MICRO WAVE NEWS

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INSIDE...

Microwave News *invites letters from readers. We ask writers to be brief, and we reserve the right to edit contributions for length.*

New Light on ELF Radiation

Leukemia Again Linked to EM Fields

A statistical analysis of mortality data from England and Wales has "reinforced" recent US findings linking leukemia to occupational exposure to electromagnetic fields. This is the third report published since last summer that identifies an association between cancer mortality and working in electrical environments. In addition, a soon-to-be published study from Sweden implicates extremely low frequency (ELF) fields as a cause of congenital malformations among the children of men who work in high voltage substations. In the last few months there have also been two other papers indicating a connection between cancer and ELF alternating magnetic fields (AMFs) among the general population.

The latest cancer report, published in the January 29 *Lancet* by Michael McDowall of the Office of Population Censuses and Surveys in London, reveals a consistently higher mortality rate from lymphoid and myeloid leukemia among male electrical and electronic engineers and telegraph radio operators aged 15-74 in England and Wales during 1970-1972. The rates of acute myeloid leukemia (AML) were particularly high. The analysis of data on AML among workers in England and Wales in 1973 identifies "consistently increased relative risks for the electrical occupations, the highest risk being for telecommunications engineers."

An editorial in the same issue of *Lancet* cautions that "it is impossible to know what the observations mean," but that "the cluster of reports relating to [AML] is worrisome." It concludes: "Since all of us are exposed to some electrical and

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Very Weak Pulsed Magnetic Fields Affect Development

Recent experiments in Spain indicate that extremely weak pulsed magnetic fields at frequencies of 10, 100 and 1,000 Hz can have a "consistent and powerful" effect on the development of chicken embryos. The field exposures were so low that many researchers find the results hard to believe. Nevertheless all agree that the experiment should be repeated. If replicated, the Spanish work would have a major impact on the direction of radiation research.

A group headed by Dr. Jose M.R. Delgado at the Centro Ramon y Cajal Hospital in Madrid has found that extremely low frequency (ELF) pulsed magnetic fields at intensities ranging from 1.2-120 milligauss can upset chick embryonic development. They reported their findings in the *Journal of Anatomy*, a well respected, peer reviewed British journal. The article has been circulating among a small circle of researchers since it was published last May, but has escaped more general scientific and public attention. Richard Tell of the Environmental Protection Agency's (EPA) Office of Radiation Programs called Delgado's findings "amazing." He said that "if it checks out, this could be one of the most significant studies in years."

Delgado's Experiment

Delgado placed newly fertilized chicken eggs inside a coil connected to a

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ELF: Leukemia *(continued from p. 1)*

magnetic fields, and continuously to low levels of non-ionizing electromagnetic radiation, it is important to know what risks, if any, are entailed." The *Lancet* is a highly regarded British medical journal.

Congenital Malformations

A soon to be released paper from Sweden also questions the safety of occupational exposures to ELF fields. Dr. Stefan Nordstrom of the University of Umea and co-workers report that children born to men who work in high voltage substations have an increased incidence of congenital malformations. The authors of the retrospective study hypothesize that "as a result of working in electrical fields in the switchyards, the employees' bodies and/or objects in the switchyards are electrically charged and then discharged ...Cell disturbances, including chromosomal aberrations, may be caused by such charges/discharges." They advise that while these results are statistically significant, they are based on only a small number of cases. The paper is scheduled to be published in the next issue of *Bioelectromagnetics*.

Commenting on these studies, Dr. Robert Becker said, "Researchers must start doing epidemiologies." Interviews with many other scientists indicated a growing consensus that more detailed research must now be carried out. Becker, the author of *Electromagnetism and Life* (with Dr. Andrew Marino), believes that ELF fields can act as generalized stressors and as enhancers of cell division. Under certain conditions, these could cause malignancies and developmental aberrations, he argues.

A similar view is held by Dr. Clay Easterly of Oak Ridge National Laboratory in Tennessee, who has written a number of papers on the risks associated with magnetic fields. In 1981, he proposed a hypothesis to explain how magnetic fields could promote cancer (rather than initiate it): magnetic fields may alter cell replication and thus act as a stimulus for the proliferation of latent tumor cells, leading to the development of malignant tumors.

Other Recent Studies

Last July, Dr. Samuel Milham, Jr., reported an association between leukemia and exposure to electric and magnetic fields among workers (see *MWN*, July/August 1982). Milham's results were then confirmed by a research group at the University of Southern California (USC) with occupational cancer data for Los Angeles (see *MWN*, December 1982). The USC study identified an increased risk of developing AML, especially among power linemen.

With respect to the general population, in 1979, Dr. Nancy Wertheimer and Ed Leeper reported a correlation between exposure to electric power lines and childhood cancer. A similar study in Rhode Island failed to show such a relationship, however. Wertheimer and Leeper recently extended their results, finding that AMFs were also associated with cancer in adults (see *MWN*, January/February 1983). And last year, a Swedish group found support for Wertheimer's original study using cancer statistics from Stockholm (see *MWN*, November 1982).

In a speech delivered last May before the new series of cancer reports appeared, Dr. J.A. Bonnell concluded that there was no evidence to contradict the view that electric fields were harmless up to transmission voltages of 400 kV, and probably for voltages as high as 800 kV. Dr. Bonnell, a medical adviser to the Central Electricity Generating Board in London, published his speech in the December issue of the *Journal of the Royal Society of Medicine*.

Phone calls to the Electric Power Research Institute in Palo Alto, CA, which sponsors some research on the biological effects of ELF fields for a consortium of electrical utilities, were not returned.

NY Sponsors Research

The New York State Department of Health's Power Lines Project is in the midst of planning an epidemiolgical study of the relationship between 60 Hz electromagnetic fields and cancer in the general population. Pre-proposals are due March 22. For more information, see the notice in the February 18 *Science* (p.893) or call (518) 474-4170.

