MICRO WAVE NEWS

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INSIDE...

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

Extremely Weak Magnetic Fields Affect Behavior

Extremely weak magnetic fields can have a profound effect on the behavior of rats, according to new experimental findings at a Navy research lab. The results have generated a great deal of excitement because the observed effects were *predicted* by a theoretical model and because the applied fields were of such low intensity.

The model assumes that biologically important ions undergo cyclotron resonances when influenced by static and oscillating magnetic fields. The results reaffirm the pivotal role played by the Earth's magnetic field in bioelectromagnetic interactions.

The new findings are the result of a collaboration between Dr. Abraham Liboff, a physicist at Oakland University in Rochester, MI, and Drs. John Thomas and John Schrot, psychologists at the Naval Medical Research Institute (NMRI) in Bethesda, MD. Using predictions from a model devised by Liboff, Thomas and Schrot found that rats exposed to 60 Hz fields of less than 100 milligauss in a static magnetic field of 270 milligauss displayed impaired timing discrimination. Thomas told *Microwave News* that the results constitute "one of the most interesting developments to come along in a long time."

Thomas is not alone in this assessment. In an October 15 site visit at NMRI for the New York State Power Lines Project, Dr. Mike Marron of

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State Power Line Actions

Several state and local governments are currently addressing power line health and safety issues. Although it is likely that only Montana will adopt power line radiation limits this year, there is a clear trend toward government intervention on behalf of a concerned public. The following status reports summarize developments in Montana, Michigan, Virginia and Texas.

Montana

The Montana Department of Natural Resources and Conservation held three hearings in October on its proposed overhaul of the state's Major Facility Siting Act rules. Proposed Rule CXIV sets a 1 kV/m limit for the electric field at the edge of a right-of-way (ROW) in residential or subdivided areas, measured one meter above the ground. Noise levels would be limited to 50 dB at the edge of the ROW. A landowner can waive these requirements, but the electric field under the line will not be permitted to exceed 7 kV/m at road crossings (see *MWN*, July/August 1983).

According to Paul Stolen in the department's Energy Division, no new technical data challenging the state's position were submitted during the hearings. He expects that the state's Board of Natural Resources will adopt the rules before Christmas. "After looking at the comments received," he said in a telephone interview, "there should be no problem making the Christmas deadline."

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the Office of Naval Research called the demonstration "stunning."

Marron went on to report that the new effect "provides strong support for the hypothesis that static magnetic fields, similar in strength to the Earth's magnetic field, can dramatically alter the response of a living organism to alternating electromagnetic fields."

In a number of interviews, researchers who had already learned of the Liboff-Thomas findings expressed similarly enthusiastic opinions.

Cyclotron Resonances

Liboff calculated the resonant frequencies of ions under conditions of cyclotron resonances for various values of a static magnetic field. According to his model, lithium ions absorb 60 Hz radiation in a static magnetic field of 270 milligauss (about half the Earth's field).

Thomas then exposed rats under these conditions and found what he called "fairly remarkable changes in behavior" for 60 Hz magnetic fields of less than 100 milligauss. Indeed, Thomas said he found statistically significant alterations in behavior for "almost immeasurable" magnetic fields.

According to Liboff, lithium ions affect the functioning of neurotransmitters, especially epinephrine (adrenaline), and therefore any changes in lithium concentrations in and around cells can translate into changes in behavior.

The effect appears to be transient. The rats exhibited the observed, altered behavioral patterns an hour after a 30-minute exposure, but returned to normal 24 hours later.

When asked about the reliability of the behavioral test, Thomas said that the timing discrimination protocol has been used to test the effects of drugs for more than 20 years and is very reliable.

Liboff and Thomas have also exposed rats to the 60 Hz field without modifying the Earth's magnetic field, to a reduced static magnetic field without the alternating magnetic field and to baseline (control) conditions. For each of these exposure conditions, they found no effects, indicating that a resonance phenomenon is present.

(A charged particle moving with an initial velocity in a magnetic field will experience a force perpendicular to the magnetic field and the line of motion. As a result, the ion will move along a circular or helical path characterized by a specific angular frequency and can absorb electromagnetic energy at that specific frequency, which is a function of the ion's charge-to-mass ratio and the magnetic flux density. That frequency is known as the cyclotron resonance frequency.)

Through or Near the Membrane

Liboff's original model assumes that ions make their way into a cell by crossing the membrane along helical structures. Thus, the ions travel in helices and, he concludes, have distinctive cyclotron resonances.

When Liboff presented his hypothesis at a NATO workshop in Erice, Italy in September, three general types of questions were raised: (1) Do such helical structures actually exist? (2) If the ions are hydrated, as some experts maintain, will the weight of the water molecules affect the crucial charge-to-mass ratio which determines the cyclotron frequency? (3) If the ions collide as they go through the membrane, how will such interactions affect the ion motion and therefore possible resonances?

While none of these questions pose insurmountable obstacles to Liboff's model, they do suggest that more research is needed if the model is to gain widespread acceptance.

Some researchers believe that you do not have to invoke helical pathways to measure cyclotron resonances. It may be that the resonances stem from the movement of ions on the surface of the membrane.

Whatever the physical mechanism, Liboff's hypothesis on the presence of cyclotron resonances yielded the precise combination of static and alternating magnetic fields that caused distinctive changes in the behavior of live animals. As Dr. Mays Swicord of the Food and Drug Administration said in an interview: "Is it a coincidence? I think there is some relationship here."

Blackman's Data

Dr. Carl Blackman of the Environmental Protection Agency invoked the concept of cyclotron resonance as a possible explanation for his experimental results on the efflux of calcium ions from brain tissue as a function of the static and alternating fields at last summer's Bioelectromagnetics Society meeting in Atlanta (see *MWN*, September 1984). At that time, he was unwilling to commit himself to this mechanism, however. Nor will he now.

At the end of October, Blackman told *Microwave News:* "Liboff's and Thomas's experimental results once again demonstrate the pivotal importance of the Earth's magnetic field, but it is still too early to bank on one mechanism to explain them. As far as I am concerned, we have a fascinating phenomenon in need of an explanation."

Equipment Limitations

Thomas ran the experiments with equipment that was designed for another project contracted by the New York State Power Lines Project. Thomas and Liboff were thus unable to change the frequency of the alternating magnetic field; they could only use a 60 Hz field with a partial ability to vary the static magnetic field.

Because of these limitations, Thomas and Liboff could not alter the Earth's magnetic field sufficiently to test whether potassium and sodium ions exhibit similar cyclotron resonances. Given the biological importance of these elements, they are natural candidates for future studies.

Meanwhile, theoreticians will be busy trying to explain how a force that is some 12 orders of magnitude smaller than natural, thermal interactions can have such profound effects on a living system.

State Power Line Actions (continued from p.1)

Michigan

State Representative Ken DeBeaussaert has drafted legislation to set limits for radiation along power line ROWs in Michigan. The brief measure instructs the state's Public Service Commission (PSC) to develop a standard to mitigate shock, fire and interference hazards as well as "any other scientifically recognized effect associated with transmission lines."

DeBeaussaert will introduce the bill soon after the legislature reconvenes on November 13, but because of his defeat in the November elections, the bill will probably have to be reintroduced next January by co-sponsor Representative Lynn Jondahl.

