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INSIDE...

Maximum EMF Exposure Emerges As Strong Miscarriage Risk

A new and innovative epidemiological study has found an up to sixfold increased risk of spontaneous abortions among women exposed to magnetic fields of 16 mG or greater. The results "should have wide implications," concludes Dr. De-Kun Li, who led the study team at Kaiser Permanente's research division in Oakland, CA.

Unlike past efforts, which have essentially all used average fields, Li focused on *maximum* magnetic field (MMF) as the key index of exposure. While Li found miscarriage risks that are significantly higher for women who had an MMF of at least 16 mG, he saw no excess for women with time-weighted averages (TWA) of 3 mG or more. Nor did he observe any increased risk for elevated spot electromagnetic field (EMF) measurements or with wire codes.

"With TWAs you are diluting any possible effect because you are combining relevant and irrelevant exposures," Li told *Microwave News.* In a paper summarizing his results, Li argued that, "It seemed more plausible to us that MF exposure has a threshold below which any exposure is biologically irrelevant." Li's paper is an appendix to the as-yet-unreleased final report of the California EMF Project (see p.2). An advance copy of Li's paper was obtained by *Microwave News.*

"My study convinced me that EMFs probably have a biological effect," Li said. "We are entering a new chapter in the field of EMF epidemiology. There is more evidence that there is an association—the better-conducted studies consistently show an association."

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Large Animal Studies on Cell Phone Radiation Planned in U.S. and Italy

The National Toxicology Program (NTP) will go forward with a series of long-term animal studies to investigate the cancer risk from mobile phone radiation. This is the first time a U.S. government health agency has sponsored a lifetime radiofrequency and microwave (RF/MW) cancer study.

In addition, by the end of the year another set of animal experiments will get under way at the Ramazzini Foundation in Bologna, Italy. "They will be the largest animal exposure studies ever done on electromagnetic radiation," Dr. Morando Soffritti, the scientific director of the foundation, told *Microwave News.* The studies, which will include both RF/MW and EMF exposures, will be paid for with private and public funds, he said.

These two new initiatives will complement the six animal studies that are being jointly sponsored by the European Commission and the mobile phone industry, under a project known as PERFORM-A (see *MWN,* M/A00 and J/A

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« Power Line Talk »

Two changes in the membership of the International Agency for Research on Cancer's (**IARC**) EMF Working Group, which will meet in Lyon, France, June 19-26: Dr. **Bernard Veyret** of the University of Bordeaux has joined the group and Dr. **Arnold Brown** of the University of Wisconsin, Madison, has withdrawn due to a medical condition. (For a complete list of the other 21 members, see *MWN*, J/F01.) There will also be at least six observers: Norbert Hankin of the U.S. **EPA**, Drs. Bill Jameson and Christopher Schonwalder of the U.S. **NIEHS**, Dr. David Longfellow of the U.S. **NCI**, Dr. Michael Repacholi of the **WHO** in Geneva and Dr. John Swanson of the U.K. **National Grid** Co. While the observers will not vote on the carcinogenicity of static and ELF EMFs, they will be allowed to present their views and participate in the discussions.

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It was supposed to be on a fast track for validation before the **IARC** review, but the repeat of an experiment that could yield a missing link in the EMF–cancer puzzle has not yet begun. Last fall, Dr. **Michael Repacholi** of the WHO International EMF Project pressured EPRI to repeat the work it had originally sponsored in Dr. **James Trosko**'s lab at Michigan State University in East Lansing. Trosko had shown that 40-50 mG magnetic fields could affect gene expression and, in some ways, act like a tumor promoter (see *MWN*, N/D00). Speaking through the EPRI media relations office, Dr. **Leeka Kheifets** told *Microwave News* that the institute is "definitely" planning to follow up the Trosko study, but as of May, there was "nothing definitive in place." Discussions are under way with potential researchers, she said.

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NIOSH and **EPRI** are jointly funding a study designed to see whether the use of new EMF exposure meters points to significantly higher cancer risks among electric utility workers, compared to the estimates based on data from the EMDEX or Positron meters. On May 4, NIOSH's Dr. **Joseph Bowman** hosted a peer review meeting in Cincinnati at which he and his collaborators, Drs. **Leeka Kheifets** and **Rob Kavet** from EPRI, presented the protocol for the new study. Over the next two years, they will measure full-shift EMF exposures of 500 workers at Southern California Edison Co. (SCE) in Los Angeles using the Multiwave III personal waveform monitor made by Electric Research and a new contact current meter developed by Enertech Consultants. If a higher risk is found, Bowman will seek additional funding to take a second look at the epidemiological cancer data collected by Dr. Jack Sahl at SCE (see *MWN*, M/A93 and J/A93), and perhaps those of Drs. David Savitz and Gilles Thériault (see *MWN* J/F95 and M/A94, respectively). Among the members of the review panel were Dr. **Dan Bracken**, a consultant based in Portland, OR, Dr. **Gary Marsh** of the University of Pittsburgh and Dr. **Teri Schnorr** of NIOSH. "The meeting produced many ideas for strengthening the study," Bowman told *Microwave News*. For more information, contact Bowman at (513) 533-8143 or by e-mail at <jdb0@cdc.gov>.

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Ahlbom and Feychting Reaffirm Support for Prudent Avoidance

Drs. Anders Ahlbom and Maria Feychting of the Karolinska Institute in Stockholm have again expressed support for a policy of prudent avoidance to deal with the still-uncertain risks associated with power-frequency EMFs.

In a commentary published in the April 14 *Lancet* (pp.1143-1144), the two Swedish epidemiologists endorse their government's recommendation to avoid "unnecessary heavy exposures" when it can be done "without excessive costs or technical difficulties." This has been the national policy since the mid-1990s (see *MWN*, N/D95 and N/D96). Last year, Ahlbom told *Microwave News* that, "In Sweden, with all the space and other resources, one should still exercise prudent avoidance" (see *MWN*, S/O00).

The editorial was prompted by the recent report from the U.K. panel chaired by Sir Richard Doll (see *MWN*, M/A 01). The British group agreed with the conclusion of Ahlbom and Feychting's pooled analysis: The statistically significant doubling of childhood leukemia above 4 mG (0.4 μT) is not likely to be explained by chance (see *MWN*, S/O00). But at the same time, Doll cited the lack of support from physical theory and experimental studies.

While the Doll panel played down the EMF risk to children in the U.K., Ahlbom and Feychting point out that even though leukemia is a rare disease and few English children are exposed to fields above 4 mG, "these small numbers in no way make the problem negligible" and they caution that "a thorough risk evaluation would require more data than [are] available."

Ahlbom and Feychting also write that, "The evidence for an effect of ELF EMF on risk of childhood leukemia remains unconvincing." But in an interview with *Microwave News*, Ahlbom said that "inconclusive" would have better expressed their assessment of the risk than "unconvincing."

An analysis of EMF health risks prepared by the **California EMF Program** is being held up by the state Public Utilities Commission (PUC). Dr. **Raymond Neutra**, the project leader, was set to release the risk report at a meeting of his science advisory panel on Monday, May 7, but late Friday afternoon May 4 the meeting was abruptly cancelled. **Ellen Stern Harris**, of the Fund for the Environment, in Beverly Hills, and a long-time EMF activist, has formally requested that the report be released. "Now that the state is considering the purchase of power lines owned by private electric utility companies, we need to know what the liabilities may be," Harris told *Microwave News*. Anything that can affect power supplies is a sensitive subject in California, which has suffered rolling blackouts. "The report is undoubtedly sitting on the governor's desk," Harris said. Neutra declined to comment, referring questions to the Department of Health Services' press office. At the end of May, a spokeswoman would only say that the PUC had asked for a briefing before the report is released but that it has not yet been scheduled. (See also p.1.)

David Savitz: EMF Epidemiology Has Reached Its Limits

In a commentary on a new study of Swiss railroad workers by Drs. C.E. Minder and D.H. Pfluger of the University of Bern (see p.13), Dr. David Savitz concludes that, "Additional studies similar to past ones are unlikely to yield important new insights." The Swiss paper and Savitz's editorial appear in the May 1 issue of the American Journal of Epidemiology. *Savitz is the chairman of the department of epidemiology at the University of North Carolina School of Public Health in Chapel Hill. He is the president of the Society for Epidemiologic Research and an editor of* Epidemiology. *Savitz talked to* Microwave News *in mid-May.*

***MWN*:** You propose suspending further epidemiological research on EMFs and brain cancer and leukemia until there are better laboratory data which point to a possible mechanism of interaction to guide future studies. Do you think that the existing epidemiological evidence is compelling enough to warrant further experimental work or should we simply resign ourselves to living with some uncertainty over EMFs and cancer?

DS: Based on the epidemiology that has been done so far, I don't think that the public health threat is great enough that the priority for EMF lab research should rise above its competition. Certainly, there is an inherent excitement in the possibility of understanding biophysical mechanisms. But here, too, I believe we need a striking new idea that competes for funding on its merits, not just a general concern with a health threat, before we spend any more money on toxicological studies. We are, in effect, stuck in gridlock.

***MWN*:** If we don't do any more epidemiology or any more lab studies, it's very unlikely we will get any new ideas. Isn't your position somewhat paradoxical, given the recent consensus among epidemiologists from all over the world that the childhood studies do indeed point to an EMF–leukemia risk?

DS: In order to extend that finding through epidemiology, one would need to either locate a population with markedly greater exposures, or identify a method of exposure assessment that is far superior to anything done to date. I believe that a proposal that met either of these conditions would be fundable.

***MWN*:** But even if we don't learn anything new about the EMF childhood cancer risk (the study under way in Japan where exposures are unusually high might surprise us), the majority opinion is that the childhood link does not appear to be a chance association. Are you willing to leave that unresolved too?

DS: Whether we should flesh out the uncertain association observed at high field strengths is not an all-or-nothing decision. Rather it's a question of urgency and opportunity. I think that the urgency is great enough to justify more studies, if there is an opportunity that is markedly better than the ones that have been pursued in the past.

***MWN*:** What about doing more epidemiology for noncancer endpoints such as possible EMF effects on neurological diseases (Alzheimer's and ALS), heart disease and suicides?

DS: For those endpoints, as I noted in the editorial, efforts that exploit data from past studies or that add EMFs to the factors being examined in new studies would be well justified. In other words, applying the tools that were appropriately applied to leukemia and brain cancer would undoubtedly move the issue forward. But whether such EMF risks alone could justify a major new study is open to question.

***MWN*:** Until we can get a clearer picture of the possible risks, do you agree with those who recommend a policy of prudent avoidance—that is, reducing exposures when one can do so at low cost?

DS: In principle, yes. The epidemiologic research suggests that limiting exposures to less than 0.4-0.5 μT (4-5 mG) could have a health benefit. But as a practical matter, given the uncertainty about causality and the magnitude of the risk, it's not clear to me that it's worth the bother. I'll leave that decision to the policymakers.

***MWN*:** In their response to your editorial, Drs. Minder and Pfluger argue that an EMF link to cancer *is* in fact biologically plausible. They point to a large body of work, including that which shows EMFs can cause chromosomal damage. If you had been given the chance, how would you have replied to the Swiss researchers?

DS: I'm really not conversant with EMF experimental work and have to defer to others who are.

