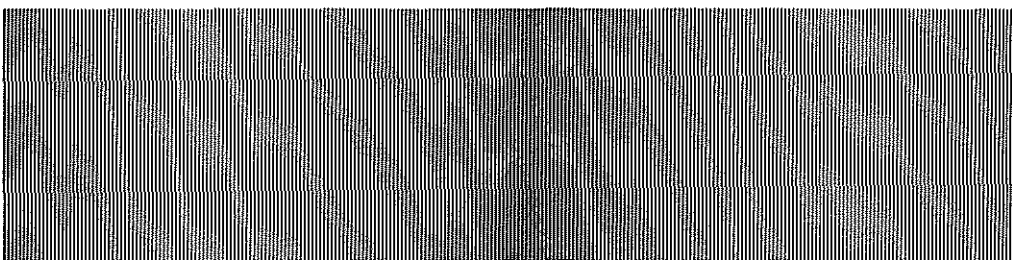
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MICRO WAVE NEWS



Vol. X No. 1

A Report on Non-Ionizing Radiation

January/February 1990

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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.

«« »»

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.)

«« »»

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 *Micro-wave 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 ef-

fects. 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 three-fold 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

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.

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.

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

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.

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.

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 Mizushima, 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
<i>F.W. Bell, Inc.</i> 6120 Hanging Moss Rd., Orlando, FL 32807 (407) 678-6900 Contact: Steve Dakel	Model 4048	\$650.00	0-12 kHz	0.1 G-20 kG/3	± 2.5% [‡]	4x7x1.8/1	All models are Hall Effect devices. All can measure DC fields. All except the 4048 can output to an oscilloscope.
	Model 9200	\$1,500.00	10 Hz-10 kHz	10 mG-20 kG/4	± 2.5% [‡]	8.8x4.5x11/8	
	Model 9500	\$2,800.00	20 Hz-10 kHz	1 mG-300 kG/6	± 1% [‡]	14x7.5x14/19	
	Model 9903	\$5,800.00	20 Hz-50 kHz	1 mG-3 MG/7	± 1% [‡]	18x7.5x16/36	
<i>Combinova AB¹, c/o Ergonomics, Inc.</i> 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.
<i>Electric Field Measurements</i> Box 326, W. Stockbridge, MA 01266 (413) 637-1929; FAX (413) 637-2826 Contact: Dr. Don Deno	Model 116	\$75.00	60 Hz	0.1 mG-200 G/4	± 3%	1.5x1.5x2/0.4	116 sensor plugs into std. digital multimeter. 116+ includes multimeter. EMDEX stores data. Waveform capture device.*
	Model 116+	\$250.00	60 Hz [‡]	0.1 mG-200 G/4	± 3%	4.75x2.5x9/2	
	EMDEX-C ²	\$2,000.00	40-400 Hz [‡]	0.1 mG-25 G/4	± 3%	1.8x4.8x6.5/1.3	
<i>Electric Power Research Institute (EPRI)</i> 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.
<i>Electro-Magnetics Design, Inc.</i> 9100 W. Bloomington Freeway, Bloomington, MN 55431, (612) 888-7473 Contact: Roger Hastings	ACGM-1	\$450.00	20-150 Hz	0.1 mG-9 G/2	± 1%	2x4x7/1	Autoranging. LCD readout.
	ACGM-2	\$990.00	20-150 Hz	0.1 µG-9 G/3	± 1%	2x4x7/1	
<i>Holaday Industries, Inc.</i> 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" dia- meter sensor)	Remote readout. Signal output for dB/dt measurements. VDT/VLF version available.
<i>Integrity Electronics and Research, Inc.</i> 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.
<i>MacIntyre Electronics Design Associates, Inc.</i> 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
<i>Monitor Industries</i> 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.
<i>Positron Industries, Inc.</i> 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.
<i>Safe Computing Co.</i> 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	
<i>Schaefer Applied Technology</i> 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.
<i>Shoden Corp.</i> 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.
<i>Sydskraft AB</i> 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	
<i>Walker Scientific, Inc.</i> 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	0.1mG-200 kG /3	± 1%	2.8x8.5x9.3/5	

† Approximate.

§ Accuracy 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/cm², were associated with UHF television transmissions—levels "commonly found in most urban areas," according to EPA. AM radio signals contributed 2-8 nW/cm². Voice of America shortwave broadcasts from a facility in nearby Delano produced much lower levels—0.2-1.3 nW/cm². FM radio fields were 0.001-0.006 nW/cm². 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 cau-

tion" 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 Erickson 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 in-

ward 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 epidemiologists 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 interaction. 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 μ sec, 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,

FROM THE FIELD

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 ($\sim 10^{-3}$ A/m²).

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 μ W/cm², 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 μ sec 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/cm², 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 0RQ, 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. Dvorák**, 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 I: 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/cm² 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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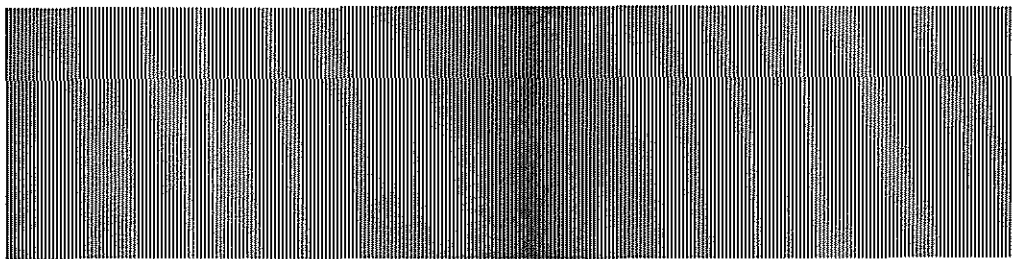
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MICRO WAVE NEWS



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A Report on Non-Ionizing Radiation

January/February 1991

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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

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

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)

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.

« 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.

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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.

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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.”

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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.”

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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."

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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 out-

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.

standing 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

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. Kadvanly 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.

to discount the epidemiological results linking EMFs to cancer. "Lack of mechanisms is a valid criticism of the epidemiological data, but it does not mean we should throw it out," Bates told *Microwave News*. On the third day of the meeting, Bates expressed his frustration at many of those who had discounted the epidemiological studies. "I don't think many of the speakers had carefully read the epidemiological literature—including the U.S. Air Force." On the previous day, the Air Force had presented a blistering attack on the EPA report which was adapted from written comments submitted in October (see *MWN*, N/D90).