A power plant siting bill introduced by DeBeaussaert and others on July 3 is also unlikely to see action. House Bill 5676 would require a utility planning to build a plant to obtain a certificate of need from the state Energy Administration. The utility would then have to obtain a certificate of environmental compatibility from the state Department of Natural Resources. Jondahl has introduced similar legislation for several years.

A much more limited measure authorizing the PSC to issue certificates of need, Senate Bill 815, was introduced earlier this year by State Senator Nick Smith.

Public concern in Michigan focuses on the Detroit Edison Company's planned 345 kV Yukon-Saratoga line. The utility has locked horns with several townships, including Columbus, Richmond and Armada, over local power line ordinances. Columbus settled with the utility out of court, Richmond's ordinance was overturned in a summary judgment and the utility's suit against Armada is just getting underway. Although some of the ordinances include radiation limits, this is not a key litigation issue.

Carroll County, VA

In a case similar to those brought in Michigan, the Virginia Supreme Court agreed in September to decide whether Carroll County has the right to establish requirements for ROWs. In September 1983 the Appalachian Power Company (APCO) successfully appealed the county's June 1982 ordinance to prohibit permanent residences within 600 feet on either side of a 765 kV power line. A lower court ruled that the county impinged on the authority of the State Corporation Commission. The utility had already purchased a substantial amount of property for a narrower ROW for its planned 72-mile Jacksons Ferry-Axton line. The county believes it has the right to impose rules to protect public health and safety.

Virginia

The joint legislative subcommittee, set up in March under Senate Joint Resolution No. 26 to determine whether power line health and safety regulations are needed in Virginia, will hold the last of three scheduled hearings on November 16 in Richmond (see *MWN*, June and July/August 1984). Under the chairmanship of State Senator Madison Marye, the group is authorized to draft legislation. Citizens groups are opposing construction of APCO's 765 kV line and are pushing for regulations.

Copies of the minutes for hearings held on August 9, October 12 and November 16 may be requested from Terry Mapp of the state's Division of Legislative Services, PO Box 3-AG, Richmond, VA 23208, (804) 786-3591.

Texas

The Public Utility Commission (PUC) of Texas has extended its review of potential health risks from a proposed ±400 kV DC power line. The September 14 decision is likely to delay a final ruling on whether to approve the Walker-Matagorda line for at least a year as more hearings are held.

On June 21, a PUC hearing examiner recommended that certification be denied because of potential health risks. Her findings were challenged by representatives of Central Power and Light Company, Houston Lighting and Power Company and Southwestern Electric Power Company, who argued that the PUC was overstepping its authority.

The state has grappled with power line health and safety issues in the past on a case-by-case basis. This is the first time it has had to evaluate a DC line, however.

Other Actions

Florida and New Jersey have also considered power line safety in the recent past. A 1983 amendment to Florida's statutes authorized the state Department of Environmental Regulation to establish public safety requirements for certain power line siting applicants (see *MWN*, July/August 1983 and July/August 1984). Toward that end, a study funded by state utilities is in progress under the chairmanship of Dr. H.B. Graves of Pennsylvania State University.

In New Jersey, the Commission on Radiation Protection has asked the federal Environmental Protection Agency to develop standards for power line radiation exposure. In addition to believing that uniform federal standards are desirable in general, the commission concluded this summer that the state does not have the resources to develop an informed standard.

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HIGHLIGHTS

FAA Okays Use of Portable Computers In Flight

The Federal Aviation Administration (FAA) plans to issue rules clearly permitting passengers to use computers, calculators and electronic games in flight. The devices may not be used during takeoffs and landings, however, "to provide an extra margin of safety."

The FAA decision to issue a policy statement follows a year of study by the Radio Technical Commission for Aeronautics' (RTCA) Special Committee 156 on "Potential Interference to Aircraft Electronics Equipment from Devices Carried Aboard." Over the summer, in a memorandum prepared for RTCA SC156 members, Frank White, chairman of the RTCA committee, recommended the policy now adopted by the FAA (see *MWN*, September 1984).

So far, the FAA has only issued a press release announcing its decision, but the agency said that it will publish an "Advisory Circular" and new rules "to make it clear that computers, calculators and electronic games do not interfere with radio and navigation equipment."

The FAA will continue to prohibit the use of walkie-talkies, radio-controlled toys, portable televisions and AM-FM radios on aircraft because they are "proven sources of interference."

Indeed, there was a new report of electromagnetic interference at the last RTCA SC156 meeting in September. According to the minutes of the meeting, D.J. Tangney of United Airlines reported that a pilot of a Boeing 727, flying over southeastern Colorado, noticed a drifting of the plane's very high frequency omnidirectional radio range (VOR) needles. A check of the passengers revealed that one was using a Panasonic radio/cassette player-recorder. When the unit was turned off, the needles "corrected themselves." (United tried to buy the device but could not.)

The next RTCA SC156 meeting is scheduled for January 23-24 in Washington, DC.

Cataract Risks

Two recent papers, described below, shed new light on the susceptibility of the human eye to non-ionizing radiation.

Cataracts in Radio Linemen

Drs. F.C. Hollows and J.B. Douglas of the University of New South Wales in Australia have found an increase in posterior subcapsular cataracts among radio linemen exposed to radiation from radio and television towers as compared to controls with other occupations. Writing in the August 18 *Lancet*, they report that workplace exposures varied from 80 uW/cm^2 to 3956 mW/cm^2 in the frequency range from 558 kHz to 527 MHz.

The researchers note that there was a very small and statistically insignificant increase in nuclear sclerosis among the exposed workers as well. This type of lens opacity is often related to exposure to solar radiation.

Hollows and Douglas's report prompted a response from Dr. B. Hocking of Telecom Australia, published in the September 29 *Lancet*. Among other points, Hocking noted that the linemen worked for Telecom and that they may have worked with microwave frequencies up to 13 GHz.

Frey Reworks Appleton Data

Dr. Allan Frey of Randomline Inc. in Huntingdon Valley, PA, has reanalyzed the data presented in a 1972 paper by Drs. Budd Appleton and George McCrossan and found that, contrary to the original conclusion, there was a statistically significant increase in lens opacities among military personnel chronically exposed to microwave radiation.

In their paper, Appleton and McCrossan concluded that their study "does not support the assumption that cataracts which develop in personnel performing duties in the vicinity of microwave generating equipment are a result of microwave exposure," except for severe exposures (*Archives of Ophthalmology, 88,* 259, 1972).

Frey came to the opposite conclusion on the basis of the original data. He explains that he found three "fundamental faults" with the earlier work: (1) the exposed group most likely included people who had little or no exposure to microwaves; (2) the control group consisted of people working with equipment known to cause eye damage; and (3) Appleton and McCrossan did not do a statistical analysis of their data.

Frey reports that his new analysis reveals that "Appleton has a statistically significant difference between groups, with the microwave-exposed showing more lens opacities than would be expected by chance."

He goes on to note that, "When one considers that Appleton's study was set up in such a way as to minimize the possibility of showing microwave-induced lens opacities, the effect of the microwaves must be quite powerful."

Frey's paper has been submitted for publication.