***MWN*:** Some years ago in another published commentary* you made some very different arguments: "The value of epidemiologic evidence for decision-making may be the greatest when other biomedical disciplines have the least to offer." And: "Even without a clear understanding of mechanisms, [epidemiologic] observations may provide the basis to modify exposures in order to prevent disease." The glass now appears to be half empty, rather than half full. What prompted your change in outlook?

DS: I continue to believe that epidemiology is capable of addressing health concerns even in the absence of biologic understanding, but what has happened with EMFs is that we've pursued that strategy and gotten the most insight that we can. We've narrowed the range of possibilities, no doubt, but I am very pessimistic that more of the same will advance science or guide policy.

*"In Defense of Black Box Epidemiology," *Epidemiology, 5,* pp.550-552, September 1994.

EPRI's Kheifets To Manage WHO EMF Project in Geneva

EPRI's Dr. Leeka Kheifets will take over day-to-day management of the World Health Organization's (WHO) International EMF Project in early July. She will report to Dr. Michael Repacholi, who launched the project five years ago (see *MWN,* J/A96).

Kheifets will be the head of the WHO radiation program, which covers both ionizing and non-ionizing radiation, and will be the main point of contact for the EMF project, Repacholi said in an interview. She will be based in Geneva.

For the last five years, Kheifets has been the manager of EPRI's EMF program. EPRI, with headquarters in Palo Alto, CA, is the research arm of the U.S. electric power industry.

Dr. Stan Sussman, EPRI's vice president for environmental programs, said that Kheifets's replacement has not yet been named. He predicted that there will be no change in direction or funding of EPRI's EMF program. "If anything, there will be an increase in funding," Sussman told *Microwave News*; he pointed to the ongoing energy crisis in California and the need to build more power lines.

Repacholi announced last year that he would step down as the head of the EMF project, citing overwork and the sometimes heated criticism of his leadership (see *MWN,* N/D00).

Li stressed that 16 mG is not a rare exposure. He noted that approximately 75% of his study population had at least one exposure above this threshold in a 24-hour period. Li said that such peak fields are more likely to come from household electrical appliances and transportation sources than from local electrical distribution lines.

The Kaiser Permanente study has cleared peer review and is scheduled to be published in the November issue of *Epidemiology*, Li said. His results were first disclosed at a meeting convened by the California EMF Program on April 25. Kaiser Permanente is the largest and oldest health care provider in the U.S.

"It's quite exciting if it holds up," Dr. Nancy Wertheimer said in an interview. "More work needs to be done on thresholds and short-term high exposures." Wertheimer, who lives in Boulder, CO, was a member of Kaiser's internal peer review team. Wertheimer and Ed Leeper have themselves reported associations between miscarriages and EMF exposures from electrically heated beds and home electrical heating systems (see *MWN*, M/J86 and N/D88, respectively).

Others have also seen a miscarriage risk due to magnetic fields from video display terminals (see *MWN*, M/J88 and M/A 92) and from power lines (see *MWN*, M/A92).

"Taken together the EMF studies of spontaneous abortions paint a consistent picture," said one epidemiologist, who has read the new Li paper but who asked not to be identified.

The new study is the first prospective study ever done for EMF health risks and the first to use maximum magnetic field exposures to gauge risks. A total of 969 women who had been pregnant for less than ten weeks qualified for the study, and the outcomes of their pregnancies were monitored. They wore an EMDEX meter for 24 hours and were then asked if their activities during that particular day were "typical" of the pregnancy.

"One of the strengths of this study was that we measured MF exposure during the relevant period and used personal measurement to capture MF exposure from all sources encountered by a woman," Li wrote.

Li found that women who were exposed to MMFs of 16 mG or more had 80% more miscarriages compared to those exposed to less than 16 mG—a statistically significant increase. But when women who said that they had worn the EMDEX on an atypical day are eliminated from the study population, the miscarriage risk increases to three times that of the less-exposed women. And for pregnancies lost during the first ten weeks of gestation, the risk is close to six times that of the less-exposed women. All these results are also significant.

Of the 159 women who had spontaneous abortions, 132 had exposures above 16 mG, and of these 95 said that they had taken measurements on a typical day.

For women who were judged to be more susceptible to environmental insults—those who had already had two or more miscarriages or who had fertility problems—the miscarriage risk is three times higher when they were exposed to 16 mG or more. This risk rises to close to five times that of the unexposed women for those pregnancies that were lost before the tenth week of gestation, a time when the fetus is most sensitive to environmental insults. Both these risks are statistically significant.

"All this evidence points to an underlying biological effect of the magnetic field rather than bias or a chance finding," Li said. "If this were a chance finding, you would not expect there to be a difference between typical and atypical exposures and between early and late abortions."

In the interview, Li said that he was "a little disappointed" by the recent commentary on EMF epidemiology by Dr. David Savitz (see p.3).

A number of researchers have argued for the need to look beyond TWAs to measure biologically relevant EMF exposures. For instance, in the early 1990s, Drs. Richard Lovely and Bary Wilson of the Battelle Labs in Richland, WA, pointed specifically to MMF exposure as an alternative exposure index (see *MWN*, M/J93). Until Li, no one had followed up their suggestion.

In a previous epidemiological study, Li found that women with fertility problems who used electric blankets during pregnancy had a greater chance of having babies with birth defects (see *MWN*, S/O95). The risk was ten times higher among women who used electric blankets during the first trimester.

A "Robust" Association

"This population-based cohort study with prospectively measured MF exposure level revealed for the first time (based on our search of Medline) an increased SAB risk associated with a MMF exposure level of ≥16 mG. The adverse MMF effect appeared to have a threshold around 16 mG and persisted regardless of the sources/locations of MMF exposure. Prenatal MMF exposure had a greater effect on early spontaneous abortion (<10 weeks of gestation) when embryos or fetuses are much more sensitive to environmental insults, and among women who may be more susceptible to environmental exposures. The association was much stronger when women whose 24-hour MF measurements may not reflect their true prenatal MF exposure were excluded. These biologically coherent observations, all based on a priori hypotheses, provide strong evidence that prenatal MF exposure above a certain level (possibly around 16 mG) may increase SAB risk. It is also unlikely that the observed association was due to biases or unmeasured confounders, because any such biases or confounders would have to explain the above observations simultaneously. The robustness of the association against potential confounders was further supported by the evidence that, despite adjusting for more than 30 variables of known or suspected risk factors for SAB, the estimates were barely altered. Moreover, prompted by the findings in this study, Lee et al.* reanalyzed the data from the study in which the findings related to TWA exposure led to funding the current study, and confirmed our observed association between MMF and SAB risk. These findings raise the question of the effect of MMF on reproductive outcomes and other health endpoints. The MMF exposure level in our study population was quite comparable to that found in a nationwide survey and our study population was racially/ethnically and socioeconomically diverse. Thus, the findings from our study should have wide implications."

De-Kun Li, "A Population-Based Prospective Study of Personal Exposure to Magnetic Fields During Pregnancy and the Risk of Spontaneous Abortion," unpublished manuscript, May 2001.

*G.M. Lee et al., "A Nested Case-Control Study of Residential and Personal Magnetic Field Measures and Spontaneous Abortions," *Epidemiology*, submitted.

« Wireless Notes »

Is the mobile phone industry getting a wide enough range of opinions when setting priorities for health research? Do the skeptics who discount nonthermal, low-level effects have too much sway? These questions have been raised once again by a two-day seminar on ***Mechanisms for Interactions of RF Energy with Biological Systems***, sponsored by the Mobile Manufacturers Forum (**MMF**) and held in Washington, May 22-23. It was organized by Drs. **Mays Swicord** of Motorola and **Sakari Lang** of Nokia, with the assistance of Dr. **Asher Sheppard**, a consultant who works for Motorola under contract. Among the dozen or so invited experts who do not work for the industry were: Drs. **Ken Foster** and **Bill Pickard**, who have argued that we should stop wasting money on non-ionizing health research (see *MWN*, J/F 88), and Drs. **Dean Astumian** and **Jim Weaver**, whose models, at least up to very recently, set thresholds that make low-level EMF interactions very unlikely (see *MWN*, M/A97 and J/A00). Drs. **Ross Adey** and **Ted Litovitz**, each of whom does believe in weak field effects, received invitations but both declined. "They will never come up with mechanisms if they don't believe there are any," Litovitz, of Catholic University in Washington, told *Microwave News*. "People who believe in something work harder to try to find it." (For Adey's pointed views on another industry meeting, see p.12.) In a telephone interview, Swicord said that, "The workshop is not supposed to be controversial—it's not a political meeting," and that the MMF did try to get some fresh points of view. Dr. **Friedemann Kaiser**, a theoretical physicist at the Technical University in Darmstadt, Germany, had been planning to come but he cancelled at the last minute, Swicord said, adding that it's hard to find qualified people who would want to come because "it's not an exciting area." Dr. **Chris Davis** of the University of Maryland, College Park—an attendee who is also openly skeptical about nonthermal effects—pointed to the vicious circle fueled by lack of funding: "There are few scientists in the U.S. who have money to work in this area, and that limits the pool of available contributors to a discussion," he told *Microwave News* before the seminar. "There may be eminent physicists who, if funded, might come up with a mechanism—but no one is receiving any support." Even some corporate insiders see the need for new blood. "We need people with a broader outlook; otherwise it will be a sterile exercise," said Dr. **Q. Balzano**, a Motorola consultant (see p.17) who attended one day of the workshop. "They will have to do it again," he predicted.

CTIA Funds Genetic Studies

On June 1, the CTIA announced that it has awarded three grants to follow up genotoxic effects of mobile phone radiation first reported by Integrated Laboratory Systems (ILS) in Research Triangle Park, NC. This study, originally funded by the CTIA through WTR, found increased chromosomal abnormalities as measured by the micronucleus assay (see *MWN*, M/A99).

Dr. Ray Tice of ILS will receive one of the two grants for *in vitro* work. The other project will be run by Dr. Maria Scarfi of the University of Naples, associated with the Italian Interuniversity Center for the Study of Interactions Between EMFs and Biosystems. Scarfi also works on the EC's CEMFEC project (see *MWN*, M/A00). Dr. Bernd Görlitz of the Fraunhofer Institute in Hannover, Germany, will do an *in vivo* study as an add-on to its PERFORM-A effort (see p.1).

"The contracts follow the scope of work recommended by the FDA and the contractors are those recommended by the FDA," Jo-Anne Basile, a CTIA vice president in Washington, told *Microwave News*. (See also p.6 and p.9.)

British Medical Association Favors Precaution on Phones

The British Medical Association (BMA) in London is advocating a precautionary approach to the possible health effects of mobile phones, including limiting their use by children and keeping calls brief.

In an interim report released on May 24, the BMA notes "large gaps in knowledge" and states that precautions are appropriate "until more detailed and scientifically robust information on any health effects becomes available."

The BMA recommendations parallel those issued by the U.K.'s Stewart panel last year (see *MWN*, M/J00). The BMA states that it "supports the advice given in the Stewart report."

The report also includes a table that summarizes ongoing health effects research in the U.K., as well as some European projects.

The full text of *Mobile Phones and Health—an Interim Report* is available on the BMA's Web site: <www.bma.org>.

