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*Microwave News* invites contributions to *From the Field*, our occasional column featuring news and opinions from the non-ionizing radiation community. Letters from readers are also welcome.

## VDT Radiation: Focus on Flyback Pulses

A number of experts now speculate that radiation emissions from video display terminals (VDTs) might be associated with biological effects. Their concern stems from new measurements showing that magnetic field pulses from flyback transformers are similar in shape and intensity to those which can alter the development of chick embryos.

In numerous interviews, researchers and regulators told *Microwave News* that they are aware of Dr. Jose Delgado's experiments — demonstrating that pulsed magnetic fields can be biologically active at extremely low levels — and their implications for the VDT safety debate. No connection between VDT emissions and health problems has been established, however, and none of the experts contacted has suggested that VDT pulsed radiation is associated with the 11 reported clusters of problem pregnancies among VDT operators.

Indeed, many investigators are still skeptical that the Delgado experiments are reproducible. In Sweden, however, Dr. Kjell Hansson Mild's partial replication is prompting new government research on the reproductive hazards associated with VDTs.

Though VDT workers have long been apprehensive about radiation hazards, government and industry experts have steadfastly maintained that the emission levels are too low to be harmful.

The Food and Drug Administration (FDA) is planning to issue a revised policy statement on VDTs in the next few weeks. In it, the agency will discuss the accumulating data on the bioeffects of low-frequency, low-intensity magnetic fields, though it is unlikely that the FDA will significantly change its position on VDT radiation.

### The Pulse Waveform

Dr. Arthur Guy, director of the Bioelectromagnetics Research Laboratory at the University of Washington's School of Medicine in Seattle, told *Microwave News* that the intensity of the current induced by VDT magnetic fields is "about the same" as that which was induced in Delgado's experiments. Guy added that the VDT's magnetic field pulse shape is similar to the signal used by Electro-Biology, Inc. (EBI) to heal bone fractures, though the internal currents induced by the EBI coil are much stronger.

Richard Tell, a physicist with the Environmental Protection Agency (EPA), said that the similarities in shape and intensity between VDT pulses and those used by Delgado should be studied closely. Tell compared the time rates of change of VDT magnetic fields to those of the magnetic fields used by Delgado and found them to be of the same order of magnitude. Thus, according to Tell, the possibility of bioeffects cannot be ruled out.

Last year, Delgado and his associates at the Centro Ramon y Cajal Hospital in Madrid, Spain, concluded that pulse shape may be the "decisive parameter" for determining whether pulsed magnetic fields affect the development of chick embryos (see *MWN*, March and November

(continued on p.10)

# HIGHLIGHTS

## ELF Bioeffects Studies at BEMS

Extremely low frequency (ELF) radiation emerged as one of the most exciting topics at this year's meeting of the Bioelectromagnetics Society (BEMS) held in Atlanta, GA, in mid-July. Summarized below are the reports from three research groups whose results are particularly noteworthy.

### Blackman and the Earth's Magnetic Field

Dr. Carl Blackman's paper was the most provocative of the conference — it provides evidence that the location of frequency windows for calcium efflux from brain tissue is dependent on the Earth's magnetic field. Blackman can now predict which frequencies induce calcium efflux as a function of the *net* static magnetic field.

At the 1982 BEMS meeting, Blackman reported that he had observed calcium efflux at odd multiples of 15 Hz — with no effect at 30 Hz. This year, he said that he could induce efflux at 30 Hz if he doubled the net static magnetic field. Thus, the original discovery of efflux by Drs. Ross Adey and Suzanne Bawin at 15 Hz would shift to 30 Hz, if the Earth's magnetic field were twice as strong.

In the course of his talk, Blackman linked the calcium work to Dr. Jose Delgado's experiments on the effects of extremely weak, pulsed magnetic fields and to Dr. Cyril Smith's work on the influence of magnetic resonance in the Earth's magnetic field.

The new theory is not complete and was described as a "work in progress." Blackman said that he is still unsure whether the underlying physical mechanism for his observations is related to the electric or to the magnetic field. If it is the electric field, he thinks a cyclotronic resonance-like phenomenon may be at work. (Cyclotronic resonance results from the acceleration of an electric charge in a static magnetic field.) Otherwise, Blackman believes he might be observing a magnetic resonance effect.

Whatever the mechanism, Blackman said that the implications are clear: researchers must measure the intensity and orientation of the steady state magnetic field at the sample during the course of a given experiment. He suggested that past failures to replicate weak field interactions may have been due to variations in the magnetic field vector.

"This could explain the problem of an effect that comes and goes depending on the immediate environment," he explained in an interview with *Microwave News*. Blackman is with the Environmental Protection Agency in Research Triangle Park, NC.

Blackman's work supports the increasingly popular hypothesis that the Earth's magnetic field plays a decisive role in causing the weak field interactions discovered by Delgado. Some researchers have been unable to duplicate Delgado's experiments (see *MWN*, March 1983 and June 1984), in which low intensity magnetic fields caused gross alterations in developing chick embryos.

Smith and his colleagues at the University of Salford in England have shown that there are observable changes in dielectric permittivity and loss in biological systems under conditions of magnetic resonance in the Earth's natural field

(see *MWN*, October 1983). Blackman has now extended Smith's work to a much more complex system, calcium efflux.

Blackman presented his paper on the opening night of the BEMS meeting at a symposium on magnetic fields and biological systems. Later that evening, Dr. Carl Durney of the University of Utah in Salt Lake City commented that a back-of-an-envelope calculation indicated that the Earth's magnetic field would not be an important variable: the energy of a proton in the Earth's field is nine orders of magnitude (a billion times) smaller than that of thermal interactions ( $kT$ ) at room temperature, he said.

Nevertheless, Durney was not willing to dismiss Blackman's (or Smith's) findings. In an interview, he said that he found them "puzzling and exciting" and that they could help us better understand basic mechanisms.

Dr. Alwyn Scott of Los Alamos National Lab in New Mexico observed that the apparent difference in magnitude may not be as great as it first seems if the biological system has a way of storing energy from the Earth's magnetic field.

### Winters's Tumor Cells

Later in the conference, Dr. Wendell Winters presented details of the experiments he is running with Dr. Jerry Phillips which show ELF radiation can greatly enhance the proliferation of human tumor cells. These results have generated a great deal of interest since first reported at a New York State Power Line Project Panel meeting in March (see *MWN*, April 1984). Winters described this effect as "permanent" because he observed it two to three weeks after the field was turned off.

By the time he came to BEMS, Winters had completed 16 sets of experiments with three different tumor cell types (colon, breast and head/neck). In each case he found the greatest enhancement in growth rate, as measured by the proliferation of cell colonies, when the tumor cells were exposed to electric and magnetic fields together or magnetic fields alone.

Winters reported that in ten experiments in which human colon cancer cells were exposed for 24 hours to an electric field of  $300 \text{ mA/m}^2$  (rms) and a magnetic field of 1 gauss, the cells formed 5.6 times more colonies than controls. For magnetic fields alone, the proliferation rate was 5.2 times greater than controls, while for the electric field alone it was only 1.8 times greater. Similar though less pronounced effects were observed with breast and head/neck tumor cells: according to Winters, the growth rates in combined fields and in magnetic fields were statistically significant.