Last year the project announced an award to SRI International for an epidemiological study of electric utility workers but the effort was suspended after questions were raised about the way the cohorts were defined (see *MWN*, November 1982).

The New York project's Scientific Advisory Panel is also looking into the possibility of re-analyzing Wertheimer's data on childhood and adult cancer. The expert panel has hired Dr. Annemarie Crocetti, a New York-based consultant in epidemiology, to advise them on the status of the data.

The panel will meet March 27-28 in Albany to review pre-proposals for the epidemiological study, consider Crocetti's report and evaluate the state's entire $3.5 million research program.

ELF: Magnetic Fields *(continued from p. 1)*

generator of rectangular waves with a pulse duration of 0.5 milliseconds. Eggs were exposed to magnetic fields of 0.12 micro Tesla (uT), 1.2 uT and 12 uT. (1 uT = 0.01 gauss, so these fields are equivalent to 1.2, 12 and 120 milligauss) for 48 hours at frequencies of 10, 100 and 1,000 Hz. At the two higher frequencies and for each of the three intensities, Delgado reports significant malformations, especially in the nervous system and the heart. While exposures to 10 Hz magnetic fields were not free of abnormalities, he notes that a "trend toward normality was evident."

Delgado found the "most marked and uniform effects on embryological development" at 100 Hz and 1.2 uT. Under these conditions, microscopic analysis indicated "drastic" changes in tissue structure: "There was little cellular differentiation, and a lack of organization of cells, without mutual cohesion, resulted in a fragile tissue..." He deduces that the mechanism of action of the ELF magnetic fields is "slow and cumulative," and that "embryonic organs reacted with different sensitivity" to the different parameters of the field. He finds that any thermal effects were "minimal and may be disregarded." Delgado also maintains that he observed frequency and power windows because embryos exposed to fields of 100 Hz and 12 uT were less developed than those exposed to higher and lower frequencies and intensities.

Skepticism Until Replication

Most scientists interviewed about Delgado's paper found it difficult to believe that such weak magnetic fields could have so profound an effect. For instance, Dr. Lionel Jaffe of Purdue University said that he viewed the results with extreme skepticism

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because the fields were so small. "I don't believe it, I can't believe it," he said. In a paper published in 1979, Jaffe reported measuring *natural* currents inside chick embryos that were much larger that those induced by the magnetic field applied by Delgado.

In contrast to Delgado's fields of 1-200 milligauss, the earth's magnetic field is about 0.5 gauss or 500 milligauss, though it is neither an alternating nor a pulsed field.

Dr. Ezra Berman, an expert in teratology at EPA's Health Research Laboratory in Research Triangle Park, NC, said Delgado's results were "very interesting" but Berman was not sure "what was going on." There appears to be a "very strong effect," he said, but the data do not support the conclusion that there is a frequency or intensity window. Berman said that he would like to see the experiment run with more eggs in order to clarify the statistics; in addition, he wants more details about the way the eggs were handled in the course of the study.

Another teratologist, Dr. Joe Lary of the National Institute for Occupational Safety and Health (NIOSH) also expressed concern over Delgado's findings, but added that he was not convinced Delgado had observed abnormalities. The fields might have caused a retardation in development, he said. "The only way to be sure," Lary added, "is to allow the chicks to hatch."

All the teratologists contacted by *Microwave News* agreed that there were very few studies on the effects of *pulsed* fields on embryonic development. The vast majority of experiments have used continuous wave radiation -- most at 27 MHz and 2450 MHz. One exception is an experiment by Czech researcher Dr. Hana Pafkova, who found "an unfavorable effect" on the embryonic development of mice after exposing them to a pulsed 300 Hz field (see *MWN*, January/February 1983).

Dr. Whit Athey of FDA's National Center for Devices and Radiological Health said that he would be dubious about Delgado's results until they are replicated. But, he added, "they must definitely be followed up." Athey said no one at the center was doing any similar experiments.

Dr. Carl Blackman, one of Berman's colleagues at the EPA lab who is well known for his work that shows window effects in the efflux of calcium from brain tissue at ELF frequencies, said that a definitive view would have to wait until another lab repeated Delgado's experiment. But he said that very low level effects were possible: "People in this field tend to think that biological effects are caused by intensities that are comparable to those caused by gross heating; yet biological systems, in their natural state, seem to be sensitive to very low electrical and magnetic fields." As examples, Blackman cited the extreme sensitivity of newts, mice and salamanders to magnetic fields and sharks and skates to electric fields.

Pulse Rise Time

EPA's Tell wonders why more scientists are not attempting to repeat Delgado's experiment. In a telephone interview, he said that one of his colleagues in Sweden has tried but failed to obtain the same results. Although Delgado does not cite the rise time of the pulses he used, Tell has discovered them to be very sharp: 1.5 microseconds. The Swedish researcher used a longer rise time and that may have been an important difference, Tell said. Meanwhile, frustrated by the inaction of others, Tell has a student trying to replicate the experiment as part of an independent study course.

Tell points out that if Delgado's findings are true, their significance is enormous. They would affect a host of different technologies: examples range from nuclear magnetic resonance (NMR) imagers to light dimmers, he said.

Before becoming the chairman of the Department of Physiology at the Centro Ramon y Cajal Hospital in Madrid, Delgado was a professor at Yale Medical School in New Haven, CT.

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HIGHLIGHTS

FY84 Budget Roundup

The Reagan Administration's proposed fiscal year 1984 (FY84) budget was released in early February. Outlined below are the requests for the federal agencies which have non-ionizing radiation bioeffects or compatibility programs. Not included here are budget items for the Department of Defense's R&D and procurement programs; these will be covered next month. One note of caution: many agencies still do not even have an approved FY83 budget (FY83 began last October 1), so all the numbers below should be considered approximate.

Air Force: The RF/MW bioeffects research budget at the AF School of Aerospace Medicine will remain at last year's level in FY84, about $2 million.

Department of Energy: The Division of Electrical Energy Systems has been cut from $21.3 million in FY83 to $12.6 million in FY84, with the electric field effects program reduced from $2.6 million to $2.0 million.

