

# MICRO WAVE NEWS

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A Report on Non-Ionizing Radiation

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## INSIDE...

### HIGHLIGHTS pp.2-7

#### BEMS Briefs

USAF Weighs Moving PAVE PAWS  
Radar at Robins AFB due to HERO Risks  
RF Heating of the Wrist and Ankle

#### Communications Roundup:

Seattle Proposes RF/MW Standard  
Hawaii Highway & VLF Omega Station  
EPA To Measure RF in McFarland, CA  
FCC Revises NEPA Rules  
EPA-FCC Spokane RF Survey

EMPRESS II on the Ocean

### ELF NEWS pp.8-11

#### Power Line Talk

#### Sleeping with EMFs:

Electric Blankets & Menstrual Cycles  
No Leukemia Risk from E. Blankets  
Field Exposure and Control

#### New Zealand Cancer Study: A Correction

TX Supreme Court Refuses To Review  
Klein Decision

E. European Literature on ELF Bioeffects  
NYPA Witnesses for Marcy-South Suit

### NEW BOOKS pp.11-12

#### Selected Reviews

#### Briefly Noted

### UPDATES pp.12-13

Reviews of EMFs and Cancer • More on  
Radar Accidents • MRI and Eye Implants •  
Space Station EMC • New LLNL RF/MW  
Limits • Changes at IRPA/INIRC • CISPR &  
IEC Draft Rules • People In the News •  
Lightning Protection? • and more....

### CONFERENCES p.7

#### New Listings

## Occupational EMF Exposure Again Linked to Brain Cancer

A new epidemiological study has once again documented an increased risk of malignant brain tumors among workers exposed to electromagnetic fields (EMFs). Dr. Marjorie Speers and co-workers found that the brain cancer risk grew linearly with the probability of EMF exposure on the job. Most dramatically, Speers found that the risk for utilities workers was 13 times the expected rate for unexposed workers.

"The literature is building in this area," Speers told *Microwave News*. "These studies point to a link between EMFs and brain cancer." Speers, who was formerly at the Department of Preventive Medicine and Community Health at the University of Texas Medical Branch in Galveston, is currently at the Centers for Disease Control in Atlanta, GA.

Speers's findings, reported in the June 1988 issue of the *American Journal of Industrial Medicine*, support those of Dr. Samuel Milham, Jr. of the Washington State Department of Social and Health Services in Olympia (see *MWN*, J/A82 & M/A86), and of Dr. Ruey Lin, formerly with the Maryland Department of Health and Mental Hygiene and now at the National Taiwan University in Taipei (see *MWN*, O84 & J/A85). Neither Milham nor Lin were able to rule out the possible contribution of toxic chemicals, however.

(continued on p.15)

## EMP Technician with Leukemia Files Suit Against Boeing

On June 10, a Seattle, WA, electronics technician diagnosed with leukemia filed a class action suit against Boeing and several other companies, claiming that his condition is a result of exposure to electromagnetic pulse (EMP) radiation. He is also seeking an injunction on behalf of approximately 600 other Boeing workers to stop their exposure to EMP without their knowledge or consent.

Robert Strom, who was employed by Boeing for 27 years, worked with EMP from 1983 through 1985, testing its effects on electrical and electronics equipment as part of the MX "Peacekeeper" missile program. In 1985, he was diagnosed with leukemia.

According to Strom's complaint, which was filed in the Superior Court of Washington for King County, Boeing and co-defendants Boeing Medical Services, Lovelace Biomedical and Environmental Research Institute and EG&G Co. had long known of the health dangers associated with exposure to EMP, yet they never warned workers or took any precautions to safeguard them.

(continued on p.14)

## BEMS Briefs

This year's Bioelectromagnetics Society (BEMS) meeting\* may be remembered more for extending earlier studies than for opening new frontiers. But as one researcher put it at the close of the conference, "The easy part is identifying the effects; now we have to dig in and explain what's going on. Some effects may not pass muster, but others will yield insights into mechanisms."

What follows are some highlights of what was said during the sessions and in the halls during the breaks.

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The blood-brain barrier (BBB) controversy is on again. Despite reports to the contrary, microwaves do seem to increase the leakage of certain chemicals through the BBB.

At BEMS, a team headed by Dr. David Lange of the Johns Hopkins University (JHU) Medical School in Baltimore, MD, reported that 2.45 GHz radiation at specific absorption rates (SARs) of 2 W/Kg—both continuous wave (CW) and pulsed microwaves (MWs)—could "significantly alter BBB function in the absence of hyperthermia." Lange told *Microwave News* that 2 W/Kg appears to be the threshold for CW radiation, but it is still too early to say anything definite about pulsed radiation.

Could the observed effect have been caused by an increase in blood flow, as has been alleged by some critics? "We anticipated that argument," Lange said, "and our system eliminates that possibility."

In their much-discussed commentary in *Nature* arguing for guidelines for halting MW-related risk research (see *MWN*, J/F88), Drs. Ken Foster and Bill Pickard cite MW-induced BBB permeability as an example of an effect that turned out to be an artifact after an "extensive" follow-up.

When asked for his reaction to the new work, Pickard said: "This is an interesting report. If validated by a number of additional groups, then it would be reasonable to reopen the question." (Foster did not attend the BEMS meeting.)

Many experts already believe that the MW-BBB link deserves more scrutiny. The well-documented work by Henry Kues of the JHU's Applied Physics Lab and by Jack Monahan of the Food and Drug Administration (FDA), showing extensive leakage through the blood-eye barrier following MW exposure, pointed to the need for a fresh look at the BBB studies. In fact, Kues is a member of Lange's study team.

In his presentation, Kues said that he and Monahan were "zeroing in" on a mechanism: "It may be thermal but not in the way that most people think of thermal effects."

The JHU-FDA results could be the basis for the next generation of safety standards. They undermine the 4 W/Kg threshold for adverse effects used by the American National Standards Institute (ANSI) and the National Council on Radiation Protection and Measurements (NCRP); but they provide sup-

port for the 1 and 2 W/Kg thresholds advocated by the Environmental Protection Agency and by the National Institute of Occupational Safety and Health (NIOSH), respectively.

The JHU-FDA data present a challenge for those writing health standards: How to deal with the MW/drug synergy problem? Kues and Monahan have shown that the permeability of the blood-eye barrier is ten times lower—0.26 W/Kg—when the eye is pretreated with glaucoma medicine, e.g., timolol maleate, before MW exposure. This is not an insignificant consideration given that, according to FDA estimates, over two million Americans use these drugs on a regular basis.

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There were rumors at BEMS that the long-delayed and nearly-forgotten NIOSH criteria document on RF/MW radiation may actually emerge from its bureaucratic limbo in the fall—nearly a decade after the first draft was released. Similar rumors have been heard in past years, so a wait-and-see attitude is in order.

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*Nature* has published a letter critical of the Foster-Pickard commentary by Dr. Ross Adey of the VA Hospital in Loma Linda, CA. Writing in the June 2 issue, Adey charges that Foster and Pickard "ignore a wealth of findings" on recent bioelectromagnetic research.

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The reopening of the BBB debate comes as a number of researchers are beginning to doubt that aqueous solutions of DNA can absorb 1-10 GHz MWs. In our last report, British and Swedish researchers had just published a paper in *Nature* stating that they could not observe the resonances, and Dr. Ken Foster was about to publish a similar report in the *Biophysical Journal* (see *MWN*, J/A87).

At BEMS, Dr. Chris Davis of the University of Maryland, in whose lab then-doctoral student Dr. Glenn Edwards first discovered this DNA phenomenon, said that he too was now unable to find the resonance and was giving up the search.

Davis used a new, improved experimental system and followed the same protocol as in the earlier studies. He said that he is not convinced that Edwards was wrong because he could not even coax the system to show an artifactual resonance. At this point, Davis said, "I am not sure what is going on."

For his part, Dr. Ted Grant of Kings College, London, U.K., who was the senior author of last year's *Nature* paper, has moved on to other research problems. "We saw no scientific reason for continuing the work on DNA absorption," he told *Microwave News* after the meeting. Grant and co-worker Dr. Camelia Gabriel are now turning their attention to the interaction of plasmid DNA with low frequencies—from a few Hz to 10 MHz.

Of course, the last word must come from Edwards himself. He was not at BEMS and was away from his office at Vander-

\*10th Annual Meeting of the Bioelectromagnetics Society, June 19-23, Stamford, CT.

bilt University in Nashville, TN.

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There was a standing room only audience for the presentation of the "Henhouse Project" results (see *MWN*, M/A88 & M/J88), and a throng always surrounded the two Henhouse poster papers.

Thanks to support from the Office of Naval Research, the proposition that weak pulsed magnetic fields (PMFs) can have serious biological effects has come a long way since Spain's Dr. Jocelyne Leal first published her landmark findings in 1982. Nevertheless, there were many skeptical looks in the room. Some people are still not ready to believe that a 1  $\mu$ T (10 mG) peak PMF—the average field is 0.05  $\mu$ T (0.5 mG)—may be hazardous.

