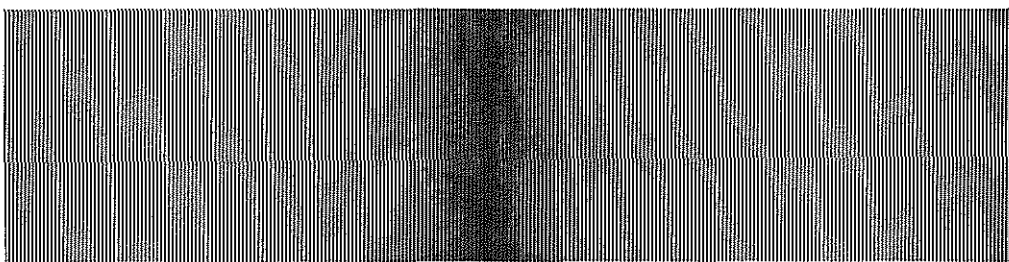


MICRO WAVE NEWS



Vol. VI No.6

A Report on Non-Ionizing Radiation

November/December 1986

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1987 Conference Calendar (Part I)

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

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

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

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

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 Wertheimer told *Microwave News* that her unpublished data for the same subsets showed a similar pattern.

In the seven years following the publication of their landmark

(continued on p.12)

What's Next?

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

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

(continued on p.12)

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

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

Tofani's group continuously exposed rats to 100 $\mu\text{W}/\text{cm}^2$ of 27.12 MHz radiation, a specific absorption rate (SAR) of 1.1×10^{-4} W/Kg, for up to 20 days during pregnancy.

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

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

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

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

Tofani and coworkers divided 40 pregnant rats into three groups: 20 were exposed for all 20 days of the experiment,

10 were exposed for the first 6 days and 10 were exposed for days 6 through 15. 20 rats served as controls.

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

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

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

OSHA's RF/MW Standard

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

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

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

Mechanisms and Cellular Effects Stressed at BRAGS Meeting

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

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

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

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

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

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

In the question-and-answer period, several BRAGS

Clash Over Reproducibility of Dixey-Rein 500 Hz Results

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

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

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

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

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

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

HIGHLIGHTS

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

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

Dr. Claudio Franceschi, also of the University of Modena, joined colleagues from the Universities of Bologna and Padua in a separate report on PEMF effects on the proliferation of human lymphocytes. They cultured lymphocytes from 37 donors, including 18 healthy individuals at least 75 years old and one patient with myotonic dystrophy (chronic, progressive muscular atrophy) who were included because they have an impaired response to

PHA. Although a 50 Hz PEMF was not itself mitogenic, it did increase the mitogenic response to PHA and it did so more effectively in the elderly patients and in the myotonic dystrophy patient than in the other subjects.

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

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

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

Microwave Weapons

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

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

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

EPA on RF/MW Exposures

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

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

Overall, most Americans are exposed to very small levels of non-ionizing radiation. According to surveys in 15 cities, more than 99 percent of the residents are exposed to less than 1 uW/cm² at AM, FM and TV frequencies. However, in high-rise buildings near FM and/or TV antennas, the levels can be much higher. For instance, EPA has measured power densities of 230 uW/cm² on the roof of the Sears Tower in Chicago and 375 uW/cm² on the roof of the Coty Tower in Honolulu.

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

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

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

RF Lighting Rules: Conflicting Views

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

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

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

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

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

Stating that the proposal was "premature" and that it

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

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

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

The Health Physics of Non-Ionizing Radiation

**March 9-13, 1987
Merrimack, New Hampshire**

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

FROM THE FIELD

Letter from China

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

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

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

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

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

NRPB on Greenham Common

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

Dear Sir:

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

Yours faithfully,

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

Adey & Sheppard and Milham Respond to Foster & Guy

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

September 25, 1986

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

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

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

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

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

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

Sincerely,

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

Asher R. Sheppard
Research Physicist

August 19, 1986

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

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

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

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

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

Sincerely,

Samuel Milham, Jr., MD
Olympia, WA

UPDATES

BIOLOGICAL EFFECTS

EPRI's ELF Teratology Plans Change Again...