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Germany's ICNIRP-based national limits for public exposure to RF/MW radiation are "too high," according to the **Ecolog Institute** in Hannover. It recommends a precautionary limit of 1μW/cm^2, independent of frequency. The institute's report cites evidence of adverse effects at levels as low as 20μW/cm^2 and argues that reducing the exposures of phone users to 50μW/cm^2 or less is an "urgent" priority. "SARs are inadequate for addressing nonthermal biological effects," Dr. **Peter Neitzke** told *Microwave News*. Neitzke is one of the authors of the report and the editor of the institute's quarterly newsletter, *EMF Monitor*. **T-Mobil**, formerly a unit of Deutsche Telekom, commissioned the Ecolog report as well as parallel assessments by Dr. **Jiri Silny** of the University of Aachen and Dr. **Roland Glaser** of Humboldt University in Berlin. The company is in the process of having the reports peer-reviewed, but Ecolog did not wait before publishing its main findings and recommendations, citing the "considerable demand for information." Soon afterwards, T-Mobil announced that the other reports do not call for stricter exposure limits. Ecolog's proposals, it said, are "not supported by science." A company spokesperson told *Microwave News* that it would provide the other reports, but they had not arrived at press time. The Ecolog report, *Mobile Telecommunications and Health*, is in German at: <www.ecolog-institut.de/emf-moni.htm>.

Congress Told Public Needs Better Info on Cell Phone Risks

Federal agencies are not doing enough to help consumers make informed choices about the health impacts of mobile phones, according to a new report from the General Accounting Office (GAO), the investigative arm of the U.S. Congress.

The GAO found that research to date "does not demonstrate" adverse effects, but that some studies "have raised questions about possible cancer and noncancer effects that require further investigation." It predicted that it will take "many more years" to obtain definitive answers. In the meantime, the GAO states that it is "particularly important" for the Food and Drug Administration (FDA) and the Federal Communications Commission (FCC) to give the public "clear, accurate and timely information."

The GAO also cast doubt on the adequacy of the FDA's oversight of the Cellular Telecommunications and Internet Association's (CTIA) ongoing research effort. The GAO calls on the FDA to publicly report whether the CTIA is heeding its advice.

The report was released on May 22 by Sen. Joseph Lieberman (D-CT) and by Rep. Edward Markey (D-MA). FDA's advice for consumers is "out of date and difficult to understand," Lieberman said. He added that the information on phone SARs provided by the FCC on its Web site is "difficult to locate" and "difficult to understand."

Markey emphasized the need to determine whether there are health impacts. With 110 million phone users in the U.S., he said, even a small effect could create "an epidemic size problem." And as long as health questions remain unresolved, consumers "will be required to make their own judgments about the level of risk and what precautions to take."

With respect to past U.S. research, the GAO stated that "many scientists and government and industry officials" questioned the "productivity and accountability" of the industry-sponsored WTR program. A 1994 GAO report noted potential concerns about WTR's "objectivity and credibility" (see *MWN*, N/D94).

Because the industry will choose, pay for and manage projects in the ongoing CTIA–FDA joint research effort, known as a CRADA (see p.5, p.9 and *MWN*, N/D99 and J/A00), Markey was adamant on the need for the FDA to play an active role: "We cannot have a cooperative agreement where an industry which has a stake in the results can handcuff a federal agency."

The GAO noted that the lack of a standard protocol for estimating radiation exposures "results in substantial variation in testing." Lieberman urged the FCC to expedite the completion of the IEEE protocol for measuring SARs, which got under way in 1997 (see p.18 and *MWN*, M/A97 and J/F99).

To assist consumers, the GAO advised, the FDA should develop a new statement on radiation health issues written for a general audience, while the FCC should provide "clear, consistent and easily accessible" information on phone SARs.

In separate letters, dated May 22, Lieberman and Markey told the FCC and the FDA to "implement these sensible steps expeditiously." The letters also proposed that the agencies work together to develop a "single, integrated Web site" for consumers, as well as a telephone information service.

At the press briefing, Lieberman demonstrated how to use a mobile phone with a hands-free set, and noted that he uses such a device himself.

A complete copy of the report, *Research and Regulatory Efforts on Mobile Phone Health Issues* (No.01-545), is available on the Internet at <www.gao.gov/new.items/d01545.pdf>, or may be ordered from GAO at (202) 512-6000, Fax: (202) 512-6061.

Conflict over Australian Senate Mobile Phone Health Report

The chair of a long-running Australian Senate investigation on mobile phones wants the government to do more to protect public health, but finds herself with little support from the other members of her own committee.

In a report issued on May 4, Sen. Lyn Allison, the chair of the six-member investigative panel of the senate's Committee on the Environment, Communications, Information Technology and the Arts, calls for a "rigorous precautionary approach," which would include keeping radiation exposures at levels "as low as reasonably achievable (ALARA)."

Allison recommends a delay in relaxing the Australian national limits for exposures to RF/MW radiation and an annual tax of Aus$5 on every phone user to pay for health research—a total of Aus$40 million (US$21 million) per year.

The other senators on the committee rejected these proposals. In a separate section of the report, the two panel members from the governing Liberal Party state that they see no need for what they call an "enormous increase" in research funding. The panel's three senators from the Labor Party filed their own minority report, which concludes that support for research "does not appear to be inadequate."

All five liberal and labor senators are also backing the adoption of less-stringent ICNIRP-based exposure limits, as proposed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) (see *MWN*, M/A01). The labor senators contend that there is "no compelling scientific argument" for the lower limits that are currently in force.

Allison downplayed the lack of support for her recommendations. "The report gives people access to some of the mounting body of evidence" pointing to possible health risks, she told *Microwave News*. "I am hopeful that public pressure will bring about a more appropriate regulatory framework for radiation exposure in due course."

Sen. John Tierney, a liberal committee member, dismissed the inquiry as a "waste of time," according to the May 5 Sydney *Herald Sun*.

Allison is sharply critical of government health officials for their handling of the mobile phone safety issue. In a statement accompanying the report, she calls ARPANSA's standard-setting process a "sham."

Allison is also questioning the National Health and Medical Research Council's (NHMRC) management of its Aus$4.5 million research program on phones and health (see *MWN*, N/D96, J/A98 and N/D00), suggesting that industry bias has influenced its choice of projects. She recommends that the Commonwealth

Scientific Industrial Research Organization (CSIRO) be put in charge of most of the funds that would be generated by the proposed tax on phone users.

In their comments, the liberal and labor senators defend ARPANSA and the NHMRC.

On some points, the panel members are in agreement. The committee calls for government testing of radiation shields and hands-free kits for mobile phones, and asks the government to consider developing health advisories for parents whose children use mobile phones.

The committee as a whole also recommends the establishment of a national register for reports of health problems associated with phone use. This is based on concerns raised by Dr. Bruce Hocking in his testimony (see *MWN*, N/D00).

The senate authorized an inquiry on health research and exposure standards relating to mobile phones in December 1999 (see *MWN*, J/F00). The panel heard from 52 witnesses from the wireless industry, public health agencies and universities (see *MWN*, S/O00, N/D00, J/F01 and M/A01).

The report, *Inquiry into Electromagnetic Radiation*, is on the Internet at: <www.aph.gov.au/senate/committee/ecita_ctte/Emr/index.htm>.

Industry Group To Close Doors

The Electromagnetic Energy Association (EEA), a Washington-based industry lobby, is closing down.

"Times have changed," said Dr. John Osepchuk, one of its founders. "The focus is more on standard-setting," he explained, and EEA's members "want to concentrate their efforts on fewer paths." Osepchuk formerly worked at Raytheon and is now a consultant based in Concord, MA.

Osepchuk helped set up the Electromagnetic Energy Policy Alliance, as it was initially called, in 1984 to represent manufacturers and users of RF/MW technology (see *MWN*, Mar84). Its current members include AT&T Labs, Lucent, Nokia, Raytheon and the National Association of Broadcasters.

The EEA has sponsored conferences and short courses and issued fact sheets on the radiation safety of various technologies (see, for example, *MWN*, J/A87). In an interview, Osepchuk said that he expects some of EEA's work will be continued by the Institute of Electrical and Electronics Engineers (IEEE). Osepchuk is the chair of the IEEE's International Committee on Electromagnetic Safety.

EEA's difficulties were highlighted recently by the weak response to its conference on the precautionary principle scheduled for May 4 (see *MWN*, M/A01). An e-mail alert sent out by EEA's Washington office described the principle as a "potentially insidious 'virus' directed toward technology." The meeting was canceled soon afterwards due to lack of interest.

Electrosmog Embroils Italy; Vatican To Reduce RF Emissions

Public concern over electromagnetic radiation reached a fever pitch in Italy this spring. Electrosmog, as it is called there, was front-page news as the controversy over radiation health effects raged at the highest levels of government.

On May 3, Willer Bordon, the environment minister, resigned when it appeared that the prime minister would not support his demand that the Vatican radio station comply with Italian radiation limits. Bordon, however, changed his mind a couple days later.

Bordon insisted on enforcing Italy's strict 6 V/m limit for RF/MW radiation. At one point, he threatened to cut the power to the transmitters, which have been blamed for causing higher-than-expected rates of cancer in the nearby community of Cesano (see *MWN*, M/A01).

As the showdown over the Vatican radio was reaching a climax, Bordon tried to push through a 2 mG (0.2 μT) limit for EMFs from new power lines next to homes, schools and playgrounds. This rule was first proposed last year (see *MWN*, M/A00).

But Bordon did not have the support of other members of the cabinet. Dr. Umberto Veronesi, an oncologist who is the minister of health, favors the more lenient ICNIRP standard.

Nevertheless, in at least a partial victory for Bordon, on May 18 the Italian government and the Holy See agreed that the Vatican radio station would meet the Italian exposure standard for its shortwave antennas. Compliance of the Vatican's other transmitters, operating at different frequencies, has been delayed until the end of August.

In an interview with *Corriere della Sera* (April 10), a national newspaper, Veronesi said he was not convinced that electromagnetic radiation was a cancer agent, adding that in his view the control of electrosmog should not be a top government priority.

Dr. Morando Soffritti of the Ramazzini Foundation in Bologna countered in an accompanying interview that practically nothing is known about the health effects of long-term exposures. "There is a nearly total lack of experimental research," he said. The Ramazzini Foundation is a major research center on occupational and environmental health (see p.1).

"We cannot ignore the cancer cluster in Cesano," Soffritti told *Microwave News*. "There is a perception of risk and we have to respond."

In the uproar over RF radiation, two transmitters operated by the U.S. Navy on Camaldoli Hill overlooking Naples were ordered shut down by local authorities, according to April 13 wire service reports. At the end of May, the transmitters that broadcast the American Forces Network were still not operational, according to a military public affairs officer in Frankfurt.

The battle over electrosmog played out during contentious national elections, and some have accused Bordon of being motivated more by politics than by concerns over health. In the May 13 vote, the center-right alliance headed by Silvio Berlusconi came to power, as Bordon lost his own bid for reelection (though he may stay in Parliament with a seat granted by his political party). Also, the Green party, which backed Bordon's electrosmog campaign, did badly and has now lost much of its political influence. It is far from clear whether the new agreement over the Vatican radio and Bordon's EMF initiative will be honored by the new government.

Angelos v. Wireless Industry: Class-Action Lawsuits Filed

Peter Angelos has assembled a network of lawyers to take on the wireless industry. Together, they are pressing a number of class-action lawsuits to force manufacturers and service providers to include a hands-free kit with every phone and to reimburse those who have already bought a phone for the cost of a headset.

Ericsson, Nokia and Motorola, along with Sprint PCS, Verizon Wireless and AT&T, are among the more than 20 defendants.

