diminished capacity of the immune system and changes in brain function. Clinically, these result in declines in fertility, low birth weights, diminished resistance to infectious diseases, diminished resistance to cancers and increases in serious psychological disturbances.

The effect on cells is in the alteration of normal cell division. Exposure of any cell in active multiplication will result in an acceleration in the production of DNA and alteration in chromosome structure. These effects will be evidenced by a marked increase in the rate of cell growth and the production of genetic abnormalities. Clinically, the results will be, an increase in the incidence of birth defects and genetic diseases such as Down's Syndrome, increases in the growth rate and malignant characteristics of cancers and, quite possibly, the production of cancerous changes via genetic alterations.

It is instructive to look at the recent statistics for these general disease patterns in our society. The incidence of birth defects has approximately doubled over the past 25 years. The incidence of cancer in general is increasing approximately 1% per year and certain types have become epidemic in nature. In 1984, the NIMH reported the incidence of serious mental disorder in the general population was 20%, with the incidence in the under 45 age group at twice that figure. The incidence of suicide in the teen-age group had more than doubled between the years 1961 to 1981 and while firm data is not available, this increase seems to be accelerating. It is recognized that our society contains other factors that may contribute to this situation. However, the link with abnormal EMFs is the only one that extends globally to all of these conditions.

It is obvious that something needs to be done; however, before plans are made and actions taken, it is essential that the record of past actions by the regulatory agencies and other governmental entities be considered to avoid past mistakes. This record can only be characterized as either, at best, unintelligent adherence to the "Thermal Effects Only" dogma or, at worst, a deliberate cover-up motivated by military concerns.

Evidence of biological hazards from exposure to non-thermal levels of microwaves was known to the military since the late 1950s, however, the response was to deny its existence and to devise an exposure "standard" based upon the old "Thermal Effects Only" concept. To the best of my knowledge this same inadequate standard is in use today in all branches of the military. In the late 1960s the Navy was considering the construction of a very large antenna system for communicating with atomic submarines. This was to operate in the ELF band at either 45 or 75 Hz, just below and above the 60 Hz electric power frequency. A series of experiments were performed by the Navy and in December 1973, a committee of civilian experts, of which I was one, was convened to evaluate the results. There was no question that the results indicated a strong possibility of serious health hazards from the Navy's antenna system and, more so, from the civilian network of 60 Hz power transmission lines. In particular, the committee noted that the strength of the field from the antenna was a million times smaller than that from a 765 kV power line and it recommended to the Navy that this information be transmitted to the White House agency responsible for EM safety. The Navy responded by burying the report and denying its existence to Congress. Shortly after the meeting, I was informed of a proposal to build a network of ultra high voltage transmission lines in New York state. Since the report was not highly classified, I notified the Public Service Commission (PSC) of the state of its existence and suggested that they request the data from the Navy. This the Navy refused and the PSC contacted me directly with the request that I, and my colleague, Dr. Andrew Marino, serve as expert witnesses in a public hearing on this question. Delays imposed by the utilities involved permitted us to conduct additional experiments at the 60 Hz power frequency, which extended and confirmed the risks found in the Navy studies. The hearings began in 1976 and during their course all grant funding from both the NIH and the VA was withdrawn from my laboratory. On separate occasions both Dr. Marino and I were informed by representatives of the VA that our withdrawal from the hearings would result in restitution of the funding (later I was told by an admiral and former Chief of the Office of Naval Research that the Navy protested the closing of my lab in this fashion but was overruled). I refused to withdraw and the laboratory was closed in December 1980. However, the PSC accepted and implemented my recommendations for a long-term research program, which I made during the hearings. This resulted in the New York Department of Health's Power Lines Project.

...Despite the fact the New York report noted some positive findings and one of its recommendations has been the occasion for this hearing, the majority of it...[has] deficiencies....These defects include the application of extremely rigorous requirements to positive reports while accepting negative reports at face value, ignoring significant positive reports in the literature, using non-applicable negative reports, etc. In short, all studies done to date by public agencies with public funding have been biased, unscientific and designed to indicate a lack of harm from these EMFs.

Large amounts of public funds have also been used for many animal experiments purportedly designed to evaluate the health risks associated with such fields. Most have actually been designed, deliberately in advance, to yield negative results and any positive results obtained have not been reported or their release has been long delayed. In such contract research the "Golden Rule" applies – "He who has the gold makes the rules." In short, despite the expenditure of many millions of dollars, the actions of federal and state agencies have been not only far less than adequate to deal with this issue but suspect as well.

This is not simply a scientific issue but a very human one. A family living on a dairy farm in New York that has been theirs since 1820 has suffered an economic and medical disaster. A 765 kV transmission line was built through their land a few hundred feet from their home. Since it began operating in 1982, their cows have produced dead or defective calves and all of their chickens produced defective, unsalable eggs and then died. Their young daughter developed Hashimoto's disease, a permanent autoimmune condition of the thyroid gland, and the husband and son have developed other autoimmune diseases. Their farm is unsalable and cannot be used for collateral for them to be able to move. I called this situation to the attention of the NY-DOH Panel, suggesting that it be studied and that other similar-case situations be looked for. They took no action whatsoever. Since 1981 I have worked with a citizen's group in a rural town of about 25,000 inhabitants in New Jersey. This town ranks fifth in the nation in the concentration of microwave sources, behind New York City, Chicago, Dallas and San Francisco and just ahead of Los Angeles. The first microwave source began operating in 1974 and 11 months later the first baby with Down's Syndrome was born. Since then the microwave sources have increased, and so have the cases of Down's Syndrome until at this time the incidence is at least five times greater than normally expected. Furthermore, these cases are located in "clusters" along with other genetic and birth defects and an excess of cancers. These cluster areas appear to be locations irradiated by the local microwaves. Studies have been made and reports issued by the New Jersey Department of Health, the EPA and the CDC, none of which adequately addressed the problem. I have provided the sub-committee with a copy of a scientific report I recently published on this situation. At this time, basically nothing is being done.

I urge the establishment of a congressionally mandated and overseen research program aimed specifically at determining the level of risk. Whether this research program is based in a federal agency or not, it must be overseen by a panel of outside experts, drawn from many disciplines, and must include full representation by advocates for the position that such irradiation may be harmful. Full and prompt disclosure of all data and all panel deliberations and decisions must be assured. I also urge consideration of a congressional investigation of human exposure in the military forces of the U.S., and consideration of a moratorium on new construction and operation of field-producing military facilities. I am well aware of the vital role played in our society by EM forces and in no way do I advocate total cessation of their use. I urge only that risk-benefit decisions in this area be based upon valid scientific data and be made by representatives of the population at risk rather than by parties of interest. It is time to seek the truth about this vital problem.

Jerry Phillips, PhD

...Although cancer is only one aspect of electromagnetic field (EMF) effects on human health and development, it is the one with which I am most familiar and which I will discuss with you this morning.

Prior to the 1979 report of Wertheimer and Leeper, which documented an association between long-term exposure to low-level household-frequency or 60 Hz EMFs and childhood leukemia, interest in EMFs and cancer in general was minimal. However, Wertheimer and Leeper's hypothesis was unique, startling and potentially frightening. Suddenly, it was possible that exposure to EMFs produced by the flow of 60 Hz electricity could be a hazard to human health. In the years following Wertheimer and Leeper's report, many additional reports have appeared in which the theme has been the same: exposure to low-level 60 Hz EMFs in the home or on the job appears to be associated with increased incidences of leukemia in children and various cancers in adults. However, the epidemiological studies are just one link in an important chain of evidence; there are also laboratory studies which form an important bridge between epidemiology and a real-world increase in cancer incidence caused by EMFs.

Before describing these laboratory studies, let me first present some basic information about cancer. Most human cancers are triggered or propagated by exposure to environmental agents. Therefore, cancer development is the result of a complex interplay between various chemical and physical agents and unknown factors dictated by human genetics. The natural history of cancer development evolves through stages that include initiation and promotion. Initiation is a process that results in the transformation of a normal cell into a cancer cell, and involves at least one permanent, heritable alteration in the basic structure of the cell's genetic information (its DNA). Promotion is a process characterized by selective growth and altered gene expression of the initiated cells (stem cells). After the initiation occurs, the tumor response is ultimately the same, whether promotion occurs one week or one year later. These distinctions are important, because the available scientific literature indicates that EMFs appear to serve as tumor promoters. The question, therefore, is not whether 60 Hz EMFs cause cancer, but rather what is the extent to which such fields contribute to the development of clinical cancer?

The available scientific data indicate that EMF exposure has effects that are both direct (i.e., on human cancer cells) and indirect (i.e., on other body cells, but having the overall effect of allowing cancer development). In the former category are studies from my laboratory. We have found that human cancer cells exposed to 60 Hz EMFs: 1) exhibit two- to 24-fold greater growth of stem cells; 2) exhibit increased expression of a growth-related cellular protein; 3) exhibit greatly increased resistance to destruction by cells of the body's defense system; and 4) these changes are permanent. These results are especially important since the key events in tumor promotion are associated with increased growth and altered gene expression in initiated stem cells. Further support comes from other laboratories, where research has indicated that EMF exposure of human and other cells changes the activity of key growth-related enzyme systems, increases the rate of DNA synthesis and alters the expression of key cellular genes.

As mentioned previously, indirect effects also may be responsible for the tumor-promoting ability of EMFs, and the most important of these effects is a decrease in the capacity of the cells of the body's immune or defense system to function properly. This can occur in two ways. First, it has been shown that EMF exposure can affect white blood cells directly, causing a decreased ability to proliferate or a decreased ability to destroy cancer cells. Alternatively, long-term exposure to EMFs has been shown to act as a general source of stress. Therefore, exposure to EMFs may influence the activities of cells of the central nervous system and cells of other hormone-secreting tissues, resulting in a depression of the body's defense system and providing fertile ground for cancer growth. In this regard, it has been known for many years that chronic administration of many drugs that suppress immune function is associated with an increased risk of cancer, particularly leukemia. Why, then, can't a similar situation arise from chronic exposure to EMFs?

To summarize: Laboratory studies by various investigators have demonstrated that mechanisms do exist to explain how real-world exposure to 60 Hz EMFs can result in an increased incidence of human cancers. Furthermore, we have a situation in which, because of EMF exposure, not only do cancer cells grow and become tougher, normal cells of the body's defense system have a decreased ability to fight them as well.

While good studies, as described above, have been performed by competent scientists, many gaps in our present knowledge remain. These could have been plugged if sufficient funding were available in years past. Obviously, therefore, we need to start plugging those gaps now with a stable, federally-funded program. The potential hazards associated with long-term exposure to EMFs appear to be severe, and the need to know the exact nature and boundaries of the problem becomes more urgent as power distribution systems worldwide continue expansion through residential areas, exposing increasing numbers of unsuspecting individuals to EMFs.

Let me close with two additional comments for committee members. First, be critical about not only what you hear and read, but also about the individual providing you with the information. In learning about human health effects of EMF exposure, for instance, one should consult with scientists who have knowledge of bioelectromagnetics as well as of a pertinent discipline, such as epidemiology, physiology, cell biology or medicine. However, in areas relating to human health and biology, one should exercise great caution in consulting with plant or poultry scientists or with engineers, whose training, actual occupational experiences and expertise may be severely limited. Second, exercise caution when you are told that certain studies are to be discounted because they have not been replicated or that data obtained in more than one laboratory for similar experiments indicates "no consistent effect." Such statements are best debated in the scientific, not political, arena. Furthermore, experiments in which exposure to EMFs has produced no effects are just as important as experiments in which exposure has produced effects, since science must involve both types of experiments to determine when and to what extent such effects occur.

It is beyond question that exposure to EMFs produces changes in

biological functions. The issue of hazards to human health and development signalled by these changes must be addressed. It cannot be ignored any longer; the science must be done. If a link is demonstrated between exposure to EMFs and adverse effects on human health, the potential liability faced by utilities, land developers and municipalities will be staggering unless a conscious effort is made to protect the public. We must determine what the hazards are and the extent to which they occur and develop methods to mitigate those hazards that exist.

David Savitz, PhD

...We began our study of the relationship between electric and magnetic fields (EMFs) from power distribution lines and childhood cancer risk in December 1983, at the University of Colorado. At that time, the pertinent research consisted of studies of childhood and adult cancers in the Denver area which suggested an association between electrical wiring and cancer occurrence, a negative report from Rhode Island and an additional study suggesting an association conducted in Stockholm, Sweden. Those studies all suffered from possible deficiencies in their design, especially in regard to exposure measurement, and their lack of information on other cancer determinants. Nonetheless, no one has been able to explain how these problems could have spuriously produced the reported pattern of results.

Our study in Denver...was a case-control study in which exposure patterns of children with cancer were compared to those of the community in which they resided. All 356 children aged 0-14 who lived in the Denver area and were diagnosed with any form of cancer during the period 1976-1983 were eligible for inclusion in the study. For comparison, 278 children of similar age, sex and area of residence were identified as controls. For as many children as possible, measurements of EMFs were taken in the home and the electrical wiring patterns in the vicinity of the home were recorded as indirect measures of the long-term 60 Hz magnetic field levels. One of the important findings was that characteristics of outside power lines are an important determinant of the magnetic fields in the home. Given our focus on the Denver area, very few homes (10 out of over 700) were in close proximity to high tension lines, such that the study results are derived from neighborhood distribution lines. It should also be noted that we were not concerned with the wires within a home or those serving a home, but with the distribution lines going past the home.

Magnetic fields measured with the house power turned off (to isolate the fields from outside lines) were found to be associated with cancer risk, with a 40% increase for homes above 2.0 milligauss (a magnetic field measure). Stronger associations were seen for leukemias, lymphomas and soft tissue tumors. Magnetic field measurements with the house power turned on and electric field measurements were not associated with cancer risk in our study. Wire configuration codes (as a surrogate for magnetic fields from outside power lines) were more convincingly related to childhood cancer risk: a 50% greater incidence of childhood cancer was found in association with higher current configurations. The contrast of highest to lowest exposure groups based on wire codes suggested a 2.3-fold increase in cancer incidence associated with the highest exposure. None of these results were changed by consideration of a number of other cancer risk factors such as parental smoking, income, education, medications during pregnancy and X-ray exposures. The major limitations to the study conclusions come from the incomplete response, uncertainty about the accuracy of exposure characterization and possible biases in the manner in which controls were selected. There is no reason, however, to suppose that these uncertainties would diminish rather than enhance the observed associations.

Our study in Denver clearly provides additional evidence that 60 Hz magnetic fields may pose a hazard. Some of the deficiencies of previous studies were remedied in this investigation and yet the pattern that others had reported remained. Most reviewers of the scientific evidence, however, find that the data from the Denver study and the other investigations fail to provide convincing evidence that magnetic fields cause cancer in human populations. The epidemiologic and laboratory research have progressed sufficiently to provide important suggestive evidence of a possible health hazard and demonstrate that meaningful research can be done which will advance our knowledge. Some suggestions for future studies are offered below.

One concern is with the scarcity of evidence from experimental studies regarding exactly how such fields would operate to produce increased cancer frequency. Interesting hypotheses and preliminary data have been gathered, but additional work is needed. In the realm of epidemiology, there is a clear need to replicate and improve upon our study of childhood cancer. Some research is in progress, including studies of childhood cancer in Los Angeles (supported by the Electric Power Research Institute [EPRI]) and studies of childhood and adult cancers in Sweden and England. In addition, research into possible carcinogenic effects of 60 Hz magnetic fields among electric utility workers is being conducted by a consortium of Canadian and French utilities as well as in a study of American electric utility workers (also supported by EPRI) which I direct. All these activities should be informative, but none of the current funding sources will be capable of mounting the large-scale effort warranted to provide more definitive data on childhood cancer risk. With the experience of our study and other past studies, we have learned enough about the approach to this issue to argue that a large, multi-center study of specific cancer types which expands upon our assessment methods would be capable of overcoming many of the limitations and uncertainties in our work. Traditionally, only the federal government has been capable of supporting such efforts.

In the area of health effects from 60 Hz EMFs, the epidemiologic data are the principal stimuli for additional research, in spite of uncertainty about biological mechanisms of effect. Historically, there have been agents which were known carcinogens based on human studies long before a laboratory demonstration of the effect could be shown (e.g., benzene, arsenic). Given the suggestive (though not conclusive) epidemiologic studies and the tremendous potential public health impact, resolution of this issue is a worthy goal. The widely cited calculation that 10-15% of all childhood cancers could be due to magnetic fields from power lines was often noted without the necessary caveats, but: 1) if the association we found reflects a causal relationship and 2) if the exposure pattern in other areas is similar to that in Denver, then a sizable proportion of childhood cancers would be related to this exposure.

There has been little enthusiasm among government research agencies for funding this area of investigation. My perception is that the uncertainty regarding biological mechanisms discourages scientists who have been most interested in issues such as ionizing radiation, for example, where the carcinogenic mechanisms are relatively well understood. The electric utility industry has provided indirect support (through the New York State Power Lines Project and EPRI) for most of the epidemiologic work in recent years. It seems essential for the federal government to assume a more active role, given the magnitude of the potential public health impact and the scale of possible future efforts to reduce exposures. Even if additional research efforts provided clear evidence that no hazard is present, the effort would still be warranted.

UPDATES

COMPATIBILITY & INTERFERENCE

EMC in Europe & TEMPEST in U.S... Frost & Sullivan, Inc. (F&S), the market research firm, predicts healthy growth – from $194 million in 1986 to $511 million in 1993 – for EMC products and services in Europe; at present, by far the largest European sales are in the U.K. and in West Germany. This growth will come in part from the increasing emphasis on designing EMC into electronic systems, according to F&S. The 384-page report, *Electromagnetic Compatibility Products and Services Market in Europe* (No.E892), is available for $2,600 from F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080....In another study, F&S anticipates that the military market for TEMPEST equipment will continue to grow and reach $2.9 billion in 1992, up from $874 million in 1986; though the specific numbers are different, the trend agrees with the predictions of International Resource Development, Inc., in its recent report on the TEMPEST market (see *MWN*, May/June 1987). According to the F&S report, the largest growth will be in the sales of secure telephones. Wang, AT&T and Digital Equipment have the largest shares of the TEMPEST market. *The Military TEMPEST Equipment Market in the U.S.* (No.A1774), which is 248 pages long, is available for $1,950 from F&S....Nancy Whelan explores some of the reasons for the huge growth in TEMPEST products in "TEMPEST and Computer Security," which appears in the September issue of *Government Executive*, published by the *National Journal* in Washington, DC.

ESD Fuel Ignition... The U.S. Army Research Office has awarded a $120,000 contract to Electro Magnetic Applications, Inc., in Denver, CO, for a three-year, in-depth investigation of electrostatic discharge (ESD) ignition of solid fuel rocket propellants. Dr. Ronal Larson is the principal investigator in this effort. (See also story on ESD and HERO risks on p.2.)

GOVERNMENT

Clarifying FCC's RF/MW Rules... Hammett & Edison (H&E), Inc., a consulting firm based in San Francisco, CA, has asked the FCC to clarify its rules for determining when an environmental assessment related to RF/MW radiation safety is needed for license applications and renewals (see *MWN*, April 1985 and March/April 1987). In a July 23 filing, H&E's Dane Ericksen asked the FCC to review three issues related to dealing with multiple sources and re-radiating metallic objects, proposing amendments to the FCC's regulations. H&E suggested that: (1) Broadcast sites that are near other antennas should be treated as separate sites if the nearby antennas contribute 5% or less of the ANSI limits at the sites' boundaries; (2) Low-power transmitters that contribute less than 5% of the ANSI limits at a site should be considered as "not significantly affecting the environment" – thereby, not requiring an environmental assessment; (3) In field surveys, probes should not be placed closer than 20 cm to any re-radiating metallic objects. In each case, H&E asked that, if the FCC disagrees with the triggers specified in its proposal, the commission should adopt conceptual versions of these amendments, substituting its own triggers. The FCC is treating H&E's proposal as a petition for rulemaking and has asked for public comments; these are due on October 30, with reply comments due on November 20. For more information, contact: Dr. Robert Cleveland, FCC, 2025 M Street, NW, Washington, DC 20554, (202) 653-8169.

MEASUREMENT

Biomedical Applications... Drs. Maria and Stanislaw Stuchly have written a comprehensive review, "Measurements of Electromagnetic Fields in Biomedical Applications," covering ELF and RF/MW electric and magnetic fields for both external and internal probes. The 47-page article, with 122 references, appears in the *CRC Critical Reviews in Biomedical Engineering, 14*, pp.241-288, 1987....A research group from the University of Utah in Salt Lake City has used a computer model to calculate near-field absorption by a spherical model of a human in the resonant frequency range. See Magdy F. Iskander and coworkers in the *IEEE Transactions on Microwave Theory and Techniques, 35*, pp.776-780, August 1987.

New From NBS... Three recently published reports from NBS's Electromagnetic Fields Division evaluate antenna measurement errors. Lorant Muth examines how moving probes can cause variations in *Displacement Errors in Antenna Near-Field Measurements and Their Effect on the Far Field* (TN 1306), which is available for $2.00, prepaid, from the U.S. Government Printing Office (GPO), Washington, DC 20402; order No. 003-003-02776-6. M. Kanda and J. C. Wyss's *Evaluation of Off-Axis Measurements Performed in an Anechoic Chamber* (TN 1305) shows that if the receiving and source antennas are misaligned in an anechoic chamber, inaccuracies can result. A copy can be ordered for $2.25, prepaid, from the GPO; order No. 003-003-02779-1. In *Out-of-Band Response of Antenna Arrays* (NBSIR 86-3047), David Hill and Michael Francis report on near-field measurements from two large arrays of slotted waveguides. The report is available for $11.95, prepaid, from the National Technical Information Service, Springfield, VA 22161; order No. PB 87-125746/AS.

MEETINGS

Zurich EMC Symposium... More than 115 papers from 28 countries were presented at the biannual *7th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility*, which was held March 3-5, 1987. The 658-page proceedings, edited by Dr. T. Dvorak, are available for 100 Swiss francs (including postage) from EMC Symposium, ETH Zentrum-IKT, 8092 Zurich, Switzerland. The 8th

symposium is planned for March 1989 and the first call for papers will be mailed out this December.

IRPA Workshop... Those going to the International Radiation Protection Association's congress (IRPA-7), to be held in Sydney, Australia, April 10-17, 1988, may want to arrive a few days early to attend a special *International Non-Ionizing Radiation Workshop*, which will be held April 5-8 in Parkville, Victoria, a suburb of Melbourne. The registration fee is $200.00 Australian, approximately $140.00 U.S. After February 1, the cost will go up to $250.00 Australian. For more information, contact: Dr. C. Roy, NIR Section, Australian Radiation Laboratory, Lower Plenty Rd., Yallambie, Victoria 3085, Australia.

EMC in Paris... The International Electrotechnical Commission (IEC) is sponsoring a workshop on *Electromagnetic Compatibility Standardization in the IEC*, December 14-16, in Paris, France. Various committees of the IEC are developing EMC standards and their work is being coordinated by the IEC's Advisory Committee on EMC. The Paris workshop is designed for those interested in the latest activities of these myriad groups. Among the subjects to be covered are power networks, information technology and broadcasting services – from ELF to millimeter waves. Registration costs 700 French francs. Contact: Comité Electrotechnique Francais, 12 Place des Etats-Unis, 75783 Paris Cedex 16, France, (1) 47-23-72-57.

OCCUPATIONAL HEALTH

Long-Distance Hazards... Ten employees of Mountain Bell, a subsidiary of US West, in Idaho Falls, ID, have reported symptoms ranging from dizziness to loss of memory to cataracts. One worker suffered a stroke. The employees, who test microwave toll and long-distance equipment, are represented by the Communications Workers of America (CWA), which asked NIOSH to conduct a Health Hazard Evaluation last February. Radiation measurements were made, but David LeGrande, the CWA's coordinator for occupational safety and health, told *Microwave News* that he is "dissatisfied" with NIOSH's survey. He criticized the agency for not taking enough measurements and for sending a physician who had little knowledge about microwave effects. In a telephone interview, Dr. Bobby Gunter of NIOSH's Denver office, who visited the Idaho site, said that he found no overexposures and that the site was "one of the safest" he has seen. Gunter sent his report to NIOSH headquarters on July 31, where it will be reviewed before being released.

OVENS

FDA Nabs Leaky Units... In July, during routine testing of a new line of microwave ovens manufactured by Samsung in South Korea, the FDA's compliance office found that a prototype failed to pass the agency's radiation emission tests. A staffer at the FDA's Center for Devices and Radiological Health told *Microwave News* that the design problems were caught before any of the imported ovens reached consumers. Following some changes, including the design of the door latch, the ovens met the FDA's leakage requirements and were cleared for marketing.

PEOPLE

On January 1, 1988, NIEHS's Dr. **Don McRee** will take over from EPA's Dr. **Richard Phillips** as the editor of *Bioelectromagnetics*. By the time he steps down, Phillips will have completed four volumes of the journal....Dr. **David Davidson**, a physicist at GTE Laboratories, Inc., in Waltham, MA, died in June. Well known to the bioeffects community, Davidson, who was one of the developers of the LORAN navigational system, was an active participant in IEEE, ARRL and ANS C95 activities.

