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## NIEHS Panel Finds EMFs Are "Possible" Human Carcinogens

Power frequency electromagnetic fields (EMFs) are "possible human carcinogens," according to a working group assembled by the National Institute of Environmental Health Sciences (NIEHS).

On June 24, the 30-member panel voted 19 to 9 in favor of categorizing extremely low frequency (ELF) EMFs, such as those from power lines and electrical appliances, as possible carcinogens. The decision followed ten days of review and debate at a conference center in an industrial park outside Minneapolis.

The panel's decision was based largely on the results of epidemiological

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studies of children exposed at home and workers exposed on the job. The results of animal (*in vivo*) and cellular (*in vitro*) experiments provided less support for designating EMFs as possible cancer agents.

The evaluation of the EMF literature—as well as the specific votes—followed procedures developed by the International Agency for Research on Cancer (IARC), based in Lyon, France. Dr. Lorenzo Tomatis, the former director  
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### Views on the News: the EMF-Cancer Decision

## NIEHS Spins the News, Downplays the Health Risks

It was the press release that gave the game away. Up to that point, the NIEHS had run a remarkably open process. But when its working group voted to list EMFs as possible human carcinogens, NIEHS managers moved quickly to control the message the public would hear.

Dr. Michael Gallo, who chaired the Minneapolis working group meeting, was picked to calm things down. "This report does not suggest the risk is high. It is probably quite small," he said in the NIEHS press release. Gallo is a toxicologist and the director of an NIEHS-sponsored Center of Excellence at the University of Medicine and Dentistry of New Jersey in Piscataway.

The sound bite worked like a charm. It was the only direct quote offered by the NIEHS and every reporter assigned to the story dutifully reprinted it. A DIVIDED NIH PANEL AGREES POWER LINES MAY POSE SMALL CANCER RISK, ran the *Boston Globe* headline (June 25).

*(continued on p.19)*

## **EMFs Shown To Change Human Cardiac Rhythms; Predicted Rise in Heart Disease Supported by Epi Study**

EMF exposure can alter heart rhythms and may lead to elevated cardiac risks, according to Dr. Antonio Sastre of the Midwest Research Institute (MRI) in Kansas City, MO.

In recent clinical studies of EMF effects, Sastre observed changes in heart rhythms that have been linked to increased risks of heart disease. This led him to predict that utility workers would have a higher rate of two specific types of heart disease. He then collaborated with Dr. David Savitz on a new epidemiological study to test this hypothesis.

The epidemiological results supported Sastre's prediction. "If you look at the hypothesis among 140,000 utility workers, it pans out," MRI's Dr. Charles Graham, a coauthor of the clinical studies, told *Microwave News*.

Savitz, of the University of North Carolina, Chapel Hill, noted that while epidemiological studies of EMFs have found some associations with leukemia and other kinds of cancer, "without any strong mechanistic hypothesis it's unclear how to follow up." But in this case, he said, "There are some immediate opportunities for further testing, both in clinical experiments and using the tools of epidemiology."

Sastre's clinical studies found that EMF exposure can reduce the extent of heart-rate variability (HRV), a measurement used by cardiovascular specialists as a diagnostic tool.

"A metronome beats at a constant rate; a healthy heart does not," Sastre, Graham and MRI's Dr. Mary Cook write in *Bioelectromagnetics* (19, pp.98-106, 1998), in their paper on the clinical studies. Beat-to-beat variations in heart rhythm are a natural result of the interactions of reflexes that control blood pressure, body temperature and respiration. "This type of variability is not consciously perceived by a person," they note; it is different from changes in heart rate in response to exertion or anxiety.

Cardiologists have found that changes in HRV can predict the risk of several important heart conditions. According to Sastre, reduced HRV is known to be linked to increased risk of sudden cardiac death, and to increased mortality in heart attack survivors.

The three clinical studies, with a total of 77 volunteers, found that HRV was significantly reduced during exposure to an intermittent 60 Hz circularly polarized magnetic field at 200 mG.\* No such changes were observed during nighttime exposure to a 10 mG intermittent field, or to a 200 mG continuous field.

Based on these findings, Sastre proposed that workers with high EMF exposure should show increased mortality from two types of cardiovascular conditions—arrhythmia and heart attacks. In a paper that Savitz and he wrote on the epidemiological study, they explain that no increase would be expected in deaths from chronic coronary heart disease and atherosclerosis, because these are "the culmination of processes which develop over extended periods of time" and are unlikely to be as affected by poor control of cardiac reflexes.

\*The field was intermittent in two ways: First, the field was "on" every other hour (for example, from midnight to 1 a.m. was on, from 1 to 2 a.m. was off, etc.). Second, during the hours designated as "on," the field was switched on or off every 15 seconds.

### **Epi Study Gets Fast Track for NIEHS EMF Working Group**

Savitz and Sastre's new epidemiological study on EMFs and heart disease was regarded as important enough to be considered by the NIEHS EMF working group (see p.1) even prior to its acceptance for publication. A paper on the study is now under review at the *American Journal of Epidemiology*.

The NIEHS considered only research results that had been published in a peer-reviewed journal—but an exception was made in this case. The subcommittee on epidemiology reviewed the study, but in the end decided that current evidence is "inadequate" to say whether EMFs can increase cardiac risk.