Winters, a cell biologist at the University of Texas Health Science Center in San Antonio, TX, also reported on an experiment with colon cells exposed to a 0.5 gauss magnetic field. The increase in tumor-associated cell surface antigens at  $300 \text{ mA/m}^2$  and 0.5 gauss was smaller than the observed increase at  $300 \text{ mA/m}^2$  and 1 gauss, though both were larger than the response of control cells.

After Winters's paper there were numerous hallway dis-

cussions on the possible connection between his *in vitro* exposures of cell cultures to 60 Hz electromagnetic fields and the many reports of leukemia among workers and the general population exposed to 50 and 60 Hz fields from power lines. The informal consensus was that it is still too early for any conclusions but that much attention will be devoted to Winters's and Phillips's newly observed effect in the future.

### Navy's Second Monkey Study

Dr. W. Gregory Lotz and Jack Saxton of the Naval Aerospace Medical Research Lab in Pensacola, FL, presented the preliminary findings of their replication study on the effects of chronic ELF exposure of young rhesus monkeys. Although they reported a significant increase in the growth rate of exposed males, confirming previous results, subsequent statistical analysis performed after the BEAMS meeting did not support this conclusion. In early September, Lotz told *Microwave News* that an overall analysis of variance indicated that the change of growth rate is not significant at the 0.05 level.

At about two-and-a-half years of age, the male monkeys exposed from the age of one month began to gain weight faster than those in the control group. Divergence continued for about a year, at which time the difference in size

stabilized. In the last six months of the 54-month exposure protocol, the divergence narrowed. The researchers also identified a trend toward higher testosterone levels among the exposed males as compared to controls.

The 30 monkeys (17 male and 13 female) were exposed to an electric field of 20 V/m and a magnetic field of 2 gauss at frequencies randomly modulated between 72 and 80 Hz.

At the meeting, Saxton and Lotz offered three hypotheses for their observations. First, ELF radiation causes a generalized growth effect; second, the neuroendocrine system is affected; and third, ELF stimulates the testes. They reject the first hypothesis because the growth effect did not occur in young females, and they are leaning away from the testes effect. While the exposures have now ended, the data analysis continues, particularly the results from the neuroendocrine end points.

Lotz said that he was planning to present a more complete picture of their results at the *23rd Hanford Life Sciences Symposium: Interaction on Biological Systems with Static and ELF Electric and Magnetic Fields*, in Richland, WA in early October.

According to Lotz, the Navy is not planning to continue its ELF studies at the Pensacola lab in the fiscal year beginning October 1. Instead Lotz and co-workers will turn their attention to biological interactions at higher frequencies.

## Future Unclear for EPA RF/MW Guidance

The future of the Environmental Protection Agency's (EPA) radiofrequency and microwave (RF/MW) radiation exposure guidance became more uncertain last month with the ouster of Glen Sjoblom as director of the Office of Radiation Programs (ORP). ORP handles both ionizing and non-ionizing radiation, and the reason or reasons for the shake-up are unknown. Sources following developments at EPA have noted, however, that Sjoblom was the highest ranking official to support proposing RF/MW exposure limits. Sjoblom now oversees international activities for the Office of Air and Radiation.

As the agency debates whether to scrap the guidance it has spent years developing, the Federal Communications Commission (FCC) plans to act on its proposed rule making on RF/MW safety this fall.

The new director of ORP, Sheldon Meyers, told *Microwave News*, that EPA has no firm schedule for deciding whether to propose general population exposure limits. Meyers said the agency is still reviewing the options laid out in a memorandum from Deputy Assistant Administrator Jack Campbell — options which range from shelving the guidance to proposing a limit of 100 uW/cm<sup>2</sup> at resonant frequencies (see *MWN*, July/August 1984).

EPA Administrator William Ruckelshaus received his first briefing on the guidance September 4, three months after the proposal was scheduled for publication. The proposed rules were completed on time but met stiff opposition

from the Office of Policy Planning and Evaluation as soon as internal review began this spring.

The agency has held a series of internal meetings on the guidance this summer and has also received input from the Electromagnetic Energy Policy Alliance (EEPA), a new industry lobbying group. Alliance representatives met with EPA's John Topping, David Janes and Sheldon Meyers on August 30 to express support for federal limits based on the 1982 ANSI guidelines.

Meanwhile, the FCC's Dr. Robert Cleveland reports that "we are moving independently from EPA and hope to consider our rule making at the commission's November 8 meeting." The proposal to extend the FCC's responsibility to include non-ionizing radiation hazards under the National Environmental Policy Act was released on January 28, 1982 (see *MWN*, March and September 1982).

Meyers, an engineer, formerly served as the Deputy Assistant Administrator for Air and Radiation. Meyers has also held a number of other EPA posts, working on solid and nuclear waste issues as well as air quality standards.

## NAS Uncertain About EMP Effects

Some electronic systems may be susceptible to electromagnetic pulse (EMP) radiation, according to a study committee of the National Academy of Sciences (NAS). In a report released on August 8, the committee concluded that electronic systems can be protected from a high altitude

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nuclear blast, but that the degree of vulnerability is difficult to estimate.

The NAS committee, chaired by Caltech's Dr. John Pierce, "strongly favored" shielding electronic equipment from EMP by placing subsystems in specially-designed copper lined buildings or metallic boxes, commonly known as Faraday cages, which electromagnetic waves cannot penetrate. It was "skeptical" about "tailored hardening" (in which components are individually shielded) because of some unpredicted failures.

No reliable test data on EMP vulnerability are available because atmospheric testing of nuclear weapons was banned in 1963. To gather needed information, the Navy is planning to build an EMP simulator called EMPRESS II in the Chesapeake Bay (see *MWN*, July/August 1984).

The NAS committee concluded that because "there is no way to base an analytical estimate of EMP vulnerability on first principles, there can be no substitute for the best physical simulations possible." It did not specifically endorse EMPRESS II, however. According to Dr. John Richardson, the principal NAS staff officer on the study, EMPRESS II was not an issue during the committee deliberations.

The study was requested by the Defense Nuclear Agency. Copies of *Evaluation of Methodologies for Estimating Vulnerability to Electromagnetic Pulse Effects* are available free from the Energy Engineering Board, NAS, 2101 Constitution Ave., NW, Washington, DC 20418.

The committee's recommendations on the engineering and statistical aspects of building EMP-resistant military systems are reprinted below.

### Recommendations

#### Engineering Aspects

- There should be a continued reappraisal of the threat, its consequences, and the best near-term practices and longer-term research needed for meeting it.
- Adequate analyses should be made of what systems, subsystems and support systems are essential to completion of mission.
- There should be great emphasis on achieving assessability by promptly developing better and cheaper means for virtually complete and effective shielding of systems essential to the completion of mission. This objective should include a strong emphasis on early use of standardized shielded boxes interconnected with optical fibers.
- There should be a program to study and devise and evaluate the best and most economical way for continual testing to assure the maintenance of hardness.
- There should be a better understanding of the mechanisms of component failure and better and more insightful component tests and interpretation of test data.
- There should be increased emphasis on thoroughgoing analysis, testing and comparison of analysis with test at the level of functional circuit aggregations, or "boxes."
- A long-range program should be initiated and directed toward the systematic validation of prediction methods. The TRESTLE and comparable high-level simulators constitute a promising avenue to that end. These simulators generate pulses that are similar in many ways to, but also significantly different from, the expected EMP event. Important insights into the credibility of prediction methods themselves could be obtained by employing these methods to predict the response of components and systems to the fields

known to be produced by the simulators and by confirming those predictions with experiments using the simulators.