Interestingly, these values are of the same order of magnitude as the hypothesized threshold of 2-3 mG for power line magnetic fields. It is especially noteworthy in the context that PMFs have been shown to be as much as ten times more active than an equivalent unmodulated field.

That the debate will continue is clear from the recent publication of a paper by a team at the University of Rochester reporting an inability to repeat the Leal chick egg findings (*Journal of Anatomy*, 157, pp.101-104, 1988). The Rochester research, which was supported by a consortium of New York State utilities, was designed to "minimize differences" with the Spanish experiments.

Leal is not so sure. She told *Microwave News* that there were some important differences between the two protocols. The extent of the difference is uncertain because a number of details are missing from the Rochester paper, but one major change is that the Rochester group used a PMF with a 42  $\mu$ sec rise time, while the Henhouse labs used a 2  $\mu$ sec rise time. "They do not appear to have seen the correction to our early papers," she said. Leal originally reported that two of the experimental PMFs had rise times of 42  $\mu$ sec, but later issued a correction noting that 2-7  $\mu$ sec was more accurate (see *MWN*, D84).

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Dr. Reba Goodman of Columbia University, who, with Dr. Ann Henderson of Hunter College, has already shown that RNA transcription is extraordinarily sensitive to specific EM signals, reported that these same signals can turn on or enhance the expression of specific oncogenes—sequences of DNA which, on activation, can trigger the development of cancer. Indeed, the oncogenes are themselves sensitive to small changes in frequency and pulse modulation.

In a paper that was just published in the *Proceedings of the National Academy of Sciences* (85, pp.3928-3932, June 1988), Goodman and Henderson show that 60 Hz and 72 Hz sine waves induced surprisingly different protein profiles. For instance, a class of proteins was synthesized with the 72 Hz sine wave signal that was absent from the 60 Hz sample. "Changes in protein synthesis are a natural outcome once you have altered RNA transcription. Now, our lab will turn to

identifying and quantifying the specific proteins associated with specific oncogenes," Goodman said.

Dr. Jerry Phillips of the Cancer Therapy and Research Center in San Antonio, TX, is pursuing a similar line of research, investigating the *ras*, *fos*, *myb* and *myc* oncogenes with a different cell line. Similarly, a group at the Battelle Pacific Northwest Labs in Richland, WA, should soon be reporting results on its oncogene studies.

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The meeting provided another boost for the fortunes of the cyclotron resonance (CR) model developed by Drs. Abe Liboff of Oakland University and Bruce McLeod of Montana State University. Dr. Judy Reese of the Battelle Pacific Northwest Labs announced that she had observed the same 16 Hz field effect in diatoms as was first reported by Liboff, McLeod and the University of Kentucky's Steve Smith (*Journal of Bioelectricity*, 6, pp.1-12 and pp.153-168, 1987 and *Bioelectromagnetics*, 8, pp.215-227, 1987).

In Smith's experiment, the earth's ambient field was adjusted so that the CR frequency of calcium ions was 16 Hz—selected to coincide with the Adey-Blackman frequency window. Smith found a sharp increase in diatom motility at 16 Hz, with a static magnetic field of 209 milligauss. Now, so has Reese.

"I have seen the same effect, but I have not replicated the experiment," Reese told *Microwave News*, explaining that she had not tested the adjacent frequencies and could not consider her experiment a replication until the whole resonance curve has been retraced. She will soon run the experiment at 14 and 18 Hz. A number of variables—including quality of light and the age of the culture—affect the experimental outcome, she said.

Liboff is understandably delighted by the news. Even without the full resonance curve, he sees it as a confirmation of the theory. "It marks a critical turning point in the general acceptance of the CR hypothesis," he said. He would now like to see Battelle expose whole animals to CR conditions.

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One of the most interesting new developments came from Battelle's Dr. Fred Leung. He reported what may be the first evidence of a marker for electric field-induced stress: Rats exposed to relatively high E-fields show a brown, sticky material at the edges of their ears. The effect, which he noticed by serendipity in the course of another study, became apparent for rats exposed to 10 kV/m, though it was only statistically significant at the next level of exposure, 65 kV/m.

Chemical analysis of the brownish substance indicates that it is made up of red porphyrins which, Leung said, are known to be related to stress reactions. While many have long alleged that electromagnetic fields can cause stress, Leung may now have found a useful indicator to pinpoint and characterize the reaction. He is planning follow-up experiments.

### **USAF Weighs Moving PAVE PAWS Radar To Counter In-Flight Explosion Hazard**

The U.S. Air Force (USAF) is considering relocating its PAVE PAWS radar at Robins Air Force Base (AFB), GA, to reduce the danger of explosions on aircraft flying through the radar's main beam. The rough cost of moving the PAVE PAWS system to a new site within a 200-mile radius is \$37.7 million, according to a new study prepared by Raytheon Co. for the Electronic Systems Division at Hanscom AFB, MA.

"The high energy contained in PAVE PAWS pulses may pose a hazard to electro-explosive devices (EEDs) carried on military and commercial aircraft," Raytheon warns. EEDs are used as detonators for munitions, among other applications.

Relocation of the radar is "only one of the alternatives still under consideration," a USAF spokesman told *Microwave News*, but added that "it wouldn't make sense economically." The USAF is "waiting for the user—the U.S. Space Command—to come back with answers and ideas before the final decision is made," he said.

Captain Dan Curtis, an electronics engineer who worked on aircraft avionics and electronic warfare (EW) systems in the USAF for 22 years, told *Microwave News* that the PAVE PAWS radar is at the end of one of the runways at Robins AFB: "It should absolutely not have been put there," he said. Since he retired from the USAF in 1979, Curtis has managed EW programs for a number of defense contractors and is now a freelance consultant.

The USAF is also planning to upgrade the PAVE PAWS radar by a factor of ten (10 dB). Raytheon estimates that the combined cost of moving and upgrading the Robins radar is \$119.7 million, excluding government and other contingency costs.

If the USAF decides to move the radar, there will be a gap in radar coverage for the Southwest region. Raytheon predicts that the Robins PAVE PAWS site will have to be completely abandoned early in the relocation program, but the new site will not go on-line for more than three years.

The "safe" exposure limit for in-flight aircraft carrying EEDs is 10 mW/cm<sup>2</sup>, according to Raytheon, creating an air space "hazard zone" of one nautical mile for the current system and three nautical miles after the 10 dB upgrade.

In its final report, *PAVE PAWS EED Hazard Study*, Raytheon proposes to use an "embedded tracker" (ET)—based on subarrays within each of the present PAVE PAWS arrays—to monitor air traffic approaching the hazard zone and to order an automatic shutdown of the radar. This and other short-term modifications would "establish a significant measure of hazard reduction through pulse energy reduction...and [through] blanking radar beams coincident with aircraft in the hazard zone."

Raytheon concludes that the ET plan is the "safest and most economical approach to solving the EED problem." The company, which is based in Wayland, MA, estimates that, under worst case conditions, the ET would fail to identify a plane in the hazard zone only once every 12 years for the current configuration and once every 1.6 years for the 10 dB system. In addition,

airplanes approaching the PAVE PAWS from the rear, as well as slow-moving helicopters, would continue to be at risk.

A spokeswoman for Raytheon had no comment on the report, saying that all the pertinent information had been sent to the USAF and that the company no longer had copies of the report. The USAF would only release portions of the report to *Microwave News* because certain sections were classified.

In a telephone interview, Ramie Thompson of the Franklin Research Center in Norristown, PA, said that the vulnerability of EEDs to accidental initiation by radiofrequency (RF) radiation depends on a number of variables, including the type of EED and the type of RF signal. Thompson, who has worked on this problem for 30 years, said that a film made at Franklin 25 years ago shows EEDs being triggered by a 1200 MHz perimeter radar at a distance of more than 700 feet.

"There have been a number of unexplained incidents that could have been caused by EEDs initiated by RF radiation," Thompson said.

A lawsuit, now pending in federal court, seeks greater protection against the accidental initiation of EEDs (see *MWN*, S/O87)—a problem called Hazards of Electromagnetic Radiation to Ordnance (HERO). Patricia Axelrod, the coordinator of Project HERO, based in Washington, DC, said that she is preparing to file a motion for summary judgment in her case.

"Based on my experience with weapon systems, both conventional and nuclear, it is my opinion that the PAVE PAWS radar at Robins AFB should discontinue operation until the existing electromagnetic radiation hazard is resolved," Robert Aldridge, a former weapons designer for Lockheed Missiles and Space Co. in Sunnyvale, CA, wrote in a statement for Project HERO's lawsuit. Aldridge is now a freelance consultant based in Santa Clara, CA.