Dr. Dimitrios Trichopoulos, the chairman of the Department of Epidemiology at the Harvard University School of Public Health—another utility witness—was less dismissive, noting that causality is a "possibility." Nevertheless, he said that, according to his calculations, if there is a true link between EMFs and childhood cancer, given the electrification of the country over the course of the century, he would have expected an "epidemic" on the order of the one attributed to tobacco smoke. "We don't see it," he said. This prompted Matanoski to point out that there has been a consistent increase in childhood leukemia since the 1930s. She later told *Microwave News* that she thought that the assumptions upon which Trichopoulos based his analysis were "extreme." Dr. Donald Pierce of Oregon State University also said he was not swayed by Trichopoulos's reasoning.

In an interview after the meeting, Bary Wilson told *Microwave News* that the Utility Health Sciences Group witnesses "did not help their cause: They did not read the literature, they came with preconceived notions from their own areas of research and did not seem to consider important findings from other areas."

At the close of the meeting, the SAB panel members divided themselves into three groups to review specific portions of the document: physics and biophysics; epidemiology; and cell biology and mechanisms. The panel will meet again as a whole in April. Matanoski said that she plans to submit the panel's report in June.

Congress Keeps Tabs on EPA EMF-Cancer Report

Congress is actively monitoring the events surrounding the release of and the Science Advisory Board's (SAB) review of the Environmental Protection Agency's (EPA) draft *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*.

A number of members of the House of Representatives have criticized both the White House for its role in delaying the release of the report and the procedures set up by the SAB for its official review.

More than two weeks after the November 27 publication date, EPA had still not issued the draft report, due in large part to objections raised by President Bush's science advisor, Dr. Allan Bromley (see *MWN*, M/J90 and N/D90). After the White House's involvement was made public, the document was released on December 14, with an agency disclaimer added to

How To Order the EPA Report

Copies of EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields* (EPA/600/6-90/005B), are available from: ORD Publications Office, CERI-FRN, U.S. EPA, 26 W. Martin Luther King Drive, Cincinnati, OH 45268, (513) 569-7562, FAX (513) 569-7566.

the front stating that "there are insufficient data to determine whether or not a cause and effect relationship exists" and that the "review draft should not be construed as representing agency policy or position."

In this interval, there were turbulent exchanges between Capitol Hill and EPA and the White House. In a December 11 letter to Bromley, Representatives George Brown (D-CA), chairman of the House Committee on Science, Space and Technology, James Scheuer (D-NY) and Frank Pallone (D-NJ) charged that Bromley's "unprecedented decision" to postpone the SAB review of the EPA report is "more likely to fan public concern than to allay it." Bromley, denying that he censored the document, responded on December 17 that his objections were rooted in the wording of the executive summary, which he claimed showed that the authors had determined that there is a causal relationship between EMFs and cancer.

Brown, Scheuer and Pallone also condemned the SAB for the manner in which the witnesses had been scheduled for the January 14-16 panel meeting. By the end of December, almost all of the slots for public comments had been assigned to speakers with ties to the utility industry. Four of the speakers represented the Utility Health Sciences Group, a coalition of more than 85 utilities "dedicated to promoting dialogue on EMF science issues" which was organized by the Washington, DC, law firm Crowell & Moring.

In a December 21 letter to EPA Administrator William Reilly, Brown, Scheuer and Pallone argued that "...the 'stacked deck' appearance of the presentations will destroy the very credibility of the SAB review process," and urged Reilly to "put an immediate halt to the practice of granting to interested parties the right to control who appears before the SAB." Pallone himself ultimately testified at the meeting before the SAB panel (see p.9).

Representative George Miller (D-CA), chairman of the House Interior Subcommittee on Water, Power and Offshore Energy Resources, scheduled a hearing for January 17 on the EPA report and the White House's involvement. "I want to know what the EPA found in its study. And...if Bush Administration officials in fact sought to manipulate the report's scientific findings for political purposes," Miller said. EPA's Erich Bretthauer, Dr. Richard Adamson of the National Cancer Institute and Eugene Wong, Bromley's assistant, were expected to testify, but the hearing was canceled at the last minute due to the Persian Gulf conflict. (For excerpts from their written statements, see pp.12-13.) At this time, there is no word when the hearing will be rescheduled.

Comments on the EPA EMF-Cancer Report

External Peer Review Panel

On June 28, 1990, a peer review panel met in Morrisville, NC, to discuss EPA's draft report on EMFs and cancer. The panel members were asked to consider, among other things, whether the document should contain a classification of cancer risk based on EPA's 1986 cancer risk guidelines (see MWN, M/J90). The following are excerpted from the panel members' written comments, which were submitted after the meeting. They were released to Microwave News under the Freedom of Information Act.

Dr. Larry Anderson, Battelle Pacific Northwest Lab (BPNL), Richland, WA: Overall the document is quite accurate as to current scientific understanding of the issues....Perhaps the major criticism of the document relates to the organizational mixing of ELF and RF study citations. Biological responses to exposure in varied frequency ranges may demonstrate marked differences....I concur with other members of the panel that it is yet too early to classify EMFs with respect to their carcinogenic potential. Certainly, it should not be designated with an A or B classification. However, sufficient evidence exists to suggest that further vigorous research is appropriate....It is especially important to expand the federal role in this area of research.

Dr. Richard Griesemer, National Toxicology Program, Research Triangle Park, NC: Among the research needs, one area that I think might deserve more attention is the possible effects of EMF exposure on gene expression.

Dr. Richard Luben, University of California, Riverside: [The executive summary] could point out more explicitly that the evidence associated with possible carcinogenicity of non-ionizing EMFs is difficult to classify using the EPA guidelines....[M]y own evaluation of the data is that the human studies provide limited evidence (i.e., suggestive but not conclusive) for the involvement of some component of EMF exposure in development of some human cancers. The animal evidence is clearly inadequate....The supportive evidence offers a number of plausible mechanistic scenarios for cancer induction or promotion, but is currently incomplete and thus inadequate. The above criteria would appear to fit into the category of a B1 carcinogen for EPA classification purposes.

Dr. Raymond Neutra, Department of Health Services, Berkeley, CA: Overall I thought [the document] was excellent....The EPA guidelines for chemical carcinogens hold for a set of agents which are acting by a familiar if not fully understood paradigm. They do not comfortably fit [EMFs]....Thus I agree with EPA that the guideline categories do not apply here and that a dose response assessment should not be made at this time.

Dr. Richard Phillips, WIL Associates, Spokane, WA: Using the weight of all evidence (human and animal data), there is limited evidence that exposure to ELF magnetic fields results in an increased incidence of cancer in humans....At present there are no data from laboratory animal studies. Such information does not really fit the EPA classification scheme that has been used for chemicals—the available data do not fit B1, B2 or C, but it is closest to B2....However, I believe it would be premature to classify the carcinogenicity of ELF magnetic fields at this time....In the interim, we direly need to initiate some lifetime exposures of experimental animals to low-level 60 Hz magnetic fields, particularly for modeling leukemia, brain cancer and breast cancer.