#### Statistical Aspects

- The EMP community, including its management, should be better educated on the key ideas and procedures of statistics and reliability. Improved standardization of statistical terminology used by the EMP community should be pursued in order to reduce confusion with respect to its interpretation and uses.
- The government should utilize qualified and experienced personnel, well trained in statistics, to oversee contractors' bids and work that involve statistics.
- Collaboration among statisticians, engineers and physicists working in the field of EMP protection and assessment should be encouraged. The statisticians on such teams should be well versed in the latest techniques and developments in statistical methodologies and reliability.
- Contractual specifications that may be interpreted to require survival with probability equal to one (that is, certainty) should be avoided. Such specifications can lead to misunderstanding and legal problems, as well as to a poor choice of contractors. We recommend, rather, a collection of tests such that passing all will be acceptable as satisfaction of EMP requirements.
- Because fault tree analysis is a useful management tool, it should be utilized in EMP work where it is applicable. Both empirical and theoretical work may be required to tailor fault trees to the particular needs of the EMP problem.
- The Defense Nuclear Agency should establish a number of post-doctoral fellowships closely integrated with the field of EMP protection and assessment. The fellowships could be administered so as to encourage interdisciplinary collaboration, attract new talent to the field, and supplement the ongoing programs.

## Seatbelts On, Cigarettes Out and Computers Off?

The chairman of a panel examining the risks of electromagnetic interference (EMI) to aircraft communication and navigation systems has suggested that airlines bar the use of portable electronic devices during takeoffs and landings.

In a memorandum to members of the Radio Technical Commission for Aeronautics' (RTCA) Special Committee 156 on possible EMI to aircraft electronics, Committee Chairman Frank White wrote: "It would, in my view, be logical to prohibit the use of passenger-operated electronic devices during takeoffs and landings when seatbelts were on, tray tops closed and seat backs vertical. This would affect passenger use of portable devices for perhaps 10-15 minutes of time...These are times when navigation and communication are the most critical to flight safety." (See also *MWN*, October 1983, April and June 1984).

White is not convinced that an EMI-related safety problem really exists, arguing in his memo to the committee that, "If we could find just one device that could be carried into an aircraft and cause interference we would have a case to build on." White also argued that it is not worth revising RTCA's 1963 Report DO-119, *Interference to Aircraft Electronic Equipment from Devices Carried Aboard*, because the emission limits proposed there have been "almost totally ignored." The limits later proposed by the Federal

Communications Commission (FCC) were unrelated to the RTCA work.

White suggested that the FCC afford greater protection to that portion of the spectrum used by aircraft. Those bands include: 10-25 kHz (Omega), 100-1750 kHz (ADF), 108-137 MHz (VOR/ILS/VHF), 329-335 MHz (glide scope) and public telephone band(s) above 400 MHz. He also raised the possibility of protecting the 2-30 MHz band. White proposed adding 10 dB or more to the present FCC limits — the exact value would be chosen after careful study.

White's memo was distributed on July 24, after the committee's last meeting on June 12-13, and his proposals will be taken up at its September 18-19 meeting.

Among the key decisions reached by the committee at its June meeting are:

- An incident file on all cases of aircraft-related EMI will be set up.
- More testing should be done in the Omega band.
- Acceptable path data can be generated without having to fly an aircraft.
- The aircraft fuselage cannot be relied upon to provide sufficient shielding of airborne receivers from RF levels allowed from FCC class B devices.
- While measurement data indicate that class B devices can be used without causing EMI, there may be some variation among different aircraft.

In addition, David Hantulla, formerly with Apple Computer and now an independent EMI consultant, observed that the interference reports received to date indicate that radios and cassette players were greater sources of EMI than computers. He argued that the committee should start classifying devices according to their EMI potential.

At its September meeting, the committee will look at the inverse problem: the possibility that an aircraft's high frequency (HF) transmissions could interfere with a passenger's electronic device.

## **Project ELF Study Continues Despite Court Ruling**

Committee selection for the American Institute of Biological Sciences' (AIBS) literature review on extremely low frequency (ELF) radiation bioeffects is in its final stages, with experts in seven out of eight topic areas on board. As of early September, however, AIBS had yet to pin down who will write summary research papers for the study, despite the October 31 due date for a preliminary draft report.

The Navy's \$319,000 contract with AIBS for an analysis of the post-1977 literature was to be part of a court-ordered supplemental environmental impact statement (SEIS) for Project ELF, a land-to-submarine communications system now under construction in Wisconsin and Michigan (see *MWN*, July/August 1984). Although AIBS will complete its study, the court order was overturned in August, and it is now unclear whether the Navy will file a SEIS.

The AIBS report committee is chaired by Dr. H.B. Graves of Pennsylvania State University. The other mem-

bers, and their topic areas are: Dr. Ralph Smialowicz, hematopoietic and immune systems; Dr. Asher Sheppard, cellular and in vitro systems; Dr. Neil Chernoff, growth/reproduction/development; Dr. David Savitz, human studies; Dr. Robert Lindberg, environmental biology; Dr. Thomas Tenforde, magnetic studies; and Dr. Lionel Jaffee, bone growth and fracture repair.

As we go to press, an expert on physiology/neuroendocrine systems has yet to be chosen, and AIBS Project Director Don Beem said it is possible that this slot will be eliminated and the material handled by other members.

The committee's work will be reviewed by an advisory group composed of private consultants Fred Dietrich and Dr. William Wisecup and Battelle's William Kaune and Dr. Richard Phillips.

The summary research papers on specific ELF bioeffects areas, along with material from a literature search being conducted by IIT Research Institute in Chicago, are key elements in the AIBS review. Although AIBS seems confident that it will enlist a strong field of contributors, at least one researcher who was asked to participate is dissatisfied with the composition of the report committee and its advisory group. In a strongly worded letter to Beem, Dr. Robert Becker backed out of writing the paper on bone growth, challenging the objectivity of a number of study participants.

### **Wisconsin Drops Suit**

On August 20, the Seventh Circuit Court of Appeals in Chicago overturned a lower court order requiring a SEIS for the Project ELF system. The 43-page decision (*Wisconsin v. Weinberger*, 84-1569) from Judges Cummings, Wood and Cudahy included a partial dissent from Cudahy, who believes a new EIS is needed.

The majority opinion concluded that the information provided by the State of Wisconsin and Marquette County, Michigan, the plaintiffs, "falls short of the threshold of 'significance' at which the duty to prepare a SEIS is triggered." Judges Cummings and Wood reasoned that: "Were we to require the Navy formally to reassess its proposed action with a SEIS every time some bit of new information appeared, we would be unjustifiably interfering with the Navy's mission."

Further, they noted that: "The Soviet Union allegedly is already advanced in this low frequency submarine communications technique. The district court gave no consideration to these serious circumstances."

Judge Cudahy, on the other hand, found that district court Judge Crabb "reviewed an extensive administrative record and heard testimony concerning controversial scientific research, and her conclusions from that evidence are precise and sound." Cudahy concluded that the public scrutiny accompanying the SEIS process "is the best available means for ensuring the Navy does indeed give the new information full consideration."