Environmental Protection Agency: As we reported last month, EPA is seeking to eliminate its health research program on non-ionizing radiation. The rationale given in the EPA program request is: "No resources have been requested for the non-ionizing radiation health effects program in 1984. This program has been focused on research to support the issuance of the 1984 federal radiation protection guidance for [RF/MW] radiation. Since development of these environmental exposure guidelines will be completed in 1984, no additional health research will be needed for incorporation in the guidelines and the program will be closed out." EPA's Office of Radiation Programs FY84 budget remains at approximately the FY83 level: $10.8 million.

Federal Communications Commission: A request of $86.159 million for FY84, an increase of $6.34 million over FY83.

Navy: The Office of Naval Research's projected FY84 non-ionizing radiation bioeffects budget shows an increase to $2.75 million from $2.26 million in FY83, although it is already clear that the budget will be cut to about $2.5 million for FY84. Most of these funds are part of ONR's special focus program. The Naval Medical R&D Command will operate at about the same level as FY83, approximately $1.1 million – not including the ELF studies at the Naval Aersopace Medical Research Laboratory in Pensacola, FL.

National Bureau of Standards: While the bureau's FY84 request is down $19.2 million to $98.7 million due to cut backs in building, fire and computer research, the Electromagnetic Fields Division will remain at approximately the FY83 level of $5.0 million.

National Institute for Occupational Safety and Health: $54.62 million for FY84 down from $57.48 million in FY83.

National Telecommunications and Information Administration: $12.2 million for FY84, down from $27.2 million in FY83. The administration is once again trying to delete the public telecommunications facilities program; Congress reinstated the funds in the FY83 budget. Otherwise, the budget is about the same.

Office of Radiological Health (FDA): The ORH program (including its inspectors in the field) is projected to increase by $902,000 to $28,796,000. ORH handles both ionizing and non-ionizing radiation.

NIOSH Scraps RF/MW Criteria Document; Plans Shorter Rationale for Safety Standard

After nearly six years of work, the National Institute for Occupational Safety and Health (NIOSH) has abandoned its criteria document on radiofrequency and microwave (RF/MW) radiation. The agency now intends to issue a much briefer report to serve as a rationale for a new occupational safety standard.

NIOSH officials in Cincinnati, OH, say they soon expect to complete a brief review of the RF/MW bioeffects literature through mid-1978 and have a rough draft of a recommended standard by the end of June. At that time, they will assess how long it will take to update the review to include research published through the end of 1981 and 1982.

According to present plans, the *Recommended Standard and Rationale* will be similar to the rationale included in the American National Standards Institute's (ANSI) new RF/MW standard (C95.1-1982) issued last year. A NIOSH spokesman said that the new NIOSH rationale document will be longer and more comprehensive than ANSI's, however.

The decision to scrap the old criteria document came after many NIOSH employees quit the agency when it moved out of Rockville, MD. The criteria development division was transferred to Cincinnati -- the rest of NIOSH went to Atlanta, GA (see *MWN*, January/February 1983). Responsibility for developing a recommended standard has now been assigned to the physical agents effects branch, which has been without a chief since Dr. Wordie Parr retired in December.

Last year, the Occupational Safety and Health Administration (OSHA) stopped enforcing its 10 mW/cm^2 RF/MW standard (see *MWN*, April 1982). The standard was only advisory, and last May OSHA proposed deleting all its voluntary standards (47 *FR* 23477, May 28, 1982). The agency had planned to issue an advanced notice of proposed rule making (ANPRM) for a new RF/MW safety standard last September (see *MWN*, October 1982), but an OSHA official said that the "ANPRM is still pending."

NIOSH announced its intention to issue a criteria document on RF/MW radiation in 1977. A 500-page draft document was released for review in April 1979, but it was heavily criticized and later withdrawn.

NIOSH staffers in Cincinnati are also working on a report describing a step-by-step approach for controlling radiation emissions from RF sealers. No publication date has yet been set, since the rationale document has top priority.

Industry Asks EPA to Act Quickly on RF/MW Guidance

The communications industry has once again urged the federal government to set a national "guidance" for exposure to radiofrequency/microwave (RF/MW) radiation. In comments submitted to the Environmental Protection Agency (EPA) last month, several companies have asked the agency to act quickly to preempt potentially restrictive state and local standards. The advice came in response to EPA's announced plan to recommend a general population exposure limit later this year. (See *MWN*, January/February 1983.)

The comments underscore the need to, as AT&T put it, "quell the public's anxiety over the issue of RF exposure" and to "ease the burden of RF equipment operators having to deal with different standards in different communities." The TV Broadcasters All

Industry Committee, the National Association of Broadcasters (NAB) and GTE Service Corp. all made similar pleas.

The companies are also united in suggesting that EPA base its recommendation on the American National Standards Institute's (ANSI) revised standard. GTE, for example, recommended ANSI's work because it is "the consensus of experts in this country who represent all of the disciplines concerned with this issue."

Massachusetts' Radiation Control Program manager Robert Watkins explained in his comments that the absence of a national non-ionizing radiation limit prompted the state to propose its own standard, which is five times stricter than ANSI's.

Specific questions posed in EPA's advanced notice of proposed recommendation elicited the following responses:

- Many filers asked EPA to cover frequencies down to at least the low kHz range, with the American Satellite Co., GTE and Massachusetts' Robert Watkins advising that the guidance include extremely low frequency (ELF) radiation. AT&T proposed starting at 10 kHz and NAB at 500 kHz.
- A frequency dependent guideline received overwhelming support. (See AT&T's comments, below.)
- Opinion is mixed as to whether the guidance should address partial body exposures, but comments tend to support a whole body approach. American Satellite Co. said partial body exposure rules should be developed at a later date, but AT&T maintained only a whole body rule is needed for the general public. GTE recommends following ANSI's approach.