PAVE PAWS radars are designed to detect sea-launched ballistic missiles. There are now four PAVE PAWS radars operating in the U.S.: at Otis AFB, MA; at Beale AFB, CA; at Goodfellow AFB, TX; and at Robins. They operate at 420-450 MHz, have a detection range of 3,000 nautical miles and are said to be capable of detecting an object the size of a basketball at a range of more than 1,200 miles, according to the 1988 *CJ Handbook*.

The Robins Air Logistics Center at Robins AFB provides worldwide logistics management for the F-15 and many other aircraft, as well as for air-to-air, air-to-ground and ground-to-ground missiles.

## RF Heating of the Wrist and Ankle

Relatively low levels of 1-50 MHz radiofrequency (RF) radiation can cause "substantial" heating of human wrists and ankles, according to the latest results from Dr. Om Gandhi's lab at the University of Utah in Salt Lake City.

In a series of studies over the last four years, Gandhi has shown that radiation levels permitted under the 1982 American National Standards Institute (ANSI) guidelines can induce surprisingly large specific absorption rates (SARs)—up to 1,045 W/Kg in the wrist when in contact with a car (see *MWN*, J/A85 & J/A86). The ANSI limits are based on an SAR of 0.4 W/Kg and 8 W/Kg for whole-body and partial-body exposures, respectively.

Writing in the June 1988 *IEEE Transactions on Bio-medical Engineering*, Gandhi and Jin-Yuan Chen warn that the temperature increases they measured among healthy human subjects were on the surfaces of the ankles and wrists and that the "internal tissue temperatures may

be still higher." And, in a strong challenge to the adequacy of the 1982 ANSI standard, Gandhi and Chen say that the new results lead them "to question the safety of the so-called safety guideline."

Gandhi recently became the co-chairman of subcommittee C95.IV, which is in the process of revising the 1982 ANSI limits (see *MWN*, M/A88).

Chen and Gandhi found that RF-induced currents can cause maximum changes in surface temperature of  $[0.0045 \times \text{SAR}]$  and  $[0.0048 \times \text{SAR}]$  degrees Centigrade per minute for the ankle and wrist, respectively (where "SAR" is in W/Kg).

J. Patrick Reilly of the Johns Hopkins University Applied Physics Lab (APL) in Laurel, MD, has been developing models of the interaction of electrical currents with nerve cells. A well-illustrated paper describing this work appears in the *Johns Hopkins APL Technical Digest*, 9, pp.44-59, 1988.

## Communications Roundup

### Seattle, WA, To Set RF/MW Standard

On August 8, the City of Seattle proposed a  $100 \mu\text{W}/\text{cm}^2$  standard for exposures to radiofrequency and microwave (RF/MW) radiation in the 30-300 MHz frequency band. The standard, if adopted, would be twice as strict as the one set by the National Council on Radiation Protection and Measurements (NCRP) and ten times as stringent as the one recommended by the American National Standards Institute (ANSI). It would be the toughest standard in the country, apart from New York City's informal  $50 \mu\text{W}/\text{cm}^2$  limit.

The proposed rules will allow for special exemptions if the  $100 \mu\text{W}/\text{cm}^2$  standard causes a hardship. Clifford Marks, a senior environmental planner with Seattle's Office of Long-Range Planning, explained that a  $200 \mu\text{W}/\text{cm}^2$  limit could be applied to certain sources if the owners could show that the relaxation would not cause an unacceptable health risk to susceptible populations, e.g., the ill and the elderly. Marks expects that broadcasters can meet the  $100 \mu\text{W}/\text{cm}^2$  limit, though he predicted that they would contest the rule to prevent it from becoming a precedent for future standards.

City officials were not persuaded by the NCRP's rationale for using a safety factor of five to convert the ANSI occupational limits to a general population standard, according to Marks. A factor of ten is more common, he said, pointing out that the scientific basis for both the  $100 \mu\text{W}/\text{cm}^2$  and the  $200 \mu\text{W}/\text{cm}^2$  standard is a bit soft and that the city government "wanted to take a strong stand."

Under the rules, which could be in place by next spring, all major sources of RF/MW radiation, especially radio and television antennas, would have to get a permit.

Last December, the city issued its *Environmental Study of Telecommunications Facilities in Seattle*, which is the basis for the proposed rules. The study includes an analysis of selected bioeffects studies by Drs. Don Justesen of the VA Hospital in Kansas City, MO, and Henry Lai of the University of Washington in Seattle. Extrapolating from their report, the Seattle study finds that the question is "whether the *in vivo* and *in vitro* experimental findings are supportive of a hypothesized connection between RF irradiation and malignant disease. The answer is a highly qualified yes."

This view, together with other biological effects studies and a desire to take a conservative approach to public health, contributed to the city's staff decision to set a conservative standard, Marks said.

One of the proposed sites for new broadcast antennas is the Columbia Center, the tallest building in downtown Seattle. However, as Jim Hatfield of Hatfield & Dawson, a consulting firm in Seattle, told *Microwave News*, "The potential for human exposure from broadcast radiation is greatest at the Columbia Center." According to a worst case analysis, the power density on the roof of the Columbia Center would be  $900\text{-}3,000 \mu\text{W}/\text{cm}^2$ . (Hatfield worked on the Seattle study.)

King County, in which Seattle is located, has been developing its own RF/MW radiation standard for many years, but the process is now bogged down in quasi-legal proceedings.

## HIGHLIGHTS

For more information, contact: Clifford Marks, Office of Long-Range Planning, City of Seattle, 200 Municipal Building, Seattle, WA 98104, (206) 684-8056.

### **Hawaii Highway and Omega VLF Station**

The long-running fight over the building of the H-3 highway under the Kaneohe OMEGA antenna on the island of Oahu in Hawaii has flared up again with the release of a Coast Guard study which warns of serious health risks to construction workers and the public (see *MWN*, J/A82 & N/D86).

The study by Paul Gailey of the EC Corp. in Oak Ridge, TN, concludes: "It is clear...that field strengths on the highway surface will exceed occupational standards and present unacceptable exposures to the public." It also states: "Failure to anticipate and mitigate shock hazards could result in serious injuries or death to construction workers."

The analysis of the risks associated with the H-3 highway appear in an appendix to Gailey's report, *Modeling and Measurement of Electromagnetic Fields near LORAN-C and OMEGA Stations*. According to the Coast Guard, the study was "initiated to determine whether or not there are any adverse effects on Coast Guard personnel working in and around the facilities."

The OMEGA system operates at 10.2-13.6 kHz. The Kaneohe station has an output of 10 kW.

Gailey himself suffered "numerous shocks" in the course of his measurements: "The shocks occurred through clothing when brushing against a conductive surface and were startling and painful. More severe shocks will be experienced if grounded workers contact insulated vehicles," he wrote.

In a telephone interview with *Microwave News*, Gailey said that the hot and humid climate on Oahu will aggravate the problem. "The fields are high—400-500 V/m on the ground and 1,000 V/m further up," he warned, "I would not be surprised if some workers suffer serious shocks—and some of these could be above the let-go threshold." He stressed that his estimates were based on a worst case analysis and that they do not include the use of mitigation techniques. As Gailey pointed out in his report, these problems are not "insurmountable."

State Transportation Director Ed Hirata told the Honolulu *Star-Bulletin & Advertiser* (July 17) that the Coast Guard report has no "credibility" and that the planning and construction of the highway will continue.

### **MWN References**

Beginning with this issue, we will abbreviate references to past issues of *Microwave News*. In the past, we have spelled out the months and listed the entire year. In our new format, July/August 1988 will appear as J/A88. Prior to July/August 1985, *Microwave News* was on a monthly schedule. To avoid confusion March and May 1985 will appear as Mr85 and My85, respectively.

For more information, contact: K.F. Doolan, Safety Programs Division, U.S. Coast Guard, Washington, DC 20593.

### **EPA To Measure RF in McFarland, CA**

Staffers from the Environmental Protection Agency's (EPA) Office of Radiation Programs will go to McFarland, CA, in the fall to measure RF radiation levels from the Voice of America transmitter in Delano.

In a May 23 letter, EPA Administrator Lee Thomas pledged to assist California health officials in finding the cause of the cancer cluster among the children of McFarland (see *MWN*, J/F88): "I share the public's concern about the suggested link between electromagnetic fields and human cancer....I believe that our involvement in your investigation of the McFarland situation may produce information valuable to our understanding of the relationship between environmental electromagnetic fields and carcinogenesis."

In April, Dr. Kenneth Kizer, the director of California's Department of Health Services, asked for EPA's technical assistance. Kizer had requested that EPA start taking measurements by the end of the month, but Thomas said that "prior commitments" would force a delay until late summer or early fall.

Meanwhile, the plight of McFarland's children took on new stature as the Rev. Jesse Jackson referred to the cluster in his nationally televised speech at the Democratic National Convention on July 19.

### **FCC Revises NEPA Rules**

On July 11, the Federal Communications Commission (FCC) released final rules to ensure that satellite transmitters aboard ships do not cause overexposure to RF radiation. The commission's action is a further refinement to its regulations for implementing the National Environmental Policy Act (NEPA), which can require the preparation of environmental impact statements (see *MWN*, A85).