POWER LINES

Fertility of Cows... Exposure to 50 Hz electric and magnetic fields has no consistent effect on the fertility of cows, according to a series of studies at the Department of Animal Hygiene of the Swedish University of Agricultural Sciences in Skara. A preliminary study, released in 1981, indicated that dairy cows exposed to 400 kV lines for less than 11 days a year (the average was 7 days) showed no change in fertility, but that those exposed for approximately 25 days suffered decreased fertility. A subsequent epidemiological study appeared to contradict the earlier finding: Herds exposed to 400 kV lines for more than 15 days a year "revealed no reduced average fertility as far as can be seen from artificial insemination results." Last year, the Skara team announced that a controlled study of 58 heifers – exposed continuously for 120 days to an average unperturbed electric field of 4 kV/m and to a magnetic field of 2 μT – showed no changes in "ovarian activity, intensity of estrous [being in heat] signs, pregnancy and fetal viability." Nor did the group find a consistent effect on the cows' circadian rhythms. The reports and papers include: Bo Algers, Ingvar Ekesbo and Katarina Hennichs, *The Effects of Ultra High-Voltage Transmission Lines on the Fertility of Dairy Cows: A Preliminary Study*, Report 5, 1981 (in Swedish, with an English summary); Hennichs, *Cows Exposed to 400 kV Lines: Inventory and Fertility Study*, Report 7, 1982; Algers and Hennichs, "Biological Effects of Electromagnetic Fields on Vertebrates: A Review," *Veterinary Research Communications, 6*, pp.265-279, 1983; Algers and Hennichs, "The Effect of Exposure to 400 kV Transmission Lines on the Fertility of Cows: A Retrospective Cohort Study," *Preventive Veterinary Medicine, 3*, pp.351-361, 1985; and Algers and Jan Hultgren, *Effects of Long-Term Exposure to a 400 kV, 50 Hz Transmission Line on Estrous, Fertility and Diurnal Rhythm in Cows*, Report 15, 1986. For more information, contact: Bo

Algers, Research Manager, Department of Animal Hygiene, Faculty of Veterinary Medicine, Swedish University of Agricultural Sciences, PO Box 345, S-532 00 Skara, Sweden.

HVDC Agricultural Effects... Studies are also underway at the DOE's Bonneville Power Administration's (BPA) Grizzly Mt. HVDC Research Facility to determine the possible impact of a ±500 kV DC line on cattle and crops. According to the just-released, second annual report of the three-year *Joint HVDC Agricultural Study*, no deleterious effects have been found. Robert Raleigh of Oregon State University is the principal investigator on the project, which is being supported by a number of utilities, as well as by EPRI. A final report is due in 1988. For more information, contact: Jack Lee, Jr., Biological Studies Coordinator, BPA, PO Box 3621 (EVRE), Portland, OR 97208.

VDTs

Australian, Finnish and German Measurements... According to a survey by staffers at the Australian Radiation Lab, the highest VLF electric and magnetic fields at 30 cm from a VDT screen were 15 V/m and 90 mA/m (0.1 μT), respectively – though the levels were usually much lower. The researchers found that the fields decreased very quickly with distance from the VDT and were unaffected by the display color. Only background levels of ionizing radiation were identified. The Australians did not measure either ELF fields – "because it was thought that they are not a hazard in the office environment" – or electrostatic fields – "There is no evidence...to support the suggestion that electrostatic fields from VDTs are linked to [facial skin rashes]." See G. Elliott, C.R. Roy, H.P. Gies and K.H. Joyner, "Video Display Terminals and Radiation Emissions – Current Status," *Radiation Protection in Australia, 4*, pp.123-130, 1986. Previously, the same group published "Electromagnetic Radiation Emissions from Video Display Terminals (VDTs)," *Clinical & Experimental Optometry, 69*, pp.53-61, March 1986, which contains measurement data on over 50 different VDT models. (Dr. Joyner has since left the radiation lab to join Australia's Telecom Research Labs.)...Finnish researchers have measured the ELF and electrostatic fields from seven VDTs, however. Jukka Juutilainen and Keijo Saali, of the University of Kuopio, report that the 50/60 Hz signal from the vertical deflection coil has a triangular waveform and dominates over the sinusoidal 50/60 Hz field everywhere except in the vicinity of the power transformer. The ELF field varied from 0.2-0.65 A/m (0.2-0.8 μT) and from 0.05-0.22 A/m (0.06-0.26 μT) at 30 and 50 cm, respectively. The background levels in the offices were on the order of 0.01-0.07 A/m (12-84 nT), though in one case the background was as high as 0.15 A/m (0.18 μT). The team found that the VLF signal was "clearly weaker" than the 50/60 Hz signal in all the tested models. These results appear in the *Scandinavian Journal of Work and Environmental Health, 12*, pp.609-613, 1986. In a second paper due to appear this year in the same journal, Juutilainen and two associates report that the measured electrostatic field from a VDT "was highly dependent on the method of measurement." They conclude that, for distances of 10-40 cm from a VDT, "there is no simple relationship between field strength and distance. The exact relationship depends on the shape and size of the measuring system and the screen." Using what the group found to be the most reliable measurement system on ten VDTs, at 30 cm the electrostatic field varied from 0 to 40 kV/m....A German computer magazine, *P.M. Computerheft*, reviewed the safety of VDTs in its May/June issue. Electrostatic, electric and magnetic fields, as well the time rate of change of the magnetic field, were measured for 16 different types of VDTs.

Canadians on Radiation... The Canadian Centre for Occupational Health and Safety (CCOHS) has just released *Emissions from Video Display Terminals and Their Measurement – A Training Manual*, by Dr. Karel Marha, Bhawani Pathak and David Charron. It covers the design of a VDT, the types of radiation emissions, their measurement and their possible biological effects. The report, No. P86-19E, is available for $3.25 U.S. or $3.00 Canadian, prepaid, from CCOHS, 250 Main St. East, Hamilton, Ontario L8N 1H6, Canada, (416) 572-2981 or (800) 263-8276....The Canadian Labour Congress (CLC) has released a 14-page report, *Fighting the Radiation Hazards of VDTs*, which argues that ELF and VLF fields from VDTs "*are* definite cause[s] for concern" (CLC's emphasis). The group recommends that more attention be devoted to finding alternatives to CRTs and strongly advocates reducing VDT emissions "at the source" and granting pregnant workers the right to alternative work. The report is in English and in French.

Epi Studies Begin... Two major VDT epidemiological studies are underway. In July, the National Institute for Occupational Safety and Health (NIOSH) started collecting data for its long-awaited epidemiological study of reproductive risks among VDT workers. Dr. Teresa Schnorr, lead researcher on the study, said that she expects a better than 70% response rate from the 4,000 AT&T and BellSouth women participating. However, others, including Dr. William Butler, co-director of the University of Michigan VDT epidemiological study, think this is an overly optimistic view, as the women are being interviewed at home by phone – a method which generally produces fewer responses than do face-to-face interviews. The study will not include stress and fertility questions which the Office of Management and Budget (OMB) ordered deleted last year (see *MWN*, September/October 1986). Researchers at the Mt. Sinai Medical Center in New York City have received funding from NIEHS for the first phase of their study on miscarriage risks among office workers (see *MWN*, June 1985 and May/June 1987). The study will be the first to monitor office workers during their pregnancies, rather than retrospectively. The pilot study will cost $30,000.

ETC...

Coffee On the Go...Coffee from the microwave just got better: now you can have it fresh-brewed, thanks to a disposable container called Micro-Cup. Just put your favorite fresh-ground coffee in one of the container's chambers and water in the other, place the Micro-Cup on top of a mug and put it in the microwave. Voilà! In minutes, freshly brewed coffee. According to Gary Grossman, president of Innovations & Development Inc., in Edgewater, NJ, the manufacturer of the Micro-Cup, "This is the first product to combine the taste of fresh-brewed coffee with the convenience of instant." Coffee is the most commonly microwaved food in America.

The Protective Watch...Some years ago, a Pentagon official reported that he protected himself from ELF electromagnetic fields by wearing a matchbook-size ELF generator (see *MWN*, May 1982). Now you too can have the same kind of protection. Manufacturers of a new watch, called the Teslar, claim that it can shield against these fields and improve the way you feel. According to Andrija Puharich, the developer of the Teslar, the watch has a magnetic wafer which not only attracts and traps ELF waves but also aligns the body's system with its "natural frequency." All this for only $79.00. And you don't have to forgo fashion for health; the Teslar comes in digital and traditional styles, for men and women.

Vision, Stealth *(continued from p.1)*

rhodopsin: the straightening out of the retinal molecule (from *cis* to *trans*) is the key to all vision. Now, Birge has found that other small changes in the conformation of retinyl Schiff bases – the movement of a counterion from one spot on the molecule to another – can result from the absorption of specific types of RF/MW radiation.

Henry Kues of the Johns Hopkins University Applied Physics Lab (JHU-APL) in Laurel, MD, said that Birge's findings "...could explain how microwaves are being absorbed in the eye. It's a possible answer and it would make sense." JHU-APL's Dr. Sam Koslov agreed: "It's a possible mechanism to explain the production of free radicals," he said in a telephone interview.

Kues has shown that low levels of pulsed 2.45 GHz radiation can affect the biochemistry of a monkey's eye. "We are gearing up to investigate the Schiff base connection," he said.

Birge's assistant told *Microwave News* that Birge "is no longer accepting any calls" on this work – which was originally funded by civilian agencies, the National Institutes of Health (NIH) and the National Science Foundation (NSF). Birge also refused to respond to queries concerning the *biological* implications of his findings.

On learning of the secrecy order, another bioeffects researcher said, "It's a shame; it could have interesting implications."

See: Robert Birge, et al., "Two-Photon, ^{13}Carbon and Two-Dimensional ^{1}H NMR Spectroscopic Studies of Retinyl Schiff Bases, Protonated Schiff Bases and Schiff Base Salts: Evidence for a Protonation Induced $\pi\pi^*$ Excited State Level Ordering Reversal," *Journal of the American Chemical Society, 109*, pp.2090-2101, 1987; Malcolm Browne, "Vision Chemical Is Found To Absorb Radar," *New York Times*, August 18, 1987; Henry Kues, et al., "Effects of 2.45 GHz Microwaves on Primate Corneal Endothelium," *Bioelectromagnetics, 6*, pp.177-188, 1985; Lubert Stryer, "The Molecules of Visual Excitation," *Scientific American*, July 1987; George Wald, "The Molecular Basis of Visual Excitation," *Nobel Lectures: Physiology or Medicine* [1967], Amsterdam, Holland: Elsevier, 1972; "New Materials Promise Low Radar Reflectance," *Aviation Week & Space Technology*, May 18, 1987; "Visions of an Invisible Aircraft," *Science News*, August 29, 1987; and *MWN*, September/October 1986 and July/August 1987.

Conference Calendar

New Listings for 1988

March 30-31: 24th Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP), Washington, DC. Contact: NCRP, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814, (301) 657-2652.

May 10-12: **EMC Expo-88**, Hilton & Towers Hotel, Washington, DC. Contact: EMC Expo-88, PO Box D, Gainesville, VA 22065, (703) 347-0030.

May 14-18: 23rd Annual Meeting & Exposition of the Association for the Advancement of Medical Instrumentation (AAMI), Sheraton Washington Hotel, Washington, DC. Contact: Debbie Tritle, AAMI, 1901 North Fort Myer Dr., Suite 602, Arlington, VA 22209, (703) 525-4890.

May 16-19: 20th Annual Meeting of the Conference of Radiation Control Program Directors (CRCPD), Hyatt Regency, Nashville, TN. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 16-20: **1988 Nuclear EMP Meeting**, SRI International, Menlo Park, CA. Contact: K.F. Casey, JAYCOR, 39650 Liberty St., Suite 320, Fremont, CA 94538.

May 25-27: **1988 IEEE MTT-S International Microwave Symposium**, New York, NY. Contact: Jesse Taub, LRW Associates, 1218 Balfour Dr., Arnold, MD 21012.

Upcoming Meetings

November 2-5: **DOE/EPRI Review of Research on Biological Effects of 50/60 Hz Electric and Magnetic Fields, Air Ions and Ion Currents**, Hyatt Regency Hotel, Kansas City, MO. Contact: W/L Associates, Suite #4, 120 West Church St., Frederick, MD 21701, (301) 663-1915.

November 9-12: **32nd Annual Conference on Magnetism and Magnetic Materials**, Marriott Hotel, Chicago, IL. Contact: Dr. John Scott, American Institute of Physics, 335 East 45th St., New York, NY 10017.

November 10-12: **2nd Annual Society of Broadcast Engineers (SBE) National Convention and Broadcast Engineering Conference**, A.J. Cervantes Convention Center, St. Louis, MO. Contact: SBE, PO Box 16861, St. Louis, MO 63105.

November 13-16: **9th Annual Conference of the IEEE Engineering in Medicine and Biology Society**, Park Plaza Hotel, Boston, MA. Contact: Dr. Ronald Newbower, Dept. of Biomedical Engineering, Massachusetts General Hospital, Boston, MA 02114, (617) 726-1676.

December 13-18: **Symposium on Hyperthermia**, Boston, MA. Held in conjunction with the *ASME Winter Annual Meeting*. Contact: Prof. Bob Roemer, Dept. of Aerospace and Mechanical Engineering, University of Arizona, Tucson, AZ 85721, (602) 621-6112.

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MICRO WAVE NEWS

Vol. VIII No. 5 A Report on Non-Ionizing Radiation September/October 1988

INSIDE...

EPA Readies NIER Cancer Assessment p.13
SAB-EPA Exchange of Letters on NIER p.14

HIGHLIGHTS pp.2-4

Swedish PMF Studies Show Teratological Effects
DOD Confirms Black Hawk Helicopter's Susceptibility to EMI
AMA Investigates EMP
NIOSH Detects No Significant RF Levels in McFarland, CA
FCC Exempts Low-Power Sources
Swedish Agency Sets Tough Limits for VDT Magnetic Fields

ELF NEWS pp.5-9

Power Line Talk
Overhead vs. Underground Lines: Field Levels and Costs
SIDS: A Melatonin Effect?
California To Sponsor Health Research
Farm Study: Stray Voltage & Dairy Cows
DOE Bioeffects Budget Set at $3 Million
New Research Papers

FROM THE FIELD p.9

Boeing Memo on EMP

UPDATES pp.10-12

Scandinavian VDT Studies • RF Endocrine Effects • Charge and Field Effects Meeting • EMFs from ESD • Pacemaker EMI • FCC Actions • IRPA Proceedings • U.K. Report on NIER • EMC Test Sites • Meeting of the Bioelectricity Society • Military Roundup • Life After a MW Oven • People in the News • NBS Becomes NIST • IEEE Special Issues • Yugoslavian RFI Standards • and more....

EPA Phasing Out NIER Program; No RF/MW Guidance Planned

The Environmental Protection Agency (EPA) is closing down its non-ionizing electromagnetic radiation (NIER) program and, following a decade-long effort, no longer plans to issue federal guidelines for public exposures to radiofrequency and microwave (RF/MW) radiation.

On September 29, Richard Guimond, the director of EPA's Office of Radiation Programs (ORP), sent letters to the 17 members of the RF/MW interagency working group notifying them that EPA will not issue exposure limits in fiscal years 1989 and 1990 (FY89 and FY90).

"It was a tough decision to make," Guimond told *Microwave News*, "but we had to set priorities. We have been plagued with the problem of too many issues and too few resources." He explained that "stronger evidence of a health problem" would be needed to justify continuing the NIER program, as well as a legislative mandate to address NIER.

EPA officials maintain that there is no constituency for NIER guidelines. But one staffer commented, "If there *is* a constituency, it may surface now." He added that EPA had continued the program "because it was the 'right' thing to do, not because we had to do it."

Government and corporate officials alike expressed surprise and disappointment at the EPA decision. "It's a crying shame after so many people worked so long and so hard. The broadcast and communications industry has consistently screamed for a national guideline for exposure and now EPA is walking away from the issue," said Richard Tell, the former chief

(continued on p.13)

$66.5 Million Marcy-South Power Line Trial Underway

On September 8, the Marcy-South trial, arguably the most important power line litigation since the Houston Lighting–Klein School case, began in a small courtroom in Goshen, NY. The landmark case, which pits 58 landowners against the New York Power Authority (NYPA), may turn out to be the most expensive as well—in terms of both trial costs and possible awards.

The landowners are suing NYPA for $66.5 million in damages, claiming that the 345-kV power line has created a "cancer corridor" that has destroyed the market value of the land surrounding it, according to their attorney, Jack McBride of Gurda, McBride, Isseks & Smith in Middletown, NY (see *MWN*, M/A87 and M/J88).

(continued on p.15)

HIGHLIGHTS

Swedish PMF Studies Again Show Teratological Effects

A new set of Swedish experiments again points to the biological activity of weak pulsed magnetic fields (PMFs). Preliminary data from Dr. Hakon Frölen's laboratory at the Swedish University of Agricultural Sciences in Uppsala support findings he reported last year which showed that PMFs can cause significant increases in fetal death and resorptions (fetal losses) among pregnant mice (see *MWN*, J/A87).

"The interesting result is that PMFs can influence a biological system," Frölen told *Microwave News*. "I did not think it was possible." He went on to say that, "The fetus is most sensitive to PMFs in the early stages of pregnancy."

Swedish researchers acquainted with Frölen's results commented that the effect was now established: "Now we must find out the interaction mechanism," said Dr. Kjell Hansson-Mild of the National Institute of Occupational Health in Umea.

At the National Institute of Radiation Protection (NIRP) in Stockholm, which sponsored Frölen's work, Lars-Erik Paulsson said that further studies were planned both in Frölen's lab and in that of Dr. Bernhard Tribukait at the Karolinska Institute, also in Stockholm.

In 1986, Tribukait showed that PMFs can cause serious malformations among pregnant mice (see *MWN*, M/A86 and M/J86). Frölen said that he too had found an increase in malformations but that it was not statistically significant.

Asked about the implications of his results for pregnant video display terminal (VDT) operators, Frölen said, "I don't think that they are at risk from VDT magnetic fields." He explained that women usually have limited exposure and that the VDT fields are weaker than those he used in his experiment. (See also p.12 for details on new papers related to VDT electromagnetic fields.)

Frölen said that he will next turn his attention to an investigation of whether PMFs can act as cancer promoters.

Frölen's two experiments were identical. In each, he exposed mice for the first 19 days of pregnancy to 15 μT 20 kHz sawtooth PMFs. Each experiment consisted of exposing approximately 3,000 fetuses; there were about 5-6 fetuses to a litter.

Frölen plans to submit a report to the NIRP by the end of the year; a paper in an English-language journal will follow. He said that he would publish the two studies together since the results were so similar.

AMA Investigates EMP

The American Medical Association (AMA) is joining the ranks of those concerned about the effects of electromagnetic pulse (EMP) radiation. A report assessing the EMP risk to medical devices and to hospital operations is scheduled to be presented at the June 1989 meeting of the AMA's governing delegates.

The AMA's Dr. Theodore Doege, who is preparing the EMP report, told *Microwave News* that he is in the process of determining whether a serious problem exists and whether the AMA should recommend precautions. "We are focusing on the vulnerability of electronic medical devices to EMP," he said.

In 1985, the Food and Drug Administration reported that many computerized medical devices are susceptible to electromagnetic interference (see *MWN*, N/D85). The U.S. Army Medical R&D Command has awarded two contracts for the protection of medical devices from EMP (see *MWN*, J/F86 and J/A87).

DOD Confirms Black Hawk Helicopter Susceptible to EMI

The Inspector General (IG) of the Department of Defense (DOD) has confirmed that the U.S. Army's UH-60 Black Hawk helicopter is susceptible to electromagnetic interference (EMI). In a June 1 report, the IG charges that the Black Hawk's EMI vulnerability may constitute a "safety of flight" concern—the Army's highest priority for problems requiring corrective action—and that its investigation into EMI should have been initiated "at least two years ago." The report was spurred in part by Senator Lowell Weicker (R-CT).

The Army's EMI problems are not limited to the Black Hawk. In a second (June 20) report on the Apache helicopter, the IG warns of "an inadequate design for the shielding of EMI effects on all Army helicopters."

The U.S. Senate is also concerned. In a June 24 report (No.100-402) accompanying its 1989 defense appropriation bill, the Appropriations Committee called the Black Hawk's vulnerability to EMI "a serious problem that deserves top-priority attention by the Army leadership." The Senate allocated $2.5 million for an interim upgrade of Black Hawk shielding to U.S. Navy standards and called for the Army to submit a Black Hawk–EMI modification plan by October 1, 1988.

For its part, the Army has now conceded that some Black Hawk subsystems are vulnerable to EMI and it plans to shield the helicopter to withstand electromagnetic fields of up to 200 V/m—the same specifications as the Navy uses for its similar Sea Hawk helicopter. (The Black Hawk is currently designed to operate in fields of up to 20 V/m.) A steering committee made up of Army and Navy staffers has been established to oversee the shielding program.

The IG's Black Hawk report recommends that the Army:

- Analyze the helicopter's overall susceptibility to EMI.
- Complete tests begun—but never finished—at the Vulnerability Assessment Lab (VAL) at the White Sands Missile

Range, NM, so that undetected susceptibilities are identified before any major engineering changes are made.

- Expand current plans for EMI shielding. By restricting its focus to previously identified weaknesses, "the Army appears to be concentrating on the symptom and ignoring the illness."
- Incorporate additional EMI shielding in new production aircraft as well as retrofit existing models and establish a continuing electromagnetic compatibility program for the Black Hawk.

A History of Mishaps

The Army grounded the Black Hawk four times over the last three years to investigate possible design flaws after several fatal crashes—though a number of the incidents still have not been resolved (see *MWN*, N/D87). The latest accident occurred in March, when two Black Hawks collided in midair on a night mission near Fort Campbell, KY, killing 17 soldiers.

In May, after EMI caused the Black Hawk's hydraulic logic module to malfunction and jammed the aircraft's tail-rotor control pedal during test flights in West Germany, the Army sent a classified warning to Black Hawk pilots to stay away from high-powered radio transmitters, according to *Defense News* (May 30) and *Aviation Week* (June 13).

Although the Army does not classify EMI as a safety of flight issue, the Army Safety Center is not so sure, according to the IG report. The center wants to identify the cause of the incidents before structural changes are made.

The IG concurs with the safety center that available test data are not "sufficiently conclusive" and it condemns the "low risk assessment category assigned to the impact of EMI on the Black Hawk."

In the July 7 *Commerce Business Daily*, the Army announced that it will award a sole-source contract to United Technologies Corp.'s Sikorsky Aircraft Division, the manufacturer of the Black Hawk, to investigate "recent field incidents" and the effects of EMI on the helicopter.

FCC Addresses Multiple RF Sources and "Hot Spots"

The Federal Communications Commission (FCC) has proposed new rules to deal with assessing the impact of multiple transmitters of radiofrequency (RF) radiation at one site and to guide the measurement of RF fields. The action came in response to a petition from Hammett & Edison, a consulting engineering firm based in San Francisco, CA (see *MWN*, S/O87).

On September 19, the FCC announced that it wants to create a new category of RF sources to "focus attention on the *major* emitters at a site rather than on low-powered newcomers whose overall effect would be negligible."

The new category would be made up of any new or modified broadcast facilities whose operation would not cause an increase, in any accessible area, of more than 1% of the allowed limits—presently the 1982 American National Standards Institute (ANSI) guidelines. Those transmitters fitting this criterion would be exempt from the FCC's RF rules. For instance, in the 30-300 MHz band, a station that does not contribute 10 $\mu W/cm^2$ would be exempt.

Members of this 1%-or-less class would also be exempt from responsibility for compliance when a number of transmitters cause RF levels to exceed the ANSI limits. Under the proposal, remedial action would be shared among all licensees whose transmitters contribute more than 1% of the limits.

RF Levels in McFarland, CA: None Detected by NIOSH

A survey by the National Institute for Occupational Safety and Health (NIOSH) in McFarland, CA, failed to detect any levels of radiofrequency (RF) radiation above the detection limits of the meters.

NIOSH's Eugene Moss, accompanied by Bob Curtis and Kevin Cummins, both of the Occupational Safety and Health Administration's Salt Lake City, UT, office, made the measurements on May 19 at the request of Dr. Raymond Neutra, the chief of the Epidemiological Studies and Surveillance Section of the California Department of Health Services. Two members of Neutra's staff were also present.

Neutra is in charge of the investigation into the possible cause of a cluster of cancer cases among children living in McFarland. The NIOSH survey came in response to concerns that RF signals from the Voice of America (VOA) station in nearby Delano may play a role in the etiology of the cluster (see *MWN*, J/F88).

Moss's group took measurements at five locations in McFarland using a Holaday Model 3001 electric field probe with a lowest meter indication level (LMIL) of 5 V^2/m^2 and a Model 3002 magnetic field probe with an LMIL of 0.005 A^2/m^2. The equivalent power densities for these electric and magnetic field LMILs are 1.3 $\mu W/cm^2$ and 190 $\mu W/cm^2$, respectively. An electric field level of 25 V^2/m^2 was measured at the fence of the VOA station. Body currents were also measured, but none were detected.

In addition, Moss checked the microwave radiation levels using a Narda Model 8616 monitor fitted with an 8621D isotropic probe, which has an LIML of 0.01 mW/cm^2. No detectable signals were identified.

The Environmental Protection Agency will send a measurement team to McFarland later this fall (see *MWN*, J/A88).

Dane Ericksen of Hammett & Edison said that he was "pleased" with the FCC decision. Although he had asked for a 5% exemption criterion, he said that he "could live with 1%." Ericksen said his firm had filed the petition because the problem of small sources came up "repeatedly." As an example, he cited the case of a small college station adding a transmitter on Mount Wilson (outside Los Angeles), where there are already 28 high-powered stations.