In complaints filed in Maryland and New York state courts, both on April 19, Angelos argued that phone radiation is capable of producing biological injury, which, in turn, creates a risk to human health, but that hands-free kits can eliminate radiation exposure. In addition, he contended that the wireless industry "knew or...should have known" that phone radiation poses a potential health hazard, and that it sought to "suppress, discredit and/or minimize" research on phone safety.

Last year, Michael Allweiss of Lowe, Stein and Conrad Williams of St. Martin & Williams filed a similar lawsuit in Louisiana on behalf of consumers across the country (see *MWN*, N/D 00). They are now collaborating with Angelos and with another Baltimore lawyer, William Gately of Howell & Gately (see box below).

The Louisiana complaint—originally brought in state court but since removed to federal court—seeks the certification of a national class of plaintiffs, while the other suits cover those phone users living in the states in which they were filed.

Also on April 19, Angelos and Allweiss, together with Joseph O'Keefe of O'Keefe & Sher and Kenneth Jacobsen, filed a complaint in Pennsylvania state court. Jacobson plans to file suit in New Jersey as well. And lawyers at Weinstock & Scavo in Atlanta are working with Angelos on a class-action suit in Georgia.

The members of the network are "all trying to achieve a common goal—to bring these health concerns to people's attention," Allweiss told *Microwave News*.

Angelos is also working with Joanne Suder on a personal injury suit on behalf of Christopher Newman, a physician who claims he developed a brain tumor as a result of using a mobile phone (see *MWN*, S/O00 and J/F01).

The contention that using a wireless phone can lead to brain cancer is not part of any of the class-action suits—in fact, the complaints filed this spring specifically exclude phone users who have been diagnosed with a brain tumor or eye cancer. "In these cases, we're not trying to prove that using a phone has made anyone sick," John Pica Jr. of the Angelos firm said in an interview, noting that this would be harder to demonstrate to a judge or jury.

Responding to the filings, Motorola's Norman Sandler said that using a mobile phone, with or without a headset, poses no known health threat. "We have always maintained that any claim of health risks associated with the use of mobile phones is ground-

Angelos Gives Litovitz $500,000 for EMF Biomedical Research

Peter Angelos and his wife, Georgia, have awarded Dr. Ted Litovitz of the Catholic University of America in Washington $500,000 for EMF research.

"We will use the money to explore therapeutic applications," Litovitz told *Microwave News*. "For example, we will extend our studies on how 60 Hz magnetic fields can protect against damage caused by heart attacks, as well as continue our work on how EMFs can improve the efficacy of chemotherapeutic agents in the treatment of cancer."

Litovitz, a physicist by training, has published a number of papers on the way EMF-induced heat shock proteins help chick embryos survive cardiac stress (see *MWN*, N/D97 and M/J99). Researchers at the Food and Drug Administration have challenged those results, however (see *MWN*, J/A00 and S/O00).

His work on EMF synergy with chemotherapeutic drugs is less well known. Litovitz explained that he has not published these results while he seeks patent protection. He said that he has succeeded in increasing the toxicity of taxol by a factor of five with 60 Hz fields. Taxol is used to treat breast, ovarian and lung cancers.

Angelos made the award through the Peter and Georgia Angelos Foundation, which, like his law office, is in Baltimore. Angelos did not respond to a request for comment.

Angelos has made some major gifts to the Johns Hopkins University, and its medical school, in Baltimore. His firm has won billions of dollars in damages from the tobacco and asbestos industries.

Peter Angelos's Network of Mobile Phone Litigators

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Richard Capriola
Michael Weinstock

less," he told *Microwave News.*

Currently the lawsuits filed in April are in federal court, in response to a request by Motorola and the other defendants. The plaintiffs are contesting this move, Allweiss said.

The suits have also elicited some sharp criticism from the press. In an editorial headlined MORE DUMB LAWSUITS, the *Washington Post* (April 23) opined that the headset remedy "makes no sense" and that "there is no excuse to go after the phone makers on the basis of 'potential hazard'." The Annapolis, MD, *Capital* (April 25) described the litigation as "frivolous" and "bizarre."

Mobile Phone Animal Studies *(continued from p.1)*

00). In addition, another animal study is scheduled to get under way in China later this year (see *MWN*, N/D00).

Dr. Christopher Portier, the director of the U.S. Environmental Toxicology Program (ETP) and the associate director of the NTP, said that the studies will take about five years and cost approximately $10 million. "It was my decision and Dr. Olden concurred," Portier said in a telephone interview. "I want to see this done."

"With over one billion cell phones in use worldwide, it is critical to obtain scientifically rigorous laboratory studies of the potential for health effects from long-term use of these products," Dr. Kenneth Olden, the director of the NTP and the National Institute of Environmental Health Sciences (NIEHS), told the Raleigh, NC, *News & Observer* (May 22).

Portier said that while he was impressed with the European studies, "We felt that the exposures did not go high enough."

Both mice and rats will be exposed at a number of different levels in the NTP studies, according to Dr. John Bucher, the deputy director of the ETP. "The focus will be on cancer," he said, "but we will also do some general toxicological evaluations." Bucher led a team of ETP–NIEHS scientists that met with the leaders of the Italian and PERFORM–A projects in Europe. "We've been working on this for a long time," Bucher said.

The most important factor still to be decided is how the animals will be exposed. "Dosimetry is a key concern," Bucher noted. The choice is between controlling the dose by restraining the animals or letting them run free in an ambient RF/MW environment. Bucher said that the NTP is leaning toward an unrestrained exposure system.

The tradeoff, Portier explained, is between, on the one hand, accepting the possibility that the effects of the radiation will be hard to separate out from the stress caused by restraining the animals and, on the other hand, not having an exact handle on the dose each animal receives because they are allowed to move around in their cages. Portier is organizing a workshop to discuss these issues at the June 10-14 meeting of the Bioelectromagnetics Society in St. Paul, MN.

In one of the Bologna experiments, rats will be exposed to 1.8 GHz GSM radiation in the far field—there will be five rats to a cage and they will be free to run around. This study will start by the end of the year, at the same time as a parallel animal study on power-frequency EMFs. A second GSM exposure study, scheduled to get under way next year, will expose restrained rats in the near field.

Soffritti said that he would have liked to have done a second set of RF exposures at 900 MHz but did not have the necessary funds.

In the PERFORM-A studies, animals will receive whole-body exposures while restrained in plastic tubes. Pre-studies are about to begin at two of the four PERFORM-A labs: RBM on the outskirts of Ivrea, Italy, and the Fraunhofer Institute in Hannover, Germany. Full-scale studies will get under way at the end of the summer. Pre-studies are scheduled to begin in the two other labs—RCC in Itingen, Switzerland, and the Austrian Research Center in Seibersdorf—in August.

The U.S. studies will be carried out by a contractor to be selected by the NTP. Portier said that the contracting process alone will take a minimum of nine months.

The Food and Drug Administration (FDA) formally requested the NTP studies two years ago; last June, NTP's executive board endorsed the recommendation (see *MWN*, N/D99 and J/A00). Previously, the FDA had tried to convince the cell phone industry's research project, run by WTR, to sponsor animal experiments, but without success (see *MWN*, M/A97).

Mobile Phone Epidemiology: Kenneth Rothman's Proposal

Dr. Kenneth Rothman has proposed that the Cellular Telecommunications and Internet Association (CTIA) sponsor a prospective epidemiological study of 50,000 mobile phone users over the next 10 to 15 years.

"A very strong case" can be made for a cohort study that would estimate radiation exposures as people use their phones, not after cancer has developed, Rothman said at the close of an all-day brainstorming session convened by the Food and Drug Administration (FDA) and the CTIA. The meeting, which was held in Cincinnati on April 18, is part of the ongoing planning process for the FDA–CTIA Cooperative Research and Development Agreement (CRADA) on cell phone research (see p.5, p.6 and *MWN*, N/D99).

Rothman, one of the leading epidemiologists in the U.S., outlined other key features of his proposed study:

- Targeting highly exposed populations—for instance, realtors
- Looking not only at brain tumors but also at other health outcomes—including other kinds of cancers and neurological diseases
- Assessing exposures and monitoring health status on a regular basis, most likely every six months
- Using the Internet to follow participants, who could also answer questionnaires online
- Including a number of different technologies, not just mobile phones.

Rothman told *Microwave News* that he did not have an estimate of what such a prospective study would cost. Rothman teaches at Boston University and is the founder and editor emeritus of *Epidemiology.*

A transcript of the FDA–CTIA panel discussion is available by e-mail from FDA's Dr. Russell Owen at <rdo@cdrh.fda.gov>.

Poland To Tighten Non-Ionizing Radiation Limits for Workers

Poland's Ministry of Labor and Social Policy has set stricter standards for occupational exposures to non-ionizing radiation (NIR). When the new rules* take effect in July, the limits covering most Polish workers will be similar to those of ICNIRP at power frequencies, but significantly lower than ICNIRP in some parts of the RF/MW frequency band.

Poland thus joins Italy and Switzerland in resisting the call for "harmonizing" RF/MW exposure limits, which has been led by the WHO International EMF Project (see *MWN*, J/F00). China and Russia have also rebuffed attempts to loosen their strict standards (see *MWN*, S/O99). Australia, New Zealand and the Czech Republic, on the other hand, have recently favored the ICNIRP approach (see *MWN*, S/O99, J/F01 and M/A01).

Poland is also planning to revise the rules for public exposures to NIR, according to Dr. Stanislaw Szmigielski of the Military Institute of Hygiene and Epidemiology in Warsaw. The current limits, which were adopted in 1998, are generally more stringent than the strictest ("safety zone") occupational limits.

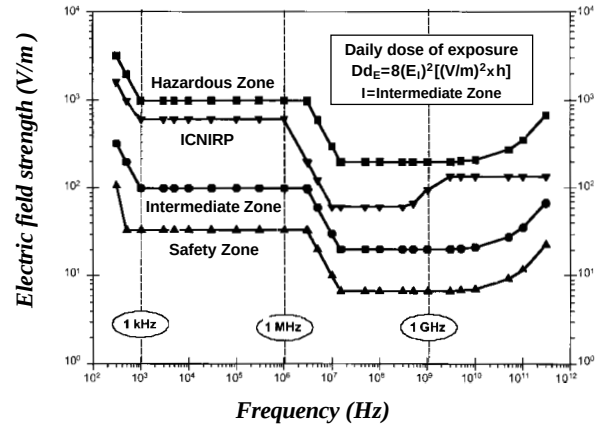
The new Polish occupational guidelines continue the existing system of a three-tiered standard (see figures 1 and 2, at right, and table below). Most workers are covered by the "intermediate" limits, which govern workdays lasting two to eight hours. A higher set of "hazardous zone" limits are for exposures lasting no more than a few minutes a day. Stricter "safety zone" rules cover workers who are not routinely exposed to NIR, as well as those exposed for more than eight hours a day.

At 50 Hz, the maximum allowable electric field exposure during an eight-hour day will be reduced from 15 to 10 kV/m — the same as ICNIRP. And 50 Hz magnetic fields must not exceed 200 A/m (2.4 G), compared to 400 A/m (4.8 G) under the current rules (the ICNIRP limit is 5 G).

At 900 MHz, the new rules specify a maximum of 20 V/m for an eight-hour shift, compared to the existing limit of 27.4 V/m and ICNIRP's 90 V/m. For potentially sensitive groups the new limit is 6.7 V/m. The rules also specify limits for exposures to pulsed radiation (see box at right).