The Office of Radiation Programs' criteria document on RF/MW bioeffects has not yet been made public. An ad hoc committee to the agency's Scientific Advisory Board has been formed to review the document, which will be the basis for the guidance. It is expected to be released in April at the group's first meeting. The tentative membership of the committee is: Professor Charles Susskind, University of California at Berkeley, Chairman; Dr. Eleanor Adair, John Pierce Foundation (New Haven): Professor Stephen Cleary, Virginia Commonwealth University, Richmond; Professor Carl Durney, University of Utah, Salt Lake City; Professor Arthur Guy, University of Washington, Seattle; Professor Abraham Lilienfeld, Johns Hopkins University; Professor Sol Michaelson, University of Rochester; and Professor Mary Ellen O'Connor, University of Tulsa.

Excerpts from Comments on EPA RF/MW Guidance Development

The extracts below are from submissions received by EPA on its advanced notice of proposed recommendation appearing in the December 23 Federal Register (47 FR 57338). A review of more comments will appear next month. Included here are comments from: American Satellite Co., AT&T, GTE Service Corp., Massachusetts Radiation Control Program, Professor Sol Michaelson, the National Association of Broadcasters, Dr. Herbert Pollack and the TV Broadcasters All Industry Committee.

American Satellite Co.: ASC feels that it is important to establish maximum acceptable exposure levels for all frequency bands from ELF to EHF [extremely high frequency]....Initially, [the guidance] would only be necessary for whole body exposure. Partial body exposure levels should be developed as a follow-on effort....The exposure limits should vary with frequency to account for body resonances and maximum absorption bands....It is ASC's opinion that limits should be placed on maximum as well as average exposure....ASC also feels that limits should be placed on instantaneous as well as time-averaged specific absorption rates.

AT&T: It is necessary for certain radio facilities to generate strong RF fields in inaccessible areas in order to serve the public. If a guideline which is appropriate for an area that is accessible to the public is applied in these situations, it will inhibit the operation of these facilities without any benefit to the public health. Therefore, the EPA guidelines should take such situations into account by making it clear that the exposure limits apply only to publicly accessible areas....In order to establish a single exposure limit that would be an acceptable health level for all frequencies, the EPA would have to select a limit that was sufficiently strict to cover the frequencies that produce the most adverse effects. This limit would be much more than is necessary for frequencies that produce less adverse effects. Such a strict limit would inhibit use of these frequencies. Clearly, this waste of a natural resource – the spectrum – would not be in the public interest.

GTE Service Corp.: GTE suggests that [the frequency range of the guidance] ought to cover, on the low frequency end, services like very low frequency (VLF) communication and navigation, low frequency (LF) navigation systems and various proposed military utilizations of the spectrum below 550 kHz. Thus the standard should start at least at 10 kHz. There should also be an attempt to establish a standard for frequencies around 50-400 Hz, to include the ubiquitous power lines and certain harmonics. GTE includes 400 Hz because the ambient 400 Hz fields inside an aircraft are not low....EPA's promulgations should make it clear to the public that there are whole classes of installations of which the general public need have no fear: microwave relay dishes on towers or tall buildings, satellite earth stations and mobile radios. To minimize operator exposure, EPA may wish to direct equipment manufacturers to include warning labels.

Massachusetts Radiation Control Program: The range of frequencies included in the Massachusetts proposed regulation are in the range of 0.3 to 100,000 MHz. This range was selected primarily due to the work done by the ANSI C95 committee. However, there is increasing concern over extremely low frequency ELF radiation sources. Thus, I suggest that your recommendations include frequencies as low as 50 Hz....

Professor Sol Michaelson: I would strongly recommend that EPA adopt the ANSI 1982 recommended standard with modifications suggested in the Commonwealth of Massachusetts recommended standard....It incorporates a large enough margin of safety to encompass the requirements of the general population as well as the worker. Adoption of this protection guide would provide a uniformity of standards which would obviate the need for local standards such as recently considered by Massachusetts and Portland, OR.

National Association of Broadcasters: Prompt issuance of an EPA standard would work in two important ways insofar as the public's reception of communication service is concerned: (1) it would provide the FCC with the guidance needed for its carrying out of statutory obligations under the terms of both the National Environmental Policy Act of 1969 and the Communications Act of 1934; and (2) it would provide non-federal authorities a uniform federal standard which could be applied to local regulation or, preferably, could be used to justify non-federal forebearance from regulation....NAB urges that the frequency range extend at least between 500 kHz and 50 GHz....It would appear that a "whole body" rather than "partial body" focus would be appropriate....NAB would have no difficulty were a reasonable frequency-dependent standard, such as ANSI C95.1-1982, be adopted by EPA.

Dr. Herbert Pollack: You refer to residential exposure in your notice. It is my impression that measurements were made in the streets or on the exterior of the buildings. Have you calculated the attenuation of the signal within the buildings or homes?... Your statistical residential exposure may be much higher than the actual one.

TV Broadcasters All Industry Committee: There is a pressing need for EPA to establish sound and reasonable radiofrequency radiation standards as promptly as possible....As EPA moves forward with its efforts to formulate sound federal standards, the committee believes the agency would be greatly aided by soliciting and facilitating the input of experts from other affected agencies and industries such as the FCC and its radio communications licensees.