In a June 13 order, the appeals court suspended the district court's injunction against further construction on the project (see *MWN*, July/August 1984).

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As a final blow to Project ELF opponents, Wisconsin and Marquette County lost their bid to have the U.S. Supreme Court reinstate the construction ban. On August 17, shortly before the appeals court issued its decision, Justice John Paul Stevens denied their petition without comment.

### **Study Discounts Vernon, NJ Birth Defect Fears**

A recently completed study of birth defects in the town of Vernon, NJ, found no evidence to support local fears that ambient radiofrequency and microwave (RF/MW) radiation in the community is a health hazard. The long-awaited report from the New Jersey State Department of Health has been sharply criticized by the community group which requested the investigation, however, and is unlikely to quiet community opposition to new RF/MW sources.

A health department team led by Dr. George Halpin reported that the incidence of birth defects in Vernon Township (34.5 per 1000 pregnancies) "was not statistically different from the rate observed in the rest of Sussex County (32.2 per 1000 pregnancies)." The study covered live births and fetal deaths occurring in the county after twenty weeks of pregnancy from 1975 through 1981, a period encompassing the startup of the first satellite communications station in Vernon. The town now has three major satcom stations (see *MWN*, November 1982).

In an interview with *Microwave News*, Halpin, the director of the department's Division of Parental and Child Health, said he was confident that the study "was sufficiently powerful to detect whether something is going on."

Citizens Against the Tower (CAT), a group of Vernon residents opposing new broadcast facilities, disagrees. Ac-

cording to CAT spokeswoman Elise Kreindler, the study was too general to address the community's chief concern: potential clusters of birth defects in several Vernon neighborhoods, including an area close to RCA Americom's satcom station.

Members of CAT also believe that the study failed to pick up many birth defect cases. For example, Kreindler said she has documented six cases of Down's syndrome within the "cluster" areas of Vernon while the Department of Health only turned up three. Finding the report "wholly inadequate," Kreindler said the group will seek independent analysis of the study data to prove its case.

No specific type of defect occurred at a higher rate in Vernon than in the county, but the report states that "the difference in the incidence of chromosomal anomalies between the two areas approached statistical significance." Four of the eight reported cases of defects resulting from chromosomal abnormalities were in Vernon.

Halpin believes the only potentially important factor left uncovered is ambient radiation levels. The state, lacking measuring equipment of its own, had asked the Environmental Protection Agency to perform a survey of the county but was turned down. As a result, the report states that "at no time did this study attempt to answer any question as to the etiology or causation of any of the defects identified," although it did determine that the incidence of defects in Vernon was within the expected range.

Investigators reviewed hospital records for 86.5 percent of the 1632 births in Vernon and 94.4 percent of the births in the rest of the county.

For more information, contact Tom Hagy, New Jersey Department of Health, CN360, Trenton, NJ 08625, (609) 984-7160.

## SHORT COURSES

October 15: **EMI Susceptibility Guidelines for Computing Devices**, Boston, MA. Fee: \$295. Contact: Greg Gore, R&B Enterprises, 20 Clipper Rd., West Conshohocken, PA 19428, (215) 825-1965. Repeated November 7: Philadelphia, PA.

October 15-18: **Fundamentals of Numerical Solution Methods in Electromagnetics**, Oxford, MS. Fee: \$550. Contact: Division of Continuing Education, University of Mississippi, University, MS 38677.

October 16-17: **Magnetic Analysis Program**, Milwaukee, WI. Fee: \$495. Contact: A.O. Smith Engineering Systems, 8901 N. Kildeer Court, Milwaukee, WI 53209, (800) 558-6980, ext. 2860. Repeated November 13-14; December 11-12.

October 16-19: **Electronic Warfare**, Bethesda, MD. Fee: \$730. Contact: Linda Billard, TSC, 962 Wayne Ave., Suite 600, Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in MD.

October 20: **Microwave Cooking**, Troy, MI. Fee: \$35-45. Contact: International Microwave Power Institute, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515.

October 22-26: **Antennas and Arrays**, Washington, DC. Fee: \$875. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773, or (202) 676-6106 in DC.

October 22-26: **Radiowave Propagation for Communications Systems Design**, Washington, DC. Fee: \$875. Contact: GWU, see October 22 above.

October 23-25: **Introduction to EMI/RFI/EMC**, Washington, DC. Fee: \$815. Contact: Don White Consultants, Inc. (DWCI), State Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

October 23-26: **Grounding & Shielding**, Atlanta, GA. Fee: \$815. Optional fourth day for \$235. Contact: DWCI, see October 23 above. Repeated November 13-16: Sunnyvale, CA; December 4-7: New York, NY.

October 24-25: **Seminar on Frequency Measurements**, Boulder, CO. Fee: \$400. Contact: Mike Lombardi, Division 524, National Bureau of Standards, Boulder, CO 80303, (303) 497-3212.

October 29-November 2: **Electromagnetic Interference and Control**, Washington, DC. Fee: \$875. Contact: GWU, see October 22 above.

October 31-November 1: **EEPA Seminar**, Chicago, IL. Fee: \$250 (members), \$275 (others). Contact: Richard Ekfelt, Electromagnetic Energy Policy Alliance, 1800 M St., NW, Washington, DC 20036, (202) 452-1070.

November 5-8: **Millimeter-Wave Engineering and Applications**, Washington, DC. Fee: \$795. Contact: GWU, see October 22 above.

November 5-15: **Bioelectrochemistry II: Membrane Phenomena**, Erice, Italy. Fee: \$500. Contact: Dr. M. Blank, College of Physicians & Surgeons, 630 West 168th St., New York, NY 10032.

# UPDATES

## BIOLOGICAL EFFECTS

**Special Issues...**The latest issue of the *Journal of Bioelectricity* (Vol.3, No.1&2, 1984) is a special symposium issue: it features seven papers on "Mechanisms of Bioelectrical Growth and Repair" edited by Dr. Betty Sisken of the Wenner Gren Research Lab at the University of Kentucky in Lexington, and eight papers presented at the *1st Annual Meeting of the International Society for Bioelectricity*, held in Boston, MA, last October 1, edited by the journal's editor Dr. Andrew Marino of the Department of Orthopaedic Surgery at Louisiana State University Medical Center in Shreveport. In addition, the volume contains seven regular papers. The journal is published by Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016....The August 1984 *IEEE Transactions on Microwave Theory and Techniques* is a special issue devoted to "Electromagnetic Wave Interactions with Biological Systems." The issue, edited by Dr. James Toler of Georgia Tech in Atlanta, features two dozen papers on dosimetry, bioeffects, measurements, imaging and hyperthermia. A copy is available for \$6.00 (IEEE members) or \$12.00 (non-members) from IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

**Annotated Bibliographies...**Dr. J. Patrick Reilly of Johns Hopkins University's Applied Physics Lab has completed the fourth edition of *Human Reactions to ELF Electric and Magnetic Fields -An Annotated Bibliography of Current Literature*, (No. PPSE T-30; June 1984). A limited number of copies are available from Reilly at JHU-APL, Johns Hopkins Road, Laurel, MD 20707....The Air Force School of Aerospace Medicine has issued two new volumes in its series, *USAFSAM Review and Analysis of Radiofrequency Radiation Bioeffects Literature*. The first two reports were released in 1982 (see *MWN*, July/August 1982) and a fifth is expected before the end of the year. The five volumes will contain analyses of about 200 papers selected from over 1,000. Each citation includes an abstract and a "critique" written by Louis Heynick and Dr. Peter Polson of SRI International in which the paper is evaluated with respect to the methodology, validity and significance of the reported findings. Copies of the reports are available from the National Technical Information Service (NTIS), Springfield, VA 22161. (The third report is No. USAFSAM-TR-84-6, March 1984, NTIS No. AD A111190; the fourth is No. USAFSAM-TR-84-17, May 1984, NTIS No. AD A116139)....Vol. VIII, No.2 of *Biological Effects of Non-Ionizing Electromagnetic Radiation* (January 1984) has been published by the Office of Naval Research. A limited number of copies are available from ONR, Code 441, 800 N. Quincy St., Arlington, VA 22217. Be sure to include a self-addressed mailing label.