The FCC explained that the Environmental Protection Agency (EPA) had argued against the 5% proposal because a 50 $\mu W/cm^2$ contribution is "not trivial" and the commission agreed that it is a "significant amount."

The proposal is part of the commission's continuing process of determining how to implement its responsibilities under the National Environmental Policy Act, which, under certain circumstances, can require the preparation of environmental impact statements (see *MWN*, A85, M/A87, J/F88 and J/A88).

Measurement Distance from Re-Radiators

The petition, which was originally filed on July 15, 1987, also requested clarification on how to measure fields near re-radiating conductive objects that can create "hot spots." The FCC recommended a separation distance of "at least 10-20 cm" between the sensing element of a measuring device and a conductive object in order to get data relevant to whole-body exposures.

The FCC's Dr. Robert Cleveland said that this distance was based on the comments received on the petition and on the EPA's recommendation of 10 cm (see *Federal Register*, July 30, 1986, p.27,333). He stressed that the commission still wants both average and maximum values to be reported.

At press time, the FCC's official proposal had not yet been released. A 60-day comment period will follow its announcement in the *Federal Register*. For more information, contact: Dr. Robert Cleveland, FCC, 1919 M Street, NW, Washington, DC 20554, (202) 653-8169.

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Swedish Agency Sets Limits for VDT Magnetic Fields

The Swedish Telecommunications Administration (STA), the nation's largest purchaser and user of video display terminals (VDTs), has set stringent electromagnetic standards for the purchase of all new terminals. In an interview with *Microwave News*, STA scientist Dr. Olov Ostberg also noted that the agency will retrofit existing terminals at a cost of $500 each for its heavy VDT users, namely 3,500 directory assistance operators.

The STA requires a maximum time rate of change of the magnetic field of 25 mT/s at a distance of 50 cm from any point around the set. At present, there is no specific limit for the maximum magnetic field. For most VDTs, the limit for the time rate of change is approximately equivalent to a maximum magnetic field of 50 nT (peak-to-peak), according to Lars-Erik Paulsson of Sweden's National Institute of Radiation Protection (NIRP).

These limits are stricter than those recommended by Swedish government officials in 1986. At that time, a maximum time rate of change of the magnetic field of 50 mT/s was recommended; a maximum magnetic field of 200 nT was also specified.

The STA calls for a maximum surface potential of 500 V—this limit was derived from the previous 1 kV/m guideline for electrostatic charge, according to Paulsson.

Sweden is the only country with guidelines for VDT magnetic fields.

JVC Designs Low Magnetic Field VDT

Four or five companies are now either selling or planning to introduce low magnetic field terminals that will meet the STA's requirements, but only one color set can do so. JVC, the Japanese electronics giant, has designed the unit and TeleNova, a subsidiary of the STA, is marketing it in Sweden.

The specifications sheet for the JVC-TeleNova terminal states that the time rate of change of its magnetic field is 8-12 mT/s at 30 cm from the screen, its magnetic field is 16-24 nT at the same distance and the surface potential is less than 500 V. The NIRP has certified that the unit meets the STA guidelines, Ostberg said.

The JVC-TeleNova unit, which costs approximately 9,000 Swedish crowns (less than $1,400), does not generate a counterbalancing magnetic field to produce a low field at the operator position, as do many of the early low-field VDTs. Rather, the electronics were entirely redesigned to reduce the field.

Contrary to expectations, the JVC-TeleNova model enhances—rather than impairs—readability. "It's a success story," Ostberg said. "When JVC redesigned the set to reduce the magnetic field, it also improved the picture quality."

Another large purchaser of VDTs, the Swedish Agency for Administrative Development, publishes a yearly list of terminals that meet its criteria for radiation, picture quality and other factors. Government agencies must choose from among this list of approved units, Ostberg said.

« Power Line Talk »

The program for the upcoming **annual review of DOE and EPRI's research on power line bioeffects** leaves little doubt that cancer is on everybody's mind. EPRI has recruited some of the leading experts to speak at a special **tutorial on cancer biology and EMFs** on October 30, the day before the review gets under way. For instance, Dr. Russell Reiter will talk about the role of the endocrine system and Dr. Thomas Slaga will describe current theories on cancer promotion. With respect to the EMF-cancer link, EPRI has tapped two well-known members of the ELF community, Drs. Tom Tenforde and Bill Kaune. Tenforde recently joined Battelle and Kaune is a recent Battelle alumnus. The next morning, Dr. Ross Adey will present an overview of the general cancer problem; members of his lab in Loma Linda, CA, will follow with updates on their latest experimental results. Dr. Reba Goodman will then review her latest findings on oncogene activation by EMFs. The meeting will close with a number of progress reports on the various epidemiological studies now underway in the U.S., U.K., Sweden and Taiwan.

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The **cyclotron resonance hypothesis** is going to be tested again. The DOE has funded a group at the University of Rochester in New York to repeat Drs. **Abe Liboff** and **John Thomas**'s 1984 experiment which showed that weak magnetic fields can have profound effects on rat behavior if the static and time-varying magnetic fields are tuned to cyclotron resonance conditions (see *MWN*, N84 and J/A88). Drs. **Sander Stern** and **Victor Laties** at the university's Environmental Health Sciences Center have been awarded a two-year, $170,000 contract to replicate the study and, if possible, extend it. In a telephone interview, Stern said that his interest in repeating the study was prompted by the "reliability and magnitude" of the original result. For his part, Liboff hopes that the Rochester group will not stop at replication. He explained that his research was discontinued because of a funding cutoff, even though "there were many aspects involving this phenomenon that were crying out to be done." In their experiment, Liboff and Thomas tuned their exposure system to the cyclotron resonance frequency of the lithium ion—leading some observers to ask: "Where's the lithium?" Dr. **Bob Smith** of the VA Hospital in Kansas City, MO, has an answer. In the next issue of *Bioelectromagnetics* (Vol.9, No.4), Smith writes that lithium is indeed a normal and a "conserved" element in mammalian tissues, especially in the neuroendocrine organs.

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EPRI is sponsoring a special workshop on **circadian rhythmicity and EMFs** next February in Boston, MA. Dr. **Martin Moore-Ede** at Harvard University's Institute for Circadian Physiology has received $101,000 to organize the meeting, with the objective of reviewing current research and outlining future needs. Attendance is by invitation only.

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In its August 22 issue, ***Newsweek*** told the public what utility professionals have long known: There is a virtual moratorium in the U.S. on building new high-voltage power lines because of "community opposition and environmental worries." In an article on electrical power transfers—utilities with power deficits buying from those with surpluses—the magazine noted that building new lines, the most obvious solution for dealing with the increased demand, is "pretty much out of the question." What's to be done? Three opinions will be presented in the next issue (Winter) of ***Forum for Applied Research and Public Policy,*** a quarterly published by the University of Tennessee with help from the TVA. Research is on everybody's list—though there is some difference of opinion on how long it will take to get some answers. In one article, Dr. **Keith Florig** of Carnegie-Mellon University writes, "Uncertainties about the health effects of power-frequency fields are likely to be with us for some time." In contrast, EPRI's Dr. **Leonard Sagan** is more optimistic: "It is likely that answers will emerge in the next few years." Dr. **David Carpenter** makes a strong case for more money to be given to the "best available scientists," and adds that the research should be "administered and interpreted by cancer and health authorities who have no relation to the financial interests of the utilities."

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A panel of experts set up by the **International Electric Research Exchange**, a consortium of national agencies, has prepared a report assessing 17 epidemiological studies, primarily related to cancer incidence among those exposed to EMFs. **EPRI** is distributing copies to its members, but refuses to release the report to the public.

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The **Public Service Commission (PSC) of Wisconsin** is considering innovative solutions for reducing power line EMFs. At a September 14-16 hearing, various suggestions were proposed, including requiring local utilities to estimate magnetic fields for a number of different configurations before a new line could be approved, according to Michael Jaeger, director of environmental analysis for the PSC. Also discussed was the possibility of utility-sponsored bioeffects studies, similar to those completed in New York and planned in California (see p.7). Among those appearing at the hearing

were Dr. **Leonard Sagan** of EPRI, Dr. **David Carpenter** of the New York Department of Health, **Dan Driscoll** of the New York PSC and **Robert Banks**, a consultant based in Minneapolis, MN. At the hearing, it emerged that line workers at one local utility who had seen EPRI video tapes on magnetic fields said that they were not worried about potential health risks, but that they would become concerned if future studies demonstrated a stronger association. Most of them said that they had already learned of potential problems from the news media and from previous safety meetings. According to the utility, the majority of the workers do not favor showing the tapes to the public because they "raise far more questions than they answer" and therefore, could be "more of a problem than a help."

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Angry parents in **Boca Raton, Florida**, are up in arms over the Palm Beach County school board's plans to open an elementary school within 230 feet of five power lines, and they have organized **Citizens Endorsing a Safer Environment (CEASE)** to mobilize public opinion to their side. Having succeeded in prompting an EMF review, CEASE is now critical of the one issued by Dr. Bernard Kimmel, a West Palm Beach physician hired by the board. In his report, Kimmel states that, "At present there is absolutely no scientific evidence that EMFs can cause cancer, either in adults or children" and recommends that the school be completed in "a timely fashion." But Kimmel also writes that, "It is probable that EMFs do have effects on the human body in various ways, many of which are not understood and all of which need further study." He then goes on to suggest that, in the future, the board locate schools and playgrounds as far as possible from power line rights-of-way and, whenever possible, bury transmission and distribution lines. CEASE President Phyllis Atler thinks Kimmel's report is contradictory: "How can he say that there is no health risk to our children from power line EMFs and then recommend that the school board bury the lines? If it's safe, why take precautions?" Atler claims that some parents, herself included, will keep their children at home rather than send them to the school. In the meantime, the board has scheduled a workshop for October 26 and will invite expert witnesses. Among the speakers suggested by Kimmel are many who have already appeared at the marathon hearings held by the state Department of Environmental Regulation over the last few years and others who are testifying on behalf of the New York Power Authority at the Marcy-South trial in New York (see p.1).

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The hearing room will be crowded next March 27-31, when the **Maryland Public Service Commission** holds hearings on ELF health effects. The proceeding will be the latest in **Potomac Electric Power Company's (PEPCO)** 12-year legal effort to build an 11.2-mile 500 kV power line (see *MWN*, M/A88). PEPCO's testimony is due on October 14. Dr. **Margaret Tucker** of the National Cancer Institute's Environmental Epidemiology Branch in Bethesda, MD, will probably be the company's witness, but PEPCO would not confirm this and Tucker did not return numerous phone calls requesting comment. (Tucker has testified on behalf of PEPCO in the past, and she will testify for the NY Power Authority at the Marcy-South trial on October 13 and will later appear in federal court on behalf of the Mississippi Power Company in another trial.) Meanwhile, the **Maryland People's Counsel** (MPC), which represents the interests of state residents, has hired Dr. **Charles Polk**, a professor of electrical engineering at the University of Rhode Island. According to the MPC's Kirsten Burger, Polk will present the health effects case. The Department of Natural Resources' Division of Power Plant and Environmental Review will also be at the hearing and is negotiating with Dr. **Bill Bailey** of ERI in New York City to present its case. **Thomas Magette**, administrator of site evaluation, said the agency favors approval of the line but will not take a position at the hearing. "More research should be done, but it's not necessary to justify the line; the need outweighs the risks, which are very small," he said. Among the other intervenors are the Brighton Community Association, local landowners and Howard County which rejected PEPCO's zoning application. PEPCO is now appealing that decision in the county circuit court of appeals.

Overhead vs. Underground Lines: Field Levels and Costs

The panel examining the proposed 220 kV Brunswick-Richmond line in Victoria, Australia, has compared the magnetic field levels and costs associated with different types of overhead and underground power lines (see *MWN*, M/A88 and J/A88).

Using the disputed line as a model for its calculations, the panel found that, for a typical load of 600 A, the maximum magnetic fields near each type of line are approximately the same—40 mG from a single circuit overhead line and 48 mG from an underground cable. For extreme loadings of 2,890 A, the fields can be as high as 193 mG and 231 mG for overhead and underground lines, respectively.

The magnetic field from an underground cable dissipates more rapidly than the field from an overhead line. At 50 meters from a single circuit overhead 600 A line, the field is 2.8 mG, but it is only 0.25 mG for an underground cable.

The panel released a report on May 30 which spells out the various alternatives and explains the trade-offs between field levels and costs. Burying a line, for example, can increase the cost by a factor of from five to seven. Panel members include representatives from the State Electricity Commission of Victoria

(SECV), which is trying to build the line, and from the government, unions and community groups.

For overhead lines, a double circuit design can approximately halve the magnetic field level, but at an added cost of 12%—excluding the cost of the extra easement. For underground cables, the cost depends on the spacing of the conductors and on how the cables are placed in the trenches.

The panel's well-illustrated report, *Electromagnetic Fields from Overhead Transmission Lines and Underground Cables*, sets out the alternatives in clearly written English. The chairman of the panel is Associate Professor W.J. Bonwick of the Department of Electrical and Computer Systems Engineering at Monash University in Clayton, Victoria.

According to its work plan, dated July 1988, the panel is scheduled to make recommendations to the Victoria government in April 1989.

SIDS: A Melatonin Effect?

Sudden Infant Death Syndrome (SIDS) may be linked to fluctuations in levels of melatonin, a hormone produced by the pineal gland.

The mysterious killer has long defied explanation. Now, researchers from the Rhode Island Medical Examiner's office in Providence and from the Massachusetts Institute of Technology (MIT) in Cambridge think they may have an important clue. "There was a disparity of melatonin levels among babies who died of SIDS as compared to those who died from other causes," Dr. William Sturner, Rhode Island's Chief Medical Examiner, told *Microwave News*. "The SIDS babies' melatonin levels were severely depressed." The cause of the suppression is unknown—but a number of stimuli *are* known to suppress melatonin production, including daylight, stress, alcohol and electromagnetic fields (EMFs). Studies linking low-level EMFs to melatonin inhibition were carried out at the Battelle Pacific Northwest Labs in Richland, WA (see *MWN*, M/J88).

After looking at the levels of melatonin in the blood and cerebrospinal fluid (CSF) among a group of SIDS victims, Sturner and his colleagues from MIT found that many of the babies had dramatically low levels of melatonin. Interestingly, most SIDS babies die at night, when melatonin levels are normally elevated, but even those who died during the day had lower levels than expected, Sturner observed. "We targeted melatonin for investigation because of its role as a sleep regulator," he said. Sturner is currently preparing his results for publication.

SIDS and Waterbeds

In a letter to the *New England Journal of Medicine* (June 23, 1988), researchers from the University of Wisconsin in Madison and from the Sudden Infant Death Center in Minneapolis, MN, report six SIDS cases in which the infants died on electrically-heated water beds. They attribute their findings to the possibility that the infants were unable to lift up their heads to breathe.

The issue of sleeping position and its possible relationship to SIDS has also been discussed in the pages of *The Lancet*. In the July 9 issue, researchers from the University of Sheffield Medical School in the U.K. and from the University of Tasmania in Australia report finding an association between babies who slept on their stomachs and SIDS. Responding in the August 27 issue, a researcher at the Adelaide Children's Hospital in South Australia writes that after examining the data of SIDS fatalities, she found that significantly fewer SIDS infants slept supine than did controls.

CA EMF Health Effects Bill Signed into Law

On September 29, California Governor George Deukmejian signed into law a bill requiring state utilities to fund a two-year, $2 million research project on the effects of electromagnetic fields. These funds are in addition to $100,000 already allocated in the governor's current budget (see *MWN*, M/J88).

The initiative, prompted by the results of the New York Power Lines Project, will allow for an independent evaluation of health risks. All electrical utilities with revenues over $25 million will help finance the research.

The new law, chapter 1551, which was proposed by Senator Herschel Rosenthal, calls for the Public Utilities Commission and the Department of Health Services to run the project as a joint effort. The agencies must submit a status report by December 1, 1990.

Copies of the law are available from: Senate Energy Committee, Room 2035, State Capitol, Sacramento, CA 95814, (916) 445-9764.

"Nine Farm" Study on Stray Voltage and Dairy Cows

In Wisconsin, dairy production losses have prompted a new look at stray voltage on the farm. A recent "nine farm" study prepared by the Stray Voltage Analysis Team (SVAT) —a state-appointed voluntary group of farmers, utility representatives and veterinarians—recommends that farmers experiencing milk production problems consult with utilities to find workable solutions. (Livestock ailments are also associated with stray voltage.)

Among the SVAT's recommendations are that utilities improve existing primary electrical systems by adding grounding rods to the neutral conductors and that power line wiring

be aboveground for easy inspection. For farmers, the SVAT advises periodic assessments of their electrical systems and regular communication with utility representatives.

Although the SVAT describes the volunteer effort as "successful" on an individual farm basis, it calls for future studies to be more formally organized and coordinated.

The report was submitted to the Stray Voltage Task Force of the Wisconsin Department of Agriculture, Trade & Consumer Protection and to the Wisconsin Public Service Commission. The task force was set up in January 1987.

For more information, contact: Bob Ehart, Executive Assistant, Wisconsin Department of Agriculture, Trade & Consumer Protection, 801 West Badger Road, PO Box 8911, Madison, WI 53708, (608) 267-9423. The report was initially released in November 1987 and was reprinted in the spring.

New Research Papers

W. Ross Adey, "Cell Membranes: The Electromagnetic Environment and Cancer Promotion," *Neurochemical Research, 13*, pp.671-677, 1988.

A general overview of Adey's research leading to the conclusion that "cancer promotion may involve a distorted inward signal stream from cell membranes to intracellular organelles, including the nucleus."

Robert Banks, F.S. Perry and L. Pearl, "Letters to the Editor," *Public Health, 102*, pp.393-394, 1988.

An exchange of views on Perry and Pearl's paper linking depression to ELF exposure in high-rise buildings (see *MWN*, N/D87 and M/J88).

Frank S. Barnes, "Mechanism of Interaction of Magnetic Fields with Biological Systems," *IEEE Transactions on Magnetics, 24*, pp. 2101-2104, July 1988.

A short introduction to possible mechanisms, with some order-of-magnitude calculations, especially with respect to environmental and occupational exposures.

Robert O. Becker, "Comments on 'Biological Effects of Power Line Fields,' " *Journal of Bioelectricity, 7*, pp.103-118, 1988.

Critique and review of the final report of the New York State Power Lines Project (see *MWN*, J/A87).

Carl F. Blackman et al., "Effect of Ambient Levels of Power-Line-Frequency Electric Fields on a Developing Vertebrate," *Bioelectromagnetics, 9*, pp.129-140, 1988.

These intriguing experimental results, first reported in 1986 (see *MWN*, J/F87), show that 10 V/m (rms) E-fields—a level "typically found inside buildings"—can have an effect on brain tissue. For eggs exposed to 60 Hz EMFs during incubation, the chick brains responded to 50 Hz, but not to 60 Hz, fields. For eggs exposed to 50 Hz, the chick brains did not respond to either 50 or 60 Hz fields.

Joseph D. Bowman et al., "Exposures to Extremely Low Frequency (ELF) Electromagnetic Fields in Occupations with Elevated Leukemia Rates," *Applied Industrial Hygiene, 3*, pp.189-194, June 1988.

Measurement data from the team at the University of Southern California (see *MWN*, J/F88).

Craig V. Byus et al., "Increased Ornithine Decarboxylase Activity in Cultured Cells Exposed to Low Energy Modulated Microwave Fields and Phorbol Ester Tumor Promoters," *Cancer Research, 48*, pp.4222-4226, August 1, 1988.

This, the second EMF-ornithine decarboxylase (ODC) paper, shows that cells respond not only to 60 Hz fields, but also to 450 MHz radiation amplitude modulated at 16 Hz. 60 or 100 Hz modulations were not effective, however (see *MWN*, N/D87).

H. Keith Florig and M. Granger Morgan, "Measurements of Housing Density Along Transmission Lines," *Bioelectromagnetics, 9*, pp.87-93, 1988.

Based on aerial photographs, the density of houses within 200 m of high- and low-voltage power lines was found to be smaller than in the rest of the service area, to increase with distance from the line and to be inversely correlated with line voltage.

Jukka Juutilainen, Esa Läära and Keijo Saali, "Relationship Between Field Strength and Abnormal Development in Chick Embryos Exposed to 50 Hz Magnetic Fields," *International Journal of Radiation Biology, 52*, pp.787-793, 1987.

This Finnish team found a strong suggestion of a "sharp threshold" between 0.9 and 1 A/m (1.1-1.3 μT) for the abnormal development of chick eggs exposed to 50 Hz sinusoidal H-fields. This threshold effect is not explainable by induced currents. (See also *MWN*, M/J86.)

J. Juutilainen, E. Pukkala and E. Läära, "Results of Epidemiological Cancer Study Among Electrical Workers in Finland," *Journal of Bioelectricity, 7*, pp.119-121, 1988.

Final data from the study, which shows an increased rate of cancer among Finnish electrical workers (see *MWN*, M/A87).

William T. Kaune and William C. Forsythe, "Current Densities Induced in Swine and Rat Models by Power-Frequency Electric

DOE EMF Bioeffects Budget Set at $3 Million

The U.S. Congress has allocated $3 million for ELF bioeffects research at the Department of Energy (DOE) for fiscal year 1989 (FY89), according to DOE's Dr. Imre Gyuk. The Reagan Administration had initially requested $2.2 million, and the House of Representatives had proposed $4 million (see *MWN*, M/J88). A House-Senate conference reached the $3 million compromise and, to the surprise of many, the final budget bill was signed on time —as FY89 began October 1.

The budget will allow the DOE to continue with its current programs, said Gyuk, a program manager at DOE's Office of Energy, Storage and Distribution. He admitted that he had hoped for more: "It would have given us elbowroom to initiate new research initiatives—this program is clearly in the national interest." He dismissed the $2.2 million request as unrealistic; it would have forced "considerable cuts."

Fields," *Bioelectromagnetics, 9,* pp.1-24, 1988.

Dosimetry data for models of swine and rats exposed to E-fields, which, the authors believe, will provide an improved rationale for extrapolating biological data across species.

Bengt Knave and Birgitta Floderus, "Exposure to Low-Frequency Electromagnetic Fields—A Health Hazard?" *Scandinavian Journal of Work, Environment & Health, 14,* pp.46-48, 1988.

A brief overview of ELF cancer studies with special emphasis on the two major Swedish epidemiological projects underway (see *MWN,* M/J87).

John R. Lymangrover et al., "Direct Power-Frequency Electric Field Effects on Mammalian Endocrine Tissue," *Environmental Research, 43,* pp.157-167, 1987.

In vitro 60 Hz E-field exposure significantly enhanced the steroidogenic response of rat adrenocortical tissue. The overall conclusion is that there are possible "optimum field intensities and exposure durations for each bioeffect."

M. Malter et al., "Tumoricidal Cells Increased by Pulsating Magnetic Field," *Anticancer Research, 7,* pp.391-394, 1987.

50 Hz H-fields were found to enhance the tumor-destroying activities of "killer" white cells in rat livers *in vitro.* Leukemia cells of mice were "insensitive" to H-fields.

M. Granger Morgan et al., "Controlling Exposure to Transmission Line Electromagnetic Fields: A Regulatory Approach That is Compatible with the Available Science," *Public Utilities Fortnightly,* pp.49-58, March 17, 1988.

The authors propose an economic incentive strategy for reducing the number of people exposed to power line EMFs: charging utilities an "exposure fee" for each individual living within a set distance from a line to encourage siting new power lines as far away from the public as possible.

I. Nordenson et al., "Chromosomal Effects in Lymphocytes of 400 kV-Substation Workers," *Radiation and Environmental Biophysics, 27,* pp.39-47, 1988.

A replication of Nordenson's 1984 study, this report also shows a significantly increased rate of chromosomal aberrations in blood cells of substation workers exposed to EMFs and spark discharges.

Koichi Shimizu, Hideto Endo and Goro Matsumoto, "Visualization of Electric Fields Around a Biological Body," *IEEE Transactions on Biomedical Engineering, 35,* pp.296-302, May 1988.

Describes a system to visualize the ELF E-fields surrounding complex shapes, such as biological bodies, using an optical sensor and a microcomputer-controlled automatic scanner, to help the study of bioeffects.

R.M. Stern, "Cancer Incidence Among Welders: Possible Effects of Exposure to Extremely Low Frequency Electromagnetic Radiation (ELF) and to Welding Fumes," *Environmental Health Perspectives, 76,* pp.221-229, December 1987.

Stern, formerly with the Danish Welding Institute and now with the WHO in Copenhagen, found a higher than expected incidence of respiratory tract cancer, but not of leukemia or acute leukemia among welders who are routinely exposed to ELF H-fields and to metallic aerosols. He concludes that his finding "does not support the hypothesis that the observed excess risk for leukemia or acute leukemia among workers in the electrical trades is due to their ELF exposure, which on average is lower than that of welders."

FROM THE FIELD

Boeing Memo on EMP

The following memorandum was released during the discovery phase of Robert Strom's claim for workers' compensation and lawsuit against the Boeing Co., in which he argues that exposure to electromagnetic pulse (EMP) radiation caused him to develop leukemia (see MWN, *J/A88).*

October 4, 1979

To: Jack Gebhart

From: William E. Morgan, Chief, Radiation Health Protection

Subject: EMP exposure limits for Boeing personnel

Because of the unknown factors associated with the biological effects of electromagnetic pulse (EMP) radiation, the Boeing Company has taken a conservative stand on the maximum permissible exposure limits.