The new limits for 500 kHz-50 MHz magnetic fields are in fact weaker than ICNIRP's. The current maximum level in this range is even higher and has drawn widespread criticism, Szmigielski told *Microwave News*. In response, the labor ministry has sought to find "a reasonable solution" for these frequencies, he said.

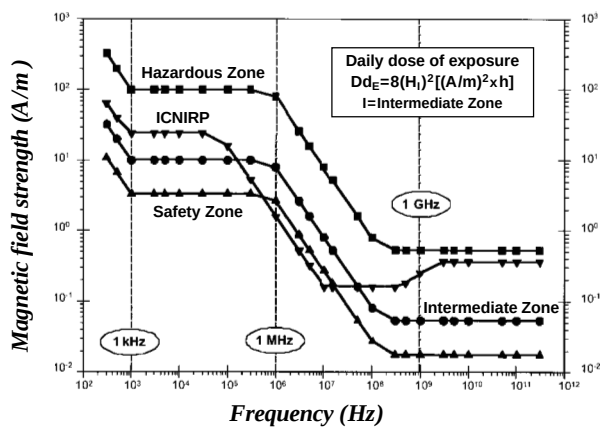
Figure 1: Limits for occupational electric fields



Limits for pulsed RF/MW fields

Frequency	100 MHz-3 GHz	3-10 GHz	10-300 GHz
Limit (kV/m)	4.5	$0.43f_{GHz}+3.2$	7.5

Figure 2: Limits for occupational magnetic fields



*Ordinance of the Polish Ministry of Labor and Social Policy, January 2, 2001, *Journal of Law*, No.4/2001, [para.] 36.

Poland's New Occupational Exposure Limits

	Limit for Electric Field Strength (V/m)			Limit for Magnetic Field Strength (A/m)		
FREQUENCY	SAFETY ZONE	INTERMEDIATE ZONE	HAZARDOUS ZONE	SAFETY ZONE	INTERMEDIATE ZONE	HAZARDOUS ZONE
0.5-50 Hz	5,000	10,000	20,000	20	200	2,000
50-300 Hz	5,000	10,000	20,000	$1/f_{kHz}$	$10/f_{kHz}$	$100/f_{kHz}$
300 Hz-1 kHz	$33.3/f_{kHz}$	$100/f_{kHz}$	$1{,}000/f_{kHz}$	$1/f_{kHz}$	$10/f_{kHz}$	$100/f_{kHz}$
1-800 kHz	33.3	100	1,000	1	10	100
800 kHz-3 MHz	33.3	100	1,000	$0.8/f_{MHz}$	$8/f_{MHz}$	$80/f_{MHz}$
3-15 MHz	$100/f_{MHz}$	$300/f_{MHz}$	$3{,}000/f_{MHz}$	$0.8/f_{MHz}$	$8/f_{MHz}$	$80/f_{MHz}$
15-150 MHz	6.7	20	200	0.053-0.0053	0.53-0.053	5.3-0.53
150 MHz-3 GHz	6.7	20	200	0.0053	0.053	0.53
3-300 GHz	$0.16f_{MHz}+6.5$	$0.053f_{MHz}+19.5$	$1.6f_{MHz}+195$	no limits established		

"Portability" of Bioeffects Across Frequencies and Modulations: A Report From an International Workshop Sponsored by the German Wireless Industry

Last December 4-5, a Workshop on Biological and Biophysical Research at Extremely Low and Radio Frequencies (ELF & RF): (1) Application of Research Results Across the Frequencies and Modulation Schemes of Present and Future Wireless Technologies and (2) Demodulation in Biological Systems *was held in Bad Münstereifel, Germany.*

The by-invitation workshop was sponsored by the German wireless industry research group Forschungsgemeinschaft Funk (FGF), in cooperation with BGFE, the occupational insurance provider for the electronics industry, and COST 244bis, the now-defunct European research coordination program; 42 specialists from Europe and the U.S. attended the meeting. The FGF is based in Bonn.

Drs. Roland Glaser (Germany), Christopher Portier (U.S.) and Asher Sheppard (U.S.) prepared an internal draft report on the workshop with the assistance of Drs. Kenneth Foster (U.S.), William Pickard (U.S.) and Bernard Veyret (France). Microwave News *obtained a copy of the draft. It has been edited for length and clarity, and is reprinted below. The FGF published a report on the workshop, based on this same draft, in the April issue of its newsletter, which is in German.*

Introduction

The number and variety of radio technologies have increased dramatically in recent years. In addition to existing cellular telephone systems that use FM, TDMA (GSM), CDMA and other modulations, prominent forthcoming technologies include UMTS cellular telephones and Bluetooth devices for local wireless networking and data transmission. This rapid expansion occurs at a time when evaluations of all potential categories of hazard are incomplete. A prohibitive number of studies would be needed if each modulation scheme were fully tested in a battery of experiments.

A large experimental database demonstrates hazards from acute and chronic exposures only if the body or localized tissues are heated, typically requiring an increase of several degrees. There is also a body of uncertain evidence for bioeffects under exposure conditions that, with varying degrees of certainty, do not produce significant heating. Lastly, there are data showing modulation-specific effects, but no direct evidence for hazardous effects specific to modulation.

Do similar biological effects occur over the range of frequencies and modulation types used in modern wireless communications, or do particular signals have unique biological effects? Rapid technical change in wireless communications and ever-wider human RF exposure add urgency to this long-standing question. The ability to apply biological research data broadly, rather than requiring specific testing for each signal type, has been called "portability."

The workshop addressed three main questions:

1) Whether biological systems respond to modulation of an RF field. A discussion of this topic was moderated by C. Davis (U.S.) and featured presentations by G. d'Inzeo (Italy), Pickard, J. Silny (Germany) and J. Weaver (U.S.).

2) Whether the results of research on ELF fields are relevant for RF modulated at ELF (ELF to RF portability). This session was moderated by C. Portier (U.S.), with talks by U. Bergqvist (Sweden), Foster, S. Johnston (U.K.), A. Lerchl (Germany), R. Meyer (Germany), M. Swicord (U.S.) and Veyret.

3) Whether results obtained with one modulation scheme are relevant for others (modulation scheme portability).

The biological significance of low-frequency signal components encoded in radio signals was addressed in light of normal nerve and muscle activity that produces low-frequency electrical activity in the body over the range from a few Hz to a few kHz. The workshop examined biophysical and biological information to address the hypothesis that biological systems respond to modulated RF signals through direct demodulation or other mechanisms.

For frequencies above ≈10 MHz, there is no evidence that ELF EMFs are produced at biologically significant levels in biological systems as a result of direct demodulation of modulated RF. Moreover, the mechanisms for producing bioeffects by exposure to an ELF field show low-pass properties and are not significant at RF frequencies. Consequently, physical principles indicate that the extensive literature from studies conducted at power frequencies (50/60 Hz) is not directly portable to RF.

An alternative RF research model stresses direct testing, emphasizing epidemiology and studies of laboratory animals exposed to specific signals and exposure scenarios. Guidance from physical mechanisms is given less emphasis than answering questions directly from human health experience and animal research. Generalizations permitting portability would be drawn from phenomenological databases and secondarily would make use of mechanistic models. This research model gives little opportunity to avoid a multiplicity of tests for each of the distinct modes of RF exposure, although in time, confidence in the research and interaction models can build sufficiently to permit setting rules for portability.

Principal Ideas from the Lectures and Discussions

Are results from ELF research relevant to the RF range?

Most participants felt there was no existing theory that would support the linkage of research findings on ELF to RF. No one expressed doubts about the conclusion that exposure to amplitude-modulated (AM) RF fields in the frequency range of mobile telephones is unlikely to produce biologically significant ELF electric fields across the cell membrane, or elsewhere in biological systems. This view is based on biophysical theory and a limited amount of supporting experimental data. Consequently, results from EMF bioeffects research are very unlikely to have any direct bearing on RF exposures.

Are there experimental observations that clearly indicate that modulated RF has specific bioeffects in contrast to unmodulated fields?

There are abundant data showing that modulated high-level RF fields have biological effects and that modulation is an important factor (e.g., microwave hearing). However, these have no direct bearing on RF signals typically used by communications systems.

Although a number of experimenters have reported effects that depend on AM at low levels of RF exposure ("nonthermal" SARs that are below exposure guideline limits set by ICNIRP and ANSI/IEEE), the effects remain isolated to particular *in vitro* systems and have not generated models that can be applied to portability across the various types of AM. Although a few experiments have been repeated successfully in independent laboratories, others have not, and the question of whether modulation is important for bioeffects remains open. Many participants emphasized that established hazardous RF effects of the kinds used in communications systems (pulsed and non-pulsed) are associated only with excessive heating.

What are the demonstrated and potential mechanisms for demodulation in biological systems?

Can biological systems extract an ELF signal from modulated RF fields? In answer to this basic question, the participants could not identify a biological structure that could demodulate the RF signals used in existing and emerging wireless technologies and thereby produce ELF fields at a biologically significant level. Identified nonlinear interaction mechanisms require responses at the carrier frequency of the field and these decline sharply for frequencies greater than a few kHz and

become very ineffective for RF. RF will induce membrane potential changes up to the GHz range, but the potential changes are very small above the cell cutoff frequency, which is typically in the low MHz range. Biological studies show that the maximum frequency at which demodulation can be measured in cell preparations is about 10 MHz, and at that frequency the process is extremely inefficient. It is highly unlikely that the identified nonlinear interactions would produce fields of a biologically significant magnitude by physical demodulation of RF fields induced in the body by low-powered communications equipment.

One idea is that at frequencies above 10 MHz biological structures may cause demodulation through a nonlinear response to RF. This has not been evaluated critically or tested experimentally and therefore remains speculative. Critics have stated that naturally occurring damping mechanisms would prevent nonlinear effects.

There is also a proposal that demodulation might occur because of a direct, time-varying influence on ongoing biochemical reactions. In this case, modulation patterns would be important because rapid variations in RF energy could affect the rates of chemical reactions. For example, reactions involving calcium ions might be affected by sinusoidal or pulsed modulation at ELF frequencies. This speculation has not been developed into a theory that can be subjected to critical review.

Are investigated modulation schemes relevant for other modulations and other carrier frequencies ("modulation scheme portability")?

There was agreement that this form of portability would be supportable only if there were agreement on mechanisms of interaction. At present, only the thermal mechanism satisfies the requirements for portability, and it does not suggest that modulation plays a role for exposures with comparable average SARs. Thermal considerations indicate that, with two exceptions (MW hearing and membrane depolarization), results with different modulation patterns are equivalent if their average heating effects are the same.

What do we know about mechanisms of RF interactions?

Thermal effects have been studied extensively in animals and hu-

Ross Adey Offers a Different Point of View

Microwave News *asked Dr. Ross Adey for his opinion of the FGF workshop report. It is reprinted below. For more than 35 years, Adey worked on the biological effects of modulated and unmodulated EMFs at the University of California (UC), Los Angeles, then at the VA Hospital in Loma Linda, CA, and most recently at UC, Riverside.*

This purported review is one of the most willful and pernicious distortions of a major body of scientific evidence. Its cluttered thinking pays no heed to the historical record of nonthermal bioeffects of amplitude- and pulse-modulated RF fields.

A careful review would have revealed benchmarks—hard won over more than three decades—which have led to a convergence of many key experimental findings and to a consensus strong enough to develop predictive biophysical models that now await experimental evaluation.