At the same time, the FCC decided it could not justify similar rules for ship radar stations because there is a "lack of evidence for potential harm."

After the FCC first proposed the rules (see *MWN*, M/A87), the EPA had argued that the commission's approach was "too passive to be effective." The FCC responded that it believes that its RF rules have resulted in "widespread compliance" among the broadcasters already covered.

With this action, the commission has decided to close the docket (No.79-144) on its NEPA rules. "The basic rules have now been established," FCC's Dr. Bob Cleveland told *Microwave News*. Nevertheless, a number of related items are still pending before the commission: a method for dealing with FM boosters (see *MWN*, J/F88); a petition filed by the National Association of Broadcasters for preemption of state and local RF standards (see *MWN*, M/J86); and a petition from Hammett & Edison for clarification of when environmental assessments are required (see *MWN*, S/O87).



The FCC notes that there is a likelihood of new developments—both in basic research and in new health standards—and that it therefore may “revisit this matter in other proceedings.”

### **EPA-FCC RF Survey in Spokane, WA**

The EPA-FCC survey of RF radiation—primarily from AM radio transmitters—in Spokane, WA, has been released. In general, the field levels were far below the 1982 American National Standards Institute (ANSI) guidelines, though the report acknowledges that “levels far below the ANSI guide can cause annoying RF shock/burns.”

At the front of a school close to KGA, a 50 kW AM station, the team found fields of 13.9 V/m and 39.7 mA/m. Inside the room closest to the transmitter, the electric field measured 28 V/m, with higher levels (92-190 V/m) near fluorescent lights. The magnetic fields in that room were generally less than 50 mA/m, but larger fields (470 mA/m) were identified near metal fixtures and ground wires.

After the school was built, complaints about RF burns and shocks led to the installation of a metal roof to limit the electric fields inside the classrooms.

KGA has also been at the center of a lawsuit: in 1986, Thomas DiLuzio alleged that long-term exposure to AM radiation from the station caused his wife to develop a terminal case of multiple myeloma, a cancerous proliferation of blood plasma cells that is similar to leukemia (see *MWN*, S/O86). Robert Greer of the Spokane law firm of Feltman, Gebhardt, Eymann & Jones, which is representing DiLuzio, said that the case is still pending.

A copy of *Radiofrequency Electromagnetic Fields and Induced Currents in the Spokane, Washington Area, June 29-July 3, 1987* (EPA/520/6-88/008, June 1988) is available from: Ed Mantiply, Office of Radiation Programs, EPA, PO Box 98517, Las Vegas, NV 89193, (702) 798-2440.

### **Navy Selects Ocean Site for EMPRESS II**

Following years of controversy, the U.S. Navy is using its second Electromagnetic Pulse Radiation Simulator for Ships (EMPRESS II) in the Atlantic Ocean instead of the Chesapeake Bay (see *MWN*, 084, N84, J/F87, M/A87 & M/J88). Testing began in early June.

The EMP simulator is operating in international waters in the Virginia Capes (VACAPES) Operating Area, approximately 15 miles offshore from Currituck Light, NC. In a statement published in the June 1 *Federal Register* (53 FR 20083), the Navy stated that neither the VACAPES area nor the Chesapeake site would cause an adverse environmental impact. The ocean site was selected because it “can be utilized to test deep draft ships which do not have unrestricted access to the Chesapeake Bay” and because it “presents minimal conflict with other users in the area.”

EMPRESS II will be in operation during the months of June through August. When in use, the Navy will enforce an exclusion zone with a radius of two miles, from the ocean surface to an altitude of 6,000 feet.

With respect to the EMPRESS I facility at the Solomons Annex of the Patuxent River Naval Air Station, MD, the Navy scheduled a public meeting for August 9 to review its environmental assessment of the simulator's continued operation. For more information on the meeting, contact: Diane Palermo, Code C12, Naval Surface Warfare Center, White Oak Lab, Silver Spring, MD 20903, (301) 394-2865.

## **CONFERENCES**

### **New Listings**

#### **1988**

October 5-7: IEEE International Carnahan Conference on Security Technology, Lexington, KY. Contact: Louise McGill, Conference Secretary, IEEE International Carnahan Conference, PO Box 23961, Lexington, KY 40523, (606) 223-8580.

October 6-7: International Conference on Microwavable Foods, The Swiss Grand Hotel, Chicago, IL. Contact: Robin Geary, Conference Manager, Schotland Business Research, Inc., Princeton Corporate Center, 3 Independence Way, Princeton, NJ 08540, (609) 520-0100.

#### **1989**

January 29-February 3: Winter Meeting of the IEEE Power Engineering Society, Penta Hotel, New York, NY. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

March 19-23: 37th Annual Meeting of the Radiation Research Society (RRS), Westin Hotel, Seattle, WA. Contact: RRS, 1101 Market St., Philadelphia, PA 19107.

March 27-30: INTERMAG '89 Conference, Mayflower Hotel, Washington, DC. Contact: Diane Suiters, INTERMAG '89, 655 15th St. NW, Suite 300, Washington, DC 20005, (202) 639-5088.

March 29-30: IEEE AESS National Radar Conference, Sheraton Park Central Hotel, Dallas, TX. Contact: IEEE AESS Radar Conference, Attn: Russell Logan, PO Box 1000-262, McKinney, TX 75069.

April 4-7: 6th International Conference on Antennas and Propagation, University of Warwick, U.K. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

April 24-28: International Conference on Radar, Versailles, France. Contact: International Conference on Radar, 11 rue Hamelin, F-75783 Paris Cedex 16, France, (1) 45 05 71 69.

## « Power Line Talk »

Participants at the May 1988 International Agency for Research on Cancer (IARC) meeting on ELF fields and cancer—most of whom are planning or are now engaged in epidemiological studies—agreed to standardize study designs to aid the comparison of results (see *MWN*, M/A88). In this way, IARC's Dr. Michel Coleman told *Microwave News*, it should be easier to reach a consensus on the health risk. Specifically, there was general agreement on malignancies to be studied (leukemia and brain tumors); on how they will be defined (histology and International Classification of Diseases—Oncology); and on confounding variables (ionizing radiation and toxic chemicals). Progress was also made on standardizing exposure assessment, though this was more difficult in the absence of a well-defined mechanism of action. A summary report on the meeting has been submitted for publication.

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The International Radiation Protection Association's International Non-Ionizing Radiation Committee (IRPA/INIRC) is revising downward its guidelines for public and occupational exposures to power line electric and magnetic fields. In May 1987, the committee issued a draft proposal which specified permissible exposures of less than 5 kV/m and 2 G (200  $\mu$ T) for the public and 10 kV/m and 50 G (5 mT) for workers—for both groups, higher values would have been allowed for short periods of time (see *MWN*, M/A88). Australia's Dr. Michael Repacholi, the new chairman of IRPA/INIRC, says that a final draft should be completed by the end of September. When asked what the new values would be, he said that he would prefer to wait until the draft was finalized before citing any specific numbers.

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After 39 years with GE, Dr. Don Deno has retired to concentrate full time on his business, Electric Field Measurement Co., based in West Stockbridge, MA. He said that he is planning to introduce a number of "exciting new products" in the fall. Deno is facing increasing competition. In our last issue, we mentioned the new meter being marketed by Integrity Electronics & Research Co. of Buffalo, NY. Now Holaday Industries, which already has a major share of the meter market at RF/MW frequencies, has a new survey meter for power line fields. The HI-3600-02 can measure both electric and magnetic fields: 1 V/m–200 kV/m for electric fields and 0.01 mG–2 G for magnetic fields. The unit costs \$995. You can also buy the 50/60 Hz sensor separately (\$475) and use it with Holaday's VDT survey meter. (Contact: Holaday Industries, Inc., 14825 Martin Dr., Eden Prairie, MN 55344, (612) 934-4920.)

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**Florida watchers:** The earliest that power line siting rules

could be in place is January 1, according to Buck Oven of the state's Department of Environmental Regulation (DER), and he is quick to add that the date is "very optimistic." The 500 kV Lake Tarpon–Kathleen transmission line has been approved by the state siting board—made up of the governor and his cabinet. The latest draft of the state power line rules, dated July 6, cites specific EMF limits for that line: 1.56 kV/m and 160 mG. Oven explained that the magnetic field value applies for maximum loading conditions, which can occur only 15 hours a year. Otherwise, the magnetic field will be 37 mG at the edge of a 100-foot right-of-way. As the rule development process continues, applications for new lines continue to be received by the DER, Oven said.

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The new popular interest in power line safety in the U.K.—in large part prompted by a BBC documentary—has led the Central Electricity Generating Board (CEGB) to issue pamphlets on the health effects of EMFs. In one of these *Power Points*, the CEGB comments: "All available worldwide evidence has been reviewed by a number of national and international bodies, including the World Health Organization, and the Industrial Advisory Council...in Britain. Their unanimous conclusion is that no risk to public or occupational health has been demonstrated."