UPDATES

Biological Effects...Drs. A.F. Lawrence of Hughes Aircraft and W.R. Adey of the VA Hospital in Loma Linda, CA, are organizing an *International Conference on Nonlinear Electrodynamics in Biological Systems*, June 5-9 at the Jerry L. Pettis Memorial VA Hospital in Loma Linda, CA. Over the last few years, researchers have made considerable progress towards developing new models of energy transfer mechanisms in cellular systems. The conference will provide an opportunity to examine the relevance of nonlinear phenomena to the medical and biological sciences. According to Adey, "the meeting will be an interdisciplinary forum for industry and government researchers to set an agenda for a national research program." There will be no registration fee, but space is limited and applications will be treated on a first come, first served basis. For more information contact Barbara Kruggel at the hospital, 11201 Benton St., Loma Linda, CA 92357....Those who plan to attend and want to brush up on nonlinear interactions and soliton research should take a look at *Nonlinear Phenomena in Physics and Biology*, edited by Richard Enns *et al.* (New York: Plenum Press, 1981, 610 pp., $75.00). The book is a collection of papers presented at a NATO conference held in Alberta, Canada, in August 1980. The uninitiated will find Dr. Alwyn Scott's "Introduction to Nonlinear Waves" especially useful. Scott, who is based at the Center for Nonlinear Studies at the Los Alamos National Laboratory in New Mexico, provides a history of soliton research beginning in 1844 when John Scott Russell first described a solitary wave moving through the Union Canal in Scotland. (A solitary wave, or soliton, does not dissipate as it travels; instead it is able to keep its original shape.) Scott outlines Davydov's hypothesis that solitons can form in biological systems, allowing the transport of energy over long distances; Davydov has used the alpha helix protein as an example....A new group of researchers is looking into the question of calcium efflux, according to the abstracts of papers for the Biophysical Society meeting held in San Diego, CA, February 13-16, and published in the February issue of the *Biophysical Journal*. J.L. Schwartz of the National Research Council of Canada and his co-workers report on the effects of ELF amplitude modulated RF fields on calcium efflux from frog hearts. They tried CW radiation as well as that modulated at the heart's natural beating frequency and at 16 Hz – at SAR's between 0.15-3.0 mW/Kg. Only 16 Hz modulated radiation increased the calcium efflux. They note that the "absorbed power levels seem to exclude possible gross heating of the hearts."...A team from the University of Pennsylvania in Philadelphia have determined the dielectric permittivity and electrical conductivity of fluid saturated rat bone over the frequency range 10 Hz to 100 MHz. The results are in the February issue of the *IEEE Transactions on Biomedical Engineering*.

Communications...Residents from Vernon, Ringwood and Rockaway, NJ, met with state officials in February to discuss their concern over broadcast radiation. A spokeswoman for Assemblyman Dean Gallo said that state officals will look into citizen fears of radiation hazards. Proposed RF/MW facilities have generated community opposition in all three towns. Ringwood recently turned down an ITT proposed relay tower, which had already failed to win siting approval in South Nyack, NY. And Vernon's citizen group opposing a proposed RCA Americom point-to-point tower is organizing a national network of like-minded groups. According to Elise Kreindler, one of the leaders of Vernon's Citizens Against the Tower (CAT) people in about 20 areas want to join....AT&T Long Lines has taken its new communications network for the Northeast corridor underground. Last month the Washington, DC, to New York City leg of a planned 776-mile fiber optics system began operation. The company will finish the project by 1984 and expects this technology to save about $50 million in construction and operating costs by 1990. A similar link between Sacramento and San Diego, CA, should be finished by 1985. Japan is stepping up its already substantial investment in fiber optics. The FCC's A.M. Rutkowski reports in the December 1982 *Telecommunications* that the Japanese envision a "potentially enormous" international market as well as extensive domestic networks. In a paper prepared for the FCC's 1985 WARC advisory committee meeting, Rutkowski explains that fiber optics, fast becoming cost-effective, could take a big bite out of the future demand for satellite links....The FCC has published proposed rules for reallocating fixed service users in the 12 GHz band (48 *FR* 6730, February 15, 1983) and plans to issue a report and order in September. The commission discusses policy plans for utilization of fixed and mobile bands between 947 MHz and 40 GHz in the same notice....Brazil, China, Pakistan and Saudi Arabia are among the nations targeted as future markets for digital microwave radio (DMR). International Resource Development's report No. 533 states DMR markets in industrializing countries could reach $200 million by 1995. On the domestic front, the company predicts heavy demand for cordless phones (report No. 536). Both publications cost $985 and are available from IRD, 30 High Street, Norwalk, CT 06851, (203) 866-6914....MCI is after people on the go. The company recently won FCC permission to provide radio paging services in several major markets; it already provides paging and mobile communications services in 52 cities....An article on present and future paging technology appears in the March *High Technology*.

Compatibility & Interference...Last December we reported that state policemen were having RFI problems from their walkie talkies to Breathalyzer units, which are widely used to check the sobriety of suspected drunk drivers. The accuracy of the units took on added importance as the Supreme Court ruled on February 22 that a driver's refusal to submit to a blood alcohol test could be held against him in a trial. So, those worried that their tests might be inaccurate may have to submit to them anyway. Smith & Wesson, the manufacturer of the Breathalyzer units, has issued a customer advisory, *Guidelines for Radiofrequency Interference Testing*. For more information, contact S&W's Herb Belin, 2100 Roosevelt Avenue, Springfield, MA 01101....NBS' Electromagnetic Fields Division has delivered a high dynamic range, tunable EMI antenna system to the US Army at Ft. Huachuca, AZ. The antenna is designed for use with a Singer Stoddart NM-17/27 EMI/field intensity meter or with a spectrum analyzer. The antenna operates in the frequency range of 250 kHz to 32 MHz and was developed because the army was having EMI problems from background noises in the 10 kHz to 10 MHz range....The *New York Times* ran an item on cordless phones on February 12 and reported that household appliances like vacuum cleaners could interfere with the phones. Also the *Times* noted the theoretical possibility of "telephone raiders": people could drive through a neighborhood with a handset until a dial tone is heard and make long distance calls that would be billed to the owner of the base station....With the new Congress in session, Radio Marti is under discussion again. Senator Paula Hawkins (R-FL) has filed the first Radio Marti bill (S.602) and the NAB, many of whose members are worried about RFI to US AM radio stations, has announced its opposition to it....Electro-Metrics' William Lambdin is organizing a session on "Developments in Electromagnetic Compatibility Design and Testing" on April 19 at *Electro/83* in New York City. For a copy of the program call (800) 421-6816....James Hill of EMXX Corp. of Springfield, VA, is organizing three three-day short courses on (1) *Design of Digital Circuitry*, (2) *Grounding and Shielding Techniques*, and (3) *Achieving Compliance with FCC and VDE Standards*. The courses will be held in Washington, DC, April 26-28; Dallas, TX, May 3-5; and San Diego, CA, May 24-26. The fee is $225/day. For more information contact Hill at (703) 451-4619....The Institution of Electrical Engineers in the UK is holding a vacation school on *Designing Against RF Emission*, at the University of Sussex, July 10-15. For more information contact: IEE, Savoy Place, London WC2R 0BL.