We do not believe that an exposure limit should only be based on the "thermal" effects of RF radiation absorbed in the body. This becomes more evident from indications that the whole chemical balance within the body is disturbed by the electromagnetic field of the peak radiation.

The non-thermal effects must be included in any safe level established for personnel. Until firm data is produced as to the effect of the electromagnetic pulse on the body, Boeing personnel will be exposed only to the following limits:

A. Chronic Exposure Level

The chronic exposure level should be maintained at *less than 5 kV/m for continuous exposure of 40 hours per week.* The pulses should be limited to *one pulse per minute.*

B. Acute Exposure Level

An acute exposure level on an intermittent basis should be maintained at *less than 50 kV/m* when responsible engineering controls or administrative procedures cannot limit exposures to less than 5 kV/m.

C. General Population Exposure Level

The general population exposure level should be maintained at *less than 1 kV/m for continuous exposure.*

Baseline physical examinations should be given to all Boeing personnel who are planning to be chronically exposed to EMP radiation over a period of 30 days. Baseline exams should also be given to anyone who could possibly have an acute exposure to the EMP radiation.

UPDATES

BIOLOGICAL EFFECTS

RF and Endocrine Glands... Soviet researchers have detected subtle changes in the membranes and in the glycoprotein-polysaccharide cell walls of rabbits whose endocrine glands were exposed to 460 MHz radiation at local SARs of 6.2-20.8 W/Kg. "Our experiments demonstrated the high sensitivity of the thymus cells to EM emissions, both with exposure of the thymus itself and with the action of [RF] on separate parts of the hormone regulatory system," said Dr. V.M. Bogolyubov. Bogolyubov and coworkers at the Ministry of Health in Moscow found that, after adrenal gland exposure, "changes in the thymocyte cell membrane are preceded by changes in the cell nucleus." Their paper appears in the July 1988 issue of *Radiation Research* (*115*, pp.44-53).

COMPATIBILITY & INTERFERENCE

Pacemaker EMI... Much has been done to protect cardiac pacemakers from EMI, but some units are still unable to reject powerful signals with characteristics similar to those generated by the heart, cautions an advisory prepared by the Canadian Centre for Occupational Health and Safety's (CCOHS) Physical Hazards Group. For instance, pacemakers may be susceptible to EMFs from high-voltage power lines, theft and weapon detectors, high-power antennas and NMR imagers. Strong fields may cause pacemakers to reject normal cardiac signals and pace in competition—rather than in coordination—with the heart's natural beat. In addition, EMFs can confuse the pacemaker by mimicking cardiac signals. There are no reported cases of EMI causing pacemakers to stop completely, says CCOHS, but interference can also cause dizziness and accelerated heartbeats. The brief report, *Possible Health Hazards for Cardiac Pacemaker Wearers from Exposure to Electromagnetic Fields* (P88-5E), is available in both French and English from: CCOHS, 250 Main St. East, Hamilton, Ontario L8N 1H6, Canada, (416) 572-2981. Single copies are free for Canadians and cost $3.00 (U.S.) for all others. ...With respect to low-power sources such as microwave ovens and electronic security devices, there is little to worry about, *Consumer Reports* advises in its October 1988 issue. (See also *MWN*, J84 and J85 for more on ELF EMI and J/A86 for MRI EMI to pacemakers.)

FCC Actions... The commission has denied a request from Linear Corp. to reconsider its position on RF lighting. Last year, the FCC decided not to go forward with a proposal to regulate emissions below 30 MHz (see *MWN*, M/J86 and N/D87). In a decision issued September 19, the commission said that Linear had not presented any information not previously considered....On August 24, the commission dismissed a petition filed by the Association of Maximum Service Telecasters seeking a second look at the FCC's policy to exempt ISM equipment from the technical requirements of Part 15, subpart J....And on August 17, the FCC's laboratory in Columbia, MD, dismissed applications under Part 15 rules for five computer devices—including one from Toshiba Corp.—because the equipment had been modified.

GOVERNMENT

NBS Becomes NIST... On August 23, the National Bureau of Standards (NBS) was transformed into the National Institute of Standards and Technology by President Reagan when he signed the Omnibus Trade and Competitiveness Act into law. Along with a new name, the institute now has greater responsibilities, including starting a program to assist the transfer of technology to state and local governments and to help government officials set technology policy. The NIST has until December 21 to submit a new organization plan to Congress. No changes in NBS's traditional measurement services are anticipated and, like NBS, NIST will be part of the of Department of Commerce.

INTERNATIONAL

U.K. Report on NIER... Current evidence indicates that "chronic low-level exposure to the non-ionizing radiations appears to be generally harmless," writes Dr. J.M. Harrington in his preface to a report prepared by the Industrial Injuries Advisory Council for the U.K.'s Department of Health and Social Security. But, he adds, the council "accepts that there is concern about the potential long-term effects of some relatively new forms of technology...and will continue to monitor...this area." The December 1987 report addresses various types of NIER—RF/MW and ELF fields from power lines and VDTs—and related health concerns. The report continues to uphold the 10 mW/cm^2 safety standard and points out that, although there is "some evidence associating low intensity RF/MW with cataracts and other eye damage, the risks appear to be limited to higher-than-normal occupational exposures." It further concludes that studies linking chronic low-level RF/MW exposures to a range of health effects, such as headaches and concentration and memory lapses, are inconclusive. With respect to power lines, the report describes the studies linking power lines to childhood cancer as "conflicting," and concludes that, in general, there is insufficient evidence to link EMF exposures to any harmful effects on humans. Similarly, for VDTs, the report finds that, "Recent studies have not shown a causal relation between use of VD[T]s and an increased risk of miscarriage" or any other condition due to EMFs from VDTs. Although possible conditions associated with VDT use include cataracts and eyestrain, facial dermatitis, back problems and repetition strain injuries, these are attributable to factors unrelated to radiation, the report concludes. A copy of the report, *Non-Ionizing Radiation* (CM253), is available for £2.60 from: Her Majesty's Stationery Office (HMSO), Publication Center, PO Box 276, London SW8 5DT, U.K., (01) 622-3316.

IRPA Proceedings... The International Radiation Protection Association's International Non-Ionizing Radiation Committee

(IRPA-INIRC) has published a book assembled for a workshop held as part of IRPA's April 1988 congress (see *MWN, S/O87*). Written by members of the INIRC, the text covers the spectrum from ELF fields through RF/MW radiation to UV radiation and includes reviews of standards and risk perception, as well as a discussion of VDTs. Copies of *Non-Ionizing Radiations: Physical Characteristics, Biological Effects and Health Hazard Assessment*, edited by Dr. Michael Repacholi, are available for $50.00 plus postage and handling from: Dr. Colin Roy, Australian Radiation Lab, Lower Plenty Rd., Yallambie, Victoria 3085, Australia. Invoices will be sent with the book.

MEASUREMENT

EMFs from ESD... The NIST (née NBS, see p.10) has developed a way of measuring the EMFs radiated by electrostatic discharges (ESD). The measurement of ESD EMFs has long been hampered by the lack of commercially available antennas with enough bandwidth to measure fast pulses. Now, institute staffers have overcome the problem—at least for electric fields. Using a new broadband antenna, the NIST's Perry Wilson and coworkers found that the strongest fields are radiated by relatively low-voltage (2-4 kV) discharges. In a new report, *Electromagnetic Fields Radiated from Electrostatic Discharges: Theory and Experiment* (TN 1314), they note that "the spark fields can pose a significant interference threat to electronic equipment into the gigahertz range." The radiated magnetic field could not be measured because there is still no broadband H-sensor. The report is available for $3.50 (prepaid) from: Government Printing Office, Washington, DC 20402; Order No.003-003-02864-9.

Test Sites... You can now rent an anechoic chamber or shielded test room for FCC or antenna testing. Ray Proof Shielding Systems Corp. has introduced a test facility leasing program offering anything from a small TEMPEST room to a full-scale aircraft testing chamber—prices range from $500 to $100,000 a month. For more information, contact: Jim Graham, Ray Proof Shielding Systems Corp., 50 Keeler Ave., PO Box 5060, Norwalk, CT 06856, (203) 838-4555....Ray Proof has also just finished building a 68' x 34' x 28' chamber for IBM's Product Lab in Endicott, NY, for testing computers and other electronic devices....Or you can use the NIST's 28' x 12' x 16' anechoic chamber in Boulder, CO. The Electromagnetic Fields Division has expanded the frequency range for EMI testing, previously 200 MHz-18 GHz, up to 40 GHz. For more information, contact: Galen Koepke, Division 723.03, NIST, Boulder, CO, 80303, (303) 497-5766....In Minnesota, the EMC testing business is also booming. Amador Corp. is launching its third open area test site near Millville, 20 miles northeast of Rochester, where IBM has an office. The 32' x 66' all-weather facility features a 14' remote-control turntable with a capacity of up to 10,000 lbs. For more information, contact: Daniel Hoolihan, Amador Corp., Wild Mountain Road, Taylors Falls, MN 55084, (612) 583-3322.

MEETINGS

Charge and Field Effects... The *International Symposium on Charge and Field Effects in Biosystems* will be held June 4-9, 1989, at Virginia Commonwealth University (VCU) in Richmond. VCU's Dr. Steven Cleary, who is one of the organizers, says that the symposium will bring together—and encourage communication between—various scientific disciplines in the fields of bioelectrochemistry, bioenergetics and bioelectromagnetics. The meeting will be a follow-up to the 1983 symposium held at the University of Nottingham in the U.K. Plenum Press will publish the proceedings. For more information, contact: Conference Coordinator, Continuing Studies & Public Service, Box 2041, Virginia Commonwealth University, Richmond, VA 23284, (804) 367-8421.

Bioelectricity Society... The International Society for Bioelectricity will hold its second meeting at the University of North Texas in Denton, March 10-12. According to the society's president, Dr. Andy Marino of LSU Medical Center, the meeting will span the entire range of bioelectricity—including basic science and clinical medicine. He pointed out that biology is the key to progress: "It seems to me that since the field began, each significant advance has come from biological research as opposed to physical and engineering approaches." For more information, contact: Patricia Burnett, Dept. of Orthopaedic Surgery, LSU Medical Center, PO Box 33932, Shreveport, LA 71130, (318) 674-6180..

MILITARY SYSTEMS

News Roundup... The USAF has embarked on the third phase of its GWEN system, an EMP-resistant communications network (see *MWN*, J/F86, N/D86 and N/D87). Contel Federal Systems of Fairfax, VA, has been awarded a $30 million contract for the design and installation of 40 additional relay towers—30 fewer than originally planned by the USAF. The system is scheduled to be completed in 1992....The Naval Air Systems Command has released a draft environmental impact statement (DEIS) for its Mid-Atlantic Electronic Warfare Range (MAEWR), which will provide tactics and survival training for combat aircrews in a "hostile" environment. Although the DEIS states that the Space and Naval Warfare Systems Command and the Naval Electronics Systems Command will be responsible for the calculation of the RF/MW exposure levels from the host of different simulators to be used on the North Carolina range, it does not give any specific numbers. For more information, contact: Charles Maguire, Atlantic Division (Code 203), Naval Facilities Engineering Command, Norfolk, VA 23511, (804) 445-2307....Terry O'Laughlin reports on his visit to Project ELF's Wisconsin Transmitter Facility in the April 1988 issue of *Popular Communications*. Project ELF, the U.S. Navy's land-to-submarine communications system, operates at 76 Hz with transmitter sites at Clam Lake, WI, and on Michigan's upper peninsula. The Wisconsin antenna has been operational since 1985, broadcasting with

wavelengths of 2,500 miles at powers of up to 2.3 million watts. The Michigan facility is due to be completed later this year. Project ELF has long been controversial: Attempts to halt it were foiled in 1984 when the U.S. court of appeals overturned a lower court order requiring a supplemental EIS and suspended an injunction against further construction (see *MWN*, S84)....The July 25 *Defense News* describes Israel's efforts to protect against EMP and its export of EMP simulators to a number of European countries....The July 2 *New York Times*'s patents column notes that the U.S. Army has developed a portable EM gun....The *Armed Forces Journal International* features an item on RF weapons in its May 1988 issue....And the Associated Press reported on September 27 that Eaton Corp., the manufacturer of electronics systems for the B-1 bomber, has estimated that it would cost an additional $520 million to fix the plane's EMC problems.

OVENS

A Moveable Feast?... Cooking fish in a microwave oven may not kill all existing bacteria and other parasites, according to Drs. C. Darrell Lane, Ronald Master and Ralph Tietbohl of the Reading (PA) Hospital and Medical Center. In a letter to the *Journal of the American Medical Association* (July 15), they cite the example of a woman and her son who ate a piece of haddock cooked in a microwave oven and left the remaining fish to cool on the kitchen table. Soon after, they noticed some movement in the uneaten fish—small, tan, worm-like organisms which were later identified as *Anisakis* larvae, forerunners of a parasitic disease found in seafood known as *anisakiasis*. Neither contracted the disease, however. The physicians also note the case of a doctor who developed trichinosis from eating pork cooked in a microwave oven (see *MWN*, Ju81 and A82). They emphasize that users of microwave ovens should be aware that microwave preparation may not be sufficient to eliminate microorganisms and parasites from food. Adequate cooking requires raising food temperature to 60°C for a minimum of five minutes, they advise.

PEOPLE

Drs. **Allan Frey, Abe Liboff, Klaus-Peter Ossenkopp, Jerry Phillips** and **Betty Sisken** are joining Dr. **Rugerro Cadossi** as assistant editors of the *Journal of Bioelectricity* beginning with the first issue of 1989. Dr. **Andrew Marino**, the editor of the journal, plans to increase the number of issues published every year....Dr. **Richard Vetter** of the Mayo Clinic has taken over as the editor in chief of *Health Physics*, replacing Dr. **Genevieve Roessler**, who had headed the monthly journal for the last six years....Dr. **Tim Aldrich** has left Oak Ridge National Lab to become the director of North Carolina's new cancer registry. Aldrich is now based in Raleigh. ...**Roger Schneider**, a longtime, senior staffer at the FDA's Center for Devices and Radiological Health has retired.

STANDARDS

Yugoslavian RFI... The Yugoslavian government has proposed rules governing the immunity of broadcast receivers and related equipment from RFI. According to the current schedule, the rules will be adopted on January 1, 1989. For a copy of the new standard, contact: Standards Information Center, NIST, Administration Bldg., Room A629, Gaithersburg, MD 20899, (301) 975-4037; ask for TBT Notification No.88.113.

VDTs

Scandinavian Studies...A group headed by Dr. Mats Berg of the Karolinska Hospital in Stockholm, Sweden, has failed to find any mutagenic response to VDT EMFs—as measured by the widely used Ames Salmonella test. The team ran the experiment using both a VDT in which the electrostatic field had been eliminated and one with a 250 kV/m electrostatic charge. In each case, the response was negative. Berg and coworkers conclude that their results support "the view that there is no increased risk of skin cancer" associated with VDT work. Their findings appear in the *Scandinavian Journal of Work, Environment & Health, 14*, pp.49-51, 1988. Last year, Berg reported that many anti-static VDT screens stop working after six months (see *MWN*, M/J87)....Researchers at the University of Kuopio in Finland report that the concentration of air ions in the vicinity of a VDT decreases rapidly when the unit is turned on—due to its electrostatic charge. S. Konttinen and coworkers could not estimate the importance of their findings because "little is known of the possible health effects of ion-depleted air." The results are in the *Journal of Bioelectricity, 7*, pp.89-95, 1988. (See also *MWN*, N/D85.)

ETC...

IEEE Special Issues...A number of recent IEEE Transactions have been devoted to special topics: The May *IEEE Transactions on Microwave Theory and Techniques* commemorates the centennial of Heinrich Hertz and features a short biography by Professor Charles Süsskind and a review of the "First Century of Microwaves—1886 to 1986" by Dr. John Bryant. ...The June *IEEE Transactions on Antennas and Propagation* covers "Near-Field Scanning Techniques." Of the more than 20 papers, two present brief histories of near-field measurements at NBS (now NIST) and at Georgia Tech. (See also NIST's Dr. Lorant Muth's "Displacement Errors in Antenna Near-Field Measurements and Their Effect on the Far Field" in the journal's May 1988 issue.)...And the August *IEEE Transactions on Electromagnetic Compatibility* is devoted to electromagnetic shielding, including calculations, measurements and enclosures.

of the electromagnetics branch at EPA's ORP who now heads his own consulting firm in Las Vegas, NV.

"All the federal agencies were expecting EPA to be there in the future and I am alarmed that may not be the case," said one federal official with responsibility for NIER who asked not to be named. "It appears that almost all interested parties would like to see a federal standard—that's why it's hard to understand why this decision is being made."

Dr. Jay Brandinger, the president of the Electromagnetic Energy Policy Alliance (EEPA), a Washington, DC, trade association, called the decision a "very unfortunate and giant setback" for the public and for all those who had worked on the guidance. Brandinger, who is with SRI International, warned that without federal guidance from EPA, there will be a proliferation of state and local rules, and he said that the alliance will work to reinstate the program. EEPA, whose members include the National Association of Broadcasters, Raytheon and GTE, among others, has long pressured EPA to set RF/MW radiation exposure limits (see *MWN*, S/O86), preferably those adopted by the American National Standards Institute (ANSI) in 1982.

EPA first announced plans to issue a "guidance" for RF/MW radiation in 1979 and published an "advance notice of proposed rule-making" in 1982 (see *MWN*, J/F83, Mr83 & A83). The agency does not have the authority to set a national NIER standard, but it can adopt safety levels to be followed by other federal agencies—and any guidance limits would become de facto national standards.

As the guidance process got under way, the agency proposed to close down its NIER research lab in North Carolina, where staffers wrote the scientific rationale for the RF/MW limits. After a four-year struggle, the lab would close down for good in 1986 (see *MWN*, J/F83, D84, S/O85, J/F86 & S/O86).

In 1984, EPA was about to propose a limit of 100 $\mu W/cm^2$, when pressure from EPA's policy group forced the radiation office to shelve the initiative. Two years later, EPA outlined four options—100 $\mu W/cm^2$, 200 $\mu W/cm^2$, 1,000 $\mu W/cm^2$ and no action—for dealing with RF/MW radiation risks, but did not specify preferred levels (see *MWN*, J84). A public hearing on the options was held in Washington, DC, in 1986 (see *MWN*, S/O86).

During FY89, which began October 1, 1988, EPA will phase out its NIER activities in Washington, DC. In FY90, all work will stop—except that Ed Mantiply at EPA's lab in Las Vegas, NV, will continue the agency's NIER monitoring studies.

Staffers at EPA's Office of Health and Exposure Assessment are scheduled to release an assessment of the carcinogenic potential of NIER later this year (see box at left). That assessment could influence the perception of the health threat of NIER and the need for NIER regulations.

Pressure from EPA's Scientific Advisors

Last June, after EPA officials notified the agency's Scientific Advisory Board (SAB) that it would "defer" all NIER programs, the SAB wrote to EPA Administrator Lee Thomas urging that, "It is imperative that a viable federal presence be maintained" in the area of NIER and that EPA "must not totally abandon its work" on NIER. In its July 19 letter, the SAB noted that if the agency keeps the program alive, it "will provide an inestimable service in the public interest at a relatively small cost in budget and personnel."

The SAB letter cited the publication of the two new epidemiological studies on power line health risks—those of Drs. David Savitz and Richard Stevens—as evidence of "both the continuing interest in this field and the ambiguous nature of most current data." The letter was signed by Dr. Norton Nelson, the chairman of the SAB Executive Committee and Dr. William Schull, the chairman of the board's Radiation Advisory Committee (see p.14 for the complete text of the SAB and EPA letters).

On August 26, Thomas replied that there would be no change in plans, arguing that "deferral is not the same as abandonment." A small working group had been set up, Thomas wrote, "to effect an orderly phase down." EPA's Dave Janes, a division director within the ORP, is chairing the working group, which includes representatives from the re-

EPA Preparing Cancer Assessment for NIER

EPA scientists are preparing an assessment of the human cancer threat posed by low- and high-frequency NIER. A draft report should be completed by the end of the year, according to Dr. Robert McGaughy of the Office of Health and Exposure Assessment, who is in charge of EPA's cancer evaluation.

In May 1987, McGaughy completed a preliminary assessment, which was devoted largely to an analysis of Dr. Bill Guy's $5 million chronic exposure study at the University of Washington (see *MWN*, J/A84 and Mr85). That evaluation was inconclusive, leading McGaughy to recommend widening the scope of the effort to include the literature on cancer epidemiology and mechanisms. The preliminary report was transmitted to the Office of Radiation Programs (ORP).

The cancer assessment was initiated as part of the development of the guidance for public exposures to RF/MW radiation, which EPA no longer plans to issue. Asked what he will do if the assessment indicates a NIER-cancer link, ORP Director Richard Guimond said that he will then support a health research program. EPA's research group on NIER was disbanded in 1986, after waging a four-year battle to keep its lab open.

McGaughy said that the new assessment will be peer reviewed if it concludes that there is a cancer risk.

gional offices.

Thomas wrote that, "We envision a summary report that contains guidance on exposure levels." How those levels will be released is not yet clear. Guimond suggested that EPA may put out informal guidelines or an RF/MW radiation brochure.

In an interview with *Microwave News* from his office at the University of Texas Health Sciences Center in Houston, Schull, a longtime researcher on ionizing radiation, said that it was "less than wise" for the agency to lose its competence in this area and he predicted that the issue will resurface in the future.

Professor Charles Süsskind of the University of California at Berkeley, who drafted the SAB letter, said that he was disappointed by the agency's "indifferent response." Süsskind, who is the only NIER expert on the SAB radiation committee, added that he has been notified that he will not be reappointed when his term expires later this year. According to Kathleen Conway, the deputy director of the SAB, Süsskind

Exchange of Letters Between the SAB and EPA Administrator Lee Thomas

July 19, 1988

Dear Mr. Thomas:

The Science Advisory Board's (SAB) Radiation Advisory Committee (RAC) has been apprised of the Office of Radiation Programs' (ORP) proposal to "defer" all agency involvement in non-ionizing radiation (NIER) after the Guidance to limit exposure (now being developed) is issued. The intent is to phase out such smaller programs and focus on larger tasks with perceived higher priorities.

In its report on NIER of January 31, 1984, the SAB recommended periodic review and evaluation of new research, a strengthening of in-house and extramural research, and a continuation of the agency's monitoring of ambient levels and its technical support to other government agencies to assure compliance with its Guidance.

Apart from one periodic review, the agency has not found it possible to carry out any of these recommendations, nor is it likely to do so now, despite renewed nationwide interest in the effects of NIER as a possible cancer promoter and the imminent issuance of a Guidance that is to be implemented by other federal agencies.

At its July 19 meeting, the Executive Committee of the SAB joined with the RAC in the recommendation that the agency must not totally abandon its work in the area of NIER. This recommendation is particularly relevant in the light of two studies dealing with NIER reported in the current issue of the *American Journal of Epidemiology*, which evidence both the continuing interest in this field and the ambiguous nature of most current data.

At a minimum, the agency must continue to monitor research in this field and provide technical support and assistance (including measurement capabilities) to other government agencies, as foreseen in EPA's Notice of Proposed Recommendations, *Federal Register*, p.27,318, July 30, 1986. Some agencies have already expressed a need for such assistance in their implementation of and compliance with the forthcoming Guidance. It is imperative that a viable federal presence be maintained in the area of NIER and the support activity by the agency will provide an inestimable service in the public interest at a relatively small cost in budget and personnel.

In order to clarify these issues, the board requests additional information on the agency's near-term and long-term plans for its own NIER program and specific information about the current and planned levels of support for NIER activities elsewhere in the federal government.

Sincerely,

Norton Nelson, Chairman,
Executive Committee, SAB

William J. Schull, Chairman,
RAC, SAB

August 26, 1988

Dear Dr. Nelson:

Thank you for your July 19, 1988, letter concerning the deferral of the agency's NIER programs beginning in fiscal 1990.

As you know, the agency is faced with a large number of important radiation problems. In the past, we have attempted to work on all of them at once. This has allowed us to remain active in all problem areas, but has limited real progress in reaching solutions. We are now changing our strategy in an attempt to focus enough resources on selected problems to effect their early resolution. This approach provides for real progress and frees resources for other problems when solutions are reached. Such an approach requires some very hard decisions about which problems to address immediately and which to defer. We do not expect that everyone will endorse our selections, but I can assure you that we have not made these decisions without considerable analysis and reflection. It is also important to stress that deferral is not the same as abandonment. After due consideration of a number of factors, including such things as court-mandated activities, resources, and staff skills, we have decided to defer the NIER activities in the ORP beginning in fiscal 1990.

To effect an orderly phase down of what is already a very small program, we have formed a small working group within the ORP with representation from our regional offices. This working group has two principal tasks. The first is the preparation of a fiscal 1989 work plan that allows us to capitalize on our past work in this area. We envision a summary report that contains guidance on exposure levels. The second task is the preparation of a long-term strategy for addressing this important radiation problem so that we will have a plan to implement when resources become available. The working group will meet the latter part of August to prepare the fiscal 1989 plan. A schedule of activities will be complete by late September and long-term strategy written early in 1989. We will be happy to share with you the schedule and drafts of the long-term strategy as they become available.

I hope that you find this letter responsive to your concerns. I deeply appreciate your continued efforts to help us build a strong and scientifically defensible radiation program within EPA.

Sincerely,

Lee Thomas
Administrator, EPA

will be retained as a consultant. Conway said that she plans to schedule one meeting a year to review NIER developments.