"Because this group had a deadline, I thought they should have the opportunity to consider it before publication," Savitz told *Microwave News*. He added that, "I explored it with the journal to make sure there weren't any misunderstandings."

Following discussions with Sastre, Savitz examined data on male employees of five U.S. electric utilities, compiled for his previous EMF study for the Electric Power Research Institute (see *MWN*, J/F95). Savitz found significant increases in deaths related to arrhythmia and from heart attacks, but not from the other two types of heart disease. Their paper on these findings is currently in peer review at the *American Journal of Epidemiology* (see box above).

Savitz and Sastre report that in analyzing the utility worker data, "a dose-response gradient was observed for cumulative career magnetic field exposure." The highest exposure category showed about a doubling of risk for arrhythmia-related and heart attack deaths. Elevated risks were also found for duration of employment. This pattern was especially notable for electricians and power plant operators, and less strongly for line workers.

Previous EMF epidemiological studies have looked at cardiovascular disease in the aggregate, and most have not found significant increases in risk. The new study by Savitz and Sastre is the first to distinguish between specific types of heart disease.

"Although these epidemiological results are very intriguing, this does not necessarily mean that the hypothesis is true," Sastre told *Microwave News*. "But the beauty of this approach," he added, "is that we know how to get the data that are needed to either confirm or disprove it."

One immediate way to follow up would be to reanalyze available data from other utility worker studies to see if the same patterns emerge. Savitz said that the studies of workers at Southern California Edison (see *MWN*, M/A93) and those at Hydro-Québec and Ontario Hydro (see *MWN*, M/A94) would be good candidates. Graham noted that data from these and two other existing data sets could be analyzed within six months.

Sastre said that to test his hypothesis fully will require long-term prospective studies of HRV in people with real-world EMF

exposures. The changes in heart rhythm observed in his clinical studies were short-term and reversible, while the epidemiology points to a long-term risk. The idea that EMF exposures could permanently change HRV "is still speculative," Sastre said.

## **Fourth Lab Finds 12 mG Field Blocks Anticancer Effect**

A team at the Battelle Pacific Northwest Labs in Richland, WA, has found that a 12 mG magnetic field can block the protective action of melatonin against the growth of cancer cells. Battelle is now the fourth lab to observe this effect.

Human breast cancer (MCF-7) cells whose proliferation had been inhibited by melatonin resumed growing in the 12 mG 60 Hz field. A 2 mG magnetic field did not affect the melatonin-stabilized cells.

"We believe it," said Dr. Larry Anderson, referring to the low-level *in vitro* magnetic field effect. The Battelle team, led by Anderson and Dr. James Morris, presented the new replication results at the 20th Annual Meeting of the Bioelectromagnetics Society (BEMS) in St. Pete Beach, FL, June 7-11. "We are still on the cautious side, but we are confident enough to report our results," Anderson said.

The effect does not occur in all breast cancer cell lines, however. It has only been observed in a particular subtype—and not in others that are quite similar.

Battelle is the latest lab to repeat the EMF-melatonin experiment, which was first reported by Dr. Robert Liburdy in 1992 (see *MWN*, J/A92). In his paper published in the *Journal of Pineal Research* (14, pp.89-97, 1993), Liburdy wrote that, "These results provide the first evidence that [extremely low] frequency magnetic fields can act at the cellular level to enhance breast cancer proliferation by blocking melatonin's natural oncostatic action."

In 1996, Dr. Carl Blackman of the Environmental Protection Agency in Research Triangle Park, NC, and, later, Dr. Richard Luben of the University of California, Riverside, each reported replication of Liburdy's experiment (see *MWN*, M/A96).

"It's hard to argue with the third replication," Dr. Russel Reiter of the University of Texas Health Science Center in San Antonio told *Microwave News*. Reiter is the editor in chief of the *Journal of Pineal Research*.

Liburdy and his collaborator, Dr. Joan Harland, both of the Lawrence Berkeley National Lab in Berkeley, CA, have also found that 12 mG magnetic fields can block the growth inhibition of tamoxifen, a drug used to control breast cancer. The Battelle group confirmed this finding, too.

"This is the golden nail that drives the point home to all the skeptics," said an obviously delighted Liburdy in an interview. He added that these experimental results "should drive future animal and epidemiological work because it is mechanism-based and hypothesis-driven."

Liburdy's experiments and their subsequent replications have attracted a great deal of interest because of past failures to repeat observed magnetic field effects in other labs—for instance, EMF-induced changes in gene expression (see *MWN*, M/J95). Three

English researchers recently wrote of the "overriding need to demonstrate a single, unequivocal [extremely low frequency] EMF-induced response that will be consistently reproducible in independent laboratories" (see A. Lacy-Hulbert, p.11).

In addition, there is as yet no accepted explanation for a possible magnetic field effect at 12 mG or less from pure 50/60 Hz sine waves. Many physicists have been especially outspoken on this point, and if such an effect were to win widespread acceptance, it would put pressure on them to rethink their models.

The new Battelle study "may be the most significant paper at this year's BEMS meeting," said Dr. Gregory Lotz of the National Institute for Occupational Safety and Health in Cincinnati.