Dr. Charles Poole, Epidemiology Resources, Inc., Chestnut Hill, MA: In my opinion...the deficiencies of the guidelines are serious enough to justify a decision not to classify the human evidence as either "inadequate" or "limited" at the present time. The classification decision should be deferred until the guidelines are improved or until the immense amount of ongoing research has been completed.

Dr. Asher Sheppard, VA Hospital, Loma Linda, CA (did not attend the meeting): The draft document presents the information that leads to the conclusions on epidemiological studies in a thorough, well-balanced and fair manner and the reasoning is logical, well-supported and persuasive. The discussions of *in vivo* and *in vitro* studies have many more difficulties....[C]oncerning the finding that it is inappropriate to classify the carcinogenic potential of fields because a mechanism is unknown, I found this argument unpersuasive....The lack of adequate mechanisms is a weak excuse that would be untenable in the face of strong epidemiological or clinical findings....In summary, I find the arguments specious, but share a reluctance to label the fields as carcinogenic on the basis of weak epidemiological data in the absence of mechanistic understanding. However, I would put aside my misgivings and I find it logical to label fields as "probable" human carcinogenic agents on the basis of the "weight of the evidence." Hence, I reluctantly disagree with the EPA draft position and strongly disagree with its arguments.

Dr. Richard Stevens, BPNL: In a number of places in the text [of the epidemiological section], it seems that the authors are biased in favor of the existence of an effect....I believe that given the current state of evidence, ELF should *not* be classified as B1. At most it should be classified as C, a possible human carcinogen.

Public Comments to the SAB Panel

On January 14–16, 1991, the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee held a public meeting in Washington, DC (see pp. 6-7). The following comments are excerpted from many of the written and oral statements presented at the meeting. Those who spoke before the SAB panel are marked with an asterisk (*). Those who appeared on behalf of the Utility Health Sciences Group are marked with a dagger (†).

***Dr. Eleanor Adair, John B. Pierce Lab, New Haven, CT:** Most of the epidemiological research is flawed and risk ratios are unpersuasively low....Further, in my view, the "weight of evidence" approach adopted in the document is inadmissible; no amount of mediocre data combined with other mediocre data will generate good or even believable data. I reject this method of analysis totally.

***Dr. Robert Adair, Yale University, New Haven, CT:** [The chapter on mechanisms of interaction is] not just bad science, it's crackpot science....[The recent work by the U.S.S.R.'s Dr. V.V. Lednev is] crackpot quantum mechanics.

Alexandrians for Safe Electric Power, Virginia citizens' group: [W]e ask for a response from the EPA's [SAB] to the following question...: Would they purchase a home for themselves and their families exposed to the level of ELF EMF readings in the eight-block area of Old Town [levels averaging 20–30 mG with a maximum of 100 mG]?

Dr. C.A.L. Bassett, Columbia University, New York, NY: [With a few exceptions, I] found [the document] to be a well-considered statement at this stage of our collective ignorance.

***Dr. John Bergeron, General Electric, Schenectady, NY:** If the EPA had chosen skepticism [on the calcium efflux experiments], then there would no longer be *any experimental basis at all for the belief that bioeffects including cancer promotion can be attributed to ambient fields*....I believe it would be in the public interest for the SAB to recommend to the agency that the highest priority laboratory research ought to be a project dedicated to resolving the dispute about calcium efflux.

***Mayor Jim Connors, Scranton, PA:** Our people want to know whether they should move [away from power lines]....There are a large number of people [here] representing industry....Who is representing the people?

***Richard Doherty, Electronic Engineering Times:** [U]ntil we establish better instrumentation, which can properly classify the true nature of the beast we suspect of generating harmful effects in living tissue, we are not performing science. We are instead hunting desperately for empirical evidence to support hypotheses while using imprecise and unhone instruments.

Richard Ekfelt, Electromagnetic Energy Policy Alliance, Washington, DC: Although our review has been limited in view of the short time schedule, we have uncovered sufficient evidence of misunderstandings of physical principles and sloppiness in composition of this draft so as to suggest that it does not meet minimum standards of science and scholarship.

***Dr. David Erwin, U.S. Air Force Armstrong Lab for Human Systems, Brooks AFB, TX:** In general, there is sufficient research being carried out in various laboratories commensurate with the urgency of the problem....Our reviewers of this document are convinced that there is no suggestion that EMFs present in the environment today induce or promote cancer.

***†Dr. Edward Gelmann, Georgetown University School of Medicine, Washington, DC:** Using any of the standard scientific criteria we apply to carcinogenesis, there is no support for the notion that power frequency electric and/or magnetic fields can induce or promote cancer or have any effect on tumor progression.

***David Goeller, Environmental Action, Washington, DC:** The government should be funding the search for these answers. The researchers and reviewers must be independent....The controversy will remain and grow until we get these answers. Are EMFs safe? Are they silent killers? The public has a right to know.

***Dr. Richard Griesemer, National Toxicology Program, Research Triangle Park, NC:** [The peer review panel found the] evidence is suggestive but inadequate—something less than 'B'....The whole field needs vigorous pursuit....Overall, we thought the study is well-balanced and reflects what is in the published literature.

Barbara Iannucci, Residents Against Giant Electric (RAGE), New Jersey citizens' group: [The body of the EPA release detailing suggestive evidence of positive associations now provides a credible source for the ongoing attempt to fill the informational vacuum reflected in public records to date.

***†Dr. David Korn, Stanford University School of Medicine, Stanford, CA:** The...epidemiological studies...are so subject to procedural and methodological challenge as to be essentially uninterpretable....I be-

lieve that the evidence of the possible carcinogenicity of EMFs is vastly insufficient to support any kind of sound decision-making with respect to new cancer regulatory policy.

***Eileen Kotter, East Brunswick, NJ:** This past October 1990, the families in my neighborhood realized that there appeared to be [four] children experiencing neurological problems....The only common factor that we can discern is that our affected children have been sleeping in rooms with milligauss levels ranging from 22 to 38 and playing in areas where the level is as high as 117.

Dr. James Lin, on behalf of the Committee on Man and Radiation, IEEE: At present, there is no scientific consensus as to which factors, the electric field and/or the magnetic field, are biologically important.

Dr. James Lin, University of Illinois, Chicago: I am disturbed by a melange of frequencies and responses taken from different spectra strung together in the name of NIER.

***†Dr. Mark Mandelkern, University of California, Irvine:** [All the mechanisms of interaction are] implausible....It's hard to understand this phenomenon.

***Dr. Martin Meltz, University of Texas Health Science Center, San Antonio:** The committee should consider asking for a complete rewrite of the document.

***Dr. Sol Michaelson, University of Rochester, NY:** Mayor Connors's [Scranton, PA] anxiety and concern have been needlessly encouraged by the EPA report....Hysteria could cause greater biological effects than EMFs.