## COMPATIBILITY & INTERFERENCE

**FCC Computer RFI Rules...**On July 30, the FCC denied a petition filed by Glen Dash of Dash, Straus & Goodhue, Inc. in Boxborough, MA, requesting changes in the commission's measurement procedures for radiated emissions

from computing devices. Soon after the FCC issued new test procedures (commonly known as MP-4) last summer (see *MWN*, September 1983), Dash asked for some additional revisions. Dash, who is both an engineer and a lawyer, wanted a testing requirement specifying that all interface cables be left unterminated — MP-4 requires that peripherals be connected to the host computer via interface cables. The FCC rejected this option, arguing that "it is more important to simulate the conditions of actual use..." and that it was too soon to make such a "major shift in measurement philosophy." Other proposals made by Dash on the positioning of the cables during testing were also rejected by the commission. CBEMA had opposed the Dash petition. In a telephone interview, Dash said that his petition was "nothing more than a suggestion to streamline the testing procedure." He went on to call the MP-4 revisions a "tremendous leap forward" and said his petition was simply "asking the commission to go one step further." In retrospect he added, "I should have simply written the FCC a letter."...Responding to another petition on the same day, the FCC denied CBS Inc. an exemption from the commission's computer rules (Part 15, Subpart J) for electronic and pipe organs used primarily by churches. The organs use digital electronics for tone generation and for the operation of the console in controlling such variables as volume. (Though CBS is best known as a broadcaster, it also is in the organ business.) The FCC noted that CBS did not submit any measurement data to support its case for an exemption and decided that there was no justification for the exemption, especially given what it called the "minimal" requirements of its *verification* rules. The FCC concluded: "We believe that it is important for manufacturers to be made aware that digital electronic circuitry is capable of emitting considerable levels of radio noise which should be properly considered and controlled at the design stage."

**Low Power Devices...**The FCC has denied a July 1982 petition by RF Power Labs for an exemption from the commission's rules to allow the operation of a portable low power audio-video transmitter in the 471-507 MHz band. Five parties opposed the petition on the grounds that the proposed device would interfere with the reception of UHF TV channels 14-20. For more information, contact FCC's Alvin Reiner, (301) 725-1585.

## INTERNATIONAL

**Power Line Exposures in USSR...**Drs. I.P. Kozyarin and Yu.D. Dumanskiy of the Institute of General and Communal Hygiene in Kiev have advocated a maximum permissible dose of 12 kV/m "for occasional, short-term" exposures of up to 30 minutes a day and 5 kV/m for "daily short-term exposures" to 50 Hz electric fields. In addition, they favor a requirement that 500 and 750 kV power lines be at least 300-500 meters from inhabited areas, and that any human activity requiring frequent exposure within this zone be prohibited, like farming. The paper is written in Russian and was published in the November 1983 *Gigiyena I Sanitariya* in Moscow. An English abstract appears in the

## UPDATES

May 18, 1984 issue of *USSR Report: Life Science: Biomedical and Behavioral Sciences*, published by the Joint Publications Research Service (JPRS) which is available from the National Technical Information Service, Springfield, VA 22161. (Note that JPRS has discontinued its *USSR Report: Life Sciences: Effects of Non-Ionizing Electromagnetic Radiation* and is now publishing abstracts on NIER in the report cited above.)

**Documentaries in the UK...**Central Independent Television, based in London, has prepared a three-part series on non-ionizing radiation, called *The Good, the Bad and the Indefensible* for Channel 4 in the UK. The three shows and their air dates were: "Hidden Potential" (August 25); "Currently at Risk" (September 1); "Opening Pandora's Box" (September 8). The series was produced by David Jones and directed by Richard Belfield. Part 1 focussed on medical applications, including bone and ulcer healing and the treatment of lung and chest cancers with electric current. Part 2 was about the risks associated with power line radiation. Among those interviewed on the show were Dr. John Bonnell of the Central Electricity Generating Board, Dr. Stephen Perry, a general practitioner who has investigated the possible association between power lines and suicide, and Dr. Robert Becker, who has been an active participant in the health effects of ELF debate. Part 3 covered a number of topics related to the politics of non-ionizing radiation: the beaming of radiation at the US embassy in Moscow, Project Pandora, the Soviet Woodpecker over-the-horizon radar, Joe Towne of the Radar Victims Network, EMP radiation and VDTs. For further information, contact: Jean Denham, Press Office, Central Independent Television, 35-38 Portman Square, London W1A 2HZ, England, (01) 486-6688.

## MEETINGS

**Low Level Effects...**Eugene Findl of Brookhaven National Lab is organizing a two-and-a-half day workshop on the interaction of low level electromagnetic and ultrasonic fields with cells on December 9-12. The main objective of the meeting, which is by invitation only, is to explore possible mechanisms. The proceedings of the workshop will be published. For more information, contact Findl at Brookhaven National Lab, Upton, Long Island, NY 11973, (516) 282-4907...Because of the number of conferences already scheduled, ONR's Dr. Mike Marron has decided against holding a workshop on low frequency magnetic field effects (see *MWN*, June 1984). "There are so many other meetings that I just couldn't schedule another one," Marron told *Microwave News*. Instead, he is planning a joint FDA-ONR review session to identify future research directions in basic science, applications and hazards assessment. The session will be held in November. Marron added that he expects ONR to fund more research on low frequency field effects in the future.

**Call for Papers...**The 17th Annual Meeting of the Conference of Radiation Control Program Directors in Mil-

waukee, WI, May 19-23. Contact: CRCPD, 71 Fountain Place, Frankfort, KY 40601, (502) 227-4543....The 1985 IEEE International Microwave Symposium in St. Louis, MO, June 4-6. Contact: Stephen Honickman, STG Electrosystems, 720 Manchester, Suite 215, Ballwin, MO 63011....The International Aerospace and Ground Conference on Lightning and Static Electricity, in Paris, France, June 10-12. In the US, contact: Lawrence Walko, AFWAL/FIESL, Wright Patterson AFB, Dayton, OH 45433; others: Dr. Joseph Taitlet, ONERA, BP 72, 92320 Chatillon, France....The 1985 International Symposium on Microwave Technology in Industrial Development - Brazil, Campinas, Brazil, July 22-25. Contact: Attilio Jose Giarola, UNICAMP-CCPG (Reitoria), CP 1170, 13100 Campinas, SP, Brazil....The 1985 International Symposium on Electromagnetic Compatibility in Wakefield, MA (near Boston), August 20-22. Contact: Dr. Donald Weiner, Department of Electrical and Computer Engineering, 111 Link Hall, Syracuse, NY 13210.