Managers at other federal agencies were equally impressed: "I'm excited about it," commented Dr. Russell Owen of the Food and Drug Administration in Rockville, MD. And Dr. Imre Gyuk of the Department of Energy in Washington said that, "It's getting harder and harder for skeptics to deny low-level effects."

### **French Link Workplace EMFs to Immune and Nervous System Ills**

Workers exposed to EMFs from nearby transformers and power lines were more prone to fatigue and immunological disorders, according to a recent French study.

The study's results are "evidence that chronic human exposure to environmental low frequency EMFs...can cause neurovegetative, hematological and immunological disorders," wrote Dr. Laurence Bonhomme-Faivre and colleagues at Paul Brousse Hospital in Paris. Their report appeared in the March/April issue of *Archives of Environmental Health* (53, pp.87-92, 1998).

The study was small: 13 EMF-exposed subjects, who had worked near electrical transformers and 13 kV power lines for at least a year; and 13 matched controls, who had worked in other areas at the same site for the same length of time.

Two exposed workers spent eight hours daily in a lab situated directly above transformers and high-voltage wiring. Measured magnetic fields in the lab ranged from 3 mG to 66 mG. The other exposed workers divided their time between this lab and adjoining rooms, where magnetic fields were 0.9-3 mG.

The exposed group reported significantly more frequent occurrence of several subjective conditions—mental and physical fatigue, depression, melancholy, irritability, fainting and diminished libido—than did controls.

Blood samples from the two groups were also compared. The exposed workers' total lymphocyte (white blood cell) levels were significantly lower.

Especially significant, the French scientists believe, are the histories of the two people who worked full-time above the transformers. Both were found to have depressed white blood cell counts, which quickly returned to normal when they stopped working in this lab. On returning to the lab, one subject's white cell count fell again. Both now work elsewhere and have normal blood counts.

These fluctuations "strongly incriminate" chronic EMF exposure in the onset of hematological disorders, the researchers concluded.

But it is unclear if the skeptics will agree. Dr. Steven Miller of SRI International in Menlo Park, CA, noted that the observed melatonin effect is small. "It's within the variability of the system," he said. Miller, who was funded by the EMF RAPID program, has been unable to repeat a number of other scientists' *in vitro* experiments. He coauthored an editorial in the July *Radiation Research* on the importance of publishing negative results.

### **More Evidence on Lou Gehrig's Disease Among Utility Workers**

The risk of amyotrophic lateral sclerosis (ALS) among Danish utility workers is twice as high as that among the general population, according to researchers at the Danish Cancer Society. ALS is a neurodegenerative disorder that is also known as Lou Gehrig's disease.

Drs. Christoffer Johansen and Jørgen Olsen report that the increase in mortality from ALS is statistically significant. They describe their results in the August 15 issue of the *American Journal of Epidemiology* (148, pp.362-368, 1998). The risk of ALS increased with the number of years on the job, and there was a dose-response relationship with estimated EMF exposure, but these trends are not significant.

"We think we found something," Johansen told *Microwave News*. "Savitz also found it," he said, referring to a study of 140,000 U.S. utility workers by Dr. David Savitz of the University of North Carolina, Chapel Hill (see *MWN*, M/J97). Savitz's study was published this July in *Epidemiology* (9, pp.398-404, 1998).

But while EMFs might be the cause, Johansen and Olsen point to another possibility: electric shock. Their study found an 18-fold increase in deaths due to electrocution, and they point out that in animal experiments, electric shocks have been shown to cause deterioration of the myelin sheath around nerve cells, which can kill the cells. They suggest that the elevated risk of ALS observed in their study "may be due to repeated electric contusions, rather than to exposure to high levels of EMFs."

"Interestingly," the Danish researchers write, "one patient

[had] reported two episodes of electric shocks 19 and 26 years prior to diagnosis." But in this study, "it was not possible to construct an alternative exposure scale that could better distinguish exposure to shocks from EMF exposure." They note that while some previous studies have linked ALS to working in EMF-exposed jobs, others have found that the disease is associated with electric shock. Johansen told *Microwave News* that his data do not favor one explanation over the other.

Dr. Eugene Sobel of the University of Southern California (USC) in Los Angeles said in an interview that, "Severe electric shock, the kind that can lead to unconsciousness, is probably associated with a risk for ALS; it's been found enough times in small studies that this seems likely." Last year, Sobel and Dr. Zoreh Davanipour, also of USC, published evidence of a link between EMFs and ALS (see *MWN*, N/D95 and J/F97).

Sobel said it would be hard to distinguish the effect of many small shocks—which are less likely to be remembered than large ones—from that of EMF exposure. "Perhaps one way to disentangle these two factors," he suggested, "would be to study an occupation in which electric shocks are very unlikely, like airline pilots or garment workers."

Johansen and Olsen examined the primary cause of death for 21,236 people employed by Danish electric utilities between 1900 and 1993. Mortality from ALS rose along with estimates of EMF exposure: Those with background exposure had slightly fewer cases than expected; those with low exposure had nearly twice the expected number; while for medium exposure the risk ratio was 2.3 and for high exposure it was 2.8. Taken together, workers with high or medium exposure to EMFs had a significantly increased mortality from ALS, with a risk ratio of 2.5.