Government...Bernard Wunder, Jr., the administrator of NTIA has resigned and left Washington for Texas. He is the second senior NTIA official to leave the Reagan Administration this year; last month, Associate Administrator Donald Jansky quit to open a consulting firm. Wunder's deputy, Susan Stuebing, is now filling in as the acting head of NTIA....OSHA Administrator Thorne Auchter has appointed Patrick Tyson as his second in command, replacing Mark Cowan who is now Secretary of Labor Raymond Donovan's chief of staff.

Measurement...The Institution of Electrical Engineers in the UK is sponsoring a week-long "vacation school" on *Microwave Measurements* at the University of Kent in Canterbury, September 18-24. Fees range from about $300 for IEE members not requiring accommodations to about $450 for non-members who intend to stay at the University (assuming one pound equals one and a half dollars). For more information contact Carole Richards at the IEE Science, Education and Technology Division at Savoy Place, London WC2R 0BL.

Occupational Health...OSHA and the National Society to Prevent Blindness are planning a national campaign to improve worker protection against eye injuries. For more information contact a local OSHA regional office or the society at 79 Madison Avenue, New York, NY 10016....And the American Optometric Association has published a pamphlet, *A Guide to Eye Safety in the Work Environment*. Single copies are available at no charge; send a self-addressed, stamped business-sized envelope to: Communications Division, American Optometric Association, 243 N. Lindbergh Blvd., St. Louis, MO 63141....A large team of researchers headed by Anthony Sances, Jr., of the Medical College of Wisconsin in Milwaukee describes its studies on "Current Pathways in High-Voltage Injuries" in the February *IEEE Transactions on Biomedical Engineering*. The group applied voltages of 10-2000 volts (60 Hz) to hogs.

Ovens...The Office of Radiological Health's (ORH) Division of Compliance is investigating a leaking microwave oven. An oven was discovered in Norfolk, VA, that was emitting 40 mW/cm^2. According to a division spokeswoman, the door on the oven was improperly positioned, leaving a break in the seal between it and its frame. ORH receives about four reports a year which warrant oven testing....The mother of a Michigan baby girl allegedly burned by a microwave oven has been indicted for child neglect. After a number of tests, state officials have ruled out oven malfuction as a possible cause of injuries. (See *MWN*, December 1982.)...The American Society of Mechanical Engineers Committee K-19 is sponsoring a special session on Heat Transfer Measurements in Microwave Systems at its winter annual meeting in Boston, November 13-18. For information, contact Dr. Maurice Berry, Jr., FDA, 1090 Tusculum Avenue, Cincinnati, OH 45226, (513) 684-8653....Microwave oven shipments in January reached 312,000, a 16.7 percent increase over last year, according to the Association of Home Appliance Manufacturers....Magic Chef sees a strong market for its new line of "Little-Big" microwave ovens among builders and remodelers if the housing industry picks up as expected. The ovens require significantly less space for installation than other ovens with the same size cooking cavity.

Satellite Communications...NASA procurement requests for its 30/20 GHz communications program were expected out early this month. The scaled down effort is now under the Advanced Communications Technology Satellite Program (ACTS). As the US continues its on again - off again support for 30/20 GHz development, Japan is already offering four Ka-band transponders on its CS-2A satellite. Japan spent 1,126 percent more than America on satellite-link research last year, according to the January 31 *Aviation Week*. In the same issue, an article describes the strong competition that fiber optic technology may pose for some types of satellite service....MCI is growing with both technologies. The company recently purchased 24 transponders on the Hughes Communications Galaxy 2 and 3 satellites, which combined with MCI's expanding fiber optic network will increase the company's capacity for data and voice service by nearly 50 percent....Prudential Insurance Co. has invested $45 million in direct broadcast satellite service (DBS) through an agreement with United Satellite Communications (USC) (formerly United Satellite Television Corp.). USC plans to beam entertainment programs directly to homes this fall. Because USC will use Japanese equipment, Orrox Corp. of Santa Clara, CA, has announced suspension of its manufacturing for DBS: it estimates no other US company will require equipment within the next two years. Meanwhile, various DBS license holders and earth station manufacturers scheduled a meeting in Washington, DC, last month to form a standards development group, according to the February 21 *Broadcasting*. In January, United States Satellite Broadcasting asked the FCC to develop DBS earth station standards.

Standards...The TLV Physical Agents Committee of the American Conference of Governmental Industrial Hygienists (ACGIH) is set to meet March 23-24 in San Antonio, TX. On the agenda is consideration of proposed changes to the RF/MW radiation (TLV) standard. In 1981 the committee suggested that the standard be revised in a manner similar to the ANSI safety standard (though the ACGIH proposal is less strict than ANSI's) and extended down to 10 kHz (see *MWN*, September 1981). Last year the committee proposed allowing exceptions to the exposure limits under certain conditions (see *MWN*, July/August 1982). Both sets of revisions are still listed under ACGIH's "Notice of Intended Changes." The committee wants to resolve any remaining objections to the proposed changes at the meeting so that the new RF/MW TLV can be approved. ...ANSI has published the 1983 issue of its *Catalog of American National Standards*, which lists some 10,000 approved ANSI standards. The catalog is available for $10.00 from the ANSI Sales Office, 1430 Broadway, New York, NY 10018. Buyers will receive all 1983 supplements at no charge.