Navy Review of EMP

Last month we reported on the potential impact of siting an electromagnetic pulse (EMP) simulator on the Chesapeake Bay near the Calvert Cliffs, MD, nuclear power plant. As a followup, details from the Navy's draft environmental impact statement (EIS) for the EMPRESS II facility regarding EMP biological effects and electromagnetic interference (EMI) are summarized below.

The Navy has concluded that radiation from EMPRESS II will have no biological effects on humans and is unlikely to affect birds or marine life. Bay area life will be monitored, however, when the simulator goes into operation in late 1986. The Navy also believes that the simulator's pulse will be too weak and the pulse rate too slow to create serious EMI problems.

Biological Effects

The draft EIS provides an interesting overview of EMP research, including health checks on approximately 600 workers conducted by defense agencies and their contractors in the 1970s. The largest study, encompassing approximately 400 workers, was conducted by Boeing Aerospace from 1970 to 1976. Much smaller studies were performed by

Bell Laboratories, the Air Force, the Navy, EG&G Inc., Science Applications Inc., Rockwell International, Physics International Co., Pulsar Associates Inc. and Avco. None of these surveys uncovered harmful effects.

Subtle EMP bioeffects were found in a small percentage of animal studies conducted in the late 1960s and early 1970s, all of which used extremely high intensity fields. For example, in studies for the Armed Forces Radiobiology Research Institute (AFRRI), W.D. Skidmore, S.J. Baum and coworkers found that the blood counts of rats were temporarily affected after exposure to 447 kV/m pulses for a 20-week period. These findings were dismissed as being either transient or insignificant.

Some temporary behavioral effects in animals were reported by F.G. Hirsch and coworkers at the Lovelace Biomedical and Environmental Research Institute. Behavioral changes in rodents, such as in level of activity and degree of heat stress, were also reported by W.C. Milroy and coworkers at the Naval Surface Weapons Center.

Present knowledge of potential effects of EMP on birds and marine life is limited. Very few studies have been done, so the EIS speculates on possible impacts based on other electromagnetic interactions such as interference with migration patterns.

The only defense agency standard for human EMP exposure is currently under review. According to the draft EIS, the Air Force occupational standard (AFOSH 161-9, October 10, 1978) of 100 kV/m — based on the old American National Standards Institute (ANSI) guidelines for other forms of non-ionizing radiation — is being reviewed "for possible significant downward revision." Both Bell Labs and Boeing established much lower in-house standards in the 1970s: the Bell limit varies from 1 to 5 kV/m, depending on the pulse repetition rate and Boeing's is "nearly comparable."

In the early 1970s, Boeing petitioned the Occupational Safety and Health Administration to promulgate an EMP standard to "assure that Boeing's duty to control employee exposures satisfied the employer requirements of OSHA Public Law 91-596."

The majority of comments on the Occupational Safety and Health Administration's (OSHA) 1974 proposal to set an EMP standard stressed that no standard should be issued, however, and OSHA shelved the proposal. The Navy states in the EIS that, "repeatedly, it was implied that an appropriate rationale for predicting EMP bioeffects was lacking." Further, it was noted at the time that an EMP standard would have to consider the possibility of non-thermal effects, which were not included in ANSI's deliberations.

Electromagnetic Interference

The Navy's evaluation of potential EMP-induced EMI covers cardiac pacemakers as well as communications equipment, computers and other electric or electronic systems.

In general, the Navy places the threshold for EMP damage to sensitive electronic/digital systems at 2.5 kV/m. The interference threshold for less serious disturbances is about 1.5 kV/m. These evaluations are in part based on observations of the effects caused by other simulators, as well as on laboratory tests.

The Navy cautions, however, that the current generation of electronic equipment may be more sensitive to EMPs than similar units produced only a few years ago because of the use of lower voltage (5 volts) digital logic circuits.

The Navy's specific examples of EMP EMI include televisions, AM/FM receivers and microcomputers. Several years ago, damage to a television and a short wave receiver was reported in a house where fields reached 5-6 kV/m. But in tests conducted for the Defense Nuclear Agency (DNA) in 1978, the lowest level for "sensitivity degradation" for a television was about 8 kV/m, with damage occurring above this level. According to the Navy, the DNA results are similar to those for military communications equipment.

Upsets were reported for digital systems such as word processors, desk top computers and peripheral equipment in buildings near the Naval Aircraft Vertical EMP Simulator II (NAVES II) at field intensities of 1.5 and 2 kV/m. A Hewlett-Packard series 9825 computer was among the affected units.

Interestingly, recent tests of an Apple II computer at the Army's Harry Diamond Laboratories revealed that EMPs may have a cumulative effect. An upset occurred only with the eleventh pulse of 10-13 kV/m radiation, and the computer's disk drive and an attached printer failed altogether after the twelfth pulse.

The Navy reports that more detailed information on EMP effects on small computers will be gathered by the Air Force Weapons Laboratory in upcoming tests of Radio Shack TRS-80 units.

The EIS describes a number of exposure situations for aircraft and aircraft communications facilities, none of which resulted in interference. For example, the control tower of the Albuquerque International Airport, which is 330 yards from the Vertically Polarized Dipole I (VPD I) simulator, was unaffected by EMPs ranging between 960 and 2000 V/m. And aircraft on a taxiway approximately 200 yards away from VPD I reported no problems in 1.75 kV/m fields.

The Navy believes its general threshold estimates apply to pacemakers. In the major EMP-pacemaker study, conducted by B.M. Jenkins and J.A. Woody for the DNA in 1978, none of the 40 units tested were affected at 1.35 kV/m. At a level of 5 kV/m, about 20 percent of the units suffered "temporary perturbations" but no permanent damage. It is generally acknowledged, however, that newer pacemakers are likely to be more susceptible to EMP.

Air Force tests showed that "single EMP exposures caused no catastrophic failures even at 50 kV/m." But the Air Force set an electric field limit of 300 V/m for repetitive pulses of two to one hundred pulses per second in unrestricted areas.

For further information on the draft EIS, contact Lt. Pietropaoli, Office of Information, Department of the Navy, Washington, DC 20350, (202) 697-5342.

Site Visit Report on Dr. Wendell Winters's ELF Research

On August 29, 1984, Drs. Jeffrey Trent of the University of Arizona and Ronald Buick of the University of Toronto visited Dr. Wendell Winters's laboratory at the University of Texas Health Science Center in San Antonio. Also present during the meeting were Dr. Michael Shelanski of New York University, the chairman of the New York State Power Lines Project scientific advisory panel, and Mr. T. McDermott of the Power Authority of the State of New York. (For background information on Winters's work see MWN, *April, September and October 1984 and* Updates, *p.11.) Reprinted below is the report submitted by Trent and Buick to the project, followed by Winters's October 9 reply to Michael Rampolla, administrator of the project. [All emphases in the text are in the originals.]*

Site Visit Report

Description:

Dr. Winters's laboratory efforts related to determining biologic effects of electromagnetic exposure are multiple, including analysis of antibody expression, immunologic features of canine hematopoietic cells, normal cell "transformation" and most recently, agar cloning. The purpose for this recent site visit was to review Dr. Winters's program solely in regard to the agar cloning studies performed in collaboration with Dr. Jerry Phillips of the Southwest Texas Cancer Research and Treatment Center of San Antonio (CRTC). Dr. Phillips declined to participate in the site visit, and neither he nor any representative of the CRTC was present for this review. The site visit followed an informal format, with Dr. Winters providing adequate data for review and answering all questions posed by the site visitors. *It can be stated categorically that Dr. Winters was fully cooperative with the site visit team.*

The basic experimental design applied by these investigators related to determining whether a significant and reproducible effect on agar clonogenicity occurred as a result of exposure to electric (E), magnetic (M) or electromagnetic (EM) fields. The investigators utilized agar clonogenicity in an apparent attempt to document changes in proliferative potential of established tumor cell lines. Dr. Winters's presentation provided detailed methodology of cell culture and EM exposure and the results of several of their current experiments. The site visitors also were provided with copies of Drs. Winters's and Phillips's published reports on this work (consisting entirely of abstracts to scientific meetings).