High exposure was defined as working in an environment that typically had fields of 10 mG or more, while medium exposure was defined as 3-9 mG. Estimates were based on a job-exposure matrix that combined 25 different job titles with 19 kinds of work areas.

In an earlier study based on the same cohort, Johansen and Olsen found no consistent link between EMF exposure and leukemia, breast cancer or brain cancer (see *MWN*, M/A98). This June, Johansen said that he had completed a paper on EMFs and multiple sclerosis, which has been submitted for publication.

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of IARC, and two current IARC staffers were members of the NIEHS panel—all three voted with the majority for the possible carcinogen designation.

The working group's detailed, 523-page report will be the basis for NIEHS Director Dr. Kenneth Olden's report to Congress on the EMF Research and Public Information Dissemination program, known as EMF RAPID. This five-year research program was established by the Energy Policy Act of 1992 to investigate the potential health effects of EMFs associated with the production and distribution of electricity (see *MWN*, N/D92).

#### **Exposure Guidelines Would Be Premature**

The Minneapolis meeting closed with a debate as to whether the decision to categorize EMFs as possible carcinogens might

be used as the basis for exposure guidelines. Panel member Dr. Paul Gailey drafted a statement that, after some editing, was endorsed by the working group and inserted into the closing paragraphs of the report. It read:

Because of the extreme complexity of the electromagnetic environment, the review of epidemiological and other biological studies did not allow precise determination of the specific ELF EMF critical exposure conditions associated with the disease end points studied.\*

\*In the report as published, the word "extreme" was dropped. Also, instead of being placed immediately before the panel's final conclusion, as originally planned, this statement appears at the end of a section titled "non-cancer adverse health effects." NIEHS' Dr. Christopher Portier said that he did not know the reason for the change in placement.

In an interview with *Microwave News*, Gailey explained the motivation for his cautionary language: “The working group was not making a statement about safe and unsafe levels of exposure, because we don’t know enough about what types of fields are biologically active, or at what levels.”

“This lays the agenda for future research,” commented Dr. Michael Gallo, the panel’s chair, after Gailey’s proposal was adopted. He noted that it captures the task before the EMF—and the larger scientific—communities. Gallo is a toxicologist who has done extensive work on dioxin, but has little EMF experience.

An outside observer, Dr. Leslie Robison of the University of Minnesota, Minneapolis, took a different view. “I actually believe that a great deal will not be learned from more research,” he told the Minneapolis *Star Tribune* (June 25). Robison was a member of the team that conducted last year’s National Cancer Institute (NCI) EMF–childhood cancer study.

Gailey’s paragraph became part of the summary chapter of the report, which was drafted by the NIEHS’ Dr. Christopher Portier with Gallo’s assistance. It had been brought before the working group as the meeting was drawing to a close and members of the panel were leaving to go home. The NIEHS at first attempted to hurry the drafting of the final statement. A sometimes heated discussion followed on the importance of the panel’s summary statement and the accompanying press release.

At this point, Dr. Daniel Wartenberg, a member of the working group, walked out of the meeting room with a feeling of déjà vu. As a member of the National Academy of Sciences (NAS) EMF panel, Wartenberg had been frustrated by the academy’s decision to limit the participation of its committee members in deciding how the NAS would deliver to the public what turned out to be a dismissive view of EMFs.

### **How Big Are the Health Risks?**

“This report does not suggest that the risk is high. It is probably quite small, compared to other public health risks.” These were the words of Dr. Michael Gallo in the NIEHS’ June 24 press release announcing the working group’s decision to designate EMFs as a “possible human carcinogen.” The quote, which went on to urge that EMF research continue, was widely reproduced in the subsequent media coverage—indeed, it was the only one the NIEHS included in its press release.

Dr. Christopher Portier, the chief of the NIEHS Laboratory of Computational Biology and Risk Analysis, who organized the Minnesota meeting, acknowledged, however, that no one had discussed EMF health risks during the ten days of deliberations. “We do not know the extent of the risk in human populations,” he told *Microwave News* after the meeting.

Portier declined to comment further on the extent or nature of EMF health risks, noting only that, “In the next two months, we will be estimating the degree of risk in the human population.”

When asked by *Microwave News* about his quote, Gallo replied: “When I think of public health risks, I think of AIDS, TB and benzene. I think of the whole public health spectrum.”

### **Working Group’s Overall Conclusion**

A majority of the working group concluded that classification of ELF EMFs as possibly carcinogenic (Group 2B) is a conservative, public health decision based on limited evidence for an increased occurrence of childhood leukemias and an increased occurrence of chronic lymphocytic leukemia associated with occupational exposure. For these particular cancers, the results of *in vivo*, *in vitro*, and mechanistic studies do not confirm or refute the findings of the epidemiological studies. The overall body of evidence has, however, laid a foundation for furthering our understanding of the biological effects, mechanisms and exposure circumstances that may be related to the possible carcinogenicity and other adverse human health effects of exposure to ELF EMFs.

“Given that the NIEHS’ goal was to inform the public of the working group’s assessment of EMFs, the NIEHS should have involved us in the process,” Wartenberg told *Microwave News*. The NIEHS did not consult the working group on the wording of the press release sent out that same afternoon. (See “Views on the News,” p.1.)