VDTs...Radiation tests have not resolved the controversy surrounding a cluster of pregnancy problems among VDT workers at Surrey Memorial Hospital, BC, reported last year. (See *MWN*, July/August and October 1982.) Consultants hired by the hospital and by the worker's union have come up with different results. Professor A.W. Guy of the University of Washington, Seattle, tested a Surrey VDT at the request of the hospital and concluded that it produced no harmful radiation. Commenting on his results, Guy said he detected weak signals from 60 Hz to 1 GHz, with most emissions at 15 - 20 kHz: the levels never exceeded a few volts per meter. On the other hand, Dr. Hari Sharma of University of Waterloo, Ontario, who took measurments for the Hospital Employees Union, said that he had found some "pretty high" pulsed fields at 15 kHz; peak power levels near the case of one unit went to 1,000 V/m. Sharma has measured a number of sets in Canada for radiation emissions, including those at the Ontario legislative library in Toronto. (See *MWN*, November 1982.) Earlier this year, scientists at the Canadian Center for Occupational Health and Safety hypothesized that the pulsed, low frequency radiation emitted by VDTs may produce adverse effects and recommended terminals be shielded until more research is done. (See *MWN*, January/February 1983.)...M.M. Weiss of Bell Laboratories in Murray Hill, NJ, takes a different view. In a recently published paper, Weiss states that "radiation emissions from VDTs either do not exist or are not measurable. In any case their intensity is less than that to which the population in general is exposed from other sources. It is the unanimous conclusion of all studies conducted thus far that VDTs do not represent a health hazard from any radiation exposure casued by their use. It is apparent that factors other than radiation must be sought to determine the cause for the health or comfort complaints reported by various investigators." Weiss's review along with papers by Bell's S.J. Starr and R.C. Petersen and by Professor W. Ham from Virginia Commonwealth University were orginally presented at the October 1981 *Joint Conference on Occupational Health* in Nashville, TN, and are published in the February *Journal of Occupational Medicine*....Similarly, E.A. Cox of the UK's Health and Safety Executive recaps a number of radiation surveys in the January issue of *Displays: Technology and Applications*, and concludes that "there are no radiation emissions from VDTs that approach levels that could be considered to be of concern to the normal individual." Most emissions detected in the surveys are in the low kHz range. *Displays* is published by Butterworth Scientific Ltd. in Gilford, UK....Moving up in the spectrum, a letter in the February 24 *New England Journal of Medicine* takes issue with the potential X-ray doses from old color TVs estimated by Dr. David Nashel and co-workers and reported in the journal September 30. Stanley Savic calls the Nashel estimates "erroneous and misleading" and up to 200 times too high. Nashel based his numbers on 12 out of 1,124 sets with the highest emissions. Savic states that calculating the average from all 1,124 sets would be more accurate. (See *MWN*, October 1982.)...McGill University in Montreal and CWA Local 7200 in Minneapolis, MN, both plan to investigate VDTs. An ad hoc committee has been set up at the university to review available information and make recommendations for the safe use of some 375 terminals at McGill. Concerned over potential reproductive hazards, CWA will conduct a survey of 4,500 women VDT operators. According to a report in the Minnesota Public Interest Research Group's January *Statewatch*, the union plans to discuss VDT work issues, including the

right to alternative work for pregnant VDT users, in contract bargaining next summer. In Canada, many union workers have already won this option....A hearing on Connecticut's proposed VDT study bill was set for March 1 and Massachusetts plans to discuss its study bill at an April 20 hearing. For information, contact the Connecticut Committee on Labor and Employee (203) 566-5299 and the Massachusetts Joint Committee on Commerce and Labor (617) 722-2030. The Connecticut legislature's General Law Committee scheduled a March 7 hearing on a consumer bill with a little more punch: VDT sellers would be responsible for informing buyers about potential hazards and for ensuring that terminals do not emit hazardous levels of radiation....A conference on *VDTs/CRTs & New Technology* was held at the University of Connecticut Health Center last month. For information, contact Jane Fleishman at the center, School of Medicine, Farmington, CT 06032....American Optometric Association in St. Louis, MO, has made a number of recommendations for easing eye problems associated with VDT work. The association recommends regular rest breaks, annual eye exams and indirect office lighting....Ophthalmologists at the University of Laval Medical Center in Quebec have completed a five-year study of over 100 VDT users and non-users. In an eight-page summary report from the Association of Ophthalmologists of Quebec (No. 82-11-29), Drs. Ide Dube and Rollande Michaud conclude that long-term, full-time VDT work "does not cause any harmful effects on the ocular and visual systems." Canadian union officials have questioned the wisdom of drawing conclusions from so small a study....A case of video-game epilepsy in the US is the third to link the onset of seizures with an electronic game's flickering lights. Writing in the February 11 *Journal of the American Medical Association*, Dr. Neil Dahlquist and colleagues at the Mayo Clinic in Rochester, MN, report that a 15-year old boy experienced seizures after playing "Combat" and "Pac-Man." The doctors call this response "similar to television-induced seizures, which have been well recognized in epileptic patients who are sensitive to flickering lights or geometric patterns." Game screens flicker at about 15 Hz. (See *MWN*, April 1981 and September 1982.)...A VDT hot line has been set up by NYCOSH's New Technology Committee. You can phone in your questions about VDTs from 5:30 to 7:30 PM on the first and third Wednesday of each month. Call (212) 674-1595....The February 21 *Computerworld* zeroed in on the electronic gadgetry of special cars at the recent New York International Automobile Show. Ford's Concept 100 Electronic Car sports a CRT screen which, through a Navy satellite communications link and a microprocessor, would display the car's location on an appropriate map. There is also a screen in the back seat – Donkey Kong anyone?

Etc... Do ELF and VLF emissions warn of an impending earthquake? Writing in the February 3 *Nature*, Chi-Yu King of the US Geological Survey in Menlo Park, CA, reviews some of the recent findings which suggest that such signals may one day aid in predicting major earthquakes. For instance, one set of measurements taken in Japan detected anomalously high electromagnetic emissions half an hour before a magnitude seven earthquake. The radiation was localized in two different frequency bands, at 10-1,500 Hz and at about 81 kHz. Others have reported similar emissions in the USSR and China. At this point, there are no satisfactory explanations for the signals, but King does believe that these phenomena "must be taken seriously."