The data presented was primarily restricted to two different colon carcinoma cell lines (Colo 205 and Colo 320). [Although a single experiment on four different carcinoma cell lines also was presented (Hep 2, KB, MCF-7 and ZR-75).] The basic experimental design consisted of exposing tumor cell lines to E, M or EM fields with subsequent establishment of clonogenic potential in agar. The parameters varied included: 1) time of exposure, 2) dose of exposure, 3) cell concentration during exposure, 4) cell number plated and 5) colony size used as an endpoint. "Recloning" of several of the exposed populations was also performed and evaluated.

Critique:

Drs. Winters and Phillips have previously reported in abstract form the finding of a significant and "permanent" effect of low level EM fields on agar clonogenicity of human tumor cell lines. For numerous reasons presented below, it would appear that Drs. Winters and Phillips have prematurely reached a conclusion of significance from their preliminary data. Unfortunately, the area of electromagnetic field exposure has abounded in poorly designed and controlled studies which demonstrate "significant" biologic effects of treatment but which are irreproducible in independent laboratory tests. The present study would appear to fall in this category. With our poor knowledge of biophysical mechanisms underlying agar clonogenicity, and our equally imprecise knowledge of biophysical mechanisms of cell membrane and organelle structure and function, interpretations of treatment effects in this area and especially their biologic significance require considerable circumspection. The experiments of Drs. Winters and Phillips which were described at the site visit do not allow any definitive conclusions to be drawn with respect to the authors' central hypothesis, namely, that exposure to electromagnetic fields produces a significant alteration in agar clonogenicity. The reasons for this statement are manyfold and are provided below.

(a) Choice of Model

Disregarding any technical difficulties in accumulating data on agar clonogenicity, the choice of this endpoint as a marker of carcinoma cell behavior is problematic. If the experiments presented were in fact designed to assess tumor cell characteristics of importance to the *in vivo* situation, then the choice of agar clonogenicity of carcinoma cell lines as an endpoint is a bad one. At present, there is no established relationship between the ability of carcinoma cells to grow in agar culture and their ability to grow in xenografted host animals. Indeed there are many examples of aggressive transplantable tumors which cannot be induced to grow in semisolid culture. The reciprocal statement can also be made. Such a relationship (agar clonogenicity/tumorigenicity) does hold for fibroblastic tissue. Thus the experiments reported, if done properly, would allow statements about the phenotype of agar growth, but would not allow extrapolation to the *in vivo* growth of human carcinoma cells. The experiments might be better performed on a transformed fibroblast system in which there would be convincing evidence that agar clonogenicity does in fact correlate with *in vivo* tumor growth.

(b) Experimental Design

The data presented at the site visit did not allow any conclusions to be drawn even on the limited subject of the determinants of agar clonogenicity of human carcinoma cell lines. The major reason for this statement relates to the lack of reproducibility of the putative effects, a result caused in major part by an experimental design which varied multiple parameters in an apparently random fashion, not allowing direct comparison of separate experiments. For example, in the 27 experiments shown to us, the same combination of variables (field strength, time of exposure, cell line tested, cell concentration exposed, number of cells plated) was never used twice.

(c) Quality of Data

Of equal importance, the quality of the data presented at the site visit was poor. Since measurement of agar clonogenicity is known to be prone to artifact, the burden of proof of validity is clearly with the investigators. In the reviewers' opinion, Drs. Winters and Phillips have failed to demonstrate any effect of electromagnetic field exposure on the growth of their chosen cell lines. The basis for this conclusion is twofold:

(1) The statements by Dr. Winters that the majority of his data sets demonstrated a trend to increased clonogenicity after E or EM exposure are not justified. Only 2 of the 27 individual data sets we were shown would allow such a statement to be made with any statistical validity. When the "overall experience" is taken into account, the data demonstrated sufficient inherent noise to rule out any conclusion (positive or negative).

(2) The extent of the variability in the cloning efficiency of the

control cultures on a day-to-day basis is very disturbing. For example, both Colo 205 and 320 displayed a variance in plating efficiency (PE) over a ten-fold range on different days. There are a number of positive sources of artifact which might explain such variable behavior; (e.g., lack of linearity of colony growth with respect to cell number plated, cell clumping or general health of the cell cultures). Whatever the cause of the variability, when the postulated treatment effects are reported to be as small as sixfold, the fact that [tenfold] differences in control PE can be introduced in a random fashion clearly precludes the description of conclusions in a statistically-valid manner.

Conclusion

The unanimous consensus was that the experiments presented to the site visit team did not allow any definitive conclusion regarding either the positive or null effects of electromagnetic radiation on agar clonogenicity. Due to the inconsistency in the experimental design, it is impossible to state which variable(s) are the basis for the lack of observed reproducibility.

Winters's Reply

October 9, 1984

Dear Mr. Rampolla:

I am in receipt of the reports from you relating to the site visit of August 29, 1984.

There are a number of issues raised in these reports that do not reflect clearly the nature and quantity of the studies reviewed. Therefore, I would like to point out the following comments with specific reference to the report of the review by Drs. Trent and Buick.

Specifically commenting on (a) Choice of Model: We did not and have not raised the issue nor have we attempted to address the issue of extrapolating our *in vitro* studies into considerations of *in vivo* situations. Our discussions and objectives have been directed towards investigations of possible effects of EM exposure on a variety of structural and functional cellular parameters. The cancer cells selected have been well studied and characterized and they are ones with which we have had experience. Among the quantitative assays used, the cloning agar assay is one which we believe offered advantages as an indicator of changes in cell proliferation. To this end we have employed 2 human colon cancer cell lines, Colo 205 and Colo 320 DM, and limited studies have been performed with other cell lines. Within the context of our goals and objectives, we believe that these cell lines constitute a suitable system for study of EM exposure induced changes in cellular structure and function.

Specifically commenting on (b) Experimental Design and (c) Quality of Data: Of 27 experiments discussed at this meeting, it was pointed out that a number of them were preliminary experiments of the type used to help determine appropriate conditions for routine experimentation. Accordingly, a discussion of the experiments and the conditions of the experiments revealed a range of variables and parameters to provide the reviewers with information about the sequential progression of our experiments as we learned more about the system and about possible effects on the cells following exposure to EM fields. While the parameters may have appeared to vary in a random manner as these experiments were discussed, chronology of the experiments would indicate a sequence of decreasing variations appropriate to our aim of determining more standardized exposure conditions.