Michigan Residents Against Giant Energy (RAGE), Michigan citizens' group: We urge this committee to release this report and its findings, not diluted or influenced by the pressures of corporate politics.

***Rep. Frank Pallone (D-NJ):** [My] hope is that this report will serve as the catalyst to federal action that will help...to set the stage for the type of credible, comprehensive research program I believe we desperately need, and which the public increasingly will demand.

Parents Against an Unsafe Environment (PAUSE), Pennsylvania citizens' group: Grass-roots organizations are forming all across the [U.S.] to fight power lines, radio towers and substations....Of particular interest is the fact that power companies are spending a disproportionate amount of money defending their stances compared to the citizens' groups which challenge them.

Dr. Charles Polk, University of Rhode Island, Kingston: I find that the...statement in the "executive summary" [p.1-5, paragraph 1] is very responsible, clear and fully justified.

Joel Ray, coauthor of The Electric Wilderness, Ithaca, NY: That the mechanisms of interaction of NIER and biological processes are not fully understood should be no argument against classification as a "probable human carcinogen" by EPA on the basis of the weight of the evidence.

***Kirvil Skinnarland, Seattle City Light, Seattle, WA, and the Large Public Power Council (LPPC):** Reviews of the existing scientific literature have been prepared by numerous organizations, and we in the LPPC believe that the EPA review of previous studies should be the last. There is almost universal agreement that more research is needed. Now is the time to move ahead to the next stage—additional research. We need answers, and we need them sooner rather than later.

Dr. Thomas Tenforde, BPNL: [T]here are still two major problems with the document: one, the literature review is not critical....two,

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there is a consistent tendency to give more weight to positive findings of putative [EMF] effects than to studies where no effects were observed....I feel that it would be a serious mistake to release this document in its present form....

*†**Dr. Dimitrios Trichopoulos, Harvard University School of Public Health, Boston, MA:** A widespread and exponentially increasing exposure...would have created a 20th century epidemic of childhood cancer similar to that of lung cancer. There is no such evidence and, accordingly, the proposed association of ELF EMFs with childhood cancer lacks epidemiologic coherence.

***Sharon Webster, Alexandria, VA:** I [have] exercised "ultimate avoidance" by moving my children completely out of a home which had a milligauss level one moderately warm day of 50. This was done at great economic and personal expense....[A]s I looked around at the number of children in the neighborhood with neurological and/or learning disabilities, I felt that I had no choice.

Hawaii, EPA Studying Cancer Near Navy RF Base

The Hawaii Department of Health (DOH) and the Environmental Protection Agency (EPA) are investigating the possibility that radiofrequency (RF) radiation from Navy transmitters may be linked to a cluster of childhood leukemia cases. The Navy communications complex at Lualualei near Honolulu has been the subject of concern among local residents since 1982 (see *MWN*, J/A82, M/J87 and S/O90).

EPA sent a team to the site in late November to take measurements at the request of the DOH. Ed Mantiply of EPA's Office of Radiation Programs (ORP) in Las Vegas, NV, told *Microwave News* that the field levels were consistent with those the Navy measured in 1982. He did not specify the readings, however, explaining that they will not be disclosed until the agency completes its report later this year.

When the Navy took readings in 1982, the highest radiation levels at the boundary of its facility were 83 V/m for very low frequency (VLF) and 1.35 V/m and 4.16 mA/m for low frequency (LF). For high frequency (HF) radiation, the levels were at least 16 times (24 dB) less than the ANSI standard (63 V/m at 30 MHz and 632 V/m at 3 MHz); and for microwaves (MW), they were less than 10 $\mu\text{W}/\text{cm}^2$.

At that time, the facility included one VLF antenna, one LF antenna and several HF antennas. There were also a number of MW towers.

Dr. Bruce Anderson, deputy director of the DOH, said RF radiation is one of several possible causes of the cluster. Also under consideration in the department's "preliminary investigation" are the more than 1,000 barrels of used motor oil that were dumped improperly in and around the Wainae district where the cluster occurred. The oil contains benzene, a carcinogen, Anderson told *Microwave News*. He also noted that the cluster may have been a random occurrence. The DOH will continue its inquiry for six months to a year before developing any "tentative" conclusions, Anderson added.

U.K.'s NRPB To Review EPA EMF-Cancer Draft Report

The U.K.'s National Radiological Protection Board (NRPB) has set up an advisory group to examine the conclusions of EPA's draft report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*.

The group is chaired by Sir Richard Doll, an epidemiologist at the Imperial Cancer Research Fund (ICRF), and includes: Dr. Valerie Beral, also an epidemiologist at ICRF; Dr. Nicholas Day, a biostatistician at Cambridge University; Dr. Martin Gardner, an epidemiologist at the University of Southampton; Dr. Edward Grant, a physicist at King's College, London; and five NRPB staff members. The group's evaluation is expected to be complete in April. The NRPB, which advises the U.K. government on radiation safety standards, conducts research and directs technical training programs, is based in Chilton, outside of Didcot, Oxon.

Fourteen childhood leukemia cases were recorded for Wainae in the state tumor registry between 1980 and 1984, compared to the two to three cases that would normally be expected, Anderson noted. Nine of the cases were identified and reported in 1987 by the Cancer Research Center of Hawaii (see *MWN*, M/J87). The department learned of the additional cases during the summer of 1990 from local pediatrician Dr. Robert Wilkinson.

The new data were raised by Hawaiian officials at a U.S. Senate hearing held in Hawaii in August, increasing public concern. The hearing by the Senate Government Operations Committee had been called to address waste hazards in the state.

Anderson said that the childhood leukemia rate in the area did not exceed the expected rate during the ten years prior to and the five years following the cluster period, based on the registry records.

The EPA measurements were made using a broadband meter. Mantiply said he also took random extremely low frequency (ELF) electromagnetic field measurements in and around power distribution lines, noting that he did not know the locations of the cancer victims.

Mantiply conferred with Navy officials prior to taking measurements, and Navy staffers traveled with the EPA team and took their own measurements. There were no significant variances between the two sets of readings, Mantiply said.

FCC and FAA Clash Over Avionics-Broadcast EMI

Federal Aviation Administration (FAA) proposals to limit electromagnetic interference (EMI) from radio and television stations are being strongly opposed by the Federal Communications Commission (FCC) and the broadcasting industry. While the FAA is seeking to protect aircraft electronic com-

munications and navigation equipment from potentially hazardous interference, the FCC and broadcasters claim that the new rules are unnecessary and that compliance would be very costly for regulators and industry alike.

Under the proposed rules, the FAA would have to be notified of any construction or alteration of very high frequency (VHF) television transmitting stations or radiofrequency (RF) transmitters operating at frequencies above 30 MHz and with an effective radiated power above 10 kW. The new rules would also classify EMI as a "potential obstruction" to aircraft, restricted by the same rules as physical structures.