### **Decision on EMF–Cancer Link Was Expected**

Very few of those who were at the Minneapolis meeting were caught off guard by the decision to categorize EMFs as possible carcinogens. “I anticipated the vote,” said Portier, who organized the meeting with the assistance of the NIEHS’ Dr. Mary Wolfe. Portier and Wolfe, both based in Research Triangle Park, NC, had previously organized three EMF science review symposia to prepare for the Minneapolis meeting (see *MWN*, M/A97, J/F98 and M/J98).

Douglas Bannerman of the National Electrical Manufacturers Association in Washington, who came to Minneapolis to observe the working group’s deliberations, said that he was “very disappointed” with the panel’s overall conclusion. But in an interview with *Microwave News*, he conceded that he was not surprised by the recognition of a possible EMF–childhood cancer link.

“Now the public will know what the members of the EMF research community have known for years,” commented Dr. Michael Marron of the Office of Naval Research in Arlington, VA. Marron is a member of the EMF Interagency Advisory Committee, which must submit its own report on the EMF RAPID program to Congress.

In a June 26 statement, the U.K.’s National Radiological Protection Board (NRPB) in Chilton noted that the views of its Advisory Group on Non-Ionizing Radiation—chaired by Sir Richard Doll—are “consistent with those of the NIEHS expert panel.”

Interestingly, three of the four members of the working group who were also on the NAS EMF review committee—Wartenberg, Dr. Larry Anderson and Dr. Richard Luben—voted with the majority to endorse a possible cancer association. The fourth, Dr. Jerry Williams, believed that the data could not justify such a conclusion.

The 1996 NAS report has been widely interpreted as dismissing an EMF–cancer link, but a number of those in Minne-

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apolis saw no conflict between the two assessments, because the NAS committee had based its decision on the absence of “conclusive and consistent evidence” of a cancer risk (see *MWN*, N/D96). The NIEHS panel agreed that the available evidence did not support that type of definitive statement.

Luben noted that the working group had reached essentially the same conclusion as had the Environmental Protection Agency (EPA) nearly ten years ago (see *MWN*, M/J90; more recently, the EPA reaffirmed this finding, see *MWN*, J/F98). “I think it’s time to look to the future,” commented Luben.

### Votes on the Epidemiological Evidence

Earlier this spring, the NIEHS had commissioned 13 review chapters, some on the possible health impacts of EMFs and others on theoretical and engineering issues (see *MWN*, M/A98). The health effects were not limited to cancer—they included mis-

carriages, Alzheimer’s disease, ALS, depression and heart disease, among other effects.

In Minneapolis, members of the working group were assigned to one of five small groups to review and edit the chapters. The revised chapters were then reedited, line by line, by the full working group and a number of NIEHS staff members.

Each small group voted to categorize the evidence it had reviewed using the IARC cancer criteria. The votes were then repeated by the full working group meeting in plenary session.

IARC has four categories for classifying associations between EMFs and cancer: “1: sufficient,” “2: limited,” “3: inadequate” and 4: evidence of “lack” of carcinogenicity (see p.7). The “limited” evidence category is divided into two subcategories: “2A: probable” and “2B: possible” evidence of carcinogenicity, a distinction that the NIEHS working group used in its final summary vote.

The epidemiology small groups were unanimous that there was “limited” evidence of an association between residential magnetic field exposures and childhood leukemia. In plenary session, the vote was 22 to 4, with 2 abstentions and 1 member absent.\* (Fred Dietrich and Drs. James Felton, Steven Miller and Paul Zweacker found the evidence to be “inadequate”; Williams and Dr. Martin Misakian abstained.) There was near unanimity that there was “inadequate” evidence to judge the carcinogenicity of adult residential exposures. (Only Zweacker favored the “lack” of evidence designation.)

Dr. Maria Feychting, who chaired the small group on childhood epidemiology, noted that its decision was not based on a meta-analysis, but rather on an evaluation of the individual studies. “We see trends,” she said. Addressing the NCI’s recent childhood leukemia study, she noted that, “It’s a very good study, but it’s not superior to the others” (see *MWN*, J/A97). She added that the childhood study by Dr. David Savitz also has its merits (see *MWN*, N/D86) and pointed to the specific problem of low participation rates in the NCI study, especially for the wire code populations.

The link between EMFs and occupational cancers was deemed to be more uncertain. The panel voted 14 to 11, with 2 abstentions and 2 members absent, that there was “limited” evidence of a link to chronic lymphocytic leukemia (CLL). This finding was based to a large degree on the persuasive epidemiological study by Sweden’s Dr. Birgitta Floderus, now at the Karolinska Institute in Stockholm (see *MWN*, S/O92 and M/J94).

In the working group vote, Dr. Leeka Kheifets agreed with the majority that there was “limited” evidence of a link to childhood cancer, but sided with the minority with respect to the possible link to CLL among EMF-exposed workers. “For me, the consistency is not there” across occupational studies, she said (see also *MWN*, N/D97).

For acute myeloid leukemia, brain tumors and breast cancer (both female and male) among workers, the panel voted by an overwhelming majority that there was “inadequate” support for an association with EMFs.

The EMF animal studies provoked some of the working

\*In a later vote on slightly stronger language, the working group voted 20 to 6 that there is “limited” evidence that EMFs are “carcinogenic to children.” This time, Drs. Jean Harry and Walter Rogers joined the minority.