The basic experimental design used throughout the studies consisted of preparation of tumor cells from continuously growing parent cell cultures in sufficient numbers for each experiment so that equal numbers of cells from the same population were dispersed into 4 identical cell exposure chambers. Each of the cell chambers [was] exposed to one of 4 experimental conditions, namely 3 field exposures (E, M, EM) and one non-exposed control. Following exposure, cells from each of the 4 chambers were prepared and assayed for their clonogenic capacity in soft agar assay. In the experiments discussed at the site visit the colony size used as an endpoint was not varied and was constantly greater than or equal to 60 microns in diameter as counted by the Bausch & Lomb FAS II image analyzer.

It should be emphasized that each of our experiments was internally controlled with concurrent non-exposed cultures from the same population as the cells which were exposed to the three conditions of EM fields. Each experiment was evaluated individually on the basis of the internal control.

Statistical analysis of the data using the six individual plate counts for each data point, performed and analyzed at CRTC under the direction of Dr. Phillips, has indicated that for those studies

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reported at several scientific meetings, a significant effect of EM exposure on clonogenic capacity does exist.

Direct comparisons of the individually controlled experiments is undoubtedly complicated by differences in the populations of target cells from one time to the next. No one knows what constitutes a target for E, M or EM fields and the possible influences on cell state, cell orientation in the field and even the cell's relationship to geomagnetic forces are being recognized and are subjects of investigations by others.

The problem of inherent noise sufficient to rule out any conclusion is based on the variability of the number of cell clones produced within the sets of control cultures in each of the individual experiments shown. Data shown had variability in the magnitude of response of cells to EM fields. It was discussed and acknowledged that variability in the magnitude of response of cells is not unreasonable to expect. Until research identifies what allows a cell to respond and until research allows such responses to be maximized, such a variability in response is to be expected. For that reason, concurrent internal controls such as the ones we use are an absolute requirement for *in vitro* EM exposure studies.

In summary, 1) No attempt has been made nor is being made to correlate our *in vitro* studies with an *in vivo* situation, 2) A number of the experiments discussed were preliminary thus supplementing, but differentiated from, those performed under a set of standard experimental conditions, 3) Statistical analysis of CRTC data indicates a significant effect of EM field exposure on clonogenic capacity, an effect not explained on the basis of randomness or bounce in the system and 4) Since no one knows what constitutes a target for EM radiation, response in the system is expected to be variable and, accordingly, each experiment must be controlled and evaluated individually.

Sincerely,

Wendell D. Winters, Ph.D.

Draft Guidelines for Exposure of Personnel to Stray Emissions from Radiofrequency (RF) Dielectric Sealers and Heaters

In the October 11 issue of the Federal Register, *the Food and Drug Administration's Center for Devices and Radiological Health announced the availability of draft guidelines to limit the exposure of radiofrequency (RF) sealer and heater operators to electromagnetic fields (49 FR 39992). These guidelines, which were not included in the* Federal Register *notice, are reprinted below. A public meeting to discuss the guidelines has been scheduled for November 15-16 in Rockville, MD. For more information, contact the center's Howard Bassen (301-443-6536) or Dr. Zory Glaser (301-443-7155).*

The measured values of radiofrequency (RF) electromagnetic fields emanating from some RF dielectric heaters and sealers in the U.S. exceed all world RF exposure standards. Government agencies charged with protection of health and safety have a responsibility to act to reduce excessive RF exposure to people. The Food and Drug Administration (FDA) is concerned about the potential adverse health effects on individuals exposed to radiofrequency energy emitted by RF sealers, heaters and gluers. These devices (hereafter referred to as "RF sealers") are also known as: heat sealers, fusers, molders, fasteners or embossers, high frequency sealers or dryers, electronic or electromagnetic sealers or welders, and dielectric heaters. They are generally designed to operate at frequencies between 3 and 100 megahertz (MHz).

On September 12 and 13, 1979, FDA's Bureau of Radiological Health (BRH), now the Center for Devices and Radiological Health (CDRH), and the Occupational Safety and Health Administration (OSHA) sponsored a public meeting to gather information on, and to address their concern about, the potential adverse health effects on people exposed to RF sealer emissions. Representatives of BRH, OSHA and the National Institute for Occupational Safety and Health (NIOSH) presented data from surveys and measurements performed in workplaces where RF sealers, heaters and gluers were in use. These data showed that RF field strengths (electric and magnetic fields) were very high (more than 1,000 volts/meter (V/m) and 10 amperes/meter (A/m), respectively, both of which are far in excess of 100 milliwatts per square centimeter mW/cm^2 equivalent power density); thus, exposure of individuals often exceeded the existing U.S. voluntary RF personnel exposure standards. At the meeting, RF hazard survey instrumentation was discussed, including commercially available and experimental instruments. Usage considerations and future needs were also discussed. A review of biological effects, including known animal and human effects also took place. In general, all agreed that the level of knowledge about effects was low compared to that of microwave radiation (usually at frequencies of 300 to 10,000 MHz). RF sealer radiation control technologies, including shielding and grounding, and operator location factors were also discussed.

To address these concerns, FDA, which regulates emissions from electronic products, has developed the following guidelines for RF sealers:

> FDA recommends that manufacturers construct and users operate RF sealers and related equipment in such a way that people are not exposed to time-averaged root mean square (rms) electric or magnetic fields in excess of 60 V/m or 0.16 A/m, or maximum values (as a ceiling) of 300 V/m or 0.8 A/m, measured in the vertical frontal plane (anterior surface) of the normal position of the operator. RF sealer manufacturers should also supply instruction manuals and appropriate labeling of RF sealers which provide adequate directions for safe use and warn users of potential hazards which might result from improper equipment modification or use.

FDA makes these recommendations in light of recent scientific reviews of existing standards for exposure to RF energy by such groups as the American National Standards Institute (ANSI), the American Conference of Governmental Industrial Hygienists (ACGIH), the National Institute for Occupational Safety and Health (NIOSH) and Health and Welfare, Canada. In addition, FDA believes that newly manufactured RF sealers can be constructed and old units can be economically retrofitted by methods such as shielding so as to achieve these proposed levels.

FDA will encourage voluntary compliance with these guidelines because it believes the approach of voluntary compliance is an expedient and cost-effective means to significantly reduce exposure of people to stray RF energy emanating from RF sealers. FDA will continue to assess the significance and level of exposure of individuals to stray RF energy from RF sealers and the impact of implementation of these guidelines. FDA will work closely with other agencies and groups concerned with this human exposure situation, and will, if necessary, consider other actions such as a regulatory performance standard for newly manufactured sealers, "defect action" for sealers manufactured after October 1968 which emit RF levels significantly in excess of these suggested guidelines, and/or purchasing specifications for government acquisition of RF sealers.

UPDATES

BIOLOGICAL EFFECTS

VLF Bioeffects...ONR has awarded Dr. Ross Adey of the VA Hospital in Loma Linda, CA, a $248,000, two-year contract to investigate potential bioeffects in the 10-100 kHz frequency range. Adey and co-workers will examine behavioral and neurochemical effects of CW, pulsed and amplitude modulated fields. In addition, they will study possible cellular mechanisms of interaction. Last year, the Air Force funded researchers at the Universities of Washington and Utah to study VLF hazards (10 kHz-3 MHz), with the objective of setting safety standards to protect against shock, fibrillation or burns (see *MWN*, May and September 1983).