"All the new rules do is clarify some gray areas," Gerald Markey, manager of the FAA's Spectrum Engineering Division, told *Microwave News*, adding that, "We have been accused of being conservative, but when it comes to air safety, it's our job to be conservative. If radiation interferes with an aircraft's communication system, we consider it a hazard to aviation."

The FCC does not agree. "While the FCC certainly endorses and shares the goal of improved air safety, we believe the proposed FAA rules would impose substantial additional costs—without offsetting benefits—on the FCC as well as the communications industry," wrote FCC Chairman Alfred Sikes in a January 4, 1991 letter to Samuel Skinner, Secretary of Transportation. The FAA is part of the Department of Transportation.

"Because it failed to consider the legitimate needs and views of the FCC and communications licensees when it prepared its proposed new rules, the FAA has produced proposals that are technically flawed and discriminatory...against communications licensees. These proposed rules wholly fail to serve the public interest," argued the National Association of Broadcasters (NAB) in a joint statement with the Association for Maximum Service Television. The FAA proposals have also met with objections from the land-mobile radio and cellular telephone industries.

FM radio and VHF television transmitters, which operate at frequencies close to the aircraft communications band, would be affected most directly by the new rules.

The FAA and the FCC have been struggling for control over the broadcast spectrum for over a decade. In 1978, Congress directed the FAA to consider EMI. In the years that followed, increased FAA regulation of EMI consistently met with opposition from the FCC and broadcasters.

In 1985, the FCC proposed rules to enhance the compatibility of FM broadcasts with aviation electronics. These rules were criticized as too lenient by the FAA and were never adopted (see *MWN*, My85). Though both agencies acknowledge the need to cooperate, they have yet to agree who has the final say on EMI.

The FAA's notice of proposed rulemaking appeared in the August 3, 1990 *Federal Register* (pp.31,722-31,738).

Try EMF Papers, the Microwave News clipping service (see p.16)

OSHA Warning on RF Shocks and Burns near AM Transmitters

The Occupational Safety and Health Administration (OSHA) has issued a warning against potential radiofrequency (RF) shocks and burns to longshoremen working near AM radio transmitters.

The September 5 bulletin was prompted by reports of burns suffered by longshoremen while unloading cargo in San Francisco, CA. According to OSHA, a crane cable picked up RF energy from nearby AM radio transmitters and discharged it into the workers. An OSHA health response team measured currents in the cables as high as 200 mA—double the proposed American National Standards Institute (ANSI) exposure limit for controlled environments. (The proposed limit for uncontrolled environments is 45 mA.)

Mac Cheeks, an OSHA spokesman in Washington, DC, told *Microwave News* that the wharf is considered to be a "controlled environment," even though the AM stations are not part of the work site. At a June 1989 meeting of the subcommittee charged with revising the 1982 ANSI RF limits, the definition of a "controlled" environment was a hot topic of debate (see *MWN*, S/O89). Cheeks pointed out that the longshoremen's electric field exposures were only 10 V/m—well below the 1982 ANSI safety limit of 632 V/m at AM frequencies.

In an interview, Bob Curtis, director of OSHA's Health Response Team in Salt Lake City, UT, pointed out that RF shocks and burns occur well below the ANSI contact standards. "It's a real hazard," he said.

OSHA has recommended that dock employers protect workers unloading cargo at the San Francisco site by placing an insulator between the crane hook and the crane cable, by grounding the crane cable or by providing insulating clothing.

Similar shock and burn hazards were documented in 1988 by Paul Gailey, a consultant now based in Salt Lake City, UT, at the H-3 highway site on Oahu, HI, located under an OMEGA transmitter operating at 10–13 kHz (see *MWN*, J/A88). Gailey's report for the U.S. Coast Guard was highly controversial at the time; however, OSHA has since imposed specific requirements at the worksite to protect against RF shocks and burns, according to Curtis.

In 1982, *Chemical Engineering* magazine warned of possible fire hazards at chemical plants located near AM transmitters (see *MWN*, Ap82).

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FROM THE FIELD

Testimony Prepared for the January 17 Congressional Hearing

Rep. George Miller (D-CA), chairman of the House Interior Subcommittee on Water, Power and Offshore Energy Resources, scheduled a hearing for January 17, 1991 to investigate whether the White House's OSTP had interfered with the release of EPA's report on EMFs and cancer. The hearing was canceled at the last minute due to the war in the Persian Gulf. At press time, a subcommittee staffer told Microwave News that the hearing would be rescheduled in the near future, but could not specify a date. Microwave News has obtained the written statements of EPA, NCI and OSTP officials who had been asked to appear. The following are excerpted from their prepared statements.

[Abbreviations: CDC—Centers for Disease Control; CIRRPC—Committee on Interagency Radiation Research and Policy Coordination; DHHS—Department of Health and Human Services; DOD—Department of Defense; DOE—Department of Energy; DOL—Department of Labor; EMFs—electromagnetic fields; EPA—Environmental Protection Agency; ERD—external review draft; FCCSET—Federal Coordinating Council for Science, Engineering and Technology; NCI—National Cancer Institute; ORD—Office of Research and Development; OSTP—Office of Science and Technology Policy; RF—radiofrequency; SAB—Science Advisory Board]

EPA

Erich Brethauer, assistant administrator, ORD: [A] meeting was convened by White House staff to inform our federal colleagues of [the EMF-cancer] assessment effort. This briefing occurred March 6, 1990 and included representatives from EPA, OSTP, DOE and DOD and White House staff members, among others. The briefing discussed the report and the process for completion of the document and resulted in a recommendation that other appropriate federal agencies, such as the NCI and CDC, be included in reviewing early drafts of the document.

An extensive internal review process began in March....resulted in an extensively revised draft which was distributed to a panel of external scientific peer reviewers assembled by ORD in June 1990....Approximately 700 copies of this draft were distributed between June and August 1990....Comments from that review as well as others received were considered in the revision to produce the current document, the ERD.

At this same time, recognizing the importance of EMFs, Mr. William Reilly, the administrator of EPA, asked Dr. Allan Bromley, director of OSTP, to look at the EMF issue. Mr. Reilly's request was similar to a proposal originally made by DOL....

Printed copies of the ERD were received by EPA in late November and a *Federal Register* notice announcing the SAB meeting and the availability of the draft was signed...on December 13, 1990, and published in the *Federal Register* on December 17, 1990. Copies of the ERD have been made available to the public and press upon request.