There is no discussion of existing support for a logical and hierarchical sequence of events that begins with the transduction of nonthermal EM energy at the surface of the cell membrane and leads to signal amplification and subsequent biochemical events. Nor is the ultrastructure of the cell membrane taken into account. This is critical because it leads to testable biophysical models of the detection of amplitude and pulse modulations.

Such models of ELF demodulation are the basis of the multinational PERFORM-A and REFLEX mobile phone studies, cosponsored by the European Union and the mobile phone manufacturers through the MMF [see p.1 and *MWN*, M/A00]. Yet this industry-based review reaches the egregious conclusion that, "At the present time, the concept of a demodulation process producing an ELF EMF field at a biologically significant level in biological systems exposed to AM RF fields used for telecommunication is not supported by either a defensible theory or direct experimental evidence." Clearly, the industry speaks with a divided voice on the most crucial aspects of its future research program.

Sensitivities to both ELF EMFs and ELF-modulated RF/MW fields have been reported in experiments at progressively more complex levels in the hierarchies of cellular organization.[1] Calcium efflux from brain tissue responds to ELF and to ELF-modulated RF fields. In the same and different cell culture lines, growth-regulating and stress-responsive enzymes respond to ELF fields and to ELF-modulated RF fields. Lymphocyte immune responses are sensitive to both ELF exposures and to ELF-modulated fields, but not to unmodulated fields. Cerebral amino acid neurotransmitter mechanisms are influenced by ELF fields and ELF-modulated RF fields, but not by unmodulated fields. A pivotal study by the U.S. Air Force has reported altered brain chemistry and behavior in mice exposed to pulsed ultrawideband fields at the low SAR of 37 mW/Kg, with evidence that these clearly nonthermal bioeffects involve free radical mechanisms.[2]

In addition, lifetime exposure studies carried out in my laboratory for Motorola showed clear and consistent trends in survival and the incidence of spontaneous and drug-induced tumors with digital exposures—but these results were in no way duplicated with analog exposures.[3]

Government panels have not ignored these important scientific discoveries. In June 1999 the U.S. RF Interagency Working Group identified 14 issues that it believes "need to be addressed to provide a strong and credible rationale to support RF exposure guidelines" [see *MWN*, J/A99]. One of these issues was based on studies that describe "biological responses to nonthermal ELF-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation."

In like fashion, the U.K. Independent Expert Group on Mobile Phones (the Stewart panel) concluded in its May 2000 report that, "As a precautionary measure, amplitude modulation around 16 Hz should be avoided, if possible, in future developments of signal coding" (¶5.39). [See *MWN*, M/J00.]

For whom does the report presume to speak in such a crudely biased and uninformed fashion? What is its industrial and corporate constituency? In ancient words still so profoundly true, *res ipsi loquitur*, the matter speaks for itself.

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1. W.R. Adey, "Cell and Molecular Biology Associated with Radiation Fields of Mobile Telephones," *Review of Radio Science, 1996-1999*, pp.845-872. W.R. Stone and S. Ueno, eds. New York: Oxford University Press, 1999.

2. R.L. Seaman et al., "Hyperactivity Caused by a Nitric Oxide Synthase Inhibitor Is Countered by Ultra-Wideband Pulses," *Bioelectromagnetics, 20*, pp.431-439, 1999.

3. W.R. Adey et al., "Spontaneous and Nitrosurea-Induced Primary Tumors of the Central Nervous System in Fischer 344 Rats Chronically Exposed to 836 MHz Modulated Microwaves," *Radiation Research, 152*, pp.293-302, 1999; W.R. Adey et al.,"Spontaneous and Nitrosurea-Induced Primary Tumors of the Central Nervous System in Fischer 344 Rats Exposed to Frequency-Modulated Microwave Fields," *Cancer Research, 60*, pp.1857-1863, 2000.

man subjects and in a large number of *in vitro* biological preparations. Despite many attempts to devise biophysical models for nonthermal effects, none has been experimentally verified or is free from devastating theoretical criticism.

Strategies for future research activities to develop scientific data and tools for risk assessments of emerging RF technologies

There was little support for follow-up research on reported biological effects that were difficult to replicate and not supported by biophysical theory. There was strong support for hypothesis-driven research that could enhance understanding of mechanisms of interaction.

High-duty-rate pulsed fields and AM of the type used for spread spectrum communications (e.g., CDMA) appear less likely to have bioeffects than low-duty-rate pulses and sinusoidal AM signals. Furthermore, studies with low-duty-rate pulsed waveforms were thought more likely to be useful than those with sinusoidal AM.

Conclusions

• At the present time, the concept of a demodulation process producing an ELF EMF field at a biologically significant level in biological systems exposed to AM RF fields used for communications is not supported by either a defensible theory or direct experimental evidence.

• The problem of portability of bioeffects among modulations can be solved by knowing the relevant mechanisms of interaction.

• Or, portability may emerge by development of a substantial database from phenomenological research on each of several RF signals.

• The concept that RF bioeffects are caused by heating is well established. This suggests that average SAR (and not specific waveform characteristics) is the major dosimetric quantity of biological significance. However, controversy exists because, although heating can explain effects observed for high power levels, it does not appear to explain effects reported at low power levels. There often is controversy about the reliability of such effects because of conflicting data or the absence of independent experimental confirmation.

• Further research is necessary on the question of whether modulated and pulsed fields are more effective than unmodulated fields.

• Further research on microdosimetry that applies dielectric theory to cells and subcellular entities is needed to achieve a better understanding of the proposal that, in the absence of overall temperature change, RF energy might influence biochemical processes. However, existing research on heat transport at microscopic dimensions sets the challenge of how RF energy, which cannot introduce significant temperature gradients, might be biologically significant.

Hot New Papers

Julian Peto, "Cancer Epidemiology in the Last Century and the Next Decade," *Nature, 411*, pp.390-395, May 17, 2001.

"The increase in cancer incidence caused by increased exposure to a carcinogen might not be detectable for several decades, and laboratory testing must remain the first line of defense against potentially dangerous new agents....Epidemiological data on human cancer rates still provide the only reliable evidence that the cancer risks caused by long-established activities such as working in an oil refinery or living near a high-voltage power line are not large."

Yehuda Lerman, Ruben Jacubovich and Manfred Green, "Pregnancy Outcome Following Exposure to Shortwaves Among Female Physiotherapists in Israel," *American Journal of Industrial Medicine, 39*, pp.499-504, May 2001.

"Exposure to shortwaves [typically 27.12 MHz] was associated with a significantly increased odds ratio (OR) for congenital malformations (OR 2.24, CI 1.27-4.83, p=0.006) and low birth weight (OR 2.99, CI 1.32-6.79, p=0.006). This effect increased in a dose-related manner. After controlling for potential confounding variables, only low birth weight reached statistical significance (OR 2.75, CI 1.07-7.04, p=0.03) ....[T]his study provides further support to earlier reports that occupational exposure of female physiotherapists to shortwave radiation during pregnancy could have detrimental effects on pregnancy outcome, and that shortwave use during pregnancy may be considered as being a potential reproductive hazard."

James Gurney and Nina Kadan-Lottick, "Brain and Other Central Nervous System Tumors: Rates, Trends and Epidemiology," *Current Opinion in Oncology, 13*, pp.160-166, May 2001.

"The latest available data from SEER [Surveillance, Epidemiology and End Results] show that CNS [central nervous system] cancer incidence rates have stabilized since 1991 in all age groups, including the very elderly. Nevertheless, concern that the changes in environmental toxicants have caused or are causing increases in human neurocarcinogenicity should and will continue to be monitored, assessed and debated.... An area of current concern is the potential risk from exposure to nonionizing EMFs. The hypothesis that human brain cancer can be caused by exposure to ELF EMFs, such as those emitted from 60 Hz power-frequency equipment and power line distribution systems, has been explored in earnest for more than 25 years. The preponderance of the evidence, both biologic and epidemiologic, fails to support an ELF EMF causal relation with brain cancer. Nevertheless, this research area, because of inconsistent findings and public concern, will continue to be explored....Additionally, the rapid and extensive proliferation of handheld wireless RF devices, such as analog and digital mobile tele-

Leukemia and Brain Tumor Risks Among Swiss Railroad Workers

C.E.Minder and D.H. Pfluger, "Leukemia, Brain Tumors and Exposure to Extremely Low-Frequency Electromagnetic Fields in Swiss Railway Employees," *American Journal of Epidemiology, 153*, pp.825-835, May 1, 2001.

"[T]he authors compared occupations with high average exposures (line engineers: 25.9 μT [259 mG]) to those with medium and low exposures (station masters: 1 μT). The mortality rate ratio for leukemia was 2.4 (95% confidence interval (CI): 1.0-6.1) among line engineers....The mortality rate ratio for brain tumors was 1.0 (95% CI: 0.2-4.6) among line engineers and 5.1 (95% CI: 1.2-21.2) among shunting yard engineers....Two exposure characteristics were evaluated: cumulative exposure in μT-years and years spent under exposure to magnetic fields of ≥10 μT. There was a significant increase in leukemia mortality of 0.9% (95% CI: 0.2-1.7) per μT-year of cumulative exposure to extremely low-frequency magnetic fields. The increase by years spent under exposure of ≥10 μT was even stronger: 62% per year (95% CI: 15-129). Brain cancer risk did not show a dose-response relation. This study contributes to the evidence for a link between heavy exposure to extremely low-frequency magnetic fields and leukemia....Swiss trains run on 16 2/3 Hz [AC]."

See also accompanying invited commentary by David Savitz (pp.836-838) and Minder and Pfluger's reply (pp.839-840). In addition, see p.3 and *MWN*, S/O90, M/J94 and J/A96.

phones, has prompted studies to investigate the anecdotal reports of brain tumor occurrence associated with use of these phones....Although current scientific evidence suggests no brain cancer risk from use of wireless mobile phones, effects from long-term exposure await assessment, and many years will pass before resolution of this issue."

P. Heikkinen et al., "Effects of 50 Hz Magnetic Fields on Cancer Induced by Ionizing Radiation in Mice," *International Journal of Radiation Biology, 77,* pp.483-495, April 2001.

"A total of 150 female CBA/S mice were randomized into three equal groups at the age of 3-5 weeks. One of the groups served as a 'cage-control group.' The two other groups were exposed to ionizing radiation in the beginning of the study. One of these two groups was exposed 24 h per day, for 1.5 years, to a 50 Hz vertical MF, the intensity of which varied regularly between 1.3, 13 and 130 µT [13 mG, 130 mG and 1.3 G]. The other served as a control group and was sham-exposed to MF....MF exposure did not increase the incidence of any primary neoplasms. However, the incidence of basophilic liver foci, a probable pre-neoplastic change in liver, was increased. The incidence of hepatocellular adenomas was unchanged, whereas the incidence of hepatocellular carcinomas was slightly, but not statistically significantly, elevated. It is concluded that overall the results of this study do not support a role for MF as a tumor promoter."

J.M. Harrington et al. "Leukemia Mortality in Relation to Magnetic Field Exposure: Findings from a Study of United Kingdom Electricity Generation and Transmission Workers, 1973-97," *Occupational and Environmental Medicine, 58,* pp.307-314, May 2001.