More on DNA Resonances... In our May issue, we described recent experiments which show that aqueous solutions of DNA can resonantly absorb microwaves. A paper detailing these findings has now been published in the September 24 issue of *Physical Review Letters*. The research group of Drs. Glenn Edwards and Christopher Davis of the University of Maryland, College Park, NCI's Dr. J.D. Saffer and FDA's Dr. Mays Swicord concludes: "Although there is no demonstrated relationship between these phenomena [microwave resonances] and reported genetic effects, these observations indicate that a mechanism exists for coherent frequency-specific deposition of microwave energy in DNA. This mechanism has surprising physical characteristics and intriguing implications for future polymer and biochemical research. It is unexpected that DNA solutions exhibit microwave resonances and fascinating that such sharp resonances occur in dense solutions at room temperature. It will be interesting to see if these phenomena can be used to alter biochemical processes and if similar phenomena exist in other symmetric macromolecules." The work will continue in Davis's lab under a new $103,000, two-year award from ONR. Edwards, who worked on this project as part of his doctoral thesis, will pursue his research on microwave effects under a one-year, post-doctoral fellowship at the Max Planck Institute in Stuttgart, Germany....The possibility that microwaves could interact with DNA was originally suggested by the theories of Dr. Earl Prohofsky of Purdue University. Science writer Stefi Weisburd outlines Prohofsky's work on DNA vibrations in the June 9 *Science News*.

COMMUNICATIONS

Secure, Airborne and Cordless Telephones... President Reagan has signed an order to improve the security of classified phone calls. National Security Directive 145 could lead to the purchase of as many as 500,000 telephones protected against Soviet eavesdropping, thus guarding conversations between military and intelligence officials and private contractors. More than $33 million has already been allocated for computers to encode and decode telephone transmissions. Each phone is likely to cost between $15,000 and $30,000, though the NSA hopes to develop a less expensive model. Current plans call for the purchase of 30,000 secure units, but NSA officials are lobbying the administration to purchase an additional 470,000 phones, according to *The New York Times*. Concerned that excessive caution may end up costing taxpayers a lot of money, Oklahoma Congressman Glenn English has asked the GAO to evaluate the need for the new phones. "The national security bureaucracy has a tendency to require a degree of protection for classified information that may be excessive," he suggested to the GAO....Six airlines have introduced cordless telephones on some of their flights to allow passengers to "reach out and touch" people from their seats at 30,000 feet. Using a nationwide network of ground receiving stations, the Airfone Inc. system is capable of handling a total of 222 calls simultaneously. The cost of calls is likely to deter chatting, however — the first three minutes cost $7.50 and each additional minute is $1.25. The FCC has allocated the frequencies used by Airfone on a temporary basis only and has yet to decide whether the allocation should be permanent....A federal jury has awarded $150,000 to a St. Louis man who suffered hearing damage caused by the ringer in the earpiece of his cordless telephone. The precedent-setting decision is the first among more than a dozen pending suits. The FDA's Center for Devices and Radiological Health (CDRH) has received more than 120 complaints about the ringing problem. Officials there are studying the problem and considering action, including the possibility of a recall. Explaining the problem, a recent issue of the center's *Radiological Health Bulletin* (August 1984) notes that: "Laboratory tests indicate that some phones emit sound levels that may exceed thresholds for hearing loss as well as established standards for occupational auditory exposure." When cordless phones were introduced, many manufacturers put the bells, which ring at close to 140 decibels, in the phones' earpieces. Hearing experts explain that the intensity of the ring is comparable to a pistol shot beside your ear. Virtually all companies have since moved the ringers elsewhere in the phone. For information on CDRH's research, contact Wendy Johnson, CDRH (HFZ-100), 5600 Fishers Lane, Rockville, MD 20857, (301) 443-5860.

COMPATIBILITY & INTERFERENCE

Preparing for Radio Marti... The FCC has removed the $250,000 compensation cap for costs incurred by broadcasters who must protect against possible interference from Cuba in retaliation for Radio Marti broadcasts. At a meeting on August 1, the commission also ruled that the costs of protective equipment were reimbursable, less depreciation on the equipment being replaced (see *MWN*, April 1984). Notice of these changes appeared in the August 28 *Federal Register* (49, *FR* 34004). FCC action was prompted by a petition for reconsideration filed on April 30 by the Florida Association of Broadcasters and the South Florida Broadcasters Association. In its notice, the commission noted that congressional sponsors of the Radio Broadcasting to Cuba Act, which established Radio Marti, supported the petition, as did the United States Information Agency (USIA), which will operate Radio Marti through its Voice of America (VOA) branch. For information, contact FCC's Louis Stephens at (202) 632-7792....In related developments,

Paul Drew has been hired as a consultant to Radio Marti and is expected to take over as director, pending congressional approval. In addition to Drew, VOA has hired 58 of its projected staff of 150. The station, which USIA officials hope will begin operating soon, will broadcast at 1180 kHz....To help broadcasters determine the level of potential interference, the FCC has prepared a list of Cuban radio stations known to operate on the 107 channels allocated for AM broadcasting in the U.S. It is available for $0.49 from Wilbur Thomas, International Transcription Service, Inc., 4006 University Drive, Fairfax, VA 22030, (703) 857-3800.

GOVERNMENT

FCC RF Sampling Program... The FCC's Equipment Authorization Branch has changed its policy and will no longer test new types of equipment for potential RF interference before permitting them to be marketed. Branch Chief Charles Cobb explained that new products will be granted approval solely on the basis of testing data submitted by manufacturers. In the past, the agency required some applicants to provide prototypes for testing prior to market approval. Now, sampling will be done later on production models. Cobb emphasized that the change was made to "speed up development and introduction of new technology." Under the new procedures, sampling will focus on cordless telephones, computing devices and RF lighting sources. Cobb estimated that the FCC receives approximately 10,000 applications each year and that 20-25 percent are rejected because of possible interference problems, while 40-45 percent of the applicants are asked to provide additional testing data. For more information on the new program, contact Richard Fabina, FCC Laboratory, PO Box 429, Columbia, MD 21045, (301) 725-1585.