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Australia's 220 kV line between Brunswick and Richmond has not been canceled as we reported in our March/April issue (see also *MWN*, J/A86), according to Peter Wallace of the State Electricity Commission of Victoria (SECV). Instead, a review panel, chaired by David Scott, Victoria's Environment Commissioner, has been set up to consider the proposed line as well as other options. Scott was also a Community Commissioner of the SECV, but he has stepped down until the review is completed. Construction of the transmission line is on hold until the panel issues its report. The panel will make sure that interested groups have the resources to participate. One such association, Powerline Action, an umbrella organization of community groups and residents based in Melbourne, plan to monitor the work of the panel. Meanwhile, the new analysis by Dr. Nancy Wertheimer and Ed Leeper of Dr. Richard Stevens's epidemiological data has been picked up in the Australian press. It was the lead article in the June 27 issue of *Electricity Week*, a publication based in Sydney, and was featured in a number of newspapers.

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It's official—Drs. Richard Stevens and David Savitz's epidemiological studies are in print: *American Journal of Epidemiology*, 128, pp.10-20 and 21-38, respectively. The New York State Power Lines Project (NYPLP) has issued a supple-



ment to Savitz's original report which presents some additional methodological details not contained in the published paper; these include analyses of traffic density and wire coding. This new Savitz report, which includes a copy of the published paper, is available for \$22.50 from: Charlene McAuliffe, NYPLP, School of Public Health, Corning Tower, Room 2517, Empire State Plaza, Albany, NY 12237. Allow 2-4 weeks for delivery and make checks payable to *Health Research Inc.*

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EPRI has again expanded its staff working on power line health research. Dr. Leeka Kheifets has joined the institute's radiation studies program, where she will oversee epidemiological studies on both power line EMFs and ionizing radiation.

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From 1987 to 1993, Canada's Ontario Hydro will contribute \$4.5 million (Canadian) to a \$7.1 million program assessing the risks associated with EMFs. Speaking at the Bioelectromagnetics Society meeting in June, Hydro's Murray Walsh said that the utility is negotiating with the Royal Society of Canada to act as the Scientific Review Committee "to establish credibility for the program." Of the \$7.1 million, \$2.8 million has been allocated to occupational epidemiology and \$1.3 million to animal carcinogenesis. Ontario Hydro's position is that biological responses to EMFs have been identified, but that no human health risk has yet been established, Walsh said. Consequently, there have been no changes in operating or design practices.

### **Correction on New Zealand Cancer Study**

Dr. Neil Pearce has issued a correction to his 1985 survey of leukemia in New Zealand electrical workers (see *MWN*, My85). Pearce now reports that the odds ratios for "radio/television repair" workers and for "electricians" are 8.17 and 4.75 respectively—both are statistically significant. He notes, however, that the causes of the increased risks "remain unclear."

Pearce, who is at the Department of Community Health at the Wellington School of Medicine in Wellington, New Zealand, previously had reported an odds ratio of 8.17 for "electronic equipment assemblers," but this was actually the odds ratio for radio/television repairmen. The assemblers, in fact, did not have an elevated incidence of leukemia. The "electricians" category was omitted in the 1985 table.

Pearce's correction appears in the July 2 issue of *The Lancet* (p.48). The original survey was published in the April 6, 1985 issue of *The Lancet* (pp.811-812).

## **Sleeping with EMFs**

### **Electric Blankets Shift Menstrual Cycles**

Sleeping with an electric blanket may affect menstrual cycles in women, according to the interim results of a new study by Dr. Bary Wilson of Battelle Pacific Northwest Labs in Richland, WA. Wilson believes that this previously undetected effect may be mediated by the pineal gland.

The study, which he presented in June at the *Annual Meeting of the Bioelectromagnetics Society* in Stamford, CT, revealed "dramatic" changes in the cycles of those using AC-powered electric blankets.

"It's an observation at this point," Wilson told *Microwave News*, "but if confirmed, this will be the first indication that the mechanisms for pineal effects in animals may also be at work in humans."

Earlier Battelle studies have shown a link between electric field exposures and changes in pineal rhythms in rats (see *MWN*, M/J88). Melatonin, which is produced and secreted by the pineal gland, plays a key role in hormonal cycles associated with menstruation and reproduction in women.

Wilson collected urine samples from 33 women three times a week and tested them for a melatonin metabolite. In addition, a clinical psychologist monitored and assessed the participants' general mood. The results of the melatonin experiments are still incomplete; only 40% of the data had been analyzed by the time of the presentation. No statistically significant changes in mood and affect were observed. Wilson plans to follow up the study with detailed analyses of the menstrual cycle changes. The work is being sponsored by the Electric Power Research Institute (EPRI).

### **CA Study Finds No Leukemia Risk**

There is no increased risk of myelogenous leukemia among adults who use electric blankets in Los Angeles county, according to a new study by a research group at the Department of Preventive Medicine at the University of Southern California School of Medicine in Los Angeles.

The study, which was published in the most recent issue of *Bioelectromagnetics* (9, pp.207-213, 1988), estimates that general electric blanket use increases overall electric and magnetic field exposures by 36% and 82%, respectively. Typical field strengths were 40 V/m and 24 mG.

Dr. John Peters and co-workers suggest that the hypothetical link between electric blanket use and leukemia should now be tested in an area "with a harsher climate."

The work was supported by grants from the American Cancer Society and the National Cancer Institute.

### **EMF Exposure and Control**

- EPRI is funding a pilot study on the prevalence of electric blanket use among a group of 4,000 pregnant women. The objective of the study is to determine the feasibility of study-

ing the growth and development of children exposed to electromagnetic fields (EMFs) *in utero*. The eight-month effort, which is in progress, is headed by Dr. Michael Bracken of the Department of Epidemiology and Public Health at the Yale School of Medicine in New Haven, CT. EPRI is providing \$80,000 for the project, which is part of a larger study on the effects of tobacco smoke supported by the National Institutes of Health.

• In a technical report directed at waterbed heater manufacturers, Ed Leeper outlines some cost-efficient methods for minimizing the generation of magnetic fields. The report, *Possible Inexpensive Modifications of Waterbed Heaters to Reduce AC Magnetic Field Production*, argues that magnetic fields can be easily reduced—by 95% or more. For a copy of the report, contact: Ed Leeper, Salina Star Route, Boulder, CO 80302, (303) 442-3773.

## TX Supreme Court Refuses To Review Klein Decision

On July 6, the Texas Supreme Court refused the Klein Independent School District's request for a review of the state court of appeals' decision to overturn a \$25 million judgment against Houston Lighting & Power (HL&P).

The Klein-HL&P suit, arguably the most famous power line case ever litigated, was filed after HL&P built a 345 kV transmission line across school property without obtaining proper permission. A jury ordered HL&P to pay Klein \$25 million in punitive damages and to either move the line or pay tens of millions of dollars to move nearby school buildings (see *MWN*, N/D85). The utility subsequently moved the line at a cost of \$8.6 million and appealed the damage award. Last

year, the court of appeals struck down the \$25 million award (see *MWN*, N/D87), and Klein in turn appealed the reversal.

According to Harris Leven, an HL&P attorney, the utility's liability is limited to the value of the easement while its power line was on Klein property—\$104,000 plus interest, as determined by the original trial court.

On July 21, Dixon Montague of the Houston law firm of Vinson & Elkins filed a new motion with the state supreme court for a rehearing. "It's not over yet," he told *Microwave News*. He said that the issue of punitive damages "should be addressed, and it is distressing that [the judges] do not want to." He acknowledged that if the court refuses, the case would be over.

Montague said that the supreme court is now on its summer break and the earliest his motion could be considered is in mid-September.

## NY Power Authority Prepares for \$60 Million Trial

In preparation for the \$60 million Marcy-South suit beginning September 8 (see *MWN*, M/A87 & M/J88), the New York Power Authority (NYPA) on June 1 filed testimony with the New York State Court of Claims from seven scientists on the health effects of electromagnetic fields (EMFs). These experts, who are unanimous in their finding of no significant effect, have not previously done research on the biological effects of EMFs.

• Dr. Stuart Aaronson, chief of the laboratory of cellular and molecular biology at the National Cancer Institute (NCI) in Bethesda, MD, reports that "there is no scientific basis for concluding that [EMFs] induce any consistent effects on cell growth properties...associated with the acquisition of malignant properties."

• Dr. Richard Bockman, a researcher and attending physician at the Memorial Sloan-Kettering Cancer Center in New York City, states that "no endocrine or metabolic disorders can be demonstrated in animals or humans exposed to EMFs at the levels generated by electric power lines."

• Dr. Roswell Boutwell, a professor in the Department of Oncology at the University of Wisconsin in Madison, concludes that "there is no scientific basis for the assertion that power frequency EMFs are either cancer initiators or promoters."

