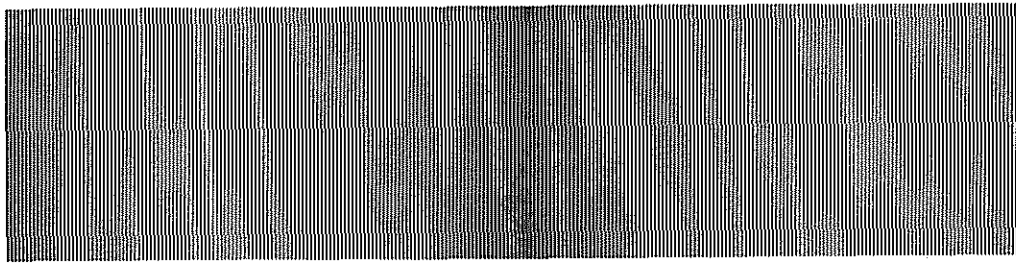


MICRO WAVE NEWS



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A Report on Non-Ionizing Radiation

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

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

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

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

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

(continued on p.14)

NY Judge Rejects Power Line "Cancerphobia" Argument

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

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

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

(continued on p.5)

« Power Line Talk »

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

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

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

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

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Confronted by growing public apprehension, utilities are also distributing pamphlets explaining EMF health risks. One from Southern California Edison (SoCalEd) quotes Dr. David Savitz as saying, "There is no solid evidence that you should be worried, even if you live under a power line...the evidence does fall short of implicating these fields as a health hazard." Given that the Savitz epidemiological study is the

principal basis for the concern over power line EMFs, we called and checked the SoCalEd quote with him. Savitz told us that it made him "uncomfortable." This is how he summed up his position: "There are several suggestions that the fields pose a hazard, but there is no definitive evidence that they do so. Given the state of affairs of having suggestive, but inconclusive, evidence, it is difficult to advise people of the appropriate level of concern."

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

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

NCI Awards Contract for EMF-Childhood Cancer Study

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

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

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

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

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

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

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

BPA Health Effects Report

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

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

predicts that the article will generate "quite a response."

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

BC Hydro Buy-Out Begins

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

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

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

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

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

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

IEEE on Power Line EMFs

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

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

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

Excerpts from the Marcy-South Decision

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

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

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

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

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

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

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

"that *some vague and unfounded* fear cannot form a basis for the recovery of consequential damage, as any *such damage* would be *speculative and capricious* in nature. Only a reluctance to purchase predicated on the *reasonable apprehension*

of a potential purchaser should be considered...." (Emphasis supplied [by the court])

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

tional claims pending against NYPA.)

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

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

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

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

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

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

HIGHLIGHTS

Revising ANSI RF/MW Limits: Debate Often Contentious

The subcommittee charged with revising the American National Standards Institute (ANSI) safety guidelines for exposures to radiofrequency and microwave (RF/MW) radiation has decided to adopt limits for induced currents in the 3 kHz-100 MHz frequency range. At the same time, the subcommittee plans to recommend a doubling of the limits above 3 GHz to 10 mW/cm².

At a meeting held in Tucson, AZ, in June, the subcommittee opted for a two-tier standard. But, instead of the usual practice of distinguishing between occupational and public exposures, the subcommittee has drawn a distinction between "controlled" and "uncontrolled" environments. The safety limits for those who submit to "controlled" exposures—for instance, workers or members of the public who "knowingly"

accept such risks—would be similar to the existing ANSI standard of 1 mW/cm² for frequencies between 100 and 300 MHz. For "uncontrolled" exposures, which would apply to "individuals who have no knowledge or control of their exposure," the limit would be five times stricter—0.2 mW/cm².

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

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

HIGHLIGHTS

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

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

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

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

Who Is Most at Risk?

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

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

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

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

Two U.S. Army Radio Systems Are Incompatible

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

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

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

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

the draft.

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

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

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

Seattle Mayor Recommends a 200 μ W/cm² Standard

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

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

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

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

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

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

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

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

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

BEMS Electronic Mail Network

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

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

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

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

standard is a "joke," they said.

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

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

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

UPDATES

COMPATIBILITY & INTERFERENCE

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

Newsletter Reverts to R&B...Ownership of the *Electromag-*

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

Lab & Consultants Directory...Liberty Labs has published

UPDATES

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

MEASUREMENT

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

MEDICAL APPLICATIONS

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

painful. They also found that magnetic stimulation of the brain can reveal clinically silent lesions—although it has its drawbacks: it appears to interfere with brain function for periods on the order of milliseconds.