MEDICAL APPLICATIONS

Resources... Drs. Santi Tofani and Giovanni Agnesod of the Italian National Health Service in Ivrea report on their studies of stray electric fields from capacitor-plate applicators used with diathermy equipment operating at 27 MHz in the August 1984 issue of *Health Physics*....Dr. Leonard Taylor of the University of Maryland has shown that, in the near field, the electromagnetic waves from suitably designed applicators can penetrate far deeper than the skin surface. His explanation appears in the October *IEEE Transactions on Antennas and Propagation*....Drs. M.K. Hessary and K-M. Chen of Michigan State University in East Lansing present a theoretical method of analyzing capacitor-plate applicators in "EM Local Heating with HF Electric Fields" in the June 1984 *IEEE Transactions on Microwave Theory and Techniques*....A team from Carnegie-Mellon University in Pittsburgh, PA, headed by Dr. Robert Peloso has failed to observe any differences in the measured dielectric properties of normal and neoplastic tissues in the 1 MHz-1 GHz frequency range. See the November *IEEE Transactions on Biomedical Engineering*....Professors Thomas Budinger and Paul Lauterbur, two of the developers of NMR imaging, have written a review paper on "Nuclear Magnetic Resonance Technology for Medical Studies," published in the October 19 *Science*....Academic Press has started a new quarterly journal, *Magnetic Resonance in Medicine*, the official journal of the Society of Magnetic Resonance in Medicine. Subscriptions are $72.00 in the U.S. and Canada and $84.00 elsewhere. Contact: Academic Press, 111 Fifth Ave., New York, NY 10003, (212) 741-6802....The Congressional Office of Technology Assessment has released two new studies, *The Emergence of Nuclear Magnetic Resonance Imaging Technology: A Clinical, Industrial and Policy Analysis*, (GPO No. 052-003-00964-1) and *Federal Policies and the Medical Devices Industry* (GPO No. 052-003-00965-0). Copies are available for $5.50 and $7.00 respectively (prepaid) from the U.S. Government Printing Office (GPO), Washington, DC 20402....Professor Richard Borgens of Purdue University in West Lafayette, IN, has published "Endogenous Ionic Currents Traverse Intact and Damaged Bone" in the August 3 *Science*.

MEETINGS

Off and On... The *Workshop on Low Level Field Effects on Cells*, scheduled to be held at Brookhaven National Lab on Long Island, NY, in December has been cancelled. Eugene Findl, the workshop organizer, was caught in a "reduction in force" at the Department of Applied Science and left Brookhaven at the end of October. In a telephone interview, he said that his future plans are uncertain, but he was optimistic that the workshop would be held in 1985 with a new sponsor....On November 29-30, there will be a meeting in London, England, to explore what is known about the clusters of miscarriages and birth defects among VDT operators. Sponsored by Humane Technology, which was set up by Brian Pearce of the HUSAT Research Center at Loughborough University, *An International Meeting to Examine the Allegation of Reproductive Hazards from VDUs* will feature speakers from the UK, Canada and Sweden. Representatives from IBM-UK and the BBC are on the program, as is Dr. Karel Marha of the Canadian Center for Occupational Health and Safety. See "Conference Calendar" for details.

Proceedings Available... The proceedings of the *19th Annual Symposium of the International Microwave Power Institute* (IMPI), held in Minneapolis, MN, in September, are now available. Topics covered include microwave ovens, plasma wave heating for nuclear fusion, bioeffects, measurements and industrial applications. The 237-page volume, which includes a mix of abstracts and complete papers, is available for $25.00 (prepaid) from IMPI, Tower Suite 520, 301 Maple Ave. West, Vienna, VA 22180, (703) 281-1515....The American Institute of Medical Climatology (AIMC) has released the proceedings of its *Conference on Environmental Ions and Related Biological Effects*, which was held in October 1982 in Philadelphia, PA. The 159-page, typescript report features five papers on the bioeffects and measurement of ions associated with high voltage DC power lines and with indoor air pollution. Each paper is followed by a brief commentary. A copy of the proceedings

is available for $15.00 for AIMC members ($25.00 for others) from AIMC, 1023 Welsh Road, Philadelphia, PA 19115, (215) 673-8368.

MILITARY SYSTEMS

EMPRESS II Hearings... The Navy has scheduled three hearings on its proposal to site an Electromagnetic Pulse Radiation Environment Simulator for Ships (EMPRESS II) on the Chesapeake Bay. Hearings will be held in Virginia on November 14 at the Rappahannock Community College North Campus in Warsaw and on November 15 at the college's South Campus in Glenns. In Maryland, a hearing is scheduled for November 20 at South Dorchester High School in Cambridge. (See *MWN,* September 1984 and related story in this issue on p.4.) For further information, contact Lt. Pietropaoli, Office of Information, Department of the Navy, Washington, DC 20350, (202) 697-5342.

OVENS

Sales Boom... Microwave oven manufacturers shipped more units in the first three quarters of 1984 than in all of 1983. The Association of Home Appliance Manufacturers (AHAM) reports that 6.2 million units were distributed through September 30, an increase of 61.4 percent over the totals for the first three quarters of 1983. In September 1984 alone, the industry shipped 310,000 more microwave ovens than in the same month last year. Industry observers explain that smaller, less expensive models, combined with rising discretionary income among consumers, account for the sharp rise in sales. American oven manufacturers have lost some of their dominance over the market, however. They now produce just 60 percent of the ovens bought in the U.S., down from their 74 percent share of the market in 1981.

PEOPLE

Eric Lerner, a contributing editor of *IEEE Spectrum* well known for his 1980 and 1984 articles on bioeffects, is out of a job. His freelance contract with *Spectrum* has not been renewed because, as he was told by his editors, all writing and editing would now be done by the in-house staff. The decision to let Lerner go followed soon after a letter of complaint was sent to Dr. **Richard Gowen,** president of IEEE, by Drs. **Sol Michaelson** and **John Osepchuk.** Writing on University of Rochester stationery, they complained that the May 1984 *Spectrum* article, "Biological Effects of Electromagnetic Fields," presents "an unbalanced and misleading treatment of the subject," and that, "such a distorted presentation will be used by mischievous elements to stimulate unnecessary and irrational fears of electromagnetic fields in our modern society." Michaelson of the University of Rochester and Osepchuk of Raytheon accused Lerner of emphasizing material that is "speculative, far from being substantiated and of questionable validity." The Lerner article was based on a round table discussion held at the 1983 BEMS meeting. Those who participated included some of the leading researchers in the field: Drs. **Ross Adey, Larry Anderson, Frank Barnes, C.K. Chou, Friedrich Kremer, Shirley Motzkin, Mays Swicord,** and **Howard Wachtel.** Dr. **Ken Foster** was also involved but he later asked that his contributions be deleted from the article. Michaelson and Osepchuk concluded their letter with the following statement: "IEEE officials should ponder what type of actions are required to prevent further repetition and perpetuation of misinformation through *Spectrum* when the damage to IEEE's reputation finally becomes clear as events evolve in this field" *Spectrum* editor **Donald Christiansen** did not return telephone calls requesting comment. Barnes, who served as the chairman of the BEMS meeting panel, said that he had been told by IEEE staffers that Lerner's fate had nothing to do with the articles or the Michaelson-Osepchuk letter. Adey thinks differently. He told *Microwave News* that he doubts the events were unrelated. In addition, Adey said that *Spectrum* had recently refused an introductory paper on mechanisms of interaction between electromagnetic radiation and biological systems, which had been *invited* by the magazine. When Lerner was asked if he believes there was any connection between the cancellation of his contract and the Michaelson-Osepchuk letter, he said that not only had the magazine not renewed his contract but had initially tried to renege on the existing agreement, which had only a short time left to run. "It is impossible to say anything definitive," he said, "because I am the only freelancer at *Spectrum,* but the timing is suspicious."...Dr. **Lionel Jaffe** has dropped out of the AIBS committee preparing a report on the bioeffects of ELF radiation for the Navy (see *MWN,* July/August and September 1984). According to Dr. **H.B. Graves,** the chairman of the AIBS study panel, Jaffe pulled out due to time pressures caused by his leaving Purdue University to join Woods Hole Oceanographic Institution. Dr. **Asher Sheppard,** already a member of the committee, will take over Jaffe's responsibilities for covering bone growth and fracture repair. Sheppard said that he will be relying on Dr. **Richard Luben** for assistance in his new duties....Dr. **Larry Anderson** will be replacing Dr. **Richard Phillips** as the coordinator for bioelectromagnetic studies at Battelle Pacific Northwest Labs. Phillips is moving to EPA's Experimental Biology Division in North Carolina.