• Dr. E.A. Egan, a professor of pediatrics and physiology at the University at Buffalo, NY, "conclude[s] with confidence that EMFs associated with electric power generation, transmission and use have had no ill effects on reproduction or prenatal development."

• Dr. Lucius Sinks, a specialist on pediatric cancer at the NCI, reports that "after consideration of genetics, hematology, immunology and epidemiology taken as a whole, it is my opinion that there is no causal relationship between exposure to power frequency EMFs and childhood cancer."

## Eastern European Literature on ELF Bioeffects

Identifying and locating papers from Eastern European countries on the biological effects of electromagnetic fields has always been difficult and time consuming. Now, the Canadian Centre for Occupational Health and Safety (CCOHS) has made it easier with a comprehensive bibliography—*Biological and Health Effects of Extremely Low Frequency (ELF) Fields: A List of Eastern European Literature*.

The 43-page guide, which features hundreds of references, was assembled by the center's Andrew Cutz and Dr. Karel Marha. Most of the citations are to papers from the 1970s and 1980s—a few date to the 1950s and 1960s.

Copies are available for \$10.00 from: Chief Accountant, CCOHS, 250 Main Street East, Hamilton, Ontario L8N 1H6, Canada. Only prepaid orders will be accepted. Make checks payable to the *Receiver General for Canada* and cite order No.B88-1E.

• Dr. H.S. Terrace, a professor at Columbia University in New York City, concludes that "the hundreds of studies...on the behavioral properties of EMFs...have failed to uncover any persuasive evidence that such fields have any psychological significance."

• Dr. Margaret Tucker, an epidemiologist at the NCI, sums up

recent research as having yielded "no persuasive scientific evidence of increased risk of cancer in children or adults from exposure to power frequency EMFs."

The Washington, DC, law firm of Crowell & Moring worked with the NYPA in assembling the expert testimony.

For more information, contact: Kathleen Ryan, NYPA, 10 Columbus Circle, New York, NY 10019, (212) 397-7410.

## NEW BOOKS

### Selected Reviews

Martin Blank and Eugene Findl, editors, **Mechanistic Approaches to Interactions of Electric and Electromagnetic Fields with Living Systems**, New York, NY: Plenum Press, 1987, 444 pp., \$85.00.

Papers on mechanisms can be tough to get through. If you have had trouble, this collection makes the task easier. Blank and Findl gave the contributors enough space to put their ideas into a larger context, allowing them to connect ideas from a number of different studies and thereby helping the reader to get a better understanding of what they are proposing. All the major theories that seek to explain EMF interactions are here—from A(dey) to Z(on). This text is a welcome addition to the literature.

Jonathan M. Charry and Robert I. Kavet, editors, **Air Ions: Physical and Biological Aspects**, Boca Raton, FL: CRC Press, Inc., 1987, 240 pp., \$132.00.

According to one contributor to this review, after decades of studies on whether air ions—for instance from DC power lines—have any health effects, the controversy "is as lively today as it was 20, 30 or 40 years ago." Nevertheless, at the end of his own 50-page chapter, replete with detailed tables, Charry concludes that, while ions can have biological and behavioral effects, they "are for the most part small in absolute magnitude" and "are for the most part transient." The nine chapters in this volume, most of which were written with the support of the EPRI and the DOE, have a huge number of references—one suspects every paper ever written on air ions is included. Unfortunately, two different footnoting systems are used, often making it difficult to find the desired citation.

Andrew A. Marino, editor, **Modern Bioelectricity**, New York, NY: Marcel Dekker, Inc., 1988, 1,136 pp., \$149.75 (U.S. and Canada).

Marino has assembled a most useful collection of papers by some of the leading members of the international research community. Of special note are the contributions by Szmigielski (Poland), Shandala (U.S.S.R.) and Smith (U.K.). Szmigielski's chapter is the first published report of his epidemiological studies documenting an increase in cancer among members of the Polish military exposed to RF/MW radiation (see *MWN*, Mr85 & J/F87). Information on Soviet power line health research is very rare, making Shandala's contribution all the more welcome. And Smith's experiments on EMF effects under conditions of nuclear magnetic resonance (NMR) prompted a lot of interest when they were first published in 1983, and the new details presented here are the first to emerge since then (see *MWN*, O83). In his introductory overview, Becker writes that, "Bioelectricity...provides us with a totally new scientific paradigm by which

to understand the basic physiological mechanisms occurring within living organisms...." The 27 papers written for this book go a long way toward elucidating that paradigm.

Sol M. Michaelson and James C. Lin, **Biological Effects and Health Implications of Radiofrequency Radiation**, New York, NY: Plenum Press, 1987, 675 pp., \$79.50.

This book is testimony to the fact that the thermalists have not given up. As the authors conclude: "Most of the experimental data support the concept that the effects of microwave exposure are primarily, if not wholly, a response to hyperthermia or altered thermal gradients in the body." But this view is at the cost of passing over or ignoring the key experiments that now dominate the field. Guy's \$5 million long-term exposure study is not mentioned, nor are Szmigielski's papers on co-carcinogenicity of MWs with benzopyrene. In fact, the whole cancer issue is dismissed in one short paragraph. The permeability of the blood-brain barrier is assumed to be due to increased blood flow (see p.2 of this issue), and Thomas's landmark MW-Librium synergy paper gets only one sentence. Kues's studies on the eye and Gandhi's work on low-frequency shocks and burns are not cited. Even the chapter on standards is clearly out of date: The 1986 NCRP report is ignored—the only post-1980 references made are to IRPA (1981) and ANSI (1982).

Mary Ellen O'Connor and Richard H. Lovely, editors, **Electromagnetic Fields and Neurobehavioral Function**, New York, NY: Alan R. Liss, Inc., 1987, 416 pp., \$74.00 (*Progress in Clinical and Biological Research*, Volume 257).

Each paper in this collection, which grew out of a meeting held in Corsendonk, Belgium, in the summer of 1984, received two independent reviews. Both ELF and RF/MW frequencies are covered by experts specializing in thermal and non-thermal effects. For instance, Lotz and Saxton report on their experiments indicating that the thermoregulatory response of Rhesus monkeys exposed to 225 MHz radiation cannot fully redistribute the heat load, even in a cool environment. And on the other hand, Adey and Blackman each put forward a multi-step mechanism to explain their well-known calcium efflux results. Also of special interest are the papers by Albert, Monahan, O'Connor, Semm and Shandala.

Michael I. Sobel, **Light**, Chicago, IL: The University of Chicago Press, 1987, 263 pp., \$29.95.

Sobel, a professor of physics at Brooklyn College in New York City, has written a highly informative yet readable account of everything related to light. His elegant explanations of blackbody radiation, mirages, holograms, microscopes, black holes—to cite only a few examples—are science writing at its best. Even if you know why the sky is blue or why there is a flash of green at sunset, you will learn something new. Don't pass up this book.

## NEW BOOKS

U.S. Department of Defense, **Soviet Military Power: An Assessment of the Threat 1988**, Washington, DC: U.S. Government Printing Office, 1988, 175 pp., \$10.00 (Stock No.: 008-000-0488-9).

Tom Gervash, **Soviet Military Power\*: \*The Pentagon's Propaganda Document, Annotated and Corrected**, New York, NY: Vintage Books, 1987, 159 pp., \$14.95.

Every year since 1981, the DOD has issued its assessment of the Soviet military. This year's report, like past ones, gives the Pentagon's view of the Soviet's RF/MW weapons program: "A ground-based [RF weapon] could be tested in the 1990s," and "Recent Soviet developments in the generation of [RF] energy could lead to fundamentally new types of weapon systems that could jam or destroy electronics equipment or be used in antipersonnel roles." Gervash, a freelance editor and writer, has issued a "corrected" version of the 1987 DOD report. He has reproduced the report in a reduced format and corrected every statement he believes is inaccurate. With respect to RF weapons, he writes: "Our research...started way before theirs and has progressed far beyond theirs. Little of promise has emerged." There is also a lot about Soviet radars in each of these volumes.

### Recently Published

E.G. Bowen, **Radar Days**, Philadelphia, PA: Taylor & Francis, 1987, 231 pp., \$28.00.

Jeremy Campbell, **Winston Churchill's Nap: A Wide-Awake Inquiry Into the Human Nature of Time**, New York, NY: Touchstone Books (Simon & Schuster), 1988, 432 pp., \$8.95.

Victor L. Granatstein and Igor Alexeff, editors, **High-Power Microwave Sources**, Norwood, MA: Artech House, 1987, 500 pp., \$77.00.

A.P. Sakis Meliopoulos, **Power System Grounding and Transients**, New York, NY: Marcel Dekker, Inc., 1988, 472 pp., \$99.75 (U.S. and Canada).

National Research Council, **Health Risks of Radon and Other Internally Deposited Alpha-Emitters (BEIR IV)**, Washington, DC: National Academy Press, 1988, 602 pp., \$32.50 (paperbound), \$42.50 (clothbound).