The EPA guidance would have addressed only RF/MW radiation—not extremely low frequency (ELF) fields—although, in the past, Congress has requested EPA to work on ELF health risks (see *MWN*, J83). The ORP has never proposed issuing a guidance for ELF fields. Last year, the ORP's Janes said that the responsibility for dealing with ELF exposures was "too diffuse" (see *MWN*, N/D87).

In September, the ORP made national news headlines when EPA recommended that Americans take the health threat of radon gas more seriously and that every home in the U.S. be tested for radon. Before becoming the director of the ORP, Guimond headed EPA's radon division.

Marcy-South Power Line Trial *(continued from p.1)*

NYPA views the situation differently. In a telephone interview, NYPA attorney Tom Watson of Crowell & Moring in Washington, DC, outlined the utility's position: "The landowners want to be compensated for fear of health effects. We're saying that they're not entitled to compensation because they cannot establish that there is a reason for fear, that that fear actually exists and that it affects the value of their property."

By the end of September, when the trial recessed for two weeks, NYPA had spent $1.2 million on attorney and witness fees, according to a NYPA spokeswoman. The utility could not say how much of the money went to legal fees and how much went to expert witnesses. For his part, Watson said, "I never discuss fees except with clients."

At the same time, Michael Gurda, Sr. estimated the plaintiffs' combined expenses at $300,000, of which approximately $65,000 went for expert testimony and $100,000 for land appraisal. Gurda described NYPA's trial expenses as "arrogant," in light of the utility's original offer of $400,000 for easements on the landowners' property.

The trial opened with the expert witnesses for the landowners. Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport countered NYPA's contention that studies involving frequencies outside of the 50-60 Hz range are irrelevant by drawing an analogy to cigarettes. "If you are studying the effects of smoking, you don't limit your study to one brand of cigarettes. For the purpose of evaluating health risks, cigarettes are cigarettes and magnetic fields are magnetic fields," he said.

Marino also criticized the utility-funded studies as being "largely irrelevant" because they were designed to support corporate opinion. When asked under cross-examination whether he was testifying as an expert witness or as an advocate, Marino replied that he was speaking as "a human being."

Also testifying for the landowners was Dr. Jerry Phillips of the Cancer Therapy and Research Center in San Antonio, TX, who described his work showing that cancer cells proliferate to a greater extent in the presence of power line fields (see *MWN*, J/A86).

Dr. Harris Busch of the Baylor College of Medicine in Houston, TX, stated that, in his opinion, "It is dangerous to live in an area having an electromagnetic field (EMF) level of 3 mG or more." In his pretrial report, Marvin Chatkoff of the University of Texas in San Antonio said that, according to his calculations, fields of 3 mG or more are present at a distance of more than 500 feet from a 345-kV line with 1,250 amps per conductor.

The final witness for the landowners was Dr. Lennart Tomenius of Stockholm, Sweden, author of a 1986 study linking childhood cancer and living near power lines. Under cross-examination, Tomenius explained that his methodology could only show an association and not a causal effect.

NYPA rebutted with their own health experts. Dr. Herbert Terrace, a psychologist at Columbia University in New York City, said that there are no behavioral effects on animals. In a telephone interview with *Microwave News*, Terrace refused to discuss his testimony, saying that "the proper arena is in the courtroom." In a pretrial statement, Terrace wrote that, "Efforts to show that power frequency electric fields influence the performance of learned behavior have proved nil." Missing from his review was a study on behavioral conditioning by Dr. Kurt Salzinger of Polytechnic University for the New York State Power Lines Project—the NY panel called the results "dramatic." Asked why he had not included Salzinger's study, Terrace replied that he had indeed read it, but that there are "theoretical and procedural" problems with the work. He would not elaborate.

Dr. Ken Zaner, an assistant professor of medicine at Harvard Medical School in Cambridge, MA, testified that, from a biophysical point of view, there is no evidence of a health risk from power line EMFs.

During cross-examination, McBride made the point that scientists do not always arrive at the same conclusions based on the same information. "If the experts can't agree, how do we as lay people know whether it's safe or unsafe?" he told *Microwave News*.

With respect to engineering, Watson called NYPA's Len Panzica and Michael Silva of Enertech Consultants in Campbell, CA; according to Watson, Silva testified that the fields from an electric razor are greater than those found near a line such as Marcy-South. Silva himself refused to discuss his testimony.

The case is being heard by Judge Peter McCabe in the New York State Court of Claims. The trial will resume October 11 with the remaining NYPA witnesses and will end in November with testimony from both sides on the real estate issues.

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The rapidly increasing number of RF electromagnetic radiators such as radars and high-power radio broadcast and television stations, the large number of microwave ovens and other consumer and medical RF-generating devices in use, and the increased number of industrial RF applications constitute potential environmental, occupational, and public health hazards. The risks of exposure to intense RF fields for sensitive electronics equipment, ordnance devices, fuels, and people are examined. National defense, security, and law enforcement needs and public demand for increased consumer conveniences suggest that exposure to RF fields will probably increase. The transmission of solar power using EM fields is one of many possible future techniques that may appreciably increase the levels of environmental RF.

The presentation provides broader knowledge and understanding of the sources of RF electromagnetic fields, their transmission and interaction mechanisms, how to detect and quantify the fields, and how to protect equipment and people from their effects. The presentation is basically descriptive, with minimal use of mathematics. Examples of actual RF field surveys, investigation of human potential overexposures, and typical problem solving are provided.

The course is designed for managers, scientists, physicians, attorneys, engineers, industrial hygienists, environmental specialists, security and law enforcement personnel, electronic systems planners, and equipment operators in government, industry, and academe who need better working knowledge of hazardous radio frequency (RF) electromagnetic radiation, its effects, and the means of protecting against it. The course should be especially valuable to members of the medical electronics profession, manufacturers of portable and hand-held radio equipment, and users of test and industrial electronics equipment.

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INSIDE...

ELF NEWS pp.2-5

Power Line Talk:
SoCal Edison on Savitz • Focus on Brodeur & OTA Continues • DOE Budget • PG&E on Measurements • Sinks on NCI Witness Fees • Family Circle's EMF Alert
NCI Awards Childhood Leukemia Contract
BPA Issues Health Effects Report
BC Hydro Home Buy-Out Begins
IEEE on Power Line EMFs
Marcy-South Decision Excerpts

HIGHLIGHTS pp.5-7

Revision of ANSI RF/MW Limits Continues
Two Army Radios Are Incompatible
Seattle Mayor Asks for 200 uW/cm² Limit
BEMS Electronic Mail Network

ABSTRACTS pp.10-13

ELF Fields and Power Lines • PEMFs • RF/MW Radiation • VDTs • General Interest

UPDATES pp.7-9

Interest in Biomagnetism Grows • Computer EMI • MM Waves Marketplace • Measurement Reports from NIST • EMC Lab & Consultants Directory • Microwave Ovens Roundup • Bioelectricity Society at FASEB Meeting • People in the News • How Not To Avoid Jet Lag • Charge and Field Effects Symposium • Sterilizing with Microwaves • EMI Newsletter Reverts to R&B • Saving the Ozone Layer with RF • ANSI & CISPR Standards • and more....

LETTERS TO THE EDITOR p.13

EMFs from Electric Fans
ELF Fields in Australia: A Clarification

CONFERENCES p.16

New Listings

AM/FM Radiation Litigation:
Two Cancer Settlements Are Secret, Two Other Suits Are Pending

Radio stations and equipment manufacturers are facing a growing number of lawsuits alleging cancer and other health effects due to exposure to radiofrequency (RF) radiation. The cases are not establishing a permanent legal record, however, as most are being settled out of court, with the terms kept confidential.

Over the past summer, two wrongful death suits related to AM and FM radio transmitters were settled for undisclosed amounts of money. Two other suits—one alleging cancer, the other general health problems—will soon go to trial.

An epidemiological study of radio and TV broadcast technicians has never been attempted. In 1987, however, the Hawaii Department of Health reported that people living next to broadcast towers in Honolulu had a "significantly higher" risk of cancer than those in other parts of the city (see *MWN*, M/J87). A similar finding was previously reported in Portland, OR (see *MWN*, J/F82 and My82).

In addition, cancer clusters have been reported near communications facilities in Lualualei, HI (see *MWN*, M/J87), McFarland, CA (see *MWN*, J/F88, S/O88 and M/A89) and San Francisco, CA (see *MWN*, M/A89).

(continued on p.14)

NY Judge Rejects Power Line "Cancerphobia" Argument

On September 29, a New York judge rejected the claims of landowners along the Marcy-South power line, ruling that they had failed to prove that there is a "reasonable basis for any fear that power lines cause health problems." The judge refused to make an award for damages caused by "cancerphobia."

The long-awaited decision was the outcome of a $66.5 million lawsuit filed by 58 landowners against the New York Power Authority (NYPA) in January 1987. The landowners claimed that the 345 kV power line created a "cancer corridor" which destroyed the market value of their property (see *MWN*, M/A87 and S/O88).

In his decision, Judge Peter A. McCabe, Jr., of the New York Court of Claims in Goshen, NY, wrote that the experts testifying for the landowners "*believe* they see smoke and conclude that fire (health hazards) *might* be present. The defendants' experts don't see any smoke." The judge sided

(continued on p.5)

« Power Line Talk »

Paul Brodeur's *New Yorker* series on power lines and VDTs continues to provoke responses from the media and from industry. A number of **television** stations in the U.S. have slated EMF stories for the November "sweeps" week when audiences are estimated and advertising revenues are computed. Look for multipart news stories in Montreal, New York City, Philadelphia and other cities.

«« »»

In a critique of the *New Yorker* series commissioned by the **Edison Electric Institute** (EEI), staffers at Environmental Research Information, Inc. **(ERI)** say Brodeur's articles fail to distinguish between "biological effect" and "biological harm" and lack a "balanced perspective"—that is, they focus "almost exclusively on a few 'positive' studies" to the exclusion of "negative" ones. The EEI-ERI critique is being widely circulated by utilities.

«« »»

Despite all the hoopla, the **Department of Energy**'s FY1990 budget for power line health effects will remain at $3 million—the same as last year (see *MWN*, S/O88). The only change is that in January, the Bush Administration is expected to ask for $2.5 million for FY1991, a $300,000 increase over last year's original request.

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As more and more is written about power line risks, families are asking utilities to measure EMFs in their homes. On the west coast, **PG&E** is discouraging customers from such surveys: "Random **measurements** are meaningless" until more definitive research is completed, the company advises in the August 4 issue of its newsletter, *PG&E Week*. While agreeing that more studies are needed, Ed Hubacher, a member of PG&E's EMF task force, believes that the nation's cancer data argue against a power line-EMF link. He points out: "These studies, which suggest a link to childhood leukemias, are widely quoted as the best evidence that [EMFs] are dangerous. However, I think it's most compelling that, while use of electricity in this country has increased fivefold in the last 30 years, the reported number of new leukemia cases has fallen by about half. I find it hard to see any cause and effect there." Dr. Philip Cole has often used this argument, which, in turn, has been challenged by Dr. Nancy Wertheimer.

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Confronted by growing public apprehension, utilities are also distributing pamphlets explaining EMF health risks. One from **Southern California Edison** (SoCalEd) quotes Dr. **David Savitz** as saying, "There is no solid evidence that you should be worried, even if you live under a power line...the evidence does fall short of implicating these fields as a health hazard." Given that the Savitz epidemiological study is the principal basis for the concern over power line EMFs, we called and checked the SoCalEd quote with him. Savitz told us that it made him "uncomfortable." This is how he summed up his position: "There are several suggestions that the fields pose a hazard, but there is no definitive evidence that they do so. Given the state of affairs of having suggestive, but inconclusive, evidence, it is difficult to advise people of the appropriate level of concern."

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The **OTA** report, which has done its share of generating public interest in EMF bioeffects, could not be had for love or money this summer. The demand was so great that it was sold out immediately after its June release and remained so for months. "We had a higher-than-normal response for a technical report," an OTA staffer told us. The Government Printing Office sent it back to the presses and it is once again available (see *MWN*, J/A89).

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The fees paid to expert witnesses in power line cases continue to attract notice. A front-page story on the "recent rash of misconduct cases" at the National Institutes of Health in the September 4 issue of *The Scientist* cites the ongoing investigation of three **National Cancer Institute** (NCI) scientists who have testified for utilities across the country. While Drs.

NCI Awards Contract for EMF-Childhood Cancer Study

The National Cancer Institute (NCI) has awarded Westat, Inc. of Rockville, MD, $3,398,079 for support on its study of the possible association between childhood leukemia and electromagnetic fields (EMFs). The contract, which took effect on September 30, 1989, will run for four years.

Westat, a large survey research firm, will coordinate the cases and controls in six states for NCI. In addition, Westat will work with Enertech Consultants, Inc. of Campbell, CA, which will measure EMFs, according to Susan Gardner, Westat's project officer. Enertech's Michael Silva and Dr. Bill Kaune are already playing similar roles in other epidemiological studies of EMFs and cancer.

Dr. Martha Linet of NCI's Epidemiology and Statistics Program is the principal investigator of the NCI study, which will seek to determine whether there is a link between acute lymphocytic leukemia among children and EMF exposures at home and at school (see *MWN*, J/F89).

The study is part of a five-year NCI-sponsored effort to ascertain the risk factors for childhood leukemia.

Stuart Aaronson and Margaret Tucker refused to discuss the matter, Dr. Lucius Sinks told *The Scientist*'s Jeffrey Mervis that the NIH rules on outside income are cumbersome and do not serve the public interest. "They prevent people with expert knowledge from disseminating useful information to the public," he said. Sinks, who was paid $41,083 by the New York Power Authority for his testimony—despite his never having done EMF research (see *MWN*, J/A88 and N/D88)—is now free to testify as he pleases because, Mervis reports, Sinks has left NCI.

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If there was any doubt left, the September 18 ***Current Contents—Life Sciences*** officially labeled EMFs a **"hot topic."** The weekly digest, which is widely read by research scientists, ran excerpts from recent articles in *Technology Review, Time,* the *New York Times* and *Science* under the headline "Ill Effects from Power Lines and Appliances?"

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And things are likely to get even hotter. In its November 7 issue, ***Family Circle*** will run a "Radiation Alert" by Paul Brodeur. The magazine has a circulation of 5.2 million and a readership of 20 million—mostly women. Susan Ungaro, the magazine's executive editor, said that her readers are very concerned about health and environmental issues, and she predicts that the article will generate "quite a response."

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Of course, not everybody agrees that EMFs are a problem. A columnist for ***Forbes*** magazine—the "Capitalist Tool"—ridicules the very idea of low-level EMF effects in an article titled "Electrophobia" appearing in the September 4 issue. To buttress his case, he quotes Professor of Physics **Robert Adair** of Yale University on health hazards: "The results are about as believable as claims of perpetual motion." Adair is married to Dr. **Eleanor Adair**, who herself has long poohpoohed anything but the thermal insults from high-level exposures; she is currently coordinating a review of Brodeur's *New Yorker* articles for the IEEE's Committee on Man and Radiation, known as **COMAR**.

BPA Health Effects Report

The Bonneville Power Administration (BPA) has issued *Electrical and Biological Effects of Transmission Lines: A Review*. The well-illustrated and well-referenced 107-page overview was prepared by BPA's Biological Studies Task Team, chaired by Jack M. Lee, Jr.

Copies are available from Lee at: BPA, PO Box 3621, Portland, OR 97208, (503) 230-4530. The BPA is part of the U.S. Department of Energy.

BC Hydro Buy-Out Begins

BC Hydro has now purchased its first home as part of its policy of buying properties along a power line right-of-way, and it will soon close on five more. A total of 64 home owners have officially asked the Canadian utility to buy them out, according to Peter McMullan, a spokesman for BC Hydro.

The properties, which range in price from $60,000 to $125,000 (Canadian), will be put back on the market at a later date, McMullan told *Microwave News*.

Last May, BC Hydro sent letters to 144 home owners on Vancouver Island offering to buy the properties along a new 230 kV power line (see *MWN*, M/J89). The response was so great—even 140 who had *not* received a letter contacted the utility—that the BC Utilities Commission called a public hearing on the safety of the line in July (see *MWN*, J/A89).

The commission later ruled that BC Hydro could complete the contested line, but that it must extend the deadline for the buy-out offer to September 15.

When asked if BC Hydro would consider making such an offer again, McMullan replied that the utility does not plan to make buy-out programs a standard practice, but neither does it rule them out for the future. "We will deal with each situation as it arises. We know the issue won't go away," he said.

The line in question was recently completed and is now operational, according to McMullan.

IEEE on Power Line EMFs

Earlier this year, the Institute of Electrical and Electronics Engineers (IEEE) issued a position paper on the *Biological Effects of Power Frequency Electric and Magnetic Fields.* Reprinted below are its conclusions:

Interest in the influence of power frequency electric and magnetic fields on health is rapidly expanding, in part due to the conclusions of the [New York Power Lines Project] report. This interest is also reflected by the increase in news coverage and the occurrence of U.S. Congressional hearings on October 6, 1987. In 1987, other events such as the...EPRI-sponsored Minneapolis workshop on epidemiology, and the activities of the Edison Electric Institute EMF Task Force indicate[d] that more utilities are becoming aware of the issue.

At present there is no consensus expressed in any of the published reports as to which factor, the electric or magnetic field, is biologically important. Similarly, the roles of field strength, duration of exposure, and intermittent versus continuous exposure are also unknown. This uncertainty complicates efforts to develop and implement methods of exposure mitigation. There is no clear direction concerning whether to reduce fields, and if so by how much, or whether harmonics are a factor. The initiation of exposure mitigation without an adequate scientific base may not be effective. EPRI is beginning to address the question of what is the level of actual human exposure, with plans for a national program of power frequency magnetic fields measurements. It is expected, however, that such an effort will take years before useful information is available. It will take additional years for the biological sciences to determine what component of exposure, if any, is a factor in health risks.

Excerpts from the Marcy-South Decision

...The [plaintiff's] claim allege[s] that the property sustained consequential damages because the use to which the easements have been put caused, in the words of the claim, "cancerphobia." Claimant maintains that the market price for his land has been substantially reduced because an informed buyer could justifiably base a fear of increased health risk as a result of the land being proximate to high voltage power lines.

This issue is not a novel one. Claims of various risks associated with power lines have been dealt with by the courts of this state over a number of years. The most recent case dealing with the health issue is *Miller v. State of New York*, 117 Misc 2d 444. That court relied on the ruling in *Olin v. State of New York*, 41 Misc 2d 678, supra. The court then listed at p.450 other cases dealing with 345 kV lines and their holdings concerning the effects of transmission lines on property values. This court, following the holding in the *Miller* case, finds that the claimant has a twofold burden of proof:

1) He must prove that a potential purchaser has *reasonable grounds* for apprehension that power lines cause health problems. Claimant has the burden of proving this by a preponderance of the credible scientific evidence; and,

2) That this reasonable apprehension has affected the purchaser's willingness to pay the fair market value of the property, as evidenced by proof from the real estate market, or, as stated in *Miller*, p.450, "based on the actual pricing experience shown from before and after sales." Claimant has the burden of proof by a preponderance of the credible real estate evidence.

Claimant urges the rejection of the *Miller* case and requests the court to adopt the holding in the case of *San Diego Gas & Electric Co. v. Daley*, 205 Cal. App. 3d 1334. In the California case, the jury, in a 9-3 vote, awarded Daley damages based on the devaluation of his land caused by buyers' fear of adverse health effects posed by electromagnetic radiation. The cases are not in conflict on that point. In *Miller*, the court indicated that if proper proof was submitted such an award could be considered in New York. Both jurisdictions agree that "...the truth or lack of truth in whether electromagnetic projections caused a health hazard to humans or animals was immaterial. Rather the question was whether the fear of the danger existed and would affect market value" (*San Diego Gas & Electric*, supra, p.1349). However, the California court did not require, as does New York law, that there be proof of the existence of *reasonable grounds* for the fear. The *San Diego* case at p.1349 cited with approval *United States ex rel TVA v. Easement and Right of Way* (6th Cir. 1968) 405 F.2d 305, which, after discussing TVA studies, concluded from them that apprehension of injuries was not founded on practical experience and held that (p.309):

> "The TVA studies conducted on this issue are also creditable. However, in [the] final analysis, we are concerned only with market value. Although these studies may show objectively the *complete safety of these structures*, we are not convinced that *certain segments* of the buying public may not remain apprehensive of these high voltage lines, and therefore might be unwilling to pay as much for the property as they otherwise would." (Emphasis supplied [by the court])

In *Miller*, the court found at pp.446, 447:

> "that *some vague and unfounded* fear cannot form a basis for the recovery of consequential damage, as any *such damage would be speculative and capricious* in nature. Only a reluctance to purchase predicated on the *reasonable apprehension* of a potential purchaser should be considered...." (Emphasis supplied [by the court])

In *San Diego Gas & Electric*, it appears that the appraisers for the property owner, using a market data approach, found a before and after value but did not use actual pricing experience to prove that property proximate to power lines decreased in fair market value because "he could find no comparable sales of property with 500,000 volt power lines" (p.1343).*

This proof is not acceptable in New York courts and this court declines to follow the *San Diego* case insofar as it finds damage without proof from the marketplace.

Claimant, to sustain his first burden in the subject case, presented a number of scientific witnesses to support his claim that buyers' fears concerning health hazards on lands proximate to power lines were in fact reasonable.

Besides attacking the qualifications and credibility of claimant's experts on cross-examination, the defendants presented eight scientific witnesses to refute the claimant's experts' allegations. These experts uniformly testified that there is no scientific basis to believe that electromagnetic fields [EMFs] could cause any adverse health effects. Each of the defendants' experts also testified that there is no scientific basis for cancer fear or apprehension of [EMFs].

...Under the applicable law as acknowledged by claimant's amendment of his claim, it is *not* necessary for this court to make a determination whether there are health risks from the [EMFs] or whether there are not.

As to the proof that there is a reasonable fear concerning health risks, claimant argues that he has established that a concern exists in the scientific community "that it has not yet been established that living in close proximity to said [EMFs] does not adversely effect (sic) or increase health risks."...In effect, claimant seeks to shift his burden of proof. He argues that he proved some scientists found some negative evidence concerning health risks, and because of the failure of defendants to prove that *in fact* the [EMFs] do not cause harm, any fear by buyers is reasonable....As previously discussed, the claimant has the burden of proof that the fears were reasonable by a fair preponderance of the evidence. The burden does not shift to the defendants by the presentation of negative scientific evidence. The defendants did go forward by challenging the basis for claimant's witnesses' scientific evidence, leaving the court with an issue of credibility.

The court believes that claimant has established that scientists are concerned that potential problems they have identified need further scientific examination, but this is not the basis for a reasonable fear that power lines cause health hazards. Moreover, the defendants' witnesses, after analyzing the scientific data, believe that there is no hard scientific evidence to prove that the [EMFs] present *any* health risk to the public. In paraphrasing the conflicting testimony, by way of a very unscientific analogy, it appears to the court that the claimant's experts *believe* they see smoke and conclude that fire (health hazards) *might* be present. The defendants' experts don't see any smoke.

After reviewing all the scientific testimony and the numerous reports, the court finds that claimant failed to sustain his burden of preponderating in the evidence on the issue that there is a reasonable basis for any fear that power lines cause health problems...

*...It is interesting to note that [the appraiser] found the fear only caused *delay* in the sales of property.

with the witnesses assembled by Tom Watson of the Washington, DC, law firm of Crowell & Moring, which presented the health effects argument for NYPA. The judge found that the claimants did not effectively demonstrate that fears of harm from power line electromagnetic fields (EMFs) had an effect on the value of their property.

Michael Gurda of Gurda, Gurda, Lynch & Smith in Middletown, NY, which represented the landowners, said that they would probably not appeal the decision. "We couldn't afford it," he told *Microwave News*.

Gurda pointed out that the decision might have been different if he had been able to present the Savitz epidemiological study and other recent findings linking EMFs and cancer. He explained that the witnesses were barred from discussing research published after 1986, when NYPA filed for the easements to build the power line.

In a telephone interview, a NYPA spokesperson maintained that there were *no* restrictions on introducing published research. Watson said that NYPA had requested that he not comment on the case.

The court did, however, award one of the landowners $94,567 plus interest: the assessment includes $53,352 for direct damages and $41,215 for indirect damages—"largely, but not entirely, for visual impairment," according to the NYPA spokesperson. Prior to the lawsuit, NYPA had offered the landowner $35,500 for direct damages from the easements. NYPA later reassessed the direct value of the easements at $50,765 after the claims were filed.

All of the 58 claims represented by Gurda were consolidated for the purpose of arguing the health effects issue. Each claim will be heard separately, however, to assess property appraisals and damages. (There are approximately 40 additional claims pending against NYPA.)

The claimants will seek an award of legal expenses—up to $400,000, according to Gurda. NYPA spent approximately $2.6 million on legal expenses, including expert witness fees.

Although court dates are now being scheduled for the remaining claims, there is a "possibility that they will all be settled without litigation," the NYPA spokesperson said.

The Crowell & Moring health expert team for NYPA included: Dr. Stuart Aaronson*, National Cancer Institute (NCI), Bethesda, MD; Dr. Richard Bockman, Memorial Sloan-Kettering Cancer Center, New York, NY; Dr. Roswell Boutwell, University of Wisconsin, Madison; Dr. Edmund Egan II, University of Buffalo, NY; Michael Silva, Enertech Consultants, Inc., Campbell, CA; Dr. Lucius Sinks*, formerly at NCI, Bethesda, MD; Dr. Herbert Terrace, Columbia University, New York, NY; Dr. Margaret Tucker*, NCI, Bethesda, MD; and Dr. Ken Zaner, Harvard Medical School, Cambridge, MA (see *MWN*, J/A88 and N/D88).