### NIEHS EMF Working Group Members: How They Voted

The final vote to classify EMFs as possible human carcinogens was 19 in favor and 9 against, with 1 abstention. Listed below are the members of the working group divided into their small groups. Those who voted against are listed in italics.

**Adult Epidemiology:** Drs. Joseph Bowman, National Institute for Occupational Safety and Health, Cincinnati; Elisabeth Cardis,<sup>†‡</sup> International Agency for Research on Cancer (IARC), Lyon, France; Charles Graham, Midwest Research Institute (MRI), Kansas City, MO; *Leeka Kheifets, Electric Power Research Institute (EPRI), Palo Alto, CA;* Richard Stevens, Battelle Pacific Northwest Labs (PNL), Richland, WA.

**Childhood Epidemiology:** Drs. Maria Feychting,<sup>†</sup> Karolinska Institute, Stockholm, Sweden; Antonio Sastre, MRI; Claire Sherman, University of California, Davis; Louis Slesin, “Microwave News,” New York City; Daniel Wartenberg, University of Medicine and Dentistry of New Jersey (UMDNJ), Piscataway.

**Exposure Assessment:** *Fred Dietrich, Electric Research and Management, Pittsburgh;* Drs. Martin Misakian,\* National Institute of Standards and Technology, Gaithersburg, MD; Michael Yost,<sup>†</sup> University of Washington, Seattle.

**In Vivo:** Drs. Larry Anderson, Battelle PNL; *Arnold Brown,<sup>†</sup> University of Wisconsin, Madison (emeritus); James Felton, Lawrence Livermore National Lab, Livermore, CA; Jean Harry, NIEHS; Walter Rogers, consultant, San Antonio;* Lorenzo Tomatis, Istituto per l’Infanzia, Trieste, Italy; *Paul Zweacker, TU Services, Dallas.*

**In Vitro:** Drs. Margarita Dubocovich, Northwestern University, Evanston, IL; Paul Gailey, Oak Ridge National Lab, Oak Ridge, TN; Richard Luben, University of California, Riverside; Mats-Olof Mattsson, Umeå University, Umeå, Sweden; Kenneth McLeod,<sup>†</sup> State University of New York, Stony Brook; *Steven Miller, SRI International, Menlo Park, CA;* Charles Polk, University of Rhode Island, Kingston; *Jerry Williams, Johns Hopkins University, Baltimore;* Hiroshi Yamasaki, IARC.

**Chairman:** Dr. Michael Gallo,<sup>§</sup> UMDNJ; **Coordinator:** Dr. Christopher Portier,<sup>¶</sup> NIEHS.

<sup>†</sup>Chair of small group. <sup>‡</sup>Chair of adult and childhood combined small group. \*Abstained from voting. <sup>§</sup>Would have voted in the event of a tie. <sup>¶</sup>Nonvoting.

## Special Report: EMFs Found To Be Possible Carcinogens

group's most heated exchanges. In the *in vivo* small group vote, six members favored the "lack" of evidence classification for EMF-induced animal carcinogenicity. (Only Anderson and Tomatis dissented; the NIEHS' Dr. Gary Boorman was a member of this small group, but did not vote in the plenary session.)

The full working group disagreed with the small group and instead voted that the animal evidence was "inadequate" to reach any conclusion. (The vote was 19 to 8, with 1 member abstaining and 1 member absent.)

Williams then announced that he would file a minority opinion. When drafted the following day, it stated in part that the German studies by Drs. Wolfgang Lüscher and Meike Mevissen indicating an EMF-breast cancer risk are "fundamentally flawed" and that the bulk of the other animal results are "completely negative" (see also p.15 and *MWN*, M/A98 and M/J98).

None of the panel members argued that the animal data actually supported an EMF-cancer risk, but many were not convinced that the available data provided a complete picture of the problem. Gailey pointed out that the complex electromagnetic environments encountered in daily life bear little resemblance to the 50 Hz or 60 Hz sine waves used in laboratory studies of EMFs. He compared such studies to trying to assess drinking water toxicity by testing only two out of dozens of possible contaminants. In addition, he said, "History tells us that we don't always pick the right animal model."

The working group was in general agreement in its evaluation of the laboratory studies. There was consensus that effects above 1 G were possible, or even probable, but less likely at lower magnetic field levels.

Specifically, the working group unanimously agreed (with one abstention) that:

A limited number of well-performed studies provide moderate evidence for mechanistically plausible effects of ELF EMFs *in vitro* at intensities greater than 100  $\mu$ T [1 G] on end points generally regarded as reflecting the action of toxic agents.

For exposures below 100  $\mu$ T, the panel agreed unanimously in a

### How To Order and Comment on the Working Group Report

The working group report, *Assessment of Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields*, is available free, both in print and on CD-ROM. The full text of the report is also posted on the Internet at: <[www.niehs.nih.gov/emfrapid/home.htm](http://www.niehs.nih.gov/emfrapid/home.htm)>.

Written comments on the report can be submitted to the NIEHS by mail, fax or E-mail. The deadline is October 9, 1998. The public will also have an opportunity to make comments in person at meetings in Tucson, AZ (September 14-15), Washington (September 28), San Francisco (October 1) and Chicago (October 5). Tucson is the site of this year's Department of Energy EMF research review (see *MWN*, M/A98).