Philippe Robert, **Electrical and Magnetic Properties of Materials**, Norwood, MA: Artech House Books, 1988, 475 pp., \$72.00.

Merrill Skolnik, **Radar Applications**, New York, NY: IEEE Press, 1988, 488 pp., \$53.95 (\$40.50 for IEEE members).

Fleur L. Strand, editor, **Fourth Colloquium in Biological Sciences, Blood-Brain Transfer**, New York, NY: The New York Academy of Sciences, 1988, 325 pp., Volume 529.

### Forthcoming

Bertil R.R. Persson and Freddy Stahlberg, **Health and Safety of Clinical NMR Examinations**, Boca Raton, FL: CRC Press, Inc., November 1988, 208 pp., \$99.50.

## UPDATES

### BIOLOGICAL EFFECTS

**Reviews of EMF Effects...**Dr. Harry Brown and Swaraj Chattopadhyay of Rutgers University in New Brunswick, NJ, have written a comprehensive review article, "Electromagnetic-Field Exposure and Cancer," which appears in the May 1988 issue of *Cancer Biochemistry Biophysics* (9, pp.295-342). The review covers frequencies from ELF up to RF/MW and includes over 300 references. They conclude: "Animal carcinogenesis studies and human epidemiological data indicate that exposure to non-ionizing radiation can play a role in cancer causation." Brown does fundamental research in enzyme catalysis at the university's Department of Biochemistry. "A Review of Epidemiological Studies of the Health Effects of Living Near or Working with Electricity Generation and Transmission Equipment," by Dr. Michel Coleman of the International Agency for Research on Cancer in Lyon, France and Dr. Valerie Beral of the London School of Hygiene and Tropical Medicine in the U.K., appears in the *International Journal of Epidemiology* (17, pp.1-13, 1988). Though they cover a number of different types of health risks, their principal focus is on cancer and leukemia. Drs. Timothy Aldrich and Clay Easterly of the Oak Ridge National Lab in Tennessee also survey the ELF literature in "Electromagnetic Fields and Public Health," which is in *Environmental Health Perspectives*, 75, pp.159-171, 1987. Their review has 133 references.

**More on MW Accidents...**In their January 15 letter to the *Journal of the American Medical Association (JAMA)*, Drs. Mauricio Castillo and Robert Quencer describe the case of an

F-16 pilot accidentally exposed to MW radiation with resulting short-term memory loss (see *MWN*, J/F88). Their letter prompted responses (June 3 issue of *JAMA*) from Dr. Samuel Forman and Dr. Milton Zaret, who have both previously written on MW effects. Forman, based in Cincinnati, OH, writes that he too has seen victims of MW exposure—with headaches, insomnia, photophobia and hypertension, attributable to post-traumatic stress disorder (see *MWN*, D84). Dr. Milton Zaret, an ophthalmologist based in Scarsdale, NY, well known for his work on the ocular effects of MW radiation, notes that chronic exposure to non-ionizing radiation can also cause reactions that appear only after a time delay. He proposes that the unexplained increase in breast cancer-related deaths among white women under the age of 50 may be related to exposures from microwave ovens and VDTs—both of which are usually operated at chest level. In their response, Castillo and Quencer report that approximately one year after his exposure, the F-16 pilot has made a complete recovery.

### COMPATIBILITY & INTERFERENCE

**Space Station EMC...**NASA is in the midst of soliciting bids for ways of analyzing the EMC of its proposed space station. In the process, the contractor will develop computer-aided engineering software to predict EMI problems *before* they develop. NASA wants to avoid past approaches: either waiting for EMI to occur and then fixing it, or imposing rigid specifications that require wasteful over-engineering with no

guarantee of EMC. Bids on solicitation No. 1-8-EL-93085 were due at NASA's Marshall Space Flight Center in Alabama on August 12.

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### INTERNATIONAL

**Changes at IRPA/INIRC...**Dr. Michael Repacholi of the Royal Adelaide Hospital in Australia has taken over from France's Dr. Henri Jammet as the chairman of the International Radiation Protection Association's International Non-Ionizing Radiation Committee (IRPA/INIRC). Jammet has become chairman emeritus. Five new members have been appointed: Drs. Louis Court (France), Alastair McKinlay (U.K.), Michael Shandala (U.S.S.R.), Maria Stuchly (Canada) and Lazlo Szabo (Hungary). (At press time, Shandala and Szabo had not yet officially confirmed their appointments.) They join the following members who will continue to serve on INIRC at least until May 1992 when IRPA holds its 8th Congress in Montreal: Drs. Jürgen Bernhardt (F.R.G.), Branko Bosnjakovic (The Netherlands), Przemyslaw Czerski (U.S.), Martino Grandolfo (Italy), Bengt Knave (Sweden), David Sliney (U.S.) and Jan Stolwijk (U.S.). Drs. Dietrich Harder (F.R.G.) and John Marshall (U.K.) have retired from the committee. France's Annette Duchêne will continue as INIRC's scientific secretary. Dr. John Lakey of the Royal Naval College in the U.K. is the new president of IRPA.

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### MEDICAL APPLICATIONS

**MRI and Eye Implants...**A letter in the July 23 issue of *The Lancet* warns that magnetic eye implants can interfere with magnetic resonance imaging (MRI), making it difficult to get an accurate reading of the scan. In addition, strong fields from MRI can displace the implant. Acrylic eye implants should be used in place of magnetic ones, recommend Drs. William Power and L.M.T. Collum of the Royal Victoria Eye and Ear Hospital in Dublin, Ireland.

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### PEOPLE

**Dr. William Rea**, a Dallas, TX, surgeon who specializes in allergies and clinical ecology with an emphasis on EMFs, has been awarded the U.K.'s first research chair in environmental medicine at the University of Surrey's Robens Institute. Initial funding—£2 million for ten years—is being provided by the Environmental Medicine Foundation. Rea has collaborated with Dr. Cyril Smith of the University of Salford and Dr. Jean Munro, medical director of the Allergy and Environmental Medicine Hospital in Breakspear College in Hertfordshire, who have shown that weak EMFs can cause allergic reactions that are frequency specific (see *MWN*, M/A87). Munro was formerly with the Environmental Medicine Unit at London's Lister Hospital. Rea will also continue as director of the Environmental Control Unit in Dallas....Dr. Don Justesen of the VA Hospital in Kansas City, MO, has been appointed

the new editor of *Bioelectromagnetics*. NIEHS's Dr. Don McRee, who was originally slated to become the editor, will now be an associate editor....Dr. Tom Tenforde has left the Lawrence Berkeley Lab to become the chief scientist at Battelle Pacific Northwest Labs' Life Sciences Center in Richland, WA....Dr. Joe Lary is giving up his research position at NIOSH's labs in Cincinnati, OH, to join the agency's grants program in Atlanta, GA.

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### STANDARDS

**LLNL RF/MW Limits...**The Lawrence Livermore National Lab has adopted new exposure limits for RF/MW fields and radiation below 300 GHz. The standard appears to be the first to specify guidelines for pulsed EMFs. The LLNL limits for CW radiation are adapted from a recent draft of the ANSI proposal to revise C95.1-1982, according to LLNL's Gordon Miller. The standard also cites exposure limits for 3 kHz-300 MHz that are designed to protect against electric shocks when other safety precautions cannot control them. With respect to pulsed EMFs, two different sets of guidelines are specified, for fewer and for more than 13,000 pulses in an eight-hour shift—these are heavily annotated to address specific cases. Miller told *Microwave News* that the guidelines are probably "too complex for a general use standard." For a copy of Supplement 23.57 to the LLNL *Health & Safety Manual: Radiofrequency/Microwave Radiation and Fields*, issued May 1988, contact: Gordon Miller, LLNL, L-384, PO Box 5505, Livermore, CA 94550.

**CISPR and IEC Draft Rules...**CISPR has released a six-month draft rule amending CISPR Publication 16, Part I, *Specifications for Radio Interference and Immunity Measuring Equipment*, CISPR/A (Central Office) 47 Parts I & II (\$70.00). And IEC's Technical Committee 77 has issued a draft amendment, *Electromagnetic Environment and Compatibility Levels For Low Frequency Conducted Disturbances and Signalling in Public Power Systems*, 77(Central Office)26-27, Parts I & II (\$18.00). Copies of both are available (prepaid) from: ANSI, International Sales Department, 1430 Broadway, New York, NY 10018.

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### ETC...

**Lightning Protection?**...Lightning kills more Americans each year than any other natural phenomenon, yet there are no standard guidelines for lightning safety, complains an editorial in the July 25 *New York Times*. "Is there no one in Washington's health and science establishment capable of sorting out the confusion and establishing a standard doctrine on lightning safety?" The editorial was prompted by a rash of lightning deaths. The next day, Samuel Huntington, the CEO of New England Electric System, was killed by lightning in Aspen, CO.