The health experts who testified on behalf of the landowners were: Dr. Harris Busch, Baylor College of Medicine, Houston, TX; Marvin Chatkoff, University of Texas, San Antonio; Dr. Andrew Marino, LSU Medical Center, Shreveport, LA; Dr. Jerry Phillips, Cancer Therapy and Research Center, San Antonio, TX; and Dr. Lennart Tomenius, Stockholm, Sweden.

Donald Zappavigna v. State of New York and Power Authority of the State of New York, New York State Court of Claims, Claim No.74085, September 29, 1989.

*Aaronson, Sinks and Tucker are currently under investigation by the National Institutes of Health (NIH) for alleged violations of NIH outside income rules involving fees for testimony on behalf of utilities in this and other power line cases (see *MWN*, J/F89 and pp.2-3).

HIGHLIGHTS

Revising ANSI RF/MW Limits: Debate Often Contentious

The subcommittee charged with revising the American National Standards Institute (ANSI) safety guidelines for exposures to radiofrequency and microwave (RF/MW) radiation has decided to adopt limits for induced currents in the 3 kHz-100 MHz frequency range. At the same time, the subcommittee plans to recommend a doubling of the limits above 3 GHz to 10 mW/cm^2.

At a meeting held in Tucson, AZ, in June, the subcommittee opted for a two-tier standard. But, instead of the usual practice of distinguishing between occupational and public exposures, the subcommittee has drawn a distinction between "controlled" and "uncontrolled" environments. The safety limits for those who submit to "controlled" exposures—for instance, workers or members of the public who "knowingly" accept such risks—would be similar to the existing ANSI standard of 1 mW/cm^2 for frequencies between 100 and 300 MHz. For "uncontrolled" exposures, which would apply to "individuals who have no knowledge or control of their exposure," the limit would be five times stricter—0.2 mW/cm^2.

Much of the Tucson meeting was marked by heated exchanges. Bob Curtis of the Occupational Safety and Health Administration (OSHA) warned that workers could not be forced to accept exposure to higher levels of radiation as a condition of employment. "I guarantee that we would enforce [the stricter limits]," he said. Dr. Om Gandhi of the University of Utah in Salt Lake City (co-chair of the subcommittee) put the distinction between the two types of exposure another way: A controlled environment means "voluntary acceptance" of modern technology.

There were also differing views on the doubling of the allowable limits at high frequencies. Dr. Q. Balzano of Motor-

ola in Plantation, FL, said that, "We will look like yo-yos" by going to 10 mW/cm² from 5 mW/cm². Dr. Greg Lotz of the Naval Aerospace Medical Research Lab in Pensacola, FL, countered that there was no rationale for adopting the 5 mW/cm² limit in 1982; thus, it would be more "consistent" to return to 10 mW/cm².

Dr. Mays Swicord of the Food and Drug Administration (FDA) tried to convince the subcommittee to tighten the limits, but without success. "At the FDA, we get information from medical device manufacturers which states that they can get beneficial effects at levels specified as safe in this guide," he argued.

One very contentious issue was whether the standard should continue to exclude hand-held devices with input power no greater than seven watts. A broadcasting industry lobbyist argued that these devices should be excluded because there are millions of walkie-talkies in use. Others, citing studies showing sizable currents in the arms of users, responded that the fact that millions of people are using walkie-talkies is reason enough to provide added protection.

By the end of the meeting, the exclusion was deleted from the ANSI draft, though some members of the subcommittee promised to raise the issue again.

Who Is Most at Risk?

The most passionate exchanges were over who is at the greatest risk from exposures to RF/MW radiation. Each of the five "conclusions" reprinted below was the subject of long debate:

> While the members of the subcommittee believe the recommended exposure levels should be safe for all, they recognize that *no* reliable scientific data exist to support the conclusion 1) that certain subgroups of the population are more at risk than others, 2) that warm and/or humid environments exacerbate [RF] bioeffects, 3) that exposure duration at ANSI 1982 levels is a significant factor, 4) that damage from exposure to [RF] is cumulative, or 5) that non-thermal or modulation-specific sequelae of [RF] exposure may be meaningfully related to human health. [Emphasis added]

Motions were made to delete the first and second clauses. Dr. Herbert Pollack, a longtime consultant to the U.S. State Department and one of the two medical doctors on the subcommittee, cited people with lowered resistance to infection (e.g., diabetics) and those with impaired circulation (e.g., those with heart disease) as being especially sensitive to RF/MW radiation. When it came to a vote, Pollack could not muster the two-thirds majority needed to delete the first clause. Dr. Joe Elder of the Environmental Protection Agency called the outcome "incredible."

Elder himself moved to delete the second clause, calling it "blatantly untrue." To back up his claim, he cited two published studies. He was challenged by Dr. Eleanor Adair (co-chair of the subcommittee), a researcher on thermal effects at the John Pierce Foundation in New Haven, CT. Nevertheless, Elder prevailed and the second conclusion was removed from the draft.

The U.S. military clearly has a major stake in the outcome of the ANSI deliberations. Of the approximately 50 people at the Tucson meeting, there were eight representatives from the U.S. Navy and two each from the U.S. Army and the U.S. Air Force. In addition, there were representatives from companies with major military contracts. The broadcasting and communications industries were also in evidence.

The standard has a long way to go before publication. When it is completed, it must be approved by a number of different committees. Some members, such as Pollack and Swicord, are betting that the standard will never be approved.

For our previous two reports on the revision of the 1982 ANSI RF/MW standard, see *MWN*, J/A86 and M/A88. See also the Commentary in *MWN*, M/A89.

Two U.S. Army Radio Systems Are Incompatible

The U.S. Army has acknowledged that two of its combat radio systems, which operate on overlapping frequencies, interfere with each other when used side by side.

"We don't think it's a big problem," Major Barry Bomier told *Microwave News*. "It doesn't merit headline status." He added that the army regularly tests for "co-site interference" and that the problem was detected during an operational check of one of the systems.

At present, one radio system must be turned off in order to use the other, Bomier said. An engineering solution has been identified, but it will not be implemented until 1993 because of budget constraints, according to the July 17 *Defense News*.

The radio systems—Mobile Subscriber Equipment (MSE) and Single Channel Ground and Airborne Radio System (SINCGARS)—are used, respectively, to communicate between combat units and within a given unit. MSE is manufactured by GTE and SINCGARS is made by ITT Defense, Inc.

Seattle Mayor Recommends a 200 uW/cm² Standard

The mayor of Seattle, WA, now endorses a radiofrequency (RF) radiation standard of 200 μW/cm² in the 30-300 MHz frequency band, the same safety level recommended by the National Council on Radiation Protection and Measurements (NCRP). The mayor's proposal is at odds with the recommendations of the city's planning office and health department, both of which continue to back a 100 μW/cm² limit (see *MWN*, J/A88 and J/A89).

Informed sources told *Microwave News* that Mayor Charles Royer believes that the added protection provided by a

stricter standard would not be worth the delays which would result from the almost certain flood of legal challenges from the broadcasting community.

The final decision rests with the City Council, which is expected to take up the issue early in 1990, according to Clifford Marks, a senior environmental planner with the Seattle Office for Long-Range Planning, who has been instrumental in developing the proposed standard.

Two jurisdictions in neighboring Oregon—the city of Portland and Multnomah County—have already adopted 200 $\mu W/cm^2$ limits. Like Seattle, both originally considered more stringent standards: Multnomah County proposed a 50 $\mu W/cm^2$ limit but backed off in the face of broadcaster opposition (see *MWN*, J/A82), and Portland adopted an interim guideline of 100 $\mu W/cm^2$ in 1980—the first public standard in the U.S. —before it succumbed to local pressure and adopted a permanent 200 $\mu W/cm^2$ standard (see *MWN*, J/A85 and S/O87).

The Seattle mayor's proposal—which is contained in a formal report dated August 30—includes a provision that if the federal government promulgates an RF standard more stringent than 200 $\mu W/cm^2$, Seattle will adopt that limit.

With regard to RF shocks and burns, the proposed standard also provides that, "A source of [RF] energy shall not cause more than 50 [mA] of current to flow through the index finger of a person in contact with a metallic object in any location to which the general population has legal access."

While many local broadcasters prefer the adoption of the American National Standards Institute's (ANSI) 1,000 $\mu W/cm^2$ standard, some are willing to accept a 200 $\mu W/cm^2$ limit. For instance, in comments submitted to the city's planning office, Seattle's KTZZ-TV noted that it would "not object to the adoption of the 200 $\mu W/cm^2$ level," but it would oppose anything more stringent.

In King County, Joanne and Monty Lennox, who live on Cougar Mountain overlooking Seattle, point out that the city's proposal allows peak levels—or hot spots—up to 20 times the average levels. "It's not a 200 $\mu W/cm^2$ standard, but a 4,000 $\mu W/cm^2$ standard," they told *Microwave News*. The standard is a "joke," they said.

The Lennoxes have counted 21 towers on Cougar Mountain, housing more than 120 antennas, including 10 FM radio transmitters. A survey by the Environmental Protection Agency found "spatially averaged" readings as high as 700 $\mu W/cm^2$ in public spaces on the mountain, with hot spots rising to 2,350 $\mu W/cm^2$ (see *MWN*, J/F86).

King County, in which Seattle is located, has considered adopting a 200 $\mu W/cm^2$ standard for the last few years, but a final decision still has not been reached.

A final environmental impact study (EIS) for the mayor's recommended policy was issued in September. Copies of both documents—*Mayor's Recommended Telecommunications Policy and Regulations* and the final EIS—are available from: Clifford Marks, Office for Long-Range Planning, 600 4th Ave., Room 200, Seattle, WA 98104, (206) 684-8056. Comments submitted in response to the draft proposal are appended to the final EIS.

BEMS Electronic Mail Network

The Bioelectromagnetics Society (BEMS) is setting up an electronic mail network—BEMNet—for its members and those of sister societies.

BEMNet will be part of SCIENCENet, the world's largest independent electronic mail system for the scientific and engineering communities. Subscribers will be able to access BEMNet from 400 cities in the U.S. and from over 50 countries.

After a onetime connection fee of $40 and a monthly fee of $15, costs, which are based on length of time online, vary from 26¢/minute from 7am to 6pm (local time) to 7¢/minute from 9pm to 7am.

For more information, contact: Dr. William Wisecup, Executive Director, BEMS, 120 West Church St., Frederick, MD 21701, (301) 663-4252.

UPDATES

COMPATIBILITY & INTERFERENCE

Computer EMI...Ronald Standler of Pennsylvania State University in University Park advises computer users not to turn on household appliances using the same electrical circuit that powers their computers. Standler bases his advice on a series of measurements of the transients on the single phase 120 V electrical wiring in a residence. He found that switching on a vacuum cleaner could produce a transient with a slope as large as 17 kV/μsec. His results appear in *IEEE Transactions on Electromagnetic Compatibility, 31*, pp.170-176, May 1989. (See also *MWN*, S/O87.)

Newsletter Reverts to R&B...Ownership of the *Electromagnetic News Report* has reverted to Bob Goldblum of R&B Enterprises of West Conshohocken, PA, after Liberty Labs failed to meet a payment deadline. "We could not meet our financial obligations," Liberty Labs' Mike Howard told *Microwave News* from his office in Cedar Rapids, IA. "When we could not get the necessary financing, Goldblum held us to our letter of agreement and reclaimed the newsletter," he said. Liberty took over the bimonthly *News Report* less than a year ago (see *MWN*, J/F89). Goldblum did not respond to our request for comment. Liberty Labs will continue to issue other publications—see below.

Lab & Consultants Directory...Liberty Labs has published

the *1989 EMC Test Lab & Consultants Directory* and plans to issue updates every other year. The directory details the capabilities of and services provided by more than 150 laboratories and consultant groups in the U.S., Canada, Europe, Israel and Japan. All sorts of reference data are also provided—for instance, contacts for EMI regulations in some 40 countries and information on FCC EMC rules. A copy is available for $65.00, plus $4.00 shipping and handling in the U.S. and Canada ($9.00 in other countries), from: Liberty Express, PO Box 8268, Cedar Rapids, IA 52408, (319) 390-3646 or (800) 728-7081.

MEASUREMENT

New from NIST... Three researchers at NIST's Electromagnetic Fields Division in Boulder, CO, offer—in two new publications—some theoretical and practical advice on using TEM cells. See G.H. Koepke, M.T. Ma and W.D. Bensema, *Theory and Measurements of Radiated Emissions Using a TEM Cell*, Technical Note (TN) 1326 and "Implementation of an Automated System for Measuring Radiated Emissions Using a TEM Cell," *IEEE Transactions on Instrumentation and Measurement, 38*, pp.473-479, April 1989....Eleanor Livingston and Robert Adair recommend test methods for checking the adequacy of commercially available power meters. See *Performance Evaluation of Radiofrequency, Microwave and Millimeter Wave Power Meters*, TN 1310. The two technical notes are available from: Government Printing Office, Washington, DC 20402. (TN1326—Stock No.003-003-02932-7, $2.25; TN1310—Stock No.003-003-02931-9, $8.50.) Remember that NIST is the new name for NBS.

MEDICAL APPLICATIONS

Biomagnetism... Magnetocardiograms (MCGs), magnetoencephalograms (MEGs), magnetopneumograms (MPGs) and, of course, SQUIDs are all tools in the fast-growing field of biomagnetism. At the *7th International Conference on Biomagnetism*, August 14-18, at New York University (NYU) in New York City, approximately 200 papers were given on such varied topics as mapping of brain functions, ionic currents within developing chick eggs and the link between brain waves and tinnitus (ringing in the ear), according to an overview in the September 8 issue of *Science*. The next international conference will be held in two years in West Germany, said Dr. Samuel Williamson of NYU's department of physics, who coordinated the recent meeting. The proceedings will be published by Plenum Press under the title *Advances in Biomagnetism* and will be available in early 1990. ...Biomagnetism was also featured in the July 28 issue of the *Journal of the American Medical Association*. In a recent study, NIH researchers applied high-current magnetic pulses to stimulate the nerves and brain in a young woman with multiple sclerosis. They note that magnetic stimulation may be useful for "activating deep proximal nerves that are difficult to activate with electric stimulation" and that it may be less painful. They also found that magnetic stimulation of the brain can reveal clinically silent lesions—although it has its drawbacks: it appears to interfere with brain function for periods on the order of milliseconds.

MEETINGS

Bioelectricity Society at FASEB... The International Society for Bioelectricity (ISB) has been invited to participate at the *74th Annual Meeting of the Federation of American Societies for Experimental Biology* (FASEB), to be held in Washington, DC, April 1-5, 1990. ISB thus joins four FASEB members—the American Physiological Society, the American Society for Pharmacology and Experimental Therapeutics, the American Association of Pathologists and the American Institute of Nutrition—in inviting papers for presentation at the meeting. Two other guest societies—the Biomedical Engineering Society and the Society for Experimental Biology and Medicine—will also participate. On April 3, ISB will sponsor a symposium of invited papers entitled *EMFs and Biological Systems: An Overview*, chaired by ISB Vice President Dr. Allan Frey of Randomline, Inc. in Huntingdon Valley, PA. A total of 11,000 biologists are expected to attend the FASEB meeting to hear some 4,000 papers. For more information, contact: Dr. Andy Marino, President, ISB, Dept. of Orthopaedic Surgery, LSU Medical Center, PO Box 33932, Shreveport, LA 71130, (318) 674-6180.

Charge and Field Effects... The proceedings of the June *1989 International Symposium on Charge and Field Effects in Biosystems* will be published by Plenum Press in early 1990, according to Dr. Steve Cleary of Virginia Commonwealth University (VCU), which hosted the conference. Papers presented by a number of Soviet researchers prompted one scientist to comment to *Microwave News* that "EMF research in the U.S.S.R. is equivalent to the very best in the West." In addition to basic research, Cleary noted that applications such as biosensors, growth stimulation, electroporation and non-thermal cellular effects of RF/MW radiation were discussed. For more information, contact: Dr. Steve Cleary, Medical College of Virginia, VCU, Box 551, Richmond, VA 23298, (804) 786-9821.

OVENS

Assorted Notes... In his new book, *The Smart Kitchen*, David Goldbeck features a special section on "Educated Microwave Operation," which includes instructions for the safe use of microwave ovens and a critique of manufacturers' manuals. Goldbeck argues that, "The lack of essential operating information has undoubtedly contributed to the [reported] burns, fires, oven damage, food poisoning and possible hazardous exposure to microwaves." Goldbeck is the editor of *True Food*, a quarterly newsletter which advocates "wholefoods for modern times." *The Smart Kitchen* is available for $15.95 plus $2.00 shipping from: Ceres Press, PO Box 87, Wood-

stock, NY 12498....*Consumer Reports* rates microwave/convection ovens in its September 1989 issue and includes a short section on the safe use of a microwave oven....In her October 4 *New York Times'* column, microwave cooking specialist Barbara Kafka advises her readers to avoid letting plastic wrap touch food during microwave cooking to prevent the migration of possibly toxic chemicals—at least until FDA staffers have completed their investigations....FDA's Ray Walchle has devised an extremely fast AC power interrupter which permits the testing of a microwave oven's interlock circuitry while it operates. A U.S. patent (No.4,825,330), based on Walchle's invention, has been assigned to FDA's Center for Devices and Radiological Health. For more information, contact Walchle at (301) 443-2536....And, after a five-year effort, Hershey Foods, well-known for their chocolate Kisses, will soon start marketing four types of microwave macaroni, according to the October 5 *Wall Street Journal.*

PEOPLE

Now that he has left EPA, Dr. **Richard Phillips** is working part-time for W/L Associates, based in Frederick, MD. He is reviewing DOE-funded projects and helping to assemble an international data base on ELF bioeffects studies for a number of W/L clients. Phillips plans to move to the Pacific Northwest as soon as he can sell his house in North Carolina....**Laurie Geissinger** has left Seattle City Light (SCL), where she was the coordinator of SCL's task force on EMFs and health, to join the city's water department as a water resource planner....**Edwin Bronaugh** has resigned as the technical director of Electro-Metrics to join the Electro-Mechanics Co. (EMCO) in Austin, TX. Bronaugh will continue to serve as a consultant to Electro-Metrics.

STANDARDS

CISPR and ANSI Actions...CISPR has recently published three amendments to its standards: (1) *Organization, Rules and Procedures of the CISPR*, Amendment 3, 1989, CISPR 10: 1981; (2) *Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus*, Amendment 2, 1989, CISPR 14: 1985; and (3) *Limits and Methods of Measurement of Radio Interference Characteristics of Fluorescent Lamps and Luminaires*, Amendment 1, 1989, CISPR 15: 1985. Copies are available for $8.00 each from: Sales Department, ANSI, 1430 Broadway, New York, NY 10018....ANSI and Underwriters Laboratories have approved a revision to a 1983 EMI standard. *Electromagnetic Interference Filters*, ANSI/UL 1283-1989 (revision of ANSI/UL 1283-1983), will be available soon from ANSI.

TECHNOLOGY

Sterilizing with Microwaves... Two NIST researchers have come up with a new way to sterilize medical and dental instruments using gas plasmas generated in a conventional microwave oven. Drs. Waldemar de Rijk and John Tesk found that by heating clinical instruments in a low-vacuum glass container inside a microwave oven, a low-pressure ionized gas is created which destroys microorganisms. The gas plasma also prevents arcing from metal objects, which could damage the oven's magnetron energy source. "We are speculating that the microorganisms are being killed by ion bombardment in the plasma, which 'denatures' or destroys their protein," de Rijk said. A key advantage of the microwave plasma procedure is that it only takes about 30 seconds; traditional sterilization processes—dry heat or steam pressure—can take up to two hours. In addition, repeated applications of dry heat and steam pressure can damage rubber seals and gaskets and dull the cutting edges of some metal instruments. In the past, RF-generated gas plasmas have also been used to destroy organic matter on mirror-smooth surfaces. For more information, contact: Dr. Waldemar de Rijk, A143 Polymer Bldg., NIST, Gaithersburg, MD 20899, (301) 975-6803.

MM Waves Market... Military applications for millimeter (MM) wave systems will be a billion dollar market in the U.S. by next year and a $1.8 billion market by 1995, according to a new report by Frost & Sullivan (F&S). Military programs using MM (30-300 GHz) technology include the Milstar satellite, the multiple launch rocket system, the Maverick missile and airborne radar systems. F&S estimates that the U.S. Air Force, the largest purchaser of MM technology, will spend $630 million in 1989, followed by the U.S. Army at $280 million. Copies of the market research study (No. A2149) are available for $2,600 each from: F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080.

ETC...

Saving the Ozone Layer with RF... Dr. Alfred Wong of the University of California, Los Angeles, believes he can stop the breakdown of the ozone layer caused by chlorofluorocarbons (CFCs) with radio waves. Chlorine atoms destroy stratospheric ozone, but chlorine ions do not. According to the September 16 *New Scientist*, Wong wants to beam up 100 MW of power at 1.5 MHz to generate electrons which will then combine to form unreactive chlorine ions. And there's more. Wong then wants to use RF signals modulated at the ion-cyclotron frequency to force the chlorine ions to spiral down out of the atmosphere.

How *Not* To Avoid Jet Lag...Travelers may be able to escape jet lag by shunning bright light in the morning prior to departure and by basking in afternoon light following arrival. In the September 1989 *Condé Nast Traveler*, two Harvard University sleep researchers suggest wearing "ultradark" sunglasses —or preferably, welding goggles—to screen out the unwanted light. But they add a warning: a colleague who flew into London's Heathrow airport wearing the prescribed goggles was hauled in for questioning by airport security.

ABSTRACTS

ELF Fields and Power Lines

Maria J. Azanza, "Steady Magnetic Fields Mimic the Effect of Caffeine on Neurons," *Brain Research, 489,* pp.195-198, 1989.

Azanza, of the University of Zaragoza in Spain, found that 1,160 and 2,600 gauss static magnetic fields inhibited or excited isolated mollusc neurons by mechanisms which appear to be calcium ion dependent.

Carl F. Blackman et al., "Multiple Power-Density Windows and Their Possible Origin," *Bioelectromagnetics, 10,* pp.115-128, 1989.

In this, the latest paper on their calcium ion efflux studies, Blackman and coworkers at EPA raise the possibility that the effect may occur at levels even lower than have already been observed. They speculate that the extremely sensitive nature of the calcium ion phenomenon "could account for the major discrepancy between the energy present in the effective [EMF] and the energy required to produce the observed biochemical changes."

M.A. Chilbert et al., "Fibrillation Induced at Power Line Current Levels," *IEEE Transactions on Biomedical Engineering, 36,* pp.864-869, August 1989.

This team from the Medical College of Wisconsin and the VA Hospital in Milwaukee induced ventricular fibrillation in hogs using high current (1-50 A) for short periods of time (16 msec to 3 sec).

G. d'Ambrosio et al., "Chromosomal Aberrations in Bovine Lymphocytes Exposed to 50 Hz Electric Currents," *Journal of Bioelectricity, 7,* pp.239-245, 1988-89.

A significant increase in chromosomal aberrations in lymphocytes exposed for 45 hours to electric currents of 1 mA/cm^2 was observed, but not in those exposed to 0.1 mA/cm^2. The Italian researchers conclude that electric fields may act directly on the chromosome structure.

Lawrence J. Dlugosz et al., "Ambient 60 Hz Magnetic Flux Density in an Urban Neighborhood," *Bioelectromagnetics, 10,* pp. 187-196, 1989.

A survey of a Buffalo, NY, neighborhood indicates that "power line magnetic field levels at urban residences can be reliably characterized on a onetime site inspection using a hand-held magnetic field meter and a simple wiring classification system." This supports the findings of Wertheimer-Leeper, Tomenius and Savitz, the researchers conclude. They also observe that the magnetic fields on urban sidewalks and street corners indicate that "substantial exposures during childhood may occur outside the house."

Soheir M. El Nahas and Hanaa A. Oraby, "Micronuclei Formation in Somatic Cells of Mice Exposed to 50 Hz Electric Fields," *Environmental and Molecular Mutagenesis, 13,* pp.107-111, 1989.

Mice were exposed to 50 Hz electric fields at 100, 170, 220 or 290 kV/m for 24 hours. The Cairo, Egypt-based researchers found that at 170-290 kV/m, there was a significant, dose-dependent increase in the number of micronucleated polychromatic erythrocytes. The researchers point out that "positive results of the micronucleus test signal clastogenic and/or spindle toxicity effects. Since most carcinogenic agents are clastogens, a positive clastogenic effect of an ELF electric field raises serious concern about the potential adverse effect associated with non-ionizing radiation."

Robert J. Fitzsimmons et al., "Frequency Dependence of Increased Cell Proliferation, *in Vitro,* in Exposures to a Low-Amplitude, Low-Frequency Electric Field: Evidence for Dependence on Increased Mitogen Activity Released into Culture Medium," *Journal of Cellular Physiology, 139,* pp.586-591, 1989.

This study on cell proliferation and mitogen activity provides new support for a frequency-dependent effect, which peaks at 16 Hz. The authors, among them Ross Adey, are from Loma Linda University, CA, and the neighboring VA Hospital.

E. Gubéran et al., "Disability, Mortality, and Incidence of Cancer Among Geneva Painters and Electricians: A Historical Prospective Study," *British Journal of Industrial Medicine, 46,* pp.16-23, January 1989.