"The mortality experienced by a cohort of 83,997 employees of the former Central Electricity Generating Board of England and Wales was investigated for the period 1973-97. All employees were employed for at least 6 months with some employment in the period 1973-82....[T]he standardized mortality ratio of 84 for all leukemias (observed 111, expected 132.3) was similar to that of 83 for all causes (observed 14,845, expected 17,918). No significant positive trends were found for the risks of various types of leukemia (chronic lymphatic leukemia, acute myeloid leukemia, chronic myeloid leukemia, all leukemia) either with lifetime cumulative exposure to magnetic fields or with such exposures received in the most recent 5 years." (See also *MWN*, M/J97.)

Why Low-Frequency EMFs Can Break Chemical Bonds

Arnt Inge Vistnes and Kristoffer Gjötterud, "Why Arguments Based on Photon Energy May Be Highly Misleading for Power Line Frequency Electromagnetic Fields," *Bioelectromagnetics, 22,* pp.200-204, April 2001.

"Low-frequency EMFs may result in both (indirect) ionization (as exemplified by the corona effect) and triggering of nerve activity, in spite of a quite negligible photon energy, as given by $E=h\nu$....The purpose [and] hope [of this paper] is that the incorrect use of photon energy arguments, with which we too often have been presented until now, when discussing possible biological effects of low-frequency EMFs, will disappear....There are substantial reasons to expect that physics may be very different for visible light and EM waves at 50 Hz. For visible light, the photons come as individual packages with plenty of empty room between the photons, and one-photon interactions are the normal situation. At 50 Hz an enormous number of photons are present simultaneously at every point in space, even at the realistic field strength found in a human body, and multiple-photon interactions will be common....A system like an electron may pick up just as much energy from a power-frequency EMF as from ionizing radiation. This may in the first place seem to contradict the quantum mechanical concept of photon energy, but on second thought it does not. The key to solving the apparent contradiction is to remember that energy is exchanged by 'independent' (noncoherent) single photons at visible light and higher frequencies. At radio waves and lower frequencies, however, energy is exchanged by a very large number of highly coherent photons that act together (additively) in a constructive way, which is manifested as classical EMFs.... There are, however, very different time-scales associated with ionizing and power line frequencies."

"MICROWAVE NEWS" FLASHBACK

Years 20 Ago

• China provisionally adopts a frequency-independent 50 µW/cm^2 standard for occupational exposures to non-ionizing radiation.

• During a House subcommittee hearing at which Rep. Albert Gore Jr. (D-TN) concludes that RF sealers and heaters pose serious health risks, Rep. Bob Shamansky (D-OH) says that he is "almost flabbergasted" by OSHA's lax enforcement effort on the devices, adding that he finds it "frankly shocking."

• The lead editorial in the British medical journal *Lancet* calls for more rigorous double-blind studies on healing non-union bone fractures with pulsed EMFs.

Years 10 Ago

• Members of the EPA Science Advisory Board's panel on EMFs want to weaken the agency's finding that EMFs are a "possible, but not proven, cause of cancer in humans."

• Computer industry officials call for a U.S.-European standard for VDT emissions to head off consumer pressure for stricter limits. "If we don't come up with something soon, we're going to pay the consequences," says Apple's John Chubb.

• Citing health concerns, state legislators in Michigan, Rhode Island and Tennessee propose temporary moratoriums on power line construction.

Years 5 Ago

• Due to a dispute with the CTIA over the management of funds, WTR cancels two major cell phone health research contracts and stops payment to other researchers.

• A NJ Superior Court jury finds no EMF–leukemia link, but orders utility Atlantic Electric to pay over $750,000 to plaintiff John Altoonian and his wife for emotional distress.

• Dr. Ross Adey of the VA Hospital in Loma Linda, CA, reports that rats exposed to radiation designed to mimic digital signals had fewer and smaller tumors than control animals.

Across the Spectrum

"It's a miracle. I'll leave it at that."

—Tom Brokaw, anchor, *NBC Nightly News,* telling the graduating class of Sweet Grass County High School, MT, that after 40 years in broadcasting he still does not understand how his picture reaches television sets, quoted by Marla Harper, "Names & Faces: Commencement Comments," *Washington Post,* p.C3, May 29, 2001

"We have to be prepared for the prospect of a terrorist driving a van loaded with an RF weapon by the New York Stock Exchange and destroying its equipment and records at the touch of a button. On May 1, members of Congress will see a demonstration at Aberdeen's unique testing facility of a prototype radiofrequency weapon built using off-the-shelf commercial components with information readily available from unclassified sources."

—Rep. Roscoe Bartlett (R-MD), Special Oversight Panel on Terrorism, House Armed Services Committee, in a press release, May 4, 2001 (see also *MWN,* N/D99 and N/D00)

"A federal dictatorship over land-use issues just won't work. States won't accept it. It's a nonstarter in Congress."

—Ralph Cavanagh, Natural Resources Defense Council, San Francisco, quoted by John Fialka, "States Protest Bush's Plan for Siting Power Lines," *Wall Street Journal,* p.A2, May 15, 2001

Within the ICNIRP and NCRP committees, the process is closed, informal and nontransparent, whereas the IEEE process is open and transparent....

In the last ten years, there has been a movement, mostly within environmentalist circles, for the widespread application of the precautionary principle....But now in Europe it is being examined for potential application to any technology, even electromagnetic energy. Of course, in a sense, this idea is merely the end point in the thinking of Paul Brodeur, history professor Steneck and Nair and Morgan, who promoted the concept of "prudent avoidance" at the height of the power line scare, which is now generally acknowledged as baseless.

—Dr. John Osepchuk, chair, IEEE SCC-28 International Committee on Electromagnetic Safety, formerly with Raytheon and now a consultant, Concord, MA, and Ronald Petersen, executive secretary, SCC-28, Lucent Technologies, Murray Hill, NJ, "Safety Standards for Exposure to RF Electromagnetic Fields," *IEEE Microwave Magazine,* p.64 and p.65, June 2001 (see also p.7)

Tax police said Monday they had confiscated 60,000 counterfeit cellular telephones from two trucks at Rome's international airport. The phones bore well-known brand names such as Nokia, Motorola, Ericsson, Philips and Siemens but in fact were cheap Chinese knockoffs that lacked safeguards against electromagnetic radiation. Police said they would pose a health hazard to anyone using them.

—"Shipment of Fake Cell Phones Is Intercepted at Fiumicino" (entire article), *Italy Daily* (Italy, published by *Corriere Della Sera* and the *International Herald Tribune),* p.1, April 24, 2001

"It's scary. Hopefully, you're never going to have to transmit within 300 feet of [Nextel's] towers. It's a little nerve-wracking for officers because they are not guaranteed reliable communication anymore."

—Gary Schrader, police captain, Tigard, OR, on interference caused by Nextel's mobile phone system, which uses 800 MHz frequencies previously reserved for law enforcement, quoted in "Cell Phone Towers Are a Police Radio Nightmare," *Law Enforcement News,* p.5, March 15, 2001

Do mobile phones cause headaches? In the case of third-generation (3G) telephones, the answer is undoubtedly yes—even though nobody is yet using them. Instead, they are causing technical and financial pain for all the companies around the world that are trying to build 3G networks.

—"Pass the Painkillers," *The Economist* (U.K.), p.51, May 5, 2001

New Books

James Lin, ed., ***Advances in Electromagnetic Fields in Living Systems Volume3***, 312 pp., New York: Kluwer Academic/Plenum, 2000, $95.50. Orders: (212) 620-8000, Fax: (212) 463-0742, E-mail: <info@plenum.com>, Web: <www.wkap.nl>.

H. Takebe, T. Shiga, M. Kato and E. Masada, ***Biological and Health Effects from Exposure to Power-Line Frequency Electromagnetic Fields—Confirmation of Absence of Any Effects at Environmental Field Strengths***, 382 pp., Tokyo: Ohmsha Ltd., 2001, $120.00 + $5.00 shipping (translated from the Japanese, originally published in 1999). Fax numbers of distributors: Germany: (49+341) 995-4255; U.K.: (44+1865) 750079; U.S. and Canada: (703) 323-3668.

Hubert Trzaska, ***Electromagnetic Field Measurements in the Near Field***, 227 pp., Atlanta: Noble Publishing, 2001, $69.00. Orders: (770) 449-6774, Fax: (770) 448-2839, E-mail: <orders@noblepub.com>, Web: <www.noblepub.com>.

Advice from a Swedish Tabloid: How To Hold Your Mobile Phone

"Earpiece" "Distance" "Cheek" "Angle" "Norwegian Style"

—Illustrations accompanying Sören Bloom, "Cell Phones of the Future," *Aftonbladet* (Sweden), p.45, March 25, 2001

UPDATES

EMF MEASUREMENTS

Field Guide to the Chemical Industry... Quebec's Research Institute on Occupational Health and Safety (known by its French acronym IRSST) in Montreal has published a handbook on measuring magnetic fields in chemical processing plants. Originally intended for use by the Canadian province's health officials, the 53-page *Guide for the Measurement of Static and Alternating Magnetic Fields Around Power Bars and Rectifiers in the Electrochemical Industry* (No.R-244) is available, in French only, at no cost, from the IRSST Web site: <www.irsst.qc.ca>. A print copy costs C$6.42. Contact: (514) 288-1551 or Fax: (514) 288-7336.

MEDICAL APPLICATIONS

mm Waves Slow Tumor Growth... Tumors grew more slowly and an anticancer drug was more effective when test animals were exposed to millimeter-wave radiation, according to a team at the Russian Academy of Sciences' Institute of Radio Engineering and Electronics in Moscow. In one experiment, tumor growth was reduced by a third in rats exposed to 10 GHz pulsed radiation, Dr. N.D. Devyatkov and coauthors report in *Critical Reviews in Biomedical Engineering (29,* pp.98-110, 2001). The peak intensity of the radiation was 80 kV/cm, but its average energy level was low due to the short pulse width—10 nanoseconds—and the 40-second intervals between pulses. When rats were treated with endoxan, a chemotherapy drug, both pulsed 10 GHz and 42 and 52 GHz continuous wave (CW) radiation produced similar growth-retarding effects. In addition, mice given endoxan and exposed to pulsed or CW radiation had slower tumor growth compared to mice that received only the drug. "The combined application of microwave radiation and a chemotherapeutic compound, such as endoxan, produced the best therapeutic effect," the team concludes. Interactive effects of RF/MW radiation and drugs have long been noted. Pulsed RF/MW radiation has been found to alter the effect of some tranquilizers, including Valium (see *MWN*, F81), and to cause greater damage to eye tissue when used in conjunction with anti-glaucoma drugs (see *MWN*, J/A87).

MEETINGS

Notes... Abstracts of the papers presented at the *2nd International Symposium on Nonthermal Medical/Biological Treatments Using Electromagnetic Fields and Ionized Gases (Electromed 2001)* are available on the Web at <www.ece.odu.edu/electromed2001>. The meeting was held in Portsmouth, VA, May 20-23...The *IEEE EMC International Symposium*, which will be held in Montreal, Canada, will feature an afternoon session on August 16 on *EMC in Health-care: EMI Risk & Dealing with It*, chaired by Dr. Bernard Segal of McGill University. E-mail: <emc2001@jpdl.com>, Web: <www.2001emcmtl.org>....City & Financial, a U.K. conference organizer, is holding a two-day course on *Mobile Telephones and Health—the Latest Developments* in London, June 6-7. Among those scheduled to speak are: Stan Barnett, Lawrie Challis, Roger Coghill, Camelia Gabriel, Henry Lai, Michael Milligan, Alasdair Philips, Alan Preece, Bernard Veyret and Arne Wennberg. The program is posted at <www.cityandfinancial.com>.