"They've known since the early 1970s that EMP is potentially dangerous, but they never advised their personnel of the risk," said Michael Withey of Schroeter, Goldmark & Bender, a Seattle law firm which is representing Strom in cooperation with the Washington, DC-based Trial Lawyers for Public Justice.

According to the complaint, Boeing became aware of the potential health risk associated with EMP exposure when a cluster of leukemia and skin cancer cases developed among a small group of EMP technicians working at a Boeing test site in Montana. At a 1970 *Technical Coordination Conference on EMP Biological Effects* in Albuquerque, NM, Boeing and the others decided to proceed with their EMP research while monitoring the health of technicians. Those who were exposed were given medical exams, but were never told why: "The defendants...have exchanged medical information gathered from these examinations with one another, without the knowledge or consent of the subjects," the complaint charges.

Representatives from Boeing refused to comment on the case.

Strom worked inside a shielded room containing the EMP power supply and pulsers which, he said, were fired hundreds of times a day. "The pulsers were operated with no concern for safety other than high voltage shock hazard since Boeing...

### **EMP Bioeffects Review**

A preliminary report on the biological effects of electromagnetic pulse (EMP) radiation concludes that current studies do not "establish that EMPs represent either an occupational or a public health hazard," nor do they indicate acute or short-term health effects.

But the survey, which was prepared by Drs. Tim Aldrich, Clay Easterly, Paul Gailey and Charles Hamilton for the U.S. Department of Energy, cautions that "the appearance that several experimental studies and considerable occupational experience have resolved the EMP health effects question is misleading." Indeed, the survey calls for "more research...to adequately characterize the physical interactions of EMP fields with the body," and states that the "potential for...health effects...will eventually have to be addressed more fully for EMP simulators."

The survey notes that AT&T Bell Labs is planning to raise its EMP exposure limit from 5 kV/m to 100 kV/m to match that of the U.S. Air Force; AT&T has no plans for medical surveillance of exposed workers.

A copy of *Bioelectromagnetic Effects of EMP: Preliminary Findings* is available from: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. It includes a 31-page appendix with abstracts of EMP bioeffects studies. Aldrich and Easterly are with Oak Ridge National Lab, Gailey is with the EC Corp. and Hamilton is at the University of Tennessee's Department of Health.

provided no information or protection against EMP radiation," Strom charged. In general, the work was characterized by "a lack of training, knowledge and safety information on radiation hazards and by poor engineering design," he said.

"They told me that EMP exposure was safe, but they knew that other Boeing EMP technicians had already gotten leukemia. Ultimately, I got it too," Strom told *Microwave News*.

In 1985, during one of his required company medical examinations, Strom was informed that he had an abnormally high white blood cell count. He was later diagnosed with chronic myelogenous leukemia which he was told gave him a life expectancy of 42 months. Strom was then 45 years old.

In addition to his lawsuit, Strom filed a workers' compensation claim in August 1986 which is still pending. Michael Welch of Tacoma, WA, is handling this claim.

A number of documents obtained by Strom's attorneys indicate the delicacy with which Boeing has handled the EMP hazard issue. A March 1987 Boeing memo—which concerns proposed topics and speakers for a meeting on EMP biological effects (see *MWN*, J/A87)—warns that some EMP health hazard questions could be "an embarrassment to...governmental clients and other attendees of the meeting." It also advises against inviting participants who could be "potentially disruptive."

One document of particular interest is a May 1987 report prepared by Dr. Ralph Coates—then an epidemiologist with Boeing Medical Services. The report, *Exposure to EMP Radiation and Risk of Leukemia and Lymphoma*, chronicles the medical testing of Boeing employees throughout the 1970s and describes four possible leukemia and/or lymphoma cases out of 350 potentially exposed EMP workers—when fewer than one or two cases would be expected in a population of that size during that period of exposure.

Coates, now an assistant professor at the Department of Epidemiology and Biostatistics at Emory University in Decatur, GA, was reluctant to comment directly on the case, but in a telephone interview with *Microwave News*, he said: "There is enough information in the literature on electromagnetic fields to raise the leukemia question with EMP."

### **Montana Tests**

From 1968 to 1972, Boeing—in conjunction with the U.S. Air Force—ran extensive EMP tests on outdoor missile sites in Montana. In his 1977 book, *The Zapping of America*, Paul Brodeur wrote that Boeing was aware as early as 1971 of two cases of leukemia and one case of skin cancer among a group of 17 technicians working at the site. A few years later, two other Montana workers developed leukemia and bladder cancer.

According to Strom's complaint, in September 1972, the National Institute for Occupational Safety and Health (NIOSH) informed Boeing that "there was no justification for assuming that EMP was not a factor in the development of leukemias and skin cancers."

Several EMP technicians who worked in Montana later



told Strom that the leukemia victims had worked extensively in mobile trailers where the pulse tests were run; another EMP worker developed skin cancer on his hand after repeatedly placing it under the sensor to measure the electromagnetic field. Indeed, Strom recalled a co-worker in Seattle with skin cancer on his temple who held his ear next to the pulser during adjustments to hear it fire.

Montana technicians also revealed to Strom that many of them suffered emotional problems and personality changes; Strom said that he too was unaccountably irritable and depressed while working with EMP.

In the early 1970s, Boeing filed a petition with the Occupational Safety and Health Administration (OSHA) asking the agency to set a national EMP exposure standard. OSHA eventually denied the petition on the grounds that "the need for a standard...has not been shown" and that "the scientific information necessary for the development of a standard currently does not exist."

Without federal regulatory guidance, Boeing gradually relaxed its in-house standard; it went from 0.4 kV/m in 1970 to 1 kV/m and then to 5 kV/m over the next seven years. In 1977, the limit was raised to its present 50 kV/m, but Boeing is considering a further increase to match the Air Force's standard of 100 kV/m (see *MWN*, J/A87).

Confounding the issue, Strom also said that while working with the pulsers he was exposed to such an intense level of toxic gases—ozone, hydrogen sulfide and others—that he could identify them by smell. After his diagnosis, Boeing installed vented hoods over the pulser work area.

### **Brain Cancer** (continued from p.1)

In a telephone interview, Milham commented that, "Overall, I can't think of any clear bias that would negate Speers's results."

A study by Dr. Terry Thomas of the National Cancer Institute in Bethesda, MD, also showed an association between brain cancer and electrical work, but she rejected EMF exposure as being the responsible agent (see *MWN*, S/O87).

In an editorial appearing in the same issue of the journal, Dr. Baruch Modan of the Department of Clinical Epidemiology at Tel Aviv University Medical School in Israel notes that the Speers, Lin and Milham studies, which may support a

"true causal association," are weakened by methodological flaws, including: the lack of assessment of other toxic substances; the fact that other occupational groups (such as truckers) showed elevated risks; and the reliance on death certificates as the primary source of information.

Despite his reservations, Modan writes that "[Electromagnetic] energy, which is with us to stay, must be considered an environmental hazard and dealt with accordingly, until proven otherwise."

Speers's team targeted cancer deaths from 1969 to 1978 with positive diagnoses of primary malignant brain tumors. Although more than half of those initially identified were women, they were eliminated from the study because of the lack of occupational information on their death certificates.

The team grouped the mortalities by occupation and industry and found that, for those in the category of "transportation, communications and utilities occupations," the risk was more than twice the expected rate for unexposed workers, and was statistically significant.

Curiously, the team also found that the risk to workers in the trucking industry was more than six times the expected rate to unexposed workers. None of the other remaining occupational subgroups showed a similar risk elevation.

When asked about the possibility of citizens band (CB) radios being responsible for the increased risk, Speers said she didn't know and added that the trucking finding "should be replicated before too much is made of it." (Note: Many truckers use higher-than-allowed power outputs for their CBs and often place the antennas on the cabs above their heads.)

The team employed an index to estimate EMF exposures—the same one used by Lin in his study. When divided into exposure groups of "none, possible, probable and definite," the analyses yielded, "not only a significant elevated risk of brain cancer but also an increase in risk by probability of exposure." The risk increased from 115% in the possible exposure group (policemen, utility employees, mechanics, plumbers, steelworkers, carpenters and boilermakers) to 286% in the probable group (non-specified engineers in electrical, electronics, aerospace and telecommunications industries). As for the definite group (electric and telephone company employees, electricians and electronic, railroad and telecommunication engineers), there were six cases of brain cancer as compared to none among the controls. This increase was statistically significant at the 0.009 level.

With respect to confounding factors, such as chemical exposures, the team was unable to identify any potential chemical carcinogens for brain cancer associated with electrical work. The team did not, however, discount the possibility that unknown variables—diet, alcohol consumption and tobacco use—played a role.

Marjorie Speers et al., "Occupational Exposures and Brain Cancer Mortality: A Preliminary Study of East Texas Residents," *American Journal of Industrial Medicine*, 13, pp.629-638, June 1988; Baruch Modan, "Editorial: Exposure to Electromagnetic Fields and Brain Malignancy: A Newly Discovered Menace?" *Ibid.*, pp.625-627.

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