This Swiss epidemiological study found no significant excess among electricians for all cancers or for any type of cancer; overall mortality was similar to what was expected. The researchers note, however, that the statistical power to detect leukemia and brain cancer risks was "low." The job category "electrician" included electricity installers and repairmen, telephone installers, linemen and cable jointers and car electricians. Geneva painters, on the other hand, had significant increases in overall mortality, cancer mortality and cancer incidence.

M. Hultengren and G. Rosén, *Health Effects of Work in the Production and Distribution of Electricity, Part 5: Exposure to Chemical Factors,* Investigation Report 1988: 22; 29 pp., National Board of Occupational Safety and Health, Solna, Sweden (in Swedish).

This is part of a larger study of health hazards among workers in the electrical power production and distribution industries. The authors found that, next to asbestos, the most significant chemical exposures are to solvents—these can be above the threshold limit values (TLVs).

Jukka Juutilainen, *Health Effects of Low Frequency Magnetic Fields: Experiments with Chick Embryos and Measurements in the Environment,* Academic Dissertation, 59 pp., 1989.

This paperback volume includes Juutilainen's doctoral thesis and six of his published papers on ELF fields (see, for example, *MWN,* M/J86 and S/O88). A very limited number of copies are available from Juutilainen at the Department of Environmental Sciences, University of Kuopio, PO Box 6, SF-70211, Kuopio, Finland.

Leslie Lamarre, "TLWorkstation: Expert Assistance in Line Design," *EPRI Journal,* pp.32-39, July/August 1989.

An overview of the EPRI software program that can help engineers design transmission lines: the program can calculate EMFs, radio noise and voltage interference, among other tasks.

Robert E. Meyer, Tim E. Aldrich and Clay E. Easterly, "Effects of Noise and Electromagnetic Fields on Reproductive Outcomes," *Environmental Health Perspectives, 81,* pp.193-200, May 1989.

This review of the published data includes discussions of biological mechanisms, exposure assessment and epidemiological research. The authors consider the suspected risks to be "quite low" and to be confounded by chemical exposures such as smoking.

Robert G. Olsen and Mingde Wu, "A Wideband Model for Electromagnetic Interference from Corona on Electric Power Lines," *Radio Science, 24,* pp.340-350, May/June 1989.

This new model from Washington State University in Pullman is the first to agree with experimental data on the frequency range 2-30 MHz, according to the authors. This paper is for the mathematically-inclined.

Michael A. Persinger, "Increased Geomagnetic Activity and the Occurrence of Bereavement Hallucinations: Evidence for Melatonin-Mediated Microseizuring in the Temporal Lobe?" ***Neuroscience Letters, 88,*** **pp.271-274, 1988.**

These results, according to Persinger of Laurentian University in Sudbury, Canada, "suggest that bereavement apparitions are situation-specific hallucinations evoked by microseizures within sensitized temporal lobe structures; the occurrence of these microseizures might be facilitated by suppression in melatonin levels that could accompany sudden increases in geomagnetic activity."

H. Peter Rodemann, Klaus Bayreuther and Gerhard Pfleiderer, "The Differentiation of Normal and Transformed Human Fibroblasts ***in Vitro*** **Is Influenced by Electromagnetic Fields,"** ***Experimental Cell Research, 182,*** **pp.610-621, 1989.**

These Stuttgart, F.R.G., researchers conclude that "the exposure of normal human skin and lung fibroblasts *in vitro* to sinusoidal EMFs [20 Hz, 6 mT] induces the differentiation of mitotic to irreversibly postmitotic fibroblasts. The arising postmitotic fibroblasts are significantly more active with regard to total protein and collagen synthesis than the corresponding mitotic fibroblast populations."

Martin Rosenthal and Günter Obe, "Effects of 50 Hz [EMFs] on Proliferation and on Chromosomal Alterations in Human Peripheral Lymphocytes [HPLs] Untreated or Pretreated with Chemical Mutagens," ***Mutation Research, 210,*** **pp.329-335, 1989.**

The EMFs did not alter the spontaneous frequencies of sister-chromatid exchanges (SCEs) and of chromosomal aberrations in cultured HPLs, but did lead to an enhancement of cell cycle progression. When the cells were pretreated with chemical mutagens, EMFs led to "significantly higher frequencies of SCEs." The authors caution that more studies are needed before firm conclusions can be drawn about the effects of EMFs.

Koichi Shimizu, Hideto Endo and Goro Matsumoto, "Fundamental Study on Measurement of ELF Electric Fields at Biological Body Surfaces," ***IEEE Transactions on Instrumentation and Measurement, 37,*** **pp.779-784, June 1989.**

Three new techniques for accurately measuring electric fields on biological surfaces—especially under power lines—are detailed.

M.A. Stuchly and D.W. Lecuyer, "Exposure to Electromagnetic Fields in Arc Welding," ***Health Physics, 56,*** **pp.297-302, March 1989.**

Most arc welders use 50 or 60 Hz currents to produce a plasma arc. Users of some of these devices can be exposed to "relatively high magnetic fields"; they entail "high occupational exposures," according to this survey by the Canadian Bureau of Radiation and Medical Devices. The electric field is generally less than 50 V/m. An operator's magnetic field exposure ranges from a few μT to hundreds of μT. The welders also produce transient RF fields, which were not measured in this study.

T.S. Tenforde, "Applications, Dosimetry and Biological Interactions of Static and Time-Varying Magnetic Fields," ***ICRU News, 1/89,*** **pp.17-20, June 1989.**

Battelle's Tenforde briefly reviews the bioeffects of NMRI EMFs and the ELF-cancer literature. He classifies the Savitz epidemiological study as one which shows "no clear relationship" between childhood cancer incidence and 60 Hz magnetic fields. Until now, *ICRU News* was published on an irregular schedule; it will now be issued twice a year.

Nancy Wertheimer and Ed Leeper, and Richard K. Severson et al., "Letters to the Editor, Re: 'Acute Nonlymphocytic Leukemia [ANLL] and Residential Exposure to Power Frequency Magnetic Fields,' " ***American Journal of Epidemiology, 130,*** **pp.423-427, 1989.**

Wertheimer and Leeper argue that taking into account magnetic fields from electrically-heated beds affects the results of the New York State-sponsored adult ANLL study (see *MWN*, M/J88). The Battelle team responds.

Jonathan R. Wolpaw et al., "Chronic Exposure of Primates to 60 Hz Electric and Magnetic Fields: I. Exposure System and Measurements of General Health and Performance; II. Neurochemical Effects; III. Neurophysiologic Effects," ***Bioelectromagnetics, 10,*** **pp.277-319, 1989.**

This research, sponsored by the New York Power Lines Project, shows that EMFs can affect the balance of neurotransmitter metabolites in the cerebral spinal fluid of monkeys (see *MWN*, N/D85). Some scientists suggest that this work may explain observed increases in suicide and depression. (See also *MWN*, M/J88.)

John E. Zapotosky, ***ELF Communications System Ecological Monitoring Program: Summary of 1987 Progress,*** **Technical Report E06595-3, Chicago, IL: IIT Research Institute, 78 pp., April 1989.**

The most recent findings from the ongoing program to determine if the U.S. Navy's ELF submarine communications system is having effects on the local ecology in Michigan and in Wisconsin. The report is available from: NTIS, Springfield, VA 22161.

Pulsed Electromagnetic Fields (PEMFs)

A. Cossarizza et al., "[ELF PEMFs] Increase Interleukin-2 (IL-2) Utilization and IL-2 Receptor Expression in Mitogen-Stimulated Human Lymphocytes from Old Subjects," ***Febs Letters, 248,*** **pp.141-144, May 1989; "[ELF PEMFs] Increase Cell Proliferation in Lymphocytes from Young and Aged Subjects,"** ***Biochemical and Biophysical Research Communications, 160,*** **pp. 692-698, April 28, 1989; and "DNA Repair After Gamma Irradiation in Lymphocytes Exposed to Low-Frequency PEMFs,"** ***Radiation Research, 118,*** **pp.161-168, 1989.**

In the first two experiments, these Italian researchers found that PEMFs could affect lymphocyte proliferation. In the third experiment, they found that PEMFs do not "affect DNA repair mechanisms." In all three experiments, they used PEMFs with a pulse duration of 2 msec and a pulse repetition rate of 50 Hz. The peak intensity of the magnetic fields was 2.5 mT, with a time rate of change of 1 T/sec.

W. De Loecker, P.H. Delport and N. Cheng, "Effects of Pulsed Electromagnetic Fields on Rat Skin Metabolism," ***Biochimica et Biophysica Acta, 982,*** **pp.9-14, 1989.**

In this effort to understand the mechanism of PEMF interactions, these Belgian researchers found that the fields affect protein synthesis through changes in transport at the cellular membrane and that these changes can be mimicked by varying the composition of the electrolytes in the incubation medium.

J. Leal et al., "Embryonic Development and Weak Changes of the Geomagnetic Field," ***Journal of Bioelectricity, 7,*** **pp.141-153, 1988-89.**

Leal and coworkers in Madrid, Spain, found that the biological response of chick embryos to PEMFs was "linearly related to slight

changes in the values of the horizontal component of the geomagnetic field, especially during the gastrulation phase of the developing organisms." The vertical component of the earth's field was not a factor. The team notes that their findings could explain why different laboratories get different results. (See also *MWN*, J/F87 and M/A88.)

B.F. Sisken et al., "Stimulation of Rat Sciatic Nerve Regeneration with Pulsed Electromagnetic Fields," *Brain Research, 485*, pp.309-316, 1989.

PEMF treatment proved effective in facilitating the regeneration of the nerve. Interestingly, treatment of the animal *prior* to injury also appeared to be effective: "This experiment shows that PEMFs can affect the intact animal and is not solely effective after the infliction of an injury. Furthermore this demonstrates that PEMFs can affect regeneration indirectly, possibly by stimulating growth processes in general." Sisken is at the University of Kentucky in Lexington.

RF/MW Radiation

P.D.C. Brown-Woodman et al., "Evaluation of Reproductive Function of Female Rats Exposed to Radiofrequency Fields (27.12 MHz) Near a Shortwave Diathermy Device," *Health Physics, 56*, pp.521-525, April 1989.

Female rats exposed to 27.12 MHz RF radiation prior to mating showed signs of reduced fertility, although congenital malformations in subsequent progeny were not observed. The authors, who are at the Cumberland College of Health Sciences in Lidcombe, Australia, warn that their results indicate that female operators of diathermy units—particularly physiotherapists—may experience reduced fertility if they remain close to the consoles for prolonged periods of time.

Jin-Yuan Chen and Om P. Gandhi, "RF Currents Induced in an Anatomically-Based Model of a Human for Plane-Wave Exposures (20-100 MHz)," *Health Physics, 57*, pp.89-98, July 1989.

This is the latest in a series of papers by Gandhi's group at the University of Utah which are forcing a reevaluation of RF health risks and exposure standards (see *MWN*, J/A85 and J/A86). Using a computer model, the researchers found that RF currents of 600-800 mA can be induced "over much of the body" for E-polarized fields on the order of those suggested by the 1982 ANSI safety guidelines.

Robert F. Cleveland, Jr., and T. Whit Athey, "Specific Absorption Rate (SAR) in Models of the Human Head Exposed to Hand-Held UHF Portable Radios," *Bioelectromagnetics, 10*, pp.173-186, 1989.

Using models of the human head composed of materials that simulate bone, muscle and eye tissue, Cleveland, of the FCC, and Athey, of the FDA, calculated SARs induced by hand-held transceivers transmitting in the 800 MHz band. Their results indicate that—in addition to power and frequency—the two significant factors affecting the magnitude and distribution of SARs are "radio and antenna position relative to the head" and the "type of antenna used and location of its feed-point."

Andrew Cutz, "Effects of Microwave Radiation on the Eye: The Occupational Health Perspective," *Lens and Eye Toxicity Research, 6*, pp.379-386, 1989.

Cutz, of the Canadian Centre for Occupational Health and Safety, presents an overview of both thermal and non-thermal effects of MW exposures on the eyes. He notes that the effect of "long-term, low-intensity MW exposure on the human lens is poorly understood." This review, which is part of the proceedings of the *1st Congress of the International Society of Ocular Toxicology*, includes 23 references.

V. Delpizzo, "A Survey of Shortwave and Microwave Diathermy Devices," *Radiation Protection in Australia, 6*, pp.115-117, October 1988.

Delpizzo's survey indicates an absence of MW, as opposed to SW, diathermy units—which conforms to the prevailing view among physiotherapists that MW devices are potentially more hazardous and less effective. He notes that very few doctors use diathermy: "It is doubtful that [they] have adequate understanding of the properties, effects and hazards of SW and MW radiation." A number of users reported "adverse effects." For the most part, the injuries were minor and reversible.

***Christopher J. Gordon*, "Effect of Radiofrequency Radiation Exposure on Thermoregulation," *ISI Atlas of Science: Plants and Animals, 1*, pp.245-250, 1988.**

In this paper, Gordon considers only the potential *thermal* effects of RF radiation exposures. He proposes that, if the results of certain studies of experimental animals can be extrapolated to humans, the SAR for hazardous thermal effects may be much lower than the recommended standard of 0.4 W/Kg. Gordon points out that the data base on the thermoregulatory effects of RF radiation appears to be insufficient to develop totally safe exposure guidelines for the general population and he calls for further research. (See also *MWN*, J/A87.)

Kenneth Joyner, "Possible Adverse Thermal Responses in Operators of Radiofrequency Dielectric Heaters," *Radiation Protection in Australia, 6*, pp.107-114, October 1988.

Using a computer model, Joyner found that operators of unshielded industrial RF equipment who are exposed to whole body SARs of 4 W/Kg may experience increases in core blood temperatures of more than 2°C when the air temperature is greater than 30°C, as well as significantly increased cardiac outputs. These effects could be detrimental to pregnancy outcomes. Joyner also reviews some data from one factory using RF machines. He observes that "there is circumstantial evidence to support the premise that pregnant women or women of childbearing age who operate industrial RF (10-50 MHz) devices may be at risk if those devices emit excessive leakage radiation."

***Kenneth Joyner, Paul Copeland and Ian MacFarlane*, "An Evaluation of a Radiofrequency Protective Suit and Electrically Conductive Fabrics," *IEEE Transactions on Electromagnetic Compatibility, 31*, pp.129-137, May 1989.**

The authors, who are with Telecom Australia Research Labs, describe measurements of the shielding effectiveness of a protective suit in the frequency range 200 kHz to 4 GHz—the suit was originally designed to guard against 50/60 Hz fields. They found that the suit caused a resonant enhancement in the head of the model at 3.5 GHz and that it provided no attenuation for magnetic fields at frequencies below approximately 4 MHz. (For other reports on protective suits, see *MWN*, D81 and N/D87.)

Clifford L. Mitchell et al., "Results of a United States and Soviet Union Joint Project on Nervous System Effects of Microwave Radiation," *Environmental Health Perspectives, 81*, pp.201-209, May 1989.

Reported here are the findings of duplicate experiments conducted at the same time at NIEHS in the U.S. and—by Dr. Mikhael Shandala's group—at the Marzeev Research Institute of General and Communal Health in Kiev, U.S.S.R. (see *MWN*, J/A82 and S83). In both studies, male rats were exposed to 10 mW/cm² 2.45 GHz MWs for seven hours. Behavioral, biochemical and electrophysiol-

ogical measurements were made during or immediately after exposure. Some of the effects observed in one study differed from those observed in the other study.

J. Toler et al., "Long-Term Study of 435 MHz Radiofrequency Radiation on Blood-Borne End Points in Cannulated Rats, Part I: Engineering Considerations; Part II: Methods, Results and Summary," *Journal of Microwave Power and Electromagnetic Energy, 23,* pp.95-104 and pp.105-136, 1988.

Toler and colleagues at the Georgia Institute of Technology and at Emory University, both in Atlanta, exposed 100 adult male rats to a 1 mW/cm^2 pulsed 435 MHz field (1 μsec pulse width, 1 kHz pulse repetition rate) for 22 hours a day, seven days a week over six months—the whole-body SAR varied from 0.04 to 0.4 W/Kg, with a mean of 0.3-0.35 W/Kg. A large number of hormonal, hematological and cardiovascular end points were monitored. The authors conclude that, "Chronic exposure to the low-level, pulsed field resulted in no adverse effects on animal health, as measured by the spectrum of blood-borne end points," and that there was no evidence that the RF environment is "a source of subtle environmental stress." These results are consistent with those from Dr. Bill Guy's lab at the University of Washington in Seattle. Like Guy's study, Toler's was supported by the U.S. Air Force. Toler has now begun a new study to investigate the possible RF-cancer link raised by Guy's study (see *MWN*, J/A84 and Mr85).

VDTs

Kari Jokela, Juha Aaltonen and Ari Lukkarinen, "Measurements of Electromagnetic Emissions from Video Display Terminals at the Frequency Range from 30 Hz to 1 MHz," *Health Physics, 57,* pp.79-88, July 1989.

This group from the Finnish Centre for Radiation and Nuclear Safety in Helsinki measured the ELF and VLF fields from Amstrad, Digital VT, IBM AT and Salora VDTs. The ELF fields were greater than the VLF emissions: at 30 cm, the Amstrad had a field of 7.2 mG (0.72 μT) and the IBM color monitor had a field of 5.3 mG. The IBM unit had the highest VLF field—1.4 mG. (All are rms values.) The authors note that the fields decrease by a factor of 2.5-3.5 at 50 cm, which they call "a more realistic distance when considering actual working conditions."

J.G. Llaurado, "Spontaneous Abortion and Visual Display Terminals (VDTs)," Commentary, *International Journal of Biomedical Computing, 24,* pp.73-78, 1989.

A review of the latest developments in the VDT-pregnancy effects debate.

General Interest

E.C. Field, Jr., et al., "An Aerostat-Supported ELF/VLF Transmitter," *Radio Science, 24,* pp.235-246, March/April 1989.

Kaichi Maeda and Joseph M. Grebowsky, "VLF Emission Bursts in the Terrestrial and Venusian Nightside Troughs," *Nature, 341,* pp.219-221, September 21, 1989.

Walter Olson, "The Case Against Expert Witnesses," *Fortune,* pp.133-138, September 25, 1989.

Howard Rasmussen, "The Cycling of Calcium as an Intracellular Messenger," *Scientific American, 261,* pp.66-73, October 1989.

Letters to the Editor

To the Editor:

I would like to add a note to the ongoing discussion of 60 cycle magnetic fields present around household equipment. The small (six-inch) personal fans, which are commonly used on desks or bedside stands, project considerable AC magnetic fields. These magnetic fields range from several gauss at the fan motor housing to several milligauss at distances of two to three feet away from the fan. My son was using one of these fans on his bedside stand, and I measured an rms 60 cycle magnetic field of 5 mG on his pillow. The measurements were made with an rms milli-gaussmeter manufactured by my company.

Dr. Roger Hastings
Electro-Magnetics Design, Inc.
Burnsville, MN
September 5, 1989

To the Editor:

With regard to your article on "Australians Take Cancer Risks Seriously" [see *MWN*, M/J89], I feel that I have been misinterpreted in the headline "Call for a 15-30 mG Magnetic Field Limit." The discussion I presented was not a call for a 15-30 mG limit for ELF magnetic fields but rather was what I thought was a reasonable approach to the siting of high voltage power lines.

I would very much appreciate you reproducing the relevant paragraph so readers can draw their own conclusions:

> Epidemiological studies by themselves do not prove a case—epidemiological data must be consistent with experimental data and it must be stressed that no cause-effect relationship has been established between ELF magnetic fields and cancer. However, whilst the research work is continuing, an approach to deal with the dilemma which could be adopted embraces the principle of equipartition of risk. That is, no group in the community should be exposed to environmental levels of ELF magnetic fields significantly in excess (<2) of those already experienced by other groups in the community. Basically what this means is that as the ELF magnetic field levels from existing installations are from 15 to 30 mG then no new installations should increase this level significantly. In addition, siting criteria for high voltage transmission lines and building development should take into account the numbers of people that will be exposed and attempt to minimize that number.

Dr. Ken Joyner
Head, Electromagnetic Compatibility Section
Telecom Australia—Research Laboratories
Clayton, Victoria
September 4, 1989

FM Radiation-Leukemia Link Alleged

In September, the widow of an FM radio technician who died of leukemia settled with Collins Radio Co. for what Stuart Lemle, one of her attorneys, called a "substantial" amount. In her suit, Marie Lafferty claimed that Collins had failed to protect her husband from, or warn him against, the health risks associated with exposures to RF radiation (see *MWN*, M/J86).

Lemle, who is with the Washington, DC, firm of Land, Lemle & Arnold, refused to disclose the precise terms, but described the settlement as "considerably more than nuisance value." Mrs. Lafferty was also represented by C.V. Reynolds of Prestonsburg, KY. Reynolds handled Mrs. Lafferty's workers' compensation claim, which was settled at the same time.

Linda Hopgood of Clark, Ward & Hopgood in Lexington, KY, who represented the defendants, refused to comment on the case.

William Lafferty worked as a radio technician at Prestonsburg's WQHY-FM for 22 years, maintaining and repairing transmission equipment, which was manufactured by Collins Radio Co., then a subsidiary of Continental Electronics Manufacturing Co., Inc.—both in Dallas, TX. Collins was later bought by Rockwell International, which, in June 1988, was brought into the suit. Continental settled separately with Mrs. Lafferty in 1988 for an undisclosed amount.

In 1983, Mr. Lafferty began to complain of health problems, including a "burning or boiling sensation internally and on the surface of his skin," Mrs. Lafferty told *Microwave News*. In July of that year, he was diagnosed as having acute myelomonocytic leukemia. He died a month later at the age of 41.

On May 1, 1986, Mrs. Lafferty filed a civil suit against Collins and Continental in Kentucky's Floyd Circuit Court, alleging that WQHY's antenna and transmitter did not have "adequate safeguards to protect persons situated in close proximity from exposure to high levels of [RF] radiation."

A radio engineer familiar with the operation of the station gave a deposition stating that the RF generator at the base of the radio tower was leaking RF radiation, due to ineffective shielding on the door, according to Lemle. The engineer also claimed that safety devices could have been installed.

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Among the expert witnesses were Dr. Arthur Frank of the University of Kentucky in Lexington for Mrs. Lafferty, and Jules Cohen and Richard Tell, consultants based, respectively, in Las Vegas, NV, and Washington, DC, for the defendants.

AM Station's Neighbor Settles Suit

Another wrongful death suit was settled in August by Thomas DiLuzio, a Spokane, WA, widower who claimed that his wife's death had been caused by chronic overexposure to RF radiation from a nearby AM radio transmitter station operated by KGA-AM (see *MWN*, S/O86).

As in the Lafferty case, the terms of this settlement are confidential, according to Robert Greer, one of DiLuzio's attorneys—though there is some disagreement as to who requested that the records be kept secret. Greer, who is with the Spokane law firm of Feltman, Gebhardt, Eymann & Jones, said that KGA's attorneys requested a confidential settlement, but KGA General Manager Steve Cody maintained that it was DiLuzio's request. KGA's attorney, Richard Kuhling of Pain, Hamblen, Coffin, Brooke & Miller in Spokane commented that the question of which party called for secrecy is "water under the bridge."

Janice DiLuzio was 39 in 1982 when she was diagnosed as having multiple myeloma. She died three years later. Multiple myeloma—cancer of the plasma cells—is extremely rare among people under 40: in court papers, DeLuzio's attorneys stated that this was "one of the, if not the, earliest reported case" in the U.S.

In 1972, the DiLuzios and their two children moved into a house approximately 600 feet northwest of KGA's 50 kW AM radio transmitter tower. Their home was in the path of the transmitter's 1,510 kHz directional signal used at night, according to the complaint.

The DiLuzios and others in the neighborhood experienced significant interference with TVs, radios, telephones and other household appliances. In fact, the signal in the community was reportedly so strong that chain-link fences and metal objects inside homes could act as radio receivers.

Mr. DiLuzio filed a wrongful death claim against KGA in July 1986 in the Superior Court for Spokane County, charging the radio station with failing to warn his family and other residents in the neighborhood of the dangers of chronic RF exposure. He also claimed that his children were being exposed at their elementary school, which was located less than 200 feet from the tower on land originally owned by KGA.

KGA's Cody told *Microwave News* that the day he learned of the lawsuit, he hired a consultant to measure the RF fields. "We were well below the ANSI standard," he said, referring to the 1982 guidelines adopted by the American National Standards Institute (ANSI). "If we had been over the ANSI limits, I would have pulled the plug immediately," he added.

Although the DiLuzio case has been settled, the community's problems with KGA continue. A neighborhood commit-

tee which was organized to force the radio station to move to a less populated area is now circulating a petition which states that KGA's broadcast towers may pose a "significant long-term health hazard" to the children at the nearby elementary school and to residents in the surrounding area. The petition also requests the Federal Communications Commission (FCC) to refuse to renew KGA's license until it relocates. According to Cody, relocation is "not a viable option at this time."

In 1988, a team from the Environmental Protection Agency (EPA) and the FCC reported that RF radiation levels from a number of AM stations near the school were far below those specified by ANSI—though it acknowledged that "levels far below the ANSI guide can cause annoying RF shock/burns" (see *MWN*, J/A88).

FM Radio-Cancer Suit Readied for Trial

Beryl and Maelma Main, who own a square dance camp next to the former site of an FM radio transmitter, are suing the owner of KYGO for compensatory and punitive damages, claiming that its "extremely high and unreasonably dangerous levels of RF radiation" caused Beryl to develop non-Hodgkin's lymphoma. A trial date has not yet been set.