MEETINGS

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

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

OVENS

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

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

PEOPLE

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

STANDARDS

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

TECHNOLOGY

Sterilizing with Microwaves...Two NIST researchers have come up with a new way to sterilize medical and dental instru-

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

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

ETC...

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

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

ABSTRACTS

ELF Fields and Power Lines

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

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

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

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

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

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

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

A significant increase in chromosomal aberrations in lymphocytes exposed for 45 hours to electric currents of 1 mA/cm² was observed, but not in those exposed to 0.1 mA/cm². The Italian researchers conclude that electric fields may act directly on the chromosome structure.

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

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

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

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

Robert J. Fitzsimmons et al., "Frequency Dependence of Increased Cell Proliferation, *in Vitro*, in Exposures to a Low-

Amplitude, Low-Frequency Electric Field: Evidence for Dependence on Increased Mitogen Activity Released into Culture Medium," *Journal of Cellular Physiology*, 139, pp.586-591, 1989.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Pulsed Electromagnetic Fields (PEMFs)

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

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

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

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

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

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

ABSTRACTS

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

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

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

RF/MW Radiation

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

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

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

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

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

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

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

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

references.

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

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

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

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

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

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

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

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

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

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

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

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

Toler and colleagues at the Georgia Institute of Technology and at Emory University, both in Atlanta, exposed 100 adult male rats to a 1 mW/cm² pulsed 435 MHz field (1 μsec pulse width, 1 kHz pulse repetition rate) for 22 hours a day, seven days a week over six months—the whole-body SAR varied from 0.04 to 0.4 W/Kg, with a mean of 0.3-0.35 W/Kg. A large number of hormonal, hematological and cardiovascular end points were monitored. The authors conclude that, "Chronic exposure to the low-level, pulsed field resulted in no adverse effects on animal health, as measured by the spectrum of blood-borne end points," and that there was no evidence that the RF environment is "a source of subtle environmental stress." These results are consistent with those from Dr. Bill Guy's lab at the University of Washington in Seattle. Like Guy's study, Toler's was supported by the U.S. Air Force. Toler has now begun a new study to investigate the possible RF-cancer link raised by Guy's study (see *MWN*, J/A84 and Mr85).

VDTs

Kari Jokela, Juha Aaltonen and Ari Lukkarinen, "Measurements of Electromagnetic Emissions from Video Display Terminals at the Frequency Range from 30 Hz to 1 MHz," *Health*

***Physics*, 57, pp.79-88, July 1989.**

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

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

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

General Interest

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

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

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

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

Letters to the Editor

To the Editor:

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

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

To the Editor:

With regard to your article on "Australians Take Cancer Risks Seriously" [see *MWN*, M/J89], I feel that I have been misinterpreted in the headline "Call for a 15-30 mG Magnetic Field Limit." The discussion I presented was not a call for a

15-30 mG limit for ELF magnetic fields but rather was what I thought was a reasonable approach to the siting of high voltage power lines.

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

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

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

FM Radiation-Leukemia Link Alleged

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

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

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

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

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

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

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

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

AM Station's Neighbor Settles Suit

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

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

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

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

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

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

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

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

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

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

FM Radio-Cancer Suit Readied for Trial

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

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

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

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

For four months each summer since 1977, the Mains have run the square dance camp on Lookout Mountain within 100 feet of KYGO's tower. In February 1986, when he was in his mid-50s, Mr. Main was diagnosed with cancer. Later that year, an EPA-FCC survey identified RF hot spots up to 10.35 mW/cm² in publicly accessible areas near the base of KYGO's tower and up to 300 μ W/cm² on the camp's patio/deck (see *MWN*, M/A87).

Following the release of the survey data, KYGO agreed to reduce its power output from 100 kW to 1 kW and to limit radiation levels to 10 μ W/cm² on camp property (see *MWN*, M/J87). KYGO subsequently moved its antenna and transmitter.

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

Family Sues Nearby FM Radio Station

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

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

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

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

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

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

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

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New Listings

1990

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

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

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

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

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

May 7-11: **IEEE AP-S International Symposium & URSI Radio Science Meeting**, Dallas Convention Center, Dallas, TX. Contact: Dr. Oren Kesler,

IEEE AP-S/URSI Symposium, PO Box 860130, Plano, TX 75086, (214) 952-3772.

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

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

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

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

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

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

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