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

COMMUNICATIONS

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

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

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

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

one member of the local planning commission told the *Post*, "Let's be honest....It was an eyesore."

COMPATIBILITY & INTERFERENCE

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

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

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

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

GOVERNMENT

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

INTERNATIONAL

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

MEASUREMENT

New Narda Meter...The Narda Microwave Corp. has introduced a new set of radiation monitors. The Model 8700 series consists of the 8716 meter and a choice of two probes: the 8721, which has a "flat" frequency response, and

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

Resources...A group from the Italian Public Health Labs in Ivrea offers a solution to the problem of finding an accurate and consistent method of measuring electromagnetic fields from 100 kHz to 990 MHz. Santi Tofani and his coauthors' primary concern is protecting workers and the public from overexposure. See their paper in the July 1986 issue of the *IEEE Transactions on Microwave Theory and Techniques*....In Sweden, a group has compared the calibration of 73 commercial power density meters at 27 and 2450 MHz for levels between 10 and 100 mW/cm². At 27 MHz, only 55% of the meters were accurate within 1 dB, compared to 65% at 2450 MHz. One disturbing finding was that 5% of the probes did not work at all, "although their owners thought they did." See Ralf Bostrom, Kjell Hansson Mild and Georg Nilsson's paper in the June issue of the *IEEE Transactions on Instrumentation and Measurement*....Dr. Kun-Mu Chen and coworkers at Michigan State University in East Lansing and Dr. Elliot Postow of the Naval Medical R&D Command in Bethesda, MD, have developed an X-band microwave system that can detect a human at a distance of 30 meters or behind a cinder block wall. The life detection system consists of a low intensity signal (for example, 100 uW at 10 GHz) that is modulated by heartbeats and breathing. Writing in the July issue of the *IEEE Transactions on Biomedical Engineering*, the team suggests that the system could be used to monitor a patient in a clinic or to detect someone hiding inside a vehicle. In addition, although not specifically cited, it is easy to imagine battlefield applications....NBS has issued a new report on the *Shielding Effectiveness Measurements of Plastics* (NBSIR 85-3035) to help engineers get repeatable testing results. The report reviews five of the most common measurement methods and points out that there are substantial differences among the obtained results. John Adams and Eric Vanzura, of NBS's Electromagnetic Fields Division, show, however, that a flanged coaxial holder can overcome the typical measurement problems above 30 MHz. (They found that the system described in the ASTM Emergency Standard 7-83 is not reliable.) The 31-page

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

MEDICAL APPLICATIONS

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

Hyperthermia at VLF Frequencies...Drs. Ichiro Kimura of Saga University and Takeshi Katsuki of Saga Medical School, both in Saga, Japan, have developed an induction heating system, operating at 20-30 kHz, to treat malignant tumors. After testing a number of different materials, they found that copper braided wires, placed in magnetic fields of up to 4,000 A/m, were the most efficient medium for generating uniform heating. Treatment of two

oral cancer patients with VLF hyperthermia, in conjunction with chemo- and radiotherapy, was successful. Kimura and Katsuki argue that their new system is not only safe and effective, but is also cheaper than hyperthermia at microwave frequencies. See their paper in the November issue of the *IEEE Transactions on Magnetics*.