In an August 1988 complaint filed in U.S. District Court in Colorado, the Mains are seeking damages from Jefferson-Pilot Broadcasting, Inc., the owner and operator of KYGO. Before the station moved in 1987, KYGO's transmitter was located on Lookout Mountain above Denver, CO.

"We have a very strong case," Bruce DeBoskey, the Mains's attorney, told *Microwave News*. "No risk factors other than RF radiation are involved." DeBoskey is a partner with Silver & DeBoskey in Denver.

Jefferson-Pilot is represented by Geoffrey Race of the Denver law firm of Weller, Friedrich, Ward & Andrew. Race did not respond to a call for comment.

For four months each summer since 1977, the Mains have run the square dance camp on Lookout Mountain within 100 feet of KYGO's tower. In February 1986, when he was in his mid-50s, Mr. Main was diagnosed with cancer. Later that year, an EPA-FCC survey identified RF hot spots up to 10.35 mW/cm^2 in publicly accessible areas near the base of KYGO's tower and up to 300 $\mu W/cm^2$ on the camp's patio/deck (see *MWN*, M/A87).

Following the release of the survey data, KYGO agreed to reduce its power output from 100 kW to 1 kW and to limit radiation levels to 10 $\mu W/cm^2$ on camp property (see *MWN*, M/J87). KYGO subsequently moved its antenna and transmitter.

Drs. Robert Becker of Lowville, NY, and Andy Marino of LSU Medical Center in Shreveport, LA, are expert witnesses for the Mains. Jules Cohen of Washington, DC, Dr. Don Justesen of the VA Hospital in Kansas City, MO, Dr. Carl Sutton of the VA Hospital in Milwaukee, WI, and Dr. Paul Tyler of Potomac, MD, are testifying for Jefferson-Pilot.

Family Sues Nearby FM Radio Station

In November, a Santa Rosa, CA, family will go to court to try to recoup expenses incurred in a successful fight to force KVRE-FM's radio antenna to be moved from a site within 200 feet of their home. Sue and Jack Kantor, who filed suit in September 1987, are also seeking $500,000 in damages from KVRE and the city of Santa Rosa—which issued KVRE's permit. The Kantors claim that KVRE transmissions caused health problems for their son and potential health hazards for the rest of the family.

"It was a real nightmare for two years, but we finally got the station to leave," Sue Kantor told *Microwave News*. "I'm just hoping that we'll get our money back." She estimates their overall expenses at more than $128,500. John Flitner of the Santa Rosa law firm of Monroe, Flitner & Nellessen is representing the Kantors.

In 1985, the city of Santa Rosa issued KVRE a permit for a 3 kW FM radio transmitter and a lease for a site adjoining the Kantor's property. At that time, the Kantors had been living in their home for ten years. Soon thereafter, the Kantors' son John, who was then 11 years old and wearing a metal orthodontic device at night, began to experience "severe headaches" on a daily basis.

KVRE's start-up also caused significant TV and radio interference for the Kantors and many of their neighbors. "For years we experienced good TV reception and overnight it disappeared," Sue Kantor said. Like the DiLuzios, the Kantors suffered significant EMI with their household appliances.

In March 1986, KVRE Manager John Detz told the *Press Democrat*, a local newspaper, that the station met "all government regulations" and that the station had tried to solve the community's problems by "installing filters on TV sets and making other improvements."

The land leased to KVRE by the city was actually located in an unincorporated part of Sonoma County. The Kantors argued that the city did not have jurisdiction over the land, had disregarded local zoning rules and had failed to hold public hearings. The Sonoma County zoning board agreed and ordered KVRE to remove its antenna by April 1987. KVRE went off the air in the summer of 1987, according to David Beach of Senneff, Bernheim, Emery & Kelly, who represents the original owners of the radio station. But he said that "KVRE stopped transmitting from the location for reasons unrelated to the litigation."

Despite repeated calls, the Santa Rosa city attorney could not be reached for comment.

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CONFERENCES

New Listings

1990

February 4-9: **IEEE Power Engineering Society Winter Meeting,** Westin Peachtree Plaza, Atlanta, GA. Contact: Nancy Heitmann, IEEE Service Center, IEEE Society Special Services, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855, (201) 562-3882.

March 26-27: **16th Annual Northeast Bioengineering Conference,** Pennsylvania State University, University Park, PA. Contact: Roger P. Gaumond, Bioengineering Program, 230 Hallowell Bldg., Pennsylvania State University, University Park, PA 16802, (814) 865-1407.

April 1-5: **74th Annual Meeting of the Federation of American Societies for Experimental Biology (FASEB),** Washington, DC. Contact: FASEB Office of Scientific Meetings, 9650 Rockville Pike, Bethesda, MD 20814 (see p.8).

April 16-21: **2nd International Symposium on Microwave Processing of Materials,** San Francisco, CA. Contact: Materials Research Society, 9800 McKnight Rd., Suite 327, Pittsburgh, PA 15237.

May 5-9: **25th Annual Meeting of the Association for the Advancement of Medical Instrumentation (AAMI),** Anaheim Marriott Hotel, Anaheim, CA. Contact: AAMI Education Dept., 3330 Washington Blvd., #400, Arlington, VA 22201, (800) 332-2264 or (703) 525-4890 (in VA).

May 7-11: **IEEE AP-S International Symposium & URSI Radio Science Meeting,** Dallas Convention Center, Dallas, TX. Contact: Dr. Oren Kesler, IEEE AP-S/URSI Symposium, PO Box 860130, Plano, TX 75086, (214) 952-3772.

May 8-10: **IEEE MTT-S International Microwave Symposium,** Dallas, TX. Contact: Tatsuo Itoh/Randall Lehmann, c/o LRW Associates, 1218 Balfour Dr., Arnold, MD 21012.

May 23-25: **44th Annual Frequency Control Symposium,** Stouffer Harbor Place Hotel, Baltimore, MD. Contact: Dr. R.L. Filler, U.S. Army Electronics Technology and Devices Lab, ATTN: SLCET-EQ, Fort Monmouth, NJ 07703, (201) 544-2467.

June 5-7: **4th International Conference on Advanced Infrared Detectors and Systems,** London, U.K. Contact: Institute of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

August 21-23: **IEEE International Symposium on Electromagnetic Compatibility,** Washington Hilton Hotel, Washington, DC. Contact: Dr. William G. Duff, Atlantic Research Corp., 5390 Cherokee Ave., Alexandria, VA 22312, (703) 642-4049.

August 28-31: **7th International Conference on Electromagnetic Compatibility,** University of York, U.K. Contact: Institute of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

September 18-21: **3rd Asia-Pacific Microwave Conference,** Sunshine City Convention Center, Tokyo, Japan. Contact: Prof. Yoshiyuki Naito, Chairperson, Technical Program Committee, c/o Business Center for Academic Societies Japan, 3-23-1 Hongo, Bukyo-ku, Tokyo, 113 Japan, (81) 3-817-5831.

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MICRO WAVE NEWS

Vol. X No. 5 A Report on Non-Ionizing Radiation September/October 1990

INSIDE...

ELF NEWS pp.2-5

Power Line Talk:
Uproar Over Cluster Map in Guilford, CT • Power Line Delays Denver Airport • Boutwell Denies Health Risk • EMFs in Schools • Peters's Cancer Results Ready in 1991 • Cancer Rates Up
EMFs in the Press
Epidemiology Roundup: Three New Links
Leukemia Among Finnish Linemen
Leukemia Risks for Navy Electricians
Cancer Among Swiss Railway Engineers
Assorted Notes
Prudent Avoidance Meeting in January
Litigation and Regulation
EMF Wrongful Death Suit Dropped
NJ Drops 200 mG Limit, Opts for ALARA
NY Sets Interim Standard at 200 mG
EPA's Cancer Review p.13
FDA and Electric Blankets p.13
NIOSH Research Workshop p.13

HIGHLIGHTS pp.6-7

The Talk of Prague
Sweden Proposes ELF Limits for VDTs
EPA To Measure Maglev EMFs
Strom Case: Terms of Settlement p.11

SPECIAL REPORT pp.8-11

EMFs and Cancer Clusters: A True Link or an Epidemiologist's Nightmare?
ELF EMFs and RF/MW Radiation

UPDATES pp.14-15

Army Won't Study EMP Health Effects • EMFs and the Law • MRI Resources • Henhouse, ELF-Behavior and Melatonin-SIDS Studies Published • FDA To Test VDT EMFs • People in the News • U.S. Air Force Dismisses VDT Radiation Risk • Consensus on Hyperthermia and Cancer • and more...

CLASSIFIEDS p.16

Boeing Pays $500,000 To Settle Strom EMP-Leukemia Suit

Medical Program for EMP Workers

In the largest settlement for an electromagnetic field (EMF) injury ever recorded, the Boeing Co. of Seattle, WA, has agreed to pay more than $500,000 to Robert Strom, who claims that he developed leukemia from on-the-job exposures to electromagnetic pulse (EMP) radiation.

In addition, the out-of-court agreement provides for a comprehensive medical program for the approximately 700 Boeing employees who have worked with EMP since testing began in the 1960s. The settlement became final on September 21.

"The total value of the settlement could be well over $1.5 million," Michael Withey of Schroeter, Goldmark & Bender in Seattle, WA, told *Microwave News*. Withey is the lead attorney representing Strom and his wife Barbara on behalf of Trial Lawyers for Public Justice (TLPJ), a nonprofit group based in Washington, DC. "This landmark settlement confirms that electromagnetic radiation is hazardous to the public health and creates a mechanism for proving that fact in future cases," he said.

"It was an incredible victory. We got virtually everything we were hoping to get out of this litigation," Arthur Bryant, executive director of TLPJ, said in a telephone interview.

The class action suit, which was filed in June 1988 in King County, WA, Superior Court, charged that Boeing had long known of the health risks associated with EMP exposure, yet never warned workers or took any precautions to protect them (see *MWN*, J/A88). It further alleged that Boeing,

(continued on p.11)

Federal Health Agencies Put EMFs on Their Research Agendas

Under the prodding of Congress, federal agencies charged with protecting public and occupational health are taking a new look at electromagnetic fields (EMFs). Meetings are being scheduled and research agendas are being revised to address growing public concerns.

NTP Plans $6-10 Million Animal Studies

The National Toxicology Program (NTP) is planning a series of major animal studies on the reproductive, developmental and carcinogenic effects of extremely low frequency (ELF) EMFs. The studies will involve as many

(continued on p.12)

ELF NEWS

« Power Line Talk »

A map that appears to show a clustering of cancer cases in **Guilford, CT**, over the past 20 years, has the town in an uproar. State health officials drew up the map in response to allegations made by **Paul Brodeur** in the July 9 *New Yorker* of an abnormal number of brain tumors and other central nervous system cancers among people living near a substation and power lines (see p.9). When the map made a fleeting appearance at an August 20 public meeting, some town residents were struck by the apparent clustering of cases along the route of a Connecticut Light & Power line coming from the substation. After the meeting the health department refused to release the map, claiming it would violate the privacy of the cancer victims. But a few weeks later, local activist **Bob Hemstock** got hold of a copy when, he says, the department included the map in the literature it was distributing in response to public inquiries. Not surprisingly, within a few days the map made headlines in the local newspapers (for instance, in the October 3 *New Haven Register*). The map does indeed show a pattern of cases on Meadow Street near the substation, as well as one along Long Hill Road, on which, according to Hemstock and confirmed by Northeast Utilities, runs a 13.8 kV line. There are also a number of cases in the area where a 115 kV transmission line crosses Long Hill Road. The health department is now releasing a modified version of the map, indicating only the general locations of the cases. And no one is admitting that the cancer rate is abnormally high in the area. There is "no clustering," maintains Dr. Sandy Geschwind of the state Department of Health Services.

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Denver, CO's new international airport is being held hostage to a power line siting dispute. The line in question, a 16-mile segment of a 230 kV line, runs right through the middle of the airport site. Officials in Adams and Aurora Counties want the Public Service Co. of Colorado to consider burying the line, rather than rerouting it around the airport—the utility's current plan—according to the September 11 *Denver Post*. Burying the line would reportedly cost $100 million, while moving it east of the airport would run about $18 million. An August 21 *Post* editorial praised county officials for their concern over potential EMF health hazards, but pointed out that the proposed route would run through largely vacant farmland: "If millions of dollars are to be spent to eliminate any risks posed by high-tension lines, the money should be used first to bury the miles and miles of existing cable that were strung through residential areas before the potential hazards became known."

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It's no longer possible to deny EMF health risks categorically, according to the 1989 congressional OTA report, but some people disagree. National Cancer Advisory Board member Dr. **Roswell Boutwell** recently testified that "...sufficient scientific literature is available to assess whether exposure to power frequency fields results in the initiation, promotion or progression of cancer, and there is no scientific basis for the assertion that such exposure is associated with any of those effects," as reported in the August 5 *Asbury Park Press*, a New Jersey newspaper. Boutwell testified in May on behalf of **Jersey Central Power & Light** (JCP&L) at a hearing on the siting of a 230 kV line in Middletown, NJ (see *MWN*, J/A89). He was last seen as a utility expert witness in the 1988 Marcy-South case, for which he was paid approximately $75,000 (see *MWN*, N/D88). After a long-drawn-out battle with JCP&L, residents and the township appear to have won. On September 25, JCP&L announced that it is deferring construction of the line until the mid-1990s "as a result of a slowdown in economic activities in the state, compounded by uncertainties resulting from the Persian Gulf crisis."

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Schools may become the next major battlefield in the EMF conflict. As parents learn more about EMF health effects, they are demanding measurements and, when necessary, reductions of EMF levels in classrooms and schoolyards. Conflicts over EMFs in schools are not new. A few years ago, a school district in Houston, TX, forced Houston Lighting & Power to remove a high-voltage transmission line from school property at a cost of $8.6 million (see *MWN*, J/A88). Since then, complaints involving EMFs in schools have been heard around the country. In 1988, California adopted guidelines requiring a minimum distance between schools and power line right-of-ways (see *MWN* M/J88). What *is* new is the coverage of this issue in the popular press. In one of the most widely read articles, **Paul Brodeur** describes how parents have challenged school boards and utilities over "unacceptably" high field levels measured in and around schools (the article appears in the September 25 ***Family Circle***). One of the controversies cited by Brodeur is in Montecito, CA, where school officials have opted for a low-cost way to practice "prudent avoidance" by relocating desks and roping off certain "hotspots" to insure that students are not exposed to levels above 2 mG (see p.8). And in Fountain Valley, CA, field levels in schools were found to range from 2 mG to as high as 130 mG. **Southern California Edison** researcher Jack Sahl thinks such readings may warrant an investigation, and he told the *Los Angeles Times* (September 2) that, "My position would be: Let's find out what's going on here."

«« »»

Dr. **John Peters**'s childhood leukemia study results won't be ready until the beginning of 1991 (see *MWN*, N/D89)—contrary to reports in the September 7 ***Science*** that Peters would present results at the October EPRI utility meeting. Peters told us that he definitely won't be finished by October, nor will he

EMFs in the Press

Public interest in possible health hazards from electromagnetic fields (EMFs) continues to intensify. Here is our latest listing of recent articles and letters in the press (see *MWN*, N/D89).

American Health: Paul Raeburn, "The Switched-On House: Concerns Grow About [EMFs] and Household Devices," March....***Barron's:*** John Nicholson, "Rays of Gloom?" (letter to the editor), August 13....***Byte:*** Bill McGinnis, "Of Monitors and Emissions," September....***Columbia Journalism Review:*** Louis Slesin, "Uncovering Radiation: VDT Stories That Still Don't Make the News," July/August....***The Economist:*** "Very Debatable Units," September 1....***Family Circle:*** Paul Brodeur, "Danger in the Schoolyard," September 25....***Glamour:*** "Fast Facts About VDT Dangers," August; Cindi Leive, "Why I Can't Stop Thinking About My Computer," October....***IEEE Spectrum:*** Eleanor Adair, "Nurturing Electrophobia"; Karen Fitzgerald, Granger Morgan, Indira Nair, "Special Report—[EMFs]: The Jury's Still Out, Part 1: Biological Effects, Part 2: Societal Reverberations, Part 3: Managing the Risks," August....***Issues in Science and Technology:*** C.A.L. Basset, "Premature Alarm over [EMFs]," Spring; letters in response, Summer....***Journal of the American Medical Association:*** David Savitz, "Electric Current and Health" (a review of Brodeur's *Currents of Death*), August 1....***The Lancet:*** J.B. Sibbison, "USA: Danger from [EMFs]," July 14....***Maclean's:*** Diane Brady, "Tension in the Air," August 6....***Macworld:*** Jerry Borrell, "Is Your Computer Killing You?" (editorial), Paul Brodeur, "The Magnetic Field Menace," July; letters in response, October....***The Nation:*** David Corn, "I'm Typing as Fast as I Can," July 2; Herbert Kohl, "Screen Test" (editorial), August 27/September 3....***Nature:*** Seth Shulman, "Cancer Risks Seen in [EMFs]," June 7; David Lindley, "Risky Arguments over Cause and Effect," August 9; Seth Shulman, "All Aboard the Bandwagon," August 16....***New Scientist:*** Andy Coghlan and Nina Hall, "How Magnetic Fields Could Upset Your Ions," August 4....***New Woman:*** Sue Browder, "Warning: Your Home May Be Hazardous to Your Health," October....***New York Times:*** Peter Lewis, "Worries About Radiation Continue, as Do Studies," July 8; Natalie Angier, "Rising Incidence of Brain Tumors Is Drawing Attention and Concern," July 31; Peter Lewis, "Of Magnetism and Monitors," August 7....***The New Yorker:*** Paul Brodeur, "Annals of Radiation: Calamity on Meadow Street," July 9....***Science:*** Robert Pool, "Is There an EMF-Cancer Connection?" September 7; "[EMFs]: The Biological Evidence," September 21; "Flying Blind: The Making of EMF Policy," October 5....***Science News:*** Janet Raloff, "EPA Suspects ELF Fields Can Cause Cancer," June 30....***Scientific American:*** Granger Morgan, "Exposé Treatment Confounds Understanding of a Serious Public Health Issue" (a review of *Currents of Death*), April; Tim Beardsley, "Shocking Genes: [EMFs] Stimulate Gene Activity," July....***Time:*** "Danger from a Glowing Screen," June 18; Philip Elmer-DeWitt, "Hidden Hazards of the Airwaves," July 30....***USA Today:*** Rae Tyson, "Questions Raised About Power Lines and Health," March 15....***U.S. News & World Report:*** Marjory Roberts, "Computer Waves," September 10....***Wall Street Journal:*** "Everyday Electric Items Are Causing Concern," September 25....***Washington Post:*** Michael Specter, "Can Human Disorders Flow from Waves of Household Current?" May 7....***Whole Earth Review:*** Robert Horvitz, "Inhabiting the Electromagnetic Environment," Fall....***Woman's Day:*** Mary-Lou Weisman, "Should You Be Worried About Electricity?" May 22.

be ready for the DOE contractors review in November. His team at the University of Southern California is "working feverishly" to complete the data by the end of the year, he said. *Science* is running a three-part series by Robert Pool examining the EMF health effects debate. The second part appeared in the September 21 issue and the third in the October 5 issue.

«« »»

Dr. **Philip Cole** may have to revise his often-repeated argument that an EMF-cancer link is unlikely because increases in the power grid over the past few decades have not been matched by proportionate increases in cancer rates. A new paper in the August 25 issue of *The Lancet* shows that cancer rates have been soaring over the past two decades among people over 54. A team of international researchers led by Dr. **Devra Lee Davis** of the Mount Sinai Medical Center reports that over the past 20 years the incidences of brain and CNS tumors, breast cancer, multiple myeloma and melanoma have risen steeply in the U.S., Japan and four European countries. "The changes in many types of cancer are so dramatic and rapid that they cannot be ignored," Davis told the August 24 *New York Times*.

Epidemiology Roundup: Three New Links to Cancer

Leukemia Among Finnish Linemen

Finnish workers with "probable" exposures to extremely low frequency (ELF) electromagnetic fields (EMFs) had a statistically significant 90% increased risk of leukemia, according to a new study by Dr. Jukka Juutilainen and coworkers. For central nervous system (CNS) tumors and acute myeloid leukemia (AML), the risks increased by 30% and 50%, respectively.

Workers with "possible" EMF exposures also had increased cancer risks—40% for all leukemia, 40% for AML and 30% for CNS tumors.

"It's one more paper where an increased leukemia and brain cancer risk was identified," Juutilainen told *Microwave News*. Preliminary results of the study were first presented at a 1987 conference (see *MWN*, M/J87). Juutilainen, of the Department of Environmental Sciences at the University of Kuopio in Finland, recently reported that residential ELF exposures could be linked to early pregnancy loss (see p.6).

Among those who worked in jobs with probable exposures, linemen and cable jointers had the highest incidence of leukemia, while telephone installers and repairmen showed the greatest risk for CNS tumors. The team noted that electricians—a group which in past studies has been identified as having a higher incidence of cancer—did not have an elevated leukemia risk.

"I believe our results show that it is less likely that a confounder—other than EMFs—is responsible, since we found increased risks in a variety of different occupations," Juutilainen said.

The team investigated 25-to-64-year-old male industrial workers in Finland between 1971 and 1980 and grouped them into three exposure categories: "probable," "possible" and "no exposure." The probable exposure group included electrical occupations; the possible exposure group covered jobs in which electric motors or welding are commonly involved.

The results appeared in the *International Archives of Occupational and Environmental Health, 62*, pp.289-293, 1990.

Leukemia Risks for Navy Electricians

U.S. Navy electricians were two-and-a-half times more likely to develop leukemia than were other naval personnel, according to a new study by Dr. Frank Garland and colleagues at the Naval Health Research Center in San Diego, CA. The team called the finding "intriguing in the light of several studies showing an excess risk of leukemia associated with exposure to EMFs."

Garland and coworkers surveyed naval personnel on active duty between 1974 and 1984 and identified 102 cases of leukemia. The elevated risk for electrician's mates was the only statistically significant (though borderline) increase for a specific job category. Electrician's mates, like their civilian counterparts (electricians and electric power linemen, for example), are exposed on the job to EMFs.

Machinist's mates—the group most likely to be exposed to leukemogenic agents such as benzene and related compounds and ionizing radiation—did not show an increased risk.

The team used "person-years at risk"—instead of occupational histories—to calculate incidence rates. One knowledgeable source pointed out that the main weakness of this type of study is that it equates "one person working at a job for four years" with "four people working at that job for one year each"—which may not be the same for calculating exposure-related illnesses.

Garland declined to comment on the study.

The paper appeared in the *American Journal of Epidemiology, 132*, pp.293-303, 1990.

Cancer Among Swiss Railway Engineers

A new study from the University of Bern showed that Swiss railway engineers had significantly elevated mortality rates for blood and lymphatic cancers (see *MWN*, N/D89). A team led by Dr. Christoph Minder of the Department of Social and Preventive Medicine found that railway engineers, who are chronically exposed to ELF fields, had a statistically significant 60-70% increased risk compared with technical personnel and a nonsignificant 40% increased risk compared with workers in the metal construction and machine building industries.

"The results obtained are consistent with the findings of many other occupational studies" showing an increased leukemia mortality link, the team concluded.

Minder and Drs. M. Balli-Antunes and D.H. Pfluger looked at mortality data on male railway engineers for the years 1969 to 1983, noting that the average duration of employment was probably more than 30 years. They estimated that the engineers may have been exposed to magnetic field levels up to 10 G, although no direct measurements were taken.

Their paper appeared in the first issue of the new journal *Environmetrics (1*, pp.121-130, 1990), which is published in Canada.

Conflicting Parental Occupational Studies

Two studies in consecutive issues of the *American Journal of Epidemiology* illustrate the conflicting views on parental occupational EMF exposures and their effects on children.

In the June 1990 issue, Drs. J.R. Wilkins and Vickie Hundley reported a 90% increased risk of neuroblastomas among children of men exposed to EMFs at work. Wilkins, of Ohio State University, and Hundley, of the Ohio state Department of Health, both in Columbus, noted that there is an "apparent consistency" between their findings and those of Drs. Christine Johnson and Margaret Spitz, who in 1985 reported an elevated risk of neuroblastomas among children of men who had prolonged on-the-job exposure to EMFs—particularly electronics workers (see *MWN*, J/A85). Spitz and Johnson later reported a statistically significant increased risk of CNS tumors among children of men employed in jobs involving EMF exposures (see *MWN*, M/A90).

In the May 1990 issue, however, Dr. Greta Bunin and coworkers had reported no significant association between parental occupational EMF exposure and neuroblastomas. Bunin, of the Children's Hospital of Philadelphia, PA, did find a four-fold increase in the rate of neuroblastomas among children of electrical and electronic products assemblers, but it was not statistically significant.

The two papers appear in the *American Journal of Epidemiology, 131*, pp.776-780 and pp.995-1008, 1990. In 1988, Dr. Philip Nasca found no consistent association between parental occupation and CNS tumors (see *MWN*, J/F89).

Savitz and Loomis on Electrical Workers

Drs. Dana Loomis and David Savitz have published their paper showing that male electrical workers had a significantly elevated rate of mortality from brain tumors. There was also a slight increase for leukemia among certain occupational groups, but in general, leukemia was not associated with electrical work.

These results "corroborate reports of increased mortality from brain cancer among electrical workers, but give only