CONFERENCE CALENDAR

• March 8-10: *Microwave Systems Applications Technology*, Sheraton Washington, Washington, DC. Contact: Richard Hartman, EW Communications, 1170 East Meadow Drive, Palo Alto, CA 94303.

• March 8-10: 5th *Electromagnetic Compatibility Symposium and Technical Exhibition*, Zurich, Switzerland. Contact: Dr. T. Dvorak, EMC-83, ETH Zentrum-IKT, 8092 Zurich, Switzerland.

• April 6-7: Annual *Meeting of the National Council on Radiation Protection and Measurements*, Washington, DC. Contact: NCRP, 7910 Woodmont Avenue, Bethesda, MD 20814.

• April 10-13: 61st Annual *Convention of the National Association of Broadcasters*, Las Vegas Convention Center, NV. Contact: NAB, 1771 N Street, NW, Washington, DC 20036.

• April 12-15: 3rd Annual *International Conference on Antennas and Propagation*, University of East Anglia, Norwich, UK. Contact: IEE, Savoy Place, London WC2R 0BL, United Kingdom.

• April 25-27: *Satcom '83: 3rd Annual Satellite Communications Conference and Exhibition*, Hyatt Orlando, Orlando, FL. Contact: International Association of Satellite Users, 6845 Elm Street, PO Box DD, McLean, VA 22101.

• May 2-5: 2nd Annual *Test & Measurement World Expo*, Convention Center, San Jose, CA. Contact: Meg Bowen, Conference Director, 215 Brighton Avenue, Boston, MA 02134.

• May 15-19: 15th Annual *Meeting of the Conference of Radiation Control Program Directors*, Eldorado Hotel, Reno, NV. Contact: Charles Hardin, CRCPD, 65 Fountain Place, Frankfort, KY 40601.

• May 22-25: 18th Annual *Meeting of the Association for the Advancement of Medical Instrumentation*, Loews Anatole, Dallas, TX. Contact: AAMI, Suite 602, 1901 N. Fort Myer Drive, Arlington, VA 22209.

• May 23-26: *International IEEE/APS Symposium and National Radio Science Meeting*, University of Houston, TX. Contact: Professor Liang Shen, Department of Electrical Engineering, University of Houston, Houston, TX 77004.

• June 1-3: *IEEE/MTT-S International Microwave Symposium*, Sheraton Boston Hotel, Boston, MA. Contact: Frank Leith, Alpha Industries, 20 Sylvan Road, Woburn, MA 01801.

• June 5-9: *Conference on Nonlinear Electrodynamics in Biological Systems*, VA Hospital, Loma Linda, CA. Contact: Research Service (151), Jerry L. Pettis Memorial Veterans Hospital, 11201 Benton Street, Loma Linda, CA 92357.

• June 12-16: 5th Annual *Bioelectromagnetics Society Meeting*, University of Colorado, Boulder, CO. Contact: BEMS, 1 Bank Street, Gaithersburg, MD 20878.

• June 19-23: 28th Annual *Health Physics Society Meeting*, Baltimore Hilton Hotel and Convention Center, Baltimore, MD. Contact: HPS, 4720 Montgomery Lane, Suite 506, Bethesda, MD 20814.

• June 21-23: *International Aerospace and Ground Conference on Lightning and Static Electricity*, Fort Worth, TX. Contact: Nick Rasch, FAA Technical Center, ACT-340, Atlantic City Airport, NJ 08405.

• July 3-8: 7th *International Congress of Radiation Research*, Amsterdam, Netherlands. Contact: Dr. J.J. Broerse, Radiobiological Institute TNO, PO Box 5815, 2280 HV Rijswijk, Netherlands.

• July 18-22: 20th Annual *IEEE Conference on Nuclear and Space Radiation Effects*, Sheraton Gatlinburg Hotel, Gatlinburg, TN. Contact: E.F. Hartman, Div. 9336, Sandia National Laboratories, Albuquerque, NM 87185.

• July 18-22: 18th Annual *Microwave Power Symposium*, Franklin Plaza Hotel, Philadelphia, PA. Contact: International Microwave Power Institute, Tower Suite 520, 301 Maple Avenue West, Vienna, VA 22180.

• July 18-22: 7th *International Symposium on Bioelectrochemistry and Bioenergetics*, Stuttgart, West Germany. Contact: Professor M. Blank, Department of Physiology, Columbia University Medical School, 630 West 168th Street, New York, NY 10032.

• August 23-25: *IEEE International Symposium on Electromagnetic Compatibility*, Hyatt Regency-Crystal City, Arlington, VA. Contact: Aaron Sullivan, Jr., 7121 Wolf Tree Lane, Rockville, MD 20852.

• August 23-26: *URSI International Symposium in Electromagnetic Theory*, Santiago de Compostela, Spain. Contact: Dr. J.L. Sebastian, Dept. of Electricidad y Electronica, Facultad de Ciencias Fisicas, Ciudad Universitaria, Madrid (3), Spain.

• September 12-14: 36th Annual *Conference on Engineering in Medicine and Biology*, Hyatt Regency Hotel, Columbus, OH. Contact: Alliance for Engineering in Medicine and Biology, 4405 East-West Highway, Suite 210, Bethesda, MD 20814.

• October 3-5: 3rd Annual *Meeting of the Bioelectrical Repair and Growth Society*, San Francisco, CA. Contact: Dr. Lorraine Day, San Francisco General Hospital, 1001 Potrero, San Francisco, CA 94110.

• October 16-20: *Conference on Electrical Insulation and Dielectric Phenomena*, Buck Hill Inn, Buck Hill Falls, PA. Contact: Professor Markus Zahn, High Voltage Research Lab, MIT, Cambridge, MA 02139.