I am aware that there are reports that Dr. Bromley's participation in this process held up the release of [the current draft report.] I believe it is important to set the record straight on Dr. Bromley's involvement. Following my offer to brief Dr. Bromley on this report, a request was received to schedule a briefing....Drs. [William] Farland, Robert McGaughy (the EPA document project manager) and I then met with Dr. Bromley on November 26, 1990. At this meeting we informed Dr. Bromley of the findings of the soon-to-be-released ERD and discussed the next steps in the ongoing process of scientific review. Dr. Bromley expressed concern with certain of the studies in the evaluation and with the conclusions that the agency had reached in its evaluation. He indicated that he would inform the administrator of EPA that he felt that the CIRRPC review was critical in the development of a scientific perspective and that he felt that the CIRRPC review should precede the public review of the document. We explained the difficulties with his proposal, but I indicated that I would return to the agency and further consider his recommendation.

On December 5, 1990 I met with Dr. James Mason, assistant secretary for health, DHHS, who chairs the FCCSET committee which oversees CIRRPC, to discuss CIRRPC's review of the report. We also discussed the proposed process for review of the ERD by the

agency's SAB. Staff from OSTP and DOE also attended the meeting. Dr. Mason agreed with the proposed process, but expressed reservations concerning certain technical findings of the report. We agreed to meet the next day with technical staff to discuss these concerns. On December 6, 1990, Drs. Farland, McGaughy, John Skinner (my deputy), Peter Preuss (director of my Office of Technology Transfer and Regulatory Support) and I met with Dr. Mason and technical staff from the NCI, CDC and DOE. The primary concern raised by Dr. Mason and these agency officials was that the six-page executive summary did not convey the balanced presentation of the information found in the 381-page report; and, therefore, that it might be unnecessarily alarming to the public. Concerns were also raised about the technical interpretation of some of the studies used in preparing the latest draft. While acknowledging that they had commented on the earliest draft, none of the participants had provided comments on the intermediate "workshop review draft."

Upon further deliberations within the agency, it was decided that the technical concerns expressed by Drs. Bromley, Mason and others should be dealt with by the SAB and CIRRPC review processes and, therefore, we should proceed with the SAB meeting already scheduled for January 14–16, 1991. Further, it was decided to acknowledge the current disagreement among the federal agencies with a "Note to Reviewers" that would be inserted into the document, stating, "Currently there is a disagreement among the reviewers from various agencies about the weight of evidence and the conclusions presented in the executive summary."...

These briefings, meetings and deliberations delayed our own self-imposed deadline for the *Federal Register* notice by approximately three weeks but did not affect the planned schedule for the SAB review and did not result in any changes to the document. The only change made from the agency's original review schedule is that opportunity for public comment will be delayed. This is due to the fact that, based on the reviews by the SAB and CIRRPC, the current draft document will be revised as necessary and a *Federal Register* notice will then be published requesting public comment. The final version of the document will be developed after public comment....

NCI

Dr. Richard Adamson, acting deputy director: ...Over the past decade, there have been an increasing number of reports suggesting that low frequency EMFs might be associated with cancer in humans. Overall, the observations are inconclusive and do not demonstrate a causal connection....

Occupational studies of electrical workers have suggested associations with certain cancers, particularly leukemia and brain tumors. However, these studies are difficult to interpret because electrical workers are often exposed to chemicals, solvents and other potential carcinogens....Epidemiologic studies of residential EMFs and cancer have also been inconsistent....Further, despite the great increase in

energy consumption and exposure to low frequency EMFs that has occurred in our country over the past 40 years, there has been no corresponding increase in the incidence of childhood leukemia or other childhood cancers during this same time period.

...[I]n September 1989, the NCI initiated a four-year study of childhood leukemia and EMFs in collaboration with the Children's Cancer Study Group (CCSG). The CCSG is a multicenter network of pediatric oncologists, epidemiologists and other cancer researchers from 38 institutions and affiliated hospitals across the U.S. The EMF study is part of a larger investigation evaluating the risk of childhood leukemia associated with a number of factors, including prenatal x-rays, indoor radon, childhood and pregnancy-related diseases, pregnancy-related drug use and smoking, parental occupations, household chemical exposures and family histories of cancer....

The EMF evaluation will involve approximately 600 children who developed acute lymphocytic leukemia under the age of 15, and 600 matched controls residing in six states....The study has several methodologic advantages which should clarify the potential hazard associated with EMFs. Foremost, the study includes a very strong measurement component....Second, the study will focus on recently diagnosed cases of leukemia....

Results are still preliminary but indicate that an excellent predictor of personal magnetic field exposure can be obtained from measurements of magnetic fields in the bedroom for 24 hours, coupled with spot measurements made in the family room and kitchen....

In a letter dated March 9, 1990 from EPA, the NCI was requested to review the draft [EMF-cancer report]. NCI staff members...provided written comments that were sent to EPA on April 17, 1990. All NCI reviewers agreed that the human epidemiologic data to date did not support the sweeping conclusions made in the EPA report. In our judgment the conclusions presented were not scientifically sound and were unnecessarily alarming.

Recently, staff members at the NCI reviewed the revised EPA draft report dated October 1990. A number of concerns were raised as to the accuracy of statements found in the body of the report, but most importantly the executive summary remained scientifically unbalanced and we believe it should be substantially rewritten. The available evidence is, in our view, far too weak and contradictory to support the overall message that epidemiologic studies "involving electrical power frequency exposures show a consistent pattern of response which suggests a causal link."...There appeared to be a tendency throughout the report to dismiss negative or inconclusive findings rather than weighing these inconsistencies in the overall interpretation. These problems were then carried over to the executive summary. The childhood cancer studies, in particular, are far from "strong" when all the available data are considered.

It could be made more clear in the document that no statistically significant associations of cancer with EMF measurements have been found. The few "statistically significant associations" reported in epidemiologic surveys are with indirect indicators of EMFs, such as wire code configurations and job titles. Neither job classifications nor diagrams of nearby external power lines are known to correlate well with EMF exposures in the workplace or home, and job classifications may be indicators of exposures other than to EMFs....

[Some EPA] statements rest upon the implicit assumption that the carcinogenicity of EMFs has been demonstrated, which it has not. Missing throughout is a clear statement that we cannot conclude at this time whether EMFs pose a cancer hazard....

In summary, it is not clear today whether exposure to low intensity and low frequency EMFs pose a cancer risk. Previous studies have been inconclusive and inconsistent. There are no laboratory investigations linking EMF exposures to cellular transformation or animal carcinogenesis....[W]e found that [EPA's] conclusions were not

balanced, were open to misinterpretation and, as such, were unnecessarily alarming to the American public....

OSTP

Eugene Wong, associate director for physical sciences and engineering: The issue of low level EMFs and their possible effects on health is not new to OSTP....Over a year ago—in October 1989—CIRRPC received a request from the DOL to investigate the scientific validity of possible associations between exposure to EMFs and the development of certain forms of cancer. Last summer, Dr. James Wyngaarden, OSTP's former associate director for life sciences, and Dr. Bromley specifically asked CIRRPC to review the status of research in this field and recommend appropriate additional studies to clarify outstanding questions....