## MILITARY SYSTEMS

**TEMPEST Revisions...**The Defense Communications Agency (DCA) has announced plans to upgrade its Circular 370-D195-2. The circular governs the activities of the Data Communications TEMPEST Working Group (DTWG) in evaluating equipment for certification for use in the Data Communications portion (AUTODIN) of the Defense Communications System. DCA is soliciting views to streamline the certification process as well as to make it more economically efficient. For more information, contact: Louis Gnecco, chairman, DTWG, DCA, Attn: B665, Washington, DC 20305, (202) 692-4603. Note that because the TEMPEST program is classified, only those with the proper security clearances can participate....Of related interest, see James Schultz's article, "NSA and Industry Experience TEMPEST Growing Pains," in the June *Defense Electronics*.

## OCCUPATIONAL HEALTH

**RF Sealer Guidelines...**FDA will soon propose draft, voluntary guidelines for radiation exposures from RF dielectric heaters and sealers. FDA's Center for Devices and Radiological Health will recommend the ANSI levels of 60 V/m and 0.16 A/m for electric and magnetic fields, respectively. Though some heaters and sealers operate at frequencies below 30 MHz, FDA will propose flat guidelines instead of ANSI's frequency dependent levels, which are less stringent below 30 MHz. A meeting has been scheduled for November 15-16 to allow interested parties to comment on the FDA proposal. An explanatory notice will appear in the *Federal Register*. For more information, contact Howard Bassen, acting deputy director of the Division of Physical Sciences, HFZ-130, CDRH, Rockville, MD 20857, (301) 443-6536.

## PEOPLE

Dr. Richard Phillips is leaving Battelle to become the di-

rector of the Experimental Biology Division at EPA's Office of R&D in Research Triangle Park, NC. Phillips will leave his post as program director for bioelectromagnetics at Battelle's Pacific Northwest Labs in Richland, WA, at the end of October and expects to be at EPA by the end of November. He will be taking over from Dr. Joe Elder who has been filling in as acting division director since January 1982 when Dr. Dan Cahill left EPA for a job with Carolina Power and Light. Elder will continue as chief of the division's cellular biophysics branch...Dr. Geoffrey Voss of the University of Alberta in Canada, has replaced Dr. Satish Kashyap as the editor of the *Journal of Microwave Power*. In a telephone interview, Voss said that he planned to beef up the IMPI journal and expand coverage in a number of areas, including patents, R&D, new products, medical applications and standards. His goal, he said, is to make the publication complementary to *Bioelectromagnetics*, the BEMS journal....Dr. Robert Patterson has taken over Dr. Robert Kavet's post as manager of EPRI's project on the biological effects of electric fields. Patterson has been with EPRI for three years and before that was at SRI International. Patterson will report to Dr. Gordon Newell...On August 6, Dr. Abraham Lilienfeld died of a heart attack in Baltimore, MD, at the age of 63. Lilienfeld was a leading epidemiologist and is best known to the RF/MW community as the principal investigator on the study of employees who were exposed to microwaves at the American embassy in Moscow.

#### STANDARDS

**San Diego Weighs ANSI Limits...**An advisory panel has recommended that San Diego County, CA, adopt the 1982 ANSI standard for RF/MW radiation. This is one of a number of recommendations, including changes in zoning and site development policy, made by the Telecommunications Task Force in its recently completed final report to the county's Board of Supervisors. Late last year, the board declared a moratorium on new broadcast construction permits and established the task force. This group's recommendations "are intended to serve as the basis for the development of a regional telecommunications policy," according to the report, because, "while criteria and guidelines have been recommended which will mitigate site-specific development impacts, issues regarding alternative site locations are likely to involve multi-jurisdictional decisions." Part of the task force effort included commissioning a study on *Potential Hazards of Radio and Microwave Frequency Radiation -An Overview*, from the Tinton Falls, NJ, consulting firm of Booz, Allen and Hamilton, Inc. The firm's 19-page report concludes that "there appears to be no radiation hazard to the public" from existing RF/MW sources in the county. The board is scheduled to act on task force recommendations on September 12, the day before the moratorium expires. For more information, contact Bill Chatham, Department of Planning and Land Use, County of San Diego, 5201 Ruffin Road, Suite B, MS 0650, San Diego, CA 92123, (619) 565-3023.

**EMC in Canada...**The Canadian Standards Association's (CSA) steering committee on EMC is without a chairman. Max Melnyk of the federal Department of Communications has been reassigned and has given up the chairmanship. According to CSA's Brian Weir, no replacement has yet been named. Meanwhile, one of the groups working under the EMC steering committee is developing an immunity standard for data processing equipment which should be ready in 1985. Last year, the subcommittee, chaired by Sam Wong of Delphax Systems in Mississauga, Ontario, issued standard C108.8, *Recommended Limits and Methods of Measurement of EMI from Data Processing Equipment and Electronic Office Machines*. For more information, contact Wong at (416) 624-2643 or Weir at (416) 747-4363. A copy of C108.8 is available for \$16.00 (Canadian), pre-paid from CSA, 178 Rexdale Blvd., Rexdale, Ontario M9W 1R3, Canada, (416) 747-4044. You can use Visa, MasterCard and American Express.

**Are Public RF/MW Health Standards Needed?...**This is the question raised by Jane Clemmensen in her new book, *Non-Ionizing Radiation: A Case for Federal Standards?* Clemmensen concludes that there is no *a priori* need for a national RF/MW exposure standard because of an "absence of evidence of jeopardy to public health." Her 90-page analysis explores the risks to emerging technologies of an unscientific standard, the costs of delays and litigation in the absence of officially recognized guidelines and possible alternatives to a national standard. Dr. Arthur Guy wrote the preface to the paperback book, which is available for \$7.50 from San Francisco Press, Box 6800, San Francisco, CA 94101.

**IEEE Dictionary...**A revised and expanded edition of the *IEEE Standard Dictionary of Electrical and Electronics Terms* has been issued. Designated ANSI/IEEE Standard 100-1984, the 1173-page book contains nearly 24,000 definitions. The volume, now in its third edition, also features some 15,000 acronyms. The text is chock-full of diagrams and equations and is a most useful reference. Copies are \$33.75 for IEEE members (\$37.50 for non-members) until December 15, when the price goes up to \$44.95 and \$49.95, respectively (add \$2.00 handling and shipping charge per order). Available from IEEE Service Center, CP Dept., 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060.

**CISPR ITE Rule...**The new CISPR six months' draft rule on information technology equipment is now available. This standard could have a major impact on FCC Part 15 rules on computer emissions (see *MWN*, May 1984). *CISPR/B(Central Office)16 Second Draft -CISPR Recommendation No. ...: Information Technology Equipment: Limits of Interference and Measurement Methods* can be ordered from Sales Dept., ANSI, 1430 Broadway, New York, NY 10018. Send a check for \$31.00 with your order (price includes postage).