To order the report, to register for the meetings or for more information, contact: EMFRAPID Program/LCBRA NIEHS, PO Box 12233, MD EC-16, Research Triangle Park, NC 27709, Fax: (919) 541-0144, E-mail: <[emf-rapid@niehs.nih.gov](mailto:emf-rapid@niehs.nih.gov)>.

separate vote to replace the word "moderate" with "weak."

While the cellular studies were not evaluated in terms of the IARC criteria, Dr. Hiroshi Yamasaki, who works at IARC, noted that, "There was weak or moderate evidence" from the *in vitro* work in support of carcinogenicity."

There were many other votes on the level of evidence implicating EMFs in other, noncancer, disease end points. There was, in general, overwhelming agreement that the data were inadequate to reach any conclusion—using modified IARC criteria.

Early in the meeting, a sharp disagreement emerged as to whether the working group's votes would be by secret or open ballot. Some participants on both sides even threatened to leave if they did not get their way. In the end, all the votes were open and no one walked out.

### IARC Classifications for Evidence of Carcinogenicity

#### 1: Sufficient

*Sufficient evidence of carcinogenicity.* Exceptionally: less than sufficient evidence in humans, but sufficient evidence in experimental animals and strong human evidence that the agent acts through a relevant mechanism.

*Examples:* asbestos, benzene, dioxin, hepatitis C virus, radon, vinyl chloride. Total number of agents: 75.

#### 2A: Limited—Probable

*Limited evidence in humans and sufficient evidence in experimental animals.* Also: inadequate evidence in humans and sufficient evidence in experimental animals, and strong evidence that the mechanism also operates in humans. Exceptionally: only on the basis of limited evidence in humans.

*Examples:* benzo[a]pyrene, formaldehyde, PCBs, ultraviolet (A, B & C) radiation. Total number of agents: 59.

#### 2B: Limited—Possible

*Limited evidence in humans and less than sufficient evidence in animals.* Also: inadequate evidence in humans, but sufficient evidence in experimental animals. Sometimes: inadequate evidence in humans, but limited evidence in experimental animals, with supporting evidence from other relevant data.

*Examples:* carbon tetrachloride, chloroform, DDT, lead, PBBs, saccharin. Total number of agents: 225.

#### 3: Inadequate

*Inadequate evidence in humans and inadequate or limited evidence in experimental animals.* Exceptionally: inadequate evidence in humans, but sufficient evidence in experimental animals, with strong evidence that the mechanism in experimental animals does not operate in humans.

*Examples:* coal dust, fluorescent lighting, mercury, parathion, phenol, xylene. Total number of agents: 474.

#### 4: Lack

*Evidence suggesting lack of carcinogenicity in humans and in experimental animals.* Sometimes: inadequate evidence in humans, but evidence suggesting lack of carcinogenicity in experimental animals, consistently and strongly supported by a broad range of other relevant data.

*Only example:* caprolactam.

*Sources:* for IARC evaluation criteria: <<http://193.51.164.11/monoeval/eval.html>>; for lists of agents in each category: <<http://193.51.164.11/monoeval/crthall.html>>. For information on IARC, see: <[www.iarc.fr](http://www.iarc.fr)>.

## « Wireless Notes »

On July 14, **Australia's health minister, Michael Wooldridge**, announced three grants totaling Aus\$215,000 (approximately US\$133,000) for research projects on mobile phone safety. In late 1996, the Australian government committed Aus\$4 million (US\$2.5 million) to wireless safety research (see *MWN*, N/D96). The three grants are the first, and so far only, funding announced under the initiative. The largest grant, about Aus\$90,000, will go to **Dr. Bruce Armstrong** of the **New South Wales Cancer Council** for a pilot epidemiological study of mobile phones and tumors of the brain, salivary gland or auditory nerve. **Dr. Pamela Sykes** of **Flinders University** in South Australia will get about Aus\$75,000 to study the effects of RF/MW radiation on DNA, while **Dr. Con Stough** of the **Swinburne Institute of Technology** in Victoria will receive Aus\$50,000 to investigate whether mobile phones affect users' memory, concentration or problem-solving abilities. "The overwhelming weight of scientific evidence says there's actually not a problem," Wooldridge said on Australian television, "but as health minister I've got to be vigilant."

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**Dr. Joseph Brain** of the **Harvard School of Public Health** in Boston has asked the **National Academy of Sciences-National Research Council** (NAS-NRC) to examine the possible effects of RF/MW radiation on human health, with a focus on cellular phone towers. In a March 19 letter to the council's Commission on Life Sciences, Brain noted that the NAS-NRC had "already deliberated on EMF[s] and ELF" (see *MWN*, N/D96), and suggested that an NAS-NRC report on wireless radiation would be helpful. "These towers are being scattered across urban and suburban areas throughout the U.S.," wrote Brain. "As chair of the Department of Environmental Health at Harvard, I am repeatedly asked for my advice. I would like to point to an authoritative study [by] the NAS-NRC to give individuals and communities guidance." In a May 18 reply, **Dr. Evan Douple**, director of the NRC's Board on Radiation Effects Research, agreed that the subject is important and noted that both the **FDA** and **Rep. Edward Markey** (D-MA) want to see more research on cellular phone safety (see *MWN*, N/D97). This summer, Douple wrote, his board will discuss a proposal for a study of wireless safety and explore whether industry, government agencies or Congress is interested in supporting it.