POWER LINES

Winters Replication... The New York State Power Lines Project has decided not to attempt an exact replication of Dr. Wendell Winters's study which found that exposure to ELF fields enhanced the growth rate of certain lines of human tumor cells. Instead, the project is likely to fund an investigation of the effects of 60 Hz fields on a different type of human tumor cell. Responding to criticisms from Drs. Jeffrey Trent and Ronald Buick following a site visit to Winters's lab this summer (see *From the Field*, p.6), the project's scientific advisory panel has asked Dr. Gordon Livingston of the University of Utah to collaborate with Trent on revising his original proposal for a $30,000 replication study (see *MWN,* October 1984). A final decision on the Livingston study is expected by the end of the year. At this point the panel has not decided what kind of support it

might offer to Dr. Maimon Cohen for additional work in the same area. The panel initially asked both Livingston and Cohen to submit proposals for replication studies. Both researchers are already project participants.

STANDARDS

San Diego Adopts ANSI Standard... San Diego County, CA, has adopted the 1982 ANSI exposure standard for RF/MW radiation. The September 12 action by the county's Board of Supervisors is part of a broad plan to develop a regional telecommunications policy (see *MWN*, September 1984). According to Bill Chatham of the Department of Planning and Land Use, the rules were adopted to eliminate uncertainty in the communications industry. Operators may request waivers to the rule on a case-by-case basis.

VDTs

Legislation... Massachusetts has allocated $75,000 for a six-month VDT health and safety study. Added to the state budget by Rep. Elizabeth Metayer, a sponsor of VDT legislation, the money will be used by the Department of Labor and Industries' Division of Occupational Hygiene to "evaluate virtually every aspect of VDT work," according to a legislative staffer....Oregon's Senate Interim Labor Committee has released a final report on its eight-month investigation of VDTs. Formed in late 1983 after proposed VDT legislation was tabled until the Senate reconvenes in January 1985, the 16-member committee has made several recommendations. It urges the Labor Committee to set a statewide policy defining safe, healthy working conditions, encourages research in areas of uncertainty — including reproductive hazards — and directs the state's Accident Prevention Division of the Workers' Compensation Department to develop an educational program. Radiation risks are downplayed by the committee. A committee staffer told *Microwave News* that proposed legislation is being prepared for consideration in early December. If it gains committee support, it will be introduced when the legislature reconvenes in January. A copy of the report is available from the committee, 331 State Capitol, Salem, OR 97310, (503) 378-5720....The New York State Assembly Standing Committee on Labor has published a report on hearings it held last year (see *MWN*, May 1983). *Video Display Terminals – Blessing or Curse?* urges legislators "to err on the side of caution" in assessing radiation risks and to legislate VDT use "to minimize this possible danger." For a copy of the report, contact the office of Assemblyman Frank Barbaro, Room 713, Legislative Office Building, Albany, NY 12248, (518) 455-5828....Pennsylvania State Senator Buzz Andrezeski has introduced two bills, SB 1450 and SB 1451. Similar in almost all respects, the proposals would require shielding to block RF emissions, periodic rest breaks, office design guidelines and a maximum of five hours per day of VDT work. In addition, both bills would mandate alternative work upon request for pregnant operators. The key difference between the bills is that SB 1450 applies only to public employees, and SB 1451 applies to both public and private employees....Berkeley, CA, has become the first locality to adopt VDT purchasing rules. Approved by the City Council, the new ordinance restricts the type of VDT-related equipment which the city may purchase but stipulates only that furniture be safe and comfortable and that displays have adjustable contrast controls.

CONFERENCES

November 29-30: **An International Meeting to Examine the Allegations of Reproductive Hazards from VDUs,** London, UK. Contact: Humane Technology, PO Box 2, Quorn, Leicestershire, LE12 8EG, UK, (0509) 237428.

December 4-8: **American Clinical Hyperthermia Meeting,** Americana Canyon Hotel, Palm Springs, CA. Contact: Dr. Haim Bicher, Daniel Freeman Memorial Hospital, 333 N. Prairie Ave., Inglewood, CA 90301, (213) 674-7050.

December 6-7: **24th Automatic RF Techniques Group Conference,** Columbia Inn, Columbia, MD. Contact: ARFTG, PO Box 432, Princeton, NJ 08540.

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January 23: **A Review of the State-of-the-Art in EMC in Commercial and Military Electronics,** LA Airport Hilton, Los Angeles, CA. Contact: Ms. Terry Cantine, Eaton Corp., 5340 Alla Rd., Los Angeles, CA 90066, (213) 822-3061.

January 23-25: **RF Technology Expo,** Disneyland Hotel, Anaheim, CA. Contact: Kathy Kriner, RF Tech Expo, 6530 S. Yosemite St., Englewood, CO 80111.

February 3-8: **1985 Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: T.A. Balaska, Bishop Electric Corp., 363 Old Hook Rd., Westwood, NJ 07675, (201) 666-5553.

March 5-7: **6th Symposium & Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: EMC Symposium & Exhibition, ETH Zentrum-IKT, 8092 Zurich, Switzerland, (01) 256-27-90.

SHORT COURSES

December 17-18: **EMI & EMP Testing to the Requirements of MIL-STD-461/462,** West Conshohocken, PA. Fee: $595. Contact: R&B Enterprises, 20 Clipper Rd., West Conshohocken, PA 19428, (215) 825-1960.

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January 21-24: **Millimeter Wave Systems and Technology,** Atlanta, GA. Fee: $550 (3 days), $725 (4 days). Contact: Dept. of Continuing Education, Georgia Institute of Technology, Atlanta, GA 30332, (404) 894-2400.

January 22-24: **Cable Ampacity Calculations for Commercial, Industrial and Utility Applications,** Atlanta, GA. Fee: $575. Contact: Georgia Tech, see January 21 above.

January 28-29: **Grounding, Bonding & Shielding,** Washington, DC. Fee: $650. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773, or (202) 676-6106 in DC. **Repeated** May 2-3.

February 5-8: **Modern Microwave Techniques,** Orlando, FL. Fee: $675. Contact: Linda Billard, Technology Service Corp. (TSC), 962 Wayne Ave., Suite 600, Silver Spring, MD 20910, (800) 638-2628, or (301) 565-2970 in Maryland.

February 13-14: **Microwave Devices: Present and Future,** Atlanta, GA. Fee: $475. Contact: Georgia Tech, see January 21 above.

February 19-22: **Modern Microwave Measurements and Applications,** Los Angeles, CA. Fee: $845. Contact: UCLA Extension Short Courses, PO Box 24901, Los Angeles, CA 90024, (213) 825-1295.

February 19-22: **Millimeter Wave Radar,** Washington, DC. Fee: $835. Contact: GWU, see January 28 above.