1983). The most powerful effects were found using pulses with a 42 usec rise time, though significant effects also occurred using pulses with a 2 usec rise time. Delgado used very weak magnetic fields ranging in intensity from 0.1-100 microtesla (uT). (By comparison, the Earth's static magnetic field is approximately 50 uT.) At least three groups are trying to replicate the experiments though only Mild, of Sweden's National Board of Occupational Safety and Health, has been successful (see *MWN*, June 1984).

Very low frequency (VLF) radiation emissions are produced by the VDT's flyback transformer, which controls the electron beam's movement across the inside face of the display screen. Recent measurements, described below, indicate that there is a long magnetic field pulse associated with the horizontal tracing of a raster line from left to right and a very short electric field pulse associated with the rapid return to the left to start a new line.

The magnetic field waveform from the flyback has a rise time of approximately 45 microseconds (usec). The observed values vary according to the flyback frequency — the pulse repetition rate can change from 15-20 kHz. There also appears to be a fast magnetic field pulse associated with the short electric field pulse, which has a rise time of about 5 usec.

The shape of the electromagnetic pulse determines the time rate of change of the magnetic field; time-varying magnetic fields induce electric currents. It is not clear, however, whether induced currents or other mechanisms — possibly direct magnetic interactions — cause the Delgado effect. For instance, in a paper published earlier this year, Dr. Abraham Liboff of Oakland University in Rochester, MI, showed that weak alternating magnetic fields could alter DNA synthesis and that the effect was independent of the induced current (see *Science*, 223, 818, 1984, and *MWN*, October 1983).

### Guy's Data

At a conference on "Office Hazards: Awareness and Control" in Seattle, WA, on June 1, Guy reported that the magnetic field pulses from VDTs have rise times of approximately 40-60 usec and fall times of 10 usec, "characterized by a sawtooth-wave shape." Average (rms) field strengths at the surface of terminals were on the order of 1 A/m, decreasing to 0.02-0.14 A/m at a distance of 25-30 cm from the screen.

Guy also measured the electric fields produced by flybacks. These were in the form of 10 usec wide pulses separated by 50-70 usec intervals. The peak amplitudes

were approximately five times greater than the average. "For typical VDTs, the peak electric field levels may be as high as several thousand volts per meter [V/m] at the surface of the unit nearest the flyback transformer and near 10 V/m at 25-30 cm from the screen," Guy wrote in the abstract of his conference paper. He noted some significant exceptions, however: "these values can be ten to twenty-five times greater for some older models."

In a subsequent telephone interview, Guy said that the electric fields at 25-30 cm from the screen were approximately 5 V/m for new VDTs and about 50 V/m for old ones.

Guy advised in his abstract that, "Though there is concern about the health hazards of the emissions, the levels are far below accepted safety standards, and energy coupled to a user of the device is very small."

Guy told *Microwave News* that Delgado's experiments indicated the VDT pulse shape might not be biologically active. He said that he had observed a small ripple on the top of the VDT's magnetic field waveform; when Delgado added a ripple to the 42 usec pulse it was no longer teratogenic.

Guy tested terminals made by Digital Equipment Corporation (DEC), Hazeltine, Televideo and others and found similar pulse shapes for all units. Flyback frequencies varied between 15 and 18 kHz.

Guy has been studying VDT radiation for IBM. The company hired him to analyze the available literature and to suggest methodologies for measuring non-ionizing radiation emissions from VDTs. He took his own measurements when he found inconsistencies in the literature. An IBM spokeswoman would not say whether company officials had seen Guy's waveforms. A report Guy submitted to the company has been returned for revisions, she said. IBM is not planning to release the final report.

The conference proceedings, including Guy's abstract, are available from the Department of Environmental Health, University of Washington, SC-34, Seattle, WA 98195.

### EPA Measurements

Tell, who works at EPA's radiation lab in Las Vegas, NV, described his measurements of the magnetic field pulses at the Bioelectromagnetics Society (BEMS) meeting in July.

Tell tested Wang and Hewlett-Packard VDTs and a Sony television set (used as a computer monitor), reporting the magnetic flux density for the short magnetic pulse in terms of microtesla (uT). (For comparison with Guy's results, Tell's values are also given in ampere/meter (A/m), using the conversion factor of 1 uT=0.8 A/m.) Peak magnetic field readings ranged from 1.44 uT [1.15 A/m] for the Hewlett-Packard to 6.48 uT [5.18 A/m] for the Sony. Maximum time rates of change for the magnetic fields, measured near the flybacks at the rear of the units, were 0.222 T/sec for the Hewlett-Packard, 1.12 T/sec for the Wang and 0.926 T/sec for the Sony.

At 5, 10, 15 and 20 inches from the screen, the time rates of change dropped off sharply. At the furthest distance, however, they were all still in the range used by Delgado.

Delgado did not publish the time rates of change for his

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experiments, but according to Tell's calculations they ranged from 0.0029 T/sec to 0.29 T/sec.

Tell reported that he observed the magnetic field pulse rise times to be on the order of a few usec. Neither Guy nor the researchers from Ontario Hydro found this fast pulse. Guy told *Microwave News* that, "I feel certain that the 2 usec pulse is peculiar to the particular VDTs studied." Tell was visiting Delgado's lab in early September and could not be reached for further comment.

### Ontario Hydro and FDA

Murray Walsh, of Ontario Hydro in Pickering, Ontario, described measurements of some of the VDTs used at the utility company in a paper presented on August 29 at an *Open Symposium on the Interaction of Electromagnetic Fields with Biological Systems* held during the general assembly of the International Union of Radio Science (URSI) in Florence, Italy. In his "Assessment of the Hazards from Video Display Units," Walsh said that Ontario Hydro had "completely characterized the electromagnetic waveforms" as part of a major project to assess VDT hazards (see *MWN*, April 1984).

Explaining these data in a subsequent telephone interview, Walsh, who is manager of the company's Technical Safety Standards Section, said that the magnetic field pulses had rise times of approximately 40 usec and fall times of approximately 4 usec.

Walsh and Harvey measured the magnetic fields along three orthogonal axes near the VDTs. Along one of these,

Murray noted, the waveform was very complex.

Walsh also described 17 kHz electric field pulses as having short rise and fall times—approximately 4 usec each—separated by an estimated 52 usec. The wave shape was triangular, and the overall pulse duration was 60 usec. (A sample electric field waveform is pictured in a report on Ontario Hydro's findings in *Bioelectromagnetics*, 5, 1, 1984.)

In a telephone interview, FDA's Paul Ruggera said he had made some preliminary measurements of waveforms from two VDTs a few years ago. He explained that the magnetic field levels were so low that he did not measure them directly; instead he studied the spectral distribution of the signals.

Ruggera's data are published in *An Evaluation of Radiation Emissions from Video Display Terminals*, published by FDA in February 1981 (No. FDA 81-8153). The report is reprinted in the record of the May 1981 hearings of the House subcommittee on investigations and oversight of the Committee on Science and Technology, *Potential Health Effects of VDTs and RF Heaters and Sealers*.

A fifth set of measurements has been released in Canada but was not available at press time. In a study requested by the Hospital Employees Union of British Columbia, Dr. Hari Sharma of the University of Waterloo in Ontario measured radiation from VDTs at the Surrey Memorial Hospital in Vancouver. The hospital was the site of one of the eleven reported clusters of problem pregnancies (see *MWN*, July/August 1982). ♦

## CONFERENCES

October 2-4: **Interaction of Biological Systems with Static and ELF Electric and Magnetic Fields**, Holiday Inn, Richland, WA. Contact: Patricia Bresina, Battelle Pacific NW Labs, PO Box 999, Richland, WA 99352, (509) 376-0100.