Last summer the administrator of EPA, William Reilly, asked Dr. Bromley if it would be possible for FCCSET to independently review [EMFs and cancer], in addition to the review that would normally be conducted by EPA's SAB....

Dr. Bromley passed on Mr. Reilly's request to Dr. Alvin Young, director of the Office of Agricultural Biotechnology at the Department of Agriculture, who is chairman of CIRRPC....

Shortly before EPA's draft report was scheduled to be released to the SAB for review, EPA was asked to brief Dr. Bromley and OSTP on the contents of the report. On November 26, 1990, Dr. Erich Brethauer, the assistant administrator of EPA, and two of his staff members, Drs. William Farland and Robert McGaughy, who were heavily involved in the preparation of the report, briefed Dr. Bromley, myself and several other members of OSTP's staff.

Much of the briefing concerned the body of the report, which, in general, is a workmanlike summary of various studies of the health effects of exposure to EMFs. However, the members of OSTP at the briefing expressed concerns that the report's executive summary contained conclusions that did not accurately reflect the content of the report. For example, the executive summary states that "[a] large number of human studies are available in which the relationships between human cancer incidence or mortality and exposure to EMFs have been investigated." In fact, the report cites only about a dozen such studies involving electrical power sources and a few more involving RF sources. Some of the studies involved very few cases, and some are assessed by the report itself to be seriously flawed in methodology. Further, many of the studies did not involve a measurement of exposure to EMFs but proximity to potential sources of such fields. Indeed, one study found that "risk tended to increase with increasing distance" from such a source.

This puzzling finding illustrates the state of uncertainty left by the existing studies, a state that is accurately portrayed in the report but not in the executive summary....

At the briefing, the OSTP staff members made no demand that EPA take any particular course of action with its report. We expressed our views and left it to EPA to decide what to do.

However, about two weeks after the briefing—but before the report had been sent to the SAB and therefore released to the public—several press reports appeared implying that OSTP was in some way delaying release of the report. This implication is patently false....

Throughout this process, the objective of OSTP has been to ensure that scientific facts are presented accurately to the public. When there is general uncertainty and disagreement within the scientific community as to the meaning and implications of research findings—as is the case with the health effects of EMFs—premature and unwarranted conclusions are inappropriate. Reports should be factual, and their executive summaries should refrain from editorializing. To do otherwise is to risk unnecessary and unwarranted public concern. I might add that the senior members of EPA are in total agreement with us on these points....

shop's keynote speaker on EMF epidemiological studies, said that such a study is a "fairly high priority."

"It is important to design very good follow-up studies on male and female breast cancer," said Dr. Patricia Buffler, director of the Southwest Center for Occupational Health and Safety at the University of Texas Health Science Center in Houston. Buffler, who is chairing another major workshop on the future direction of EMF epidemiological studies, added, "I'll make sure this issue is addressed at the workshop." The invitation-only meeting, *Future Epidemiologic Studies of Health Effects of EMF*, sponsored by the Electric Power Research Institute (EPRI), was held in Carmel, CA, February 5-8 (see *MWN*, N/D90).

The new emphasis on female breast cancer was prompted by the publication of a Norwegian study which was the third to link male breast cancer to occupational EMF exposures (see story at right). The Norwegian researchers are already planning a study of female breast cancer among telephone workers. In November 1989, Matanoski and coworkers identified a cluster of male breast cancer among young New York telephone workers (see *MWN*, N/D89). Last June, Paul Demers and Dr. David Thomas, both at the Fred Hutchinson Cancer Research Center in Seattle, WA, reported that telephone linemen, electricians and electric power workers developed male breast cancer at six times the expected rate (see *MWN*, J/A90). In a telephone interview, Thomas noted that the new finding "confirms the results of the other two studies and cannot be dismissed."

Dr. Richard Stevens of Battelle Pacific Northwest Lab in Richland, WA, has long espoused a theory on breast cancer and EMFs and/or "light-at-night" (see *MWN*, J/F87), but to date has been unable to secure funding for a study. "Stevens' hypothesis should now be tested," Dr. Michel Coleman of the International Agency for Research on Cancer in Lyon, France, said in Cincinnati.

In an unusual show of agreement, researchers from academia, industry and government all called for further studies—among them were Dr. David Savitz of the University of North Carolina in Chapel Hill, Dr. John Peters of the University of Southern California in Los Angeles, Dr. Leeka Kheifets of EPRI, Dr. Linda Erdreich of Environmental Research, Inc. in New York City and NIOSH's Dr. Teresa Schnorr and David Brown.

Many of the epidemiologists cited the evidence of EMF-induced changes in melatonin production as a rationale for pursuing the female breast cancer link (see *MWN*, J/A90). "Enough is known about the biology of melatonin in animals and humans to make the link plausible," Coleman said. And Savitz noted that the melatonin work "leads to epidemiological predictions—probably the only testable hypothesis in this field."

A number of the researchers cautioned that EMF-female breast cancer studies will not be easy. "It may be hard to do," warned Matanoski. And Milham noted, "I don't think a high proportion of female breast cancer could be related to EMFs, but if the same mechanism is operating in women as in men, you should be able to detect it in women."

Dr. Russel Reiter of the University of Texas Health Science Center in San Antonio pointed out that there are a number of different types of female breast cancer and a variety of risk

Male Norwegian EMF Workers Have Excess Breast Cancer

Norwegian men exposed to ELF EMFs on the job developed breast cancer at twice the expected rate—a statistically significant increase. The new report, published in *The Lancet*, is the third in the past year to detail an increased risk of male breast cancer—an extremely rare disease—among EMF-exposed workers (see p.1).

"The results indicate an association," wrote Drs. Tore Tynes and Aage Andersen of the Cancer Registry of Norway in Oslo, but they warned that, "the numbers are small and the results should be interpreted with caution."

Tynes told *Microwave News* that he and Andersen plan to study female telephone workers exposed to EMFs from switching equipment.

In interviews, Johns Hopkins University's Dr. Genevieve Matanoski said, "Now we have three studies. I think it's fascinating," and Battelle's Dr. Richard Stevens called the new study "extremely provocative."

Using data from their registry—considered to be one of the most comprehensive in the world—Tynes and Andersen found that electrical transport workers, including railway engine drivers and tram drivers, had a statistically significant fourfold increase of male breast cancer. The incidence among electricians was more than twice that expected, though not statistically significant. There was a significant doubling of male breast cancer risk for all the groups combined.