MEETINGS

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

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

MILITARY SYSTEMS

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

STANDARDS

Slow Going for ANS C95.IV...The chairmen of the working groups of subcommittee IV of the Accredited National Standards (ANS) Committee C95 on Non-Ionizing Radiation Hazards are meeting December 1-2 in Las Vegas, NV, to draft a revised version of the exposure standard presented in Madison, WI, last June. At that time, there was considerable apprehension about discussing the substance of the proposed "strawman" draft revision of the

1982 ANSI standard because the literature review was largely incomplete (see *MWN*, July/August 1986). According to a November 13 status report by EPA's Dave Janes, who is chairing the C95.IV group on risk assessment, little progress has been made toward evaluating the more than 300 papers that have been selected for review. About 200 of these have been judged to have acceptable dosimetry, but *only 32* have been reviewed by the biological validation subcommittee -- and of these, 20 have been found to be "relevant for setting standards." (Two of the 20 failed the dosimetry test, however.) Undeterred by the absence of data, the drafting committee is preparing a second version of the strawman standard, which is scheduled to come to a vote next June at a two-day session before the annual meeting of the Bioelectromagnetics Society in Portland, OR.

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

NEW PUBLICATION

Biological Effects of Electropollution Brain Tumors and Experimental Models

Edited by Sisir K. Dutta and Richard M. Millis

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

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ELF Epi Study (continued from p.1)

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

External Field Sources Most Important

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

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

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

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

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

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

A second epidemiological study presented at the Denver

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

A Causal Relationship: Pro and Con

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

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

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

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

New EPRI Epi Study

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

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

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

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

Epidemiology Workshop

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

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

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

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

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

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

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

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

Adult Leukemia: No Link to Residential ELF Fields

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

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

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

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

Canadian Unions Press for Research on ELF Radiation Risks

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

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

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

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

proposing or setting ELF safety standards.

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

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

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

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

Other Developments

EPRI may soon no longer be the only source of utility funds for ELF research. Representatives of the 20 member utilities of the Western Energy Supply and Transmission (WEST) Associates will meet in Phoenix, AZ, in January to discuss priorities for future bioeffects research. One of the major conclusions of a report prepared for WEST Associates was that, "Stable, long-term funding will be

necessary to resolve the human health issues associated with exposure to 60 Hz E- and H-fields." According to Jack Sahl, a research scientist with Southern California Edison, a decision on funding should be reached within the next three months. A limited number of copies of the WEST report, *A Critical Review of the Scientific Literature on Low Frequency Electric and Magnetic Fields: Assessment of Possible Effects on Human Health and Recommendations for Research*, are available from Sahl at Southern California Edison R&D, 2244 Walnut Grove Ave., Rosemead, CA 91770, (818) 302-1261.... Drs. Nancy Wertheimer and David Savitz are scheduled to review the latest epidemiological ELF research at the State of Florida's Electric and Magnetic Fields Advisory Panel meeting on December 12 in Tallahassee.... Ontario Hydro has issued a "Corporate Strategy" to address the "Health and Biological Effects of Electric and Magnetic Fields." Among the utility's objectives is to "keep risks to Ontario Hydro employees and the public at a level as low as reasonably achievable." For a copy of the one-page strategy, contact John O'Grady at Ontario Hydro's Transmission Effects Unit, 700 University Ave., Suite H8D4 Toronto, Ont. M5G 1X6, Canada, (416) 592-3395.... The Western Area Power Administration and the Transmission Agency of Northern California have issued draft environmental impact statements for two 500 kV lines -- The California-Oregon Transmission Project and the Los Banos-Gates Transmission Project. For more information, contact the CA-OR project, PO Box 660970, Sacramento, CA 95866, (916) 924-3995.... Dr. Bob Patterson will soon be leaving EPRI to become an associate professor of environmental health engineering at Temple University in Philadelphia, PA. Bob Black, a 7-year EPRI veteran, will take over as project manager for EPRI's non-ionizing radiation research program.

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CONFERENCES

1987 Conference Calendar [Part I]

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

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

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

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

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

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

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

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

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

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

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

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

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

March 30-April 2: 5th International Conference on Antennas and Propagation, University of York, U.K. Contact: ICAP '87 Secretariat, Conference Services, IEE, Savoy Place, London WC2R 0BL, U.K.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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