October 2-4: **6th Annual Electrical Overstress/Electrostatic Discharge Symposium**, Marriott Hotel, Philadelphia, PA. Contact: EOS/ESD Symposium, PO Box 9172, Fort Collins, CO 80525, (303) 221-8059.

October 5-6: **1st Congress of the European Society of NMR in Medicine**, Geneva, Switzerland. Contact: Dr. M.-A. Hopf, 1 route de Floris-sant, CH-1206 Geneva, Switzerland, (41)(22) 472547.

October 10-12: **Symposium on Electromagnetic Field Measurements for Hazard Assessment**, Hacienda Resort Hotel and Casino, Las Vegas, NV. Contact: Sheri Marshall, Dynamac Corp., PO Box 2198, Kensington, MD 20895, (301) 468-2500.

October 16-18: **1984 International Symposium on Electromagnetic Compatibility**, Tokyo, Japan. Contact: Professor T. Takagi, Dept. of Communications, Tohoku University, Sendai, 980, Japan, (0222) 22-1800, ext. 4266.

October 21-24: **1984 Conference on Electrical Insulation and Dielectric Phenomena**, Wilmington Hilton Hotel, Clayton, DE. Contact: Steven Boggs, Ontario Hydro Research, 800 Kipling Ave., Toronto M8Z 5S4, Canada, (416) 231-4111, ext. 6735.

October 21-26: **Managing the Electromagnetic Environment**, Pocono Hershey Resort, White Haven, PA. Contact: Harold Comerer, Engineering Foundation, 345 East 47th St., New York, NY 10017, (212) 705-7835.

October 22-23: **International Conference on Microwave Tubes in Sys-**

tems: Problems and Prospects, London, England. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, England, (01) 240-1871, ext. 222.

October 22-24: **International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors**, Sasakawa Hall, Tokyo, Japan. Contact: Professor T. Musha, Dept. of Applied Electronics, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama, 277, Japan, (045) 922-1111, ext. 2546.

October 22-26: **9th International Conference on Infrared and Millimeter Waves**, Osaka, Japan. Contact: Professor A. Mitsuishi, Dept. of Applied Physics, Osaka University, Yamada-Oka, Suita, Osaka 565, Japan.

October 31-November 2: **Conference on Medical and Biological Effects of Light**, Barbizon Plaza Hotel, New York, NY. Contact: New York Academy of Sciences, 2 East 63rd St., New York, NY 10021, (212) 838-0230.

November 5-7: **DOE-EPRI-NYS Contractors Review: Research on Bioeffects of Transmission Lines**, Sheraton St. Louis, MO. Contact: Dr. William Wisecup, Aerospace Corp., Suite 4000, 955 L'Enfant Plaza, SW, Washington, DC 20024, (202) 488-6328.

November 5-8: **4th International Meeting of the Bioelectrical Repair and Growth Society**, Holiday Inn, Kyoto, Japan. Contact: BRAGS, 425 Medical Education Building, 36 and Hamilton Walk, Philadelphia, PA 19104, (215) 898-8653.

November 13-15: **JINA'84: International Symposium on Antennas**, Nice, France. Contact: Secretariat JINA'84, CNET-PAB Centre de la Turbie, 06320 Cap d'Ail, France.

# FROM THE FIELD

## University of Washington on Microwave-Cancer Study

Last month, we featured a report on a study by Dr. Arthur Guy at the University of Washington School of Medicine, which linked microwaves to the promotion of cancer. In response to our report and numerous other news stories appearing nationwide, the university's Health Sciences News and Information Services issued a press release on August 24.

Reprinted below is the full text of the University of Washington press release.

The stories also drew a critical response from the Electromagnetic Energy Policy Alliance (EEPA), an association of manufacturers and users of systems which employ non-ionizing radiation. In a September 8 release, EEPA Vice-President George Wilkening stressed the preliminary nature of the Guy results and noted that "there is nothing definitive...to support a conclusion that continuous exposure to radiofrequency and microwave fields is harmful to humans at the protection guide levels specified by the American National Standards Institute in 1982." Wilkening works for AT&T Bell Labs.

Over the past three years the Bioelectromagnetics Research Laboratory at the University of Washington has conducted, under the School of Aerospace Medicine's sponsorship, a biological screening study of the effects of continuous long-term exposure to low levels of microwave radiation. The major emphasis was to expose a group of rats to microwaves throughout their lifetimes and to monitor them for possible cumulative effects on general health and longevity. Two hundred animals were studied, one hundred being exposed and one hundred serving as controls.

Literally thousands of measurements were taken during the course of the study, covering many areas such as behavior, blood chemistries, metabolism, the immune system, weight and survival. All animals were also investigated at necropsy for the occurrence of lesions.

The overwhelming majority of the measurements showed that there was no difference between the animals exposed to microwaves and the controls, and in particular, there was no difference in survival between the two groups. However, several differences did emerge which merit further study:

1. There was some evidence of altered immune function, based on 10 exposed and 10 control animals sacrificed midway through the experiment, though this was not seen in animals sacrificed at the end of the experiment.
2. There was a suggestion of an increase in the weight of the adrenal glands in the exposed group, based on 10 exposed and 10 control animals sacrificed at the end of the experiment; however, this was not seen in animals sacrificed midway through the experiment.
3. There was a possible increase in the number of exposed animals with malignant tumors, which occurred in 16 of 100 animals in the microwave group and 4 of 100 control animals.

There are several reasons why these differences cannot be regarded as being definitively established. First, in a screening study such as this, with so many aspects being investigated, it is inevitable that some differences will appear by chance in the data obtained from the two groups, even if microwaves have absolutely no biological effect. Second, we have not completed the analysis of the results and, in particular, have not finished exploring the relationships between measurements and possible anomalies in the data. Third, with regard to tumors, the incidence is not significantly different in the exposed group compared to that in other unexposed groups of the same type of animals reported in the scientific literature. Finally, there wasn't a substantial increase in any specific type or location of tumor, differences emerging only when all tumors are considered, leaving biological interpretation open to question.

Nonetheless, the implications for public health of these results are such that further studies need to be done, designed specifically to address the issues raised by our research results.

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### Books from San Francisco Press

Three books on RF exposure policy: Clemmensen, *Nonionizing Radiation: A Case for Federal Standards?* (\$7.50); Steneck, *Risk/Benefit Analysis: The Microwave Case* (\$15); Marha et al., *EM Fields and the Life Environment* (\$10). Prepaid orders to San Francisco Press, Inc., Box 6800, San Francisco, CA 94101-6800. (Californians add tax.)

### VDT Health and Safety Publications

*VDT News* offers bimonthly news reports on the latest developments for \$35.00 a year. Our *VDTs: 1983 Health and Safety Update* (\$7.50) summarizes the important news from last year in thorough detail. And our booklet, *VDTs: Health and Safety*, (\$6.95) covers 1981-1982 and is an important resource for anyone concerned about VDTs. Orders must be prepaid and sent to: *VDT News*, PO Box 1799, Grand Central Station, New York, NY 10163.