The researchers noted that although the subgroups they used supported the EMF-breast cancer link, "the job titles selected may not be the best for an evaluation of cancer risk to workers exposed to ELF fields.... Our results seem to support the justification of further studies on the association between breast cancer and occupational exposure to ELF fields."

Tynes and Andersen looked at cancer data on all Norwegian residents between the years 1960 and 1985, focusing on the distribution of breast cancer cases among electrical workers according to occupational status at the 1960 and 1970 censuses. For that 25-year period, they observed 12 cases of male breast cancer among 37,953 workers (824,321 person years) where 5.8 were expected. Their letter appeared in the December 22/29, 1990 issue of *The Lancet*.

factors to be considered in designing a study: "If you think melatonin is related, it would be better to look at younger women—15 to 35 years old."

Matanoski also suggested that if there is an EMF-neuroendocrine effect, the incidence of prostatic cancer among EMF-exposed men should also be investigated.

Breast cancer is the most common type of cancer among American women, according to the American Cancer Society, and the rate is on the rise (see p.2).

UPDATES

BIOLOGICAL EFFECTS

New Hypothesis for Henhouse Results...EPA's Dr. Carl Blackman has come up with a new idea to explain the variation in results obtained by the six labs that participated in the Henhouse Project. The project sought to replicate the findings of Dr. Jocelyne Leal of the Ramón y Cajal Hospital in Madrid, Spain, showing that weak PMFs can damage developing chick embryos (see *MWN*, M/A88 and S/O90). Of the six labs, five found that a 1 μ T PMF caused an increase in abnormal embryos—though only two had statistical significance. The pooled results were significant at the $p=0.001$ level. As previously reported, one of the six labs used a different strain of eggs, indicating a genetic component to the effect (see *MWN*, J/F90). In a letter published in the November/December 1990 issue of the *Bioelectromagnetics Society Newsletter*, Blackman points to a trend of declining statistical significance of the PMF effect in the five remaining labs with decreasing levels of the earth's DC magnetic field. "From this data, it is possible to hypothesize that the mean total DC flux density must be higher than 35 μ T for a field-induced effect to be observed" for experiments using the Henhouse protocol. As early as 1986, Leal herself stressed the importance of the DC magnetic field in understanding PMF effects (see *MWN*, J/F87). Blackman urges his fellow researchers to "include a test of the potential influence of the static magnetic field on the pulsed field induced effects" in future studies.

INTERNATIONAL

Dutch RF/MW Standard...The Netherlands Environmental Health Inspectorate recently published a guideline for exposure to RF radiation from stationary emitters. The guideline is based on the International Radiation Protection Association's (IRPA) RF/MW guidelines, which were revised in 1988 (see *MWN*, Mr84 and J/F88). Dr. Branko Bosnjakovic of the Dutch Ministry of Housing, Planning and Environment told *Microwave News* that the new guideline will be used by regional authorities charged with licensing TV and radio transmitters and radar facilities. Bosnjakovic is a member of IRPA's International Non-Ionizing Radiation Committee. For a copy of *Richlijn voor Radiofrequente Straling bij Zendingrichtingen* (#90-01), available only in Dutch, contact: Ministry of Housing, Planning and Environment, Centrale Directie Voorlichting en Externe Betrekkingen, Van Alkemade laan 85, 2597 AC's-Gravenhage, The Netherlands, (31+70) 317 41 74.

MEDICAL APPLICATIONS

NASA Resets Biological Clocks...Bright lights aren't just for treatment of seasonal affective disorder (SAD). Some NASA astronauts who work on night-shift operations are using high-intensity light to alter their circadian rhythms before space launches. According to the January 14 issue of *Aviation Week and Space Technology*, astronauts on a recent space shuttle mission were able to reset their biological clocks by using bright lights for only four days before launch. In the past, astronauts

adjusted their rhythms by going to sleep earlier and earlier over a six-week period.

MEETINGS

MRI Bioeffects...The New York Academy of Sciences (NYAS) will hold a meeting on the *Biological Effects and Safety Aspects of Nuclear Magnetic Resonance Imaging and Spectroscopy*, May 15-17, 1991, at the Hyatt Regency in Bethesda, MD. Among the presenters will be Dr. Frank Shellock of the Cedars-Sinai Medical Center in Los Angeles, CA, and Sweden's Dr. Bertil Persson of the University of Lund. Contact: NYAS at (212) 838-0230.

Medical Microwaves in Yugoslavia...Belgrade will be the site of *Microwaves in Medicine '91*, April 8-11. The meeting will address medical applications, radiation risks and safety standards. Dr. Stanislaw Szmigielski of the Center for Radiobiology and Radiation Safety in Warsaw, Poland, has been invited to present a lecture on EMFs and cancer. Contact: Prof. Z. Djordjevic, Institute of MW Techniques and Electronics, Bulevar Lenjina 165b, PO Box 220, 11070 Belgrade, Yugoslavia, (38+11) 135-420.

STANDARDS

European RFI Standard...The European Committee for Electrotechnical Standardization has asked for comments on a draft standard, *Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical (ISM) Radiofrequency Equipment* (EN 55 011 prAB). Copies are available for \$8.00 each from: International Sales Dept., ANSI, 1430 Broadway, New York, NY 10018.

Power Line Effects...The IEEE has issued a call for comments on its proposed new standard, *Definitions of Terms Relating to Corona and Field Effects of Overhead Power Lines* (BSR/IEEE 539), a revision of a 1979 standard (ANSI/IEEE 539). All comments are due by February 26, 1991. For a copy of the standard, send \$30.60 to: Michelle Phillips, IEEE, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855. Comments should be sent to Linda Dame at the same address.

TECHNOLOGY

Maglev and EMFs...Understanding the effects of magnetic levitation systems is rapidly becoming a priority in Washington, DC. EPA has been required by the Clean Air Act Amendments of 1990, passed last fall, to report to Congress by May 15, 1991 on the "health and environmental aspects of maglev technology." The agency is also looking into EMFs from maglev trains for the Federal Railroad Administration (see *MWN*, S/O90). And the National Research Council's (NRC) Transportation Research Board is considering EMF effects as part of an ongoing project on *High-Speed Surface Transportation in the United States*. The NRC's Walter Diewald, the project officer, told *Microwave News* that although EMFs will only be a small part of the study, the committee assembled by the board will probably use the EPA EMF-cancer report to provide "some guidance." The committee is studying potential commercial applications of high-speed transportation technology, including magnetic levitation.

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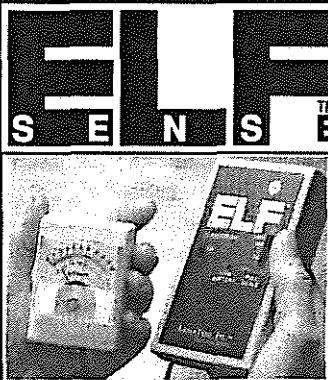
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