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As they prepare to square off in court against the **FCC** over federal preemption of antenna siting and the commission's RF/MW rules, two citizens groups are at odds with each other. At issue is Washington telecom lawyer **James Hobson**, who is handling the FCC suit for the **Ad Hoc Association** (AHA) of Parties Concerned About the FCC's RF Health and Safety Rules, based in Olympia, WA. In a June 28 letter, **Arthur Firstenberg**, president of the **Cellular Phone Taskforce** (CPT) in Brooklyn, NY, argued that Hobson has a conflict of interest and cannot effectively represent cell tower opponents while doing other work for the wireless industry—for instance, the Telecommunications Industry Association. The AHA's **David Fichtenberg** and **Libby**

**Kelley** disagree. In a July 6 response, they expressed confidence in Hobson, noting that his background qualifies him "to address the complex and demanding issues we are placing before the court." Hobson, of Donelan, Cleary, Wood & Maser, has not stepped aside. (He declined to comment on the dispute.) In separate briefs submitted to the U.S. Court of Appeals in New York City in May, the AHA and the CPT charge that the FCC's RF/MW rules are inadequate (see also *MWN*, N/D97). Oral arguments had been scheduled for August but were postponed. A new date has not yet been set. Meanwhile, Firstenberg told *Microwave News* that he has now "made peace" with Hobson. The AHA and Firstenberg's relationship has remained cool, however. He "is not communicating with us," the AHA's Kelley said in an interview in mid-July.

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It may not be the Nobel Prize, but those looking for a bit of extra cash might want to respond to the challenge laid down by **James Kaplan** of **EDX Engineering Inc.** in Eugene, OR. In a letter appearing in the July 20 issue of the trade magazine *Wireless Week*, Kaplan contends that regulating RF/MW exposures is "an absurdity." He is offering "a month's pay" (his, presumably) to anyone who can present human or animal evidence of a nonthermal health hazard of RF/MW radiation. Kaplan can be contacted by E-mail at: <jamesk@edx.com>.

### **George Carlo vs. Q. Balzano: Two Views of WTR's Record**

"I stand by what we have done," **Dr. George Carlo**, the chair of **Wireless Technology Research (WTR)** in Washington, told *Microwave News*. Carlo was reacting to criticism that his research program, sponsored by the Cellular Telecommunications Industry Association (CTIA), has failed to produce any biological results over the last five years.

When asked to contrast his record with that of Motorola, which has completed many cellular phone safety experiments over the same time period, Carlo responded: "The Motorola program is different, and I don't want to comment on it."

Motorola's **Dr. Quirino Balzano** was not so reticent. Addressing WTR's record in an interview with *Microwave News*, Balzano said, "We have lost five critical years, and money can't buy those five years back." In breaking his long official silence on the WTR program, Balzano, the director of the company's Electromagnetics Research Laboratory in Fort Lauderdale, FL, stressed that he was speaking for himself and not for Motorola.

Carlo has long argued that he could not have begun his biological studies until he had developed the right exposure systems. But Balzano counters that that should have taken only a year: "For a good experiment, dosimetry was there for anyone who wanted it."

Carlo and Balzano were interviewed in St. Pete Beach, FL, the site of this year's *Annual Meeting of the Bioelectromagnetics Society*, June 7-11.



It's been a bad summer for mobile phones in England. The **British press** has been blaming them for everything from hypertension to miscarriages—often with sensational headlines. **DO MOBILE PHONES FRY YOUR BRAINS OR JUST EGGS?** (July 13), wondered the tabloid *Evening Standard*, while the *Independent* sought to appeal to its more upscale readers: **WHY MOBILES COULD BE THE ROLLS ROYCE OF DISEASE** (June 9). Every major paper in the U.K. covered the blood pressure story from Germany in mid-June (see below). A week later, the *Daily Telegraph* followed up with word of a French study under the headline **MOBILE PHONES 'PUT PREGNANT WOMEN AT RISK'** (June 29). Interference from cell phones may also be putting the London subways at risk, warned the *Daily Mail* on June 24 in a story headlined **MOBILE**

**PHONES LINKED TO RAIL SIGNALS CHAOS**. Some of the stories featured campaigner Roger Coghill—**WHY I BELIEVE THAT ALL THESE ITEMS SHOULD CARRY A HEALTH WARNING**, *Daily Mail* (July 17)—while others hawked devices that promised some degree of protection: **HEALTH SCARES RING OUT** ran in the *Telegraph* on July 9. When word filtered out about military experiments showing loss of cognitive function, the *Mail* ran the story on its front page in large bold type: **MOBILE PHONES IN NEW HEALTH WARNING** (July 16). Even the generally more cautious BBC chimed in with **MOBILE PHONES IN BRAIN SCARE** in its Internet edition (July 16). The phones have not been doing too well in other parts of Europe, either. On the front page of the tabloid *Aftonbladet*, two Swedes blamed cell phones for their loss of vision (