Upcoming Meetings... September 2-5: *13th Conference of the International Society for Environmental Epidemiology,* Garmisch-Partenkirchen, Germany. Contact: Conference Secretariat, ISEE 2001, Interplan, Albert-Rosshaupter-Str. 65, D-81369 Munich, Germany, Fax: (49+89) 54823444, E-mail: <gap2001@i-plan.de>, Web: <www.gsf.de/epi/gap2001>...October 2-6: *Biological Effects of Ionizing Radiations, Electromagnetic Fields and Chemical Toxic Agents,* Predeal, Romania. Contact: Dr. Ileana Petcu, National Institute of Physics and Nuclear Engineering "Horia Hulubei," Str. Atomistilor 109, PO Box MG-6, RO-76900 Bucharest-Magurele, Romania, (40+1) 404-2300, Fax: (40+1) 423-1701, Web: <www.nipne.ro/Cenex/cex_eur.htm>.

PATENTS

Using EMFs To Regulate Genes... Drs. Martin Blank and Reba Goodman of Columbia University in New York City have applied for a patent for a technique that uses magnetic fields to manipulate the activity of specific genes. Using what they call electromagnetic response elements (EMRE), which consist of varying numbers of nCTCTn sequences (where C and T stand for cytosine and thymine, two of the four bases in DNA), they claim they can turn on specific genes. Eight nCTCTn sequences are needed to activate c-*myc* expression by an 80 mG magnetic field, and only three such sequences are needed for the HSP70 promoter. In a paper appearing in the April 1 issue of the *Journal of Cellular Biochemistry (81,* pp.143-148, 2001), Blank and Goodman report that by inserting the 900 base pair segment of the c-*myc* promoter containing the eight nCTCTn sequences upstream of a usually unresponsive gene, they were able to activate that gene. They offer the following possible application: A weak magnetic field could turn on an exogenous insulin gene with one or more EMREs placed upstream. "This technique could be applied to any gene you may want to control," Blank told *Microwave News.* In a second paper, which will soon appear in the same journal, they present calculations that, they write, "suggest a plausible mechanism for initiation of transcription by the generation of repulsive forces between DNA chains when EM fields interact with flowing electrons." Blank and Goodman declined to release a copy of their patent application.

PEOPLE

Sir **Richard Doll**, the U.K. cancer researcher who has been much in the news over his evolving assessment of EMF health risks (see *MWN,* M/A01), has been elected a foreign associate of the U.S. National Academy of Sciences....Dr. **David Conover** will retire from NIOSH on June 30 after having worked on non-ionizing health issues for 30 years....The Bioelectromagnetics Society will present Dr. **Tom Tenforde** of the Battelle Pacific Northwest Labs in Richland, WA, its d'Arsonval Award at its annual meeting in St. Paul, MN, on June 11. Tenforde, who is being recognized for his "lifetime achievements in the field of bioelectromagnetics," will give a talk on the "Wonders of Magnetism."... Soon after retiring from Motorola, Dr. **Q. Balzano** is back at the company doing some part-time consulting (see also p.5).... **Julius Knapp** has been appointed the deputy chief of the Office of Engineering and Technology at the FCC in Washington.

As We Go To Press

Male Breast Cancer Cluster Prompts Lawsuit

Three men who worked in the same basement office, next to equipment used to distribute electricity, developed breast cancer. On May 29, two of the men, Arthur Slater and James Montano, filed suit in state court in Albuquerque, NM, blaming their condition on exposure to EMFs and toxic chemicals.

"The odds of three men in one specific office getting breast cancer are a trillion to one," Sam Bregman of the Bregman law firm in Albuquerque told *Microwave News.*

The defendants are Bernalillo County and the City of Albuquerque, which jointly own the office building—the men work for the county. Bregman said that since 1988 there have been at least 14 cases of cancer and four known deaths among the office workers, who have "continually complained of magnetic interference problems." Magnetic fields in the center of the office were above 15 mG, according to a 1991 survey by the city. A second survey in 1996 showed that the levels had increased.

Bregman also cites repeated exposures to a host of different chemicals, including volatile organic compounds.

Slater, 78, worked in the building from 1985 to 1998, and Montano, 52, worked there from 1996 to 1998.

Dr. Genevieve Matanoski of Johns Hopkins University first reported a cluster of male breast cancers among EMF-exposed workers in 1989 (see *MWN*, N/D89 and M/A91). Three later studies also found an association (see *MWN*, J/A90, J/F91 and J/A92). There were about 1,300 new cases of male breast cancer in the U.S. in 1999, according to the American Cancer Society.

Keeping Current: Follow-Up on the News

◆ The GAO report (see p.6) has put new pressure on the IEEE SCC-34 subcommittee to complete its protocol for measuring SARs from mobile phones—the group recently marked its fourth anniversary. It will meet again during the first week of June in St. Paul, MN. The parallel European standard developed by CENELEC has been completed and is awaiting final approval by its technical board. This could happen in July.

◆ Howard Bassen of FDA's Center for Devices and Radiological Health in Rockville, MD, may have a one-year EMC engineering slot to study EMI to implanted medical devices by detectors and anti-theft systems. Contact Bassen at (301) 827-4950 or by e-mail at <hib@cdrg.fda.gov>.

◆ The April 26 *New England Journal of Medicine* features letters from Austria's Dr. Michael Kundi of the University of Vienna and a team at Hacettepe University in Ankara, Turkey, on the NCI epidemiological study of cell phone users, with NCI's response (see *MWN*, J/F01).

◆ In our last issue we presented Dr. Sam Milham's new thesis that residential electrification caused the emergence of the childhood leukemia peak. His paper has now been published in the March issue of *Medical Hypotheses (56,* pp.290-295, 2001).

◆ The Air Force Office of Scientific Research (AFOSR) is seeking proposals on the biomolecular and subcellular effects of RF/MW radiation in an effort to devise "synthetic RF sensors at the micro/nanoscale." It notes that, "It is critical that the DOD pioneer this area of research since the results will be far reaching. Understanding the genes and proteins expressed by nonthermal RF exposure will have a profound impact on a host of scientific fields." An AF spokesperson said that one project will be funded for up to $1 million a year for three to five years. For more information on "MURI Topic#16," go to: <www.onr.navy.mil/sci_tech/special/muri2002/topics.htm#16>.

◆ The IEEE's Committee on Man and Radiation (COMAR) has issued a technical information statement on "Safety Issues Associated with Base Stations Used for Personal Wireless Communications." It appears in the March/April issue of the *IEEE Engineering in Medicine and Biology Magazine.*

◆ An item posted on the Ananova Web site, <www.ananova.com>, on April 13 reports that geologists in Romania have discovered a "magic mountain" that can lower blood pressure and stop the pain from arthritis. Ananova reports that, "Scientists believe the mountain's power comes from an unusual configuration of magnetic fields."

VIEWS ON THE NEWS

Another Breakthrough, Another Dead End?

It's tempting to call Dr. Li's new study on miscarriages a breakthrough (see p.1). But that would assume that there will be a rush to extend his ideas about peak exposures and thresholds to other populations and to test it in the laboratory.

A rash assumption.

Many times over the last few years, epidemiological studies have offered new insights but were never properly followed up.

In 1994, Dr. Gilles Thériault reported a strong association between cancer and exposures to high-frequency transients that was greeted as a possible breakthrough by epidemiologists. Thériault, of Canada's McGill University, found an up-to-tenfold increased risk of lung cancer and what he called a "remarkable" dose-response relationship (see *MWN*, N/D94).

Hydro-Québec reacted swiftly and forcefully. It took the data set away from Thériault and locked it up. One of the most notable aspects of this corporate cover-up was the silence of the public health community. No one complained, no one seemed to care.

Thériault recently told us that he has been unable to raise any money to pursue the transient hypothesis after his brush with the giant electric utility. "From that day on, I have been out of the field," he said, adding that even today the memory of the experience remains painful.

Two years later, Dr. Tony Miller of the University of Toronto reported that when exposures to *both* electric *and* magnetic fields were taken into account, leukemia risks among some Ontario Hydro workers rose to up to 11 times the expected rate (see *MWN*, J/A96). To its credit, Ontario Hydro supported further analysis and last year the role of electric fields became clearer: The data pointed to a threshold effect (see *MWN*, M/J00). But these findings, like Thériault's, are gathering dust.

Thériault and Miller, like Li, had the imagination to look beyond average magnetic field exposures and were rewarded with provocative results. But the progress stopped there. Without funding institutions that are free of economic agendas, there is little hope that innovative ideas will get the attention they deserve.

The electric utility industry is currently the only source of EMF research funds. We recently asked EPRI how much is being spent and were told that such information could not possibly be divulged. Whatever the amount, it is clear that the industry is in no rush to understand EMF health risks.

An example: Seven years ago, Dr. Gene Sobel of the University of Southern California reported a strong association between EMFs and Alzheimer's disease (see *MWN*, J/A94). Despite very limited funding, Sobel continued to build on his original finding and, at the same time, Sweden's Dr. Maria Feychting reported some support for the EMF–Alzheimer's link (see *MWN*, J/F97). Then in 1998, EPRI hosted a workshop at a beach resort to see if it should get involved (see *MWN*, S/O98). "It was a very nice beach party," Sobel told us. That was EPRI's last act on Alzheimer's disease.

Another example: At the end of last year, Dr. James Trosko made a big splash when he showed that EMFs might indeed be able to act as a cancer promoter. WHO's Dr. Mike Repacholi asked EPRI to fast-track the replication effort so that the results would be available for the IARC review which will soon get under way in Lyon, France. Here again EPRI dawdled, and there will be nothing new ready for IARC (see p.2).

This has been a common strategy. Isolated and unreplicated findings are usually discounted as preliminary—and will of course remain that way, if no one supports follow-up work.

Dr. David Savitz says that there is no point in doing any more EMF epidemiology without some fresh ideas from the laboratory (see p.3). We disagree. As Thériault and Miller—and now Li—have demonstrated, epidemiologists have been stymied not by any lack of good ideas, but by lack of unfettered support. Researchers must have access to enough money to get the job done and must be given the freedom to take chances and follow their hunches. The current way is a series of dead ends.

If we are to solve the EMF enigma, what's needed first and foremost is a breakthrough on how research is funded and who controls the purse strings.

Animal Studies Galore

Kudos to the U.S. National Toxicology Program (NTP) and Italy's Ramazzini Foundation for embarking, independently, on a series of animal studies on mobile phone radiation (see p.1). Together with the six PERFORM-A animal experiments, the Australian repeat of the *Pim1* mouse study and Motorola's Iridium study, these initiatives will provide a wealth of new information.

One caveat however. The U.S. and Italian projects are a once-in-a-generation opportunity and both groups should make sure they get the most from their investments. The teams led by Drs. Christopher Portier and Morando Soffritti should solicit a wide range of opinions on the most appropriate exposure conditions and radiation signals. They must do better than the MMF and Germany's FGF. These two industry groups appear to have decided in advance what they wanted to hear at their recent workshops (see p.5 and p.11).

The NTP animal studies on power-frequency fields provide a further illustration of how the process can go awry. Only one type of exposure was investigated—sinusoidal 60 Hz fields. The fact that Dr. Gary Boorman, who led the project, had already made up his mind that there are no effects did not help. These were costly errors in judgment—which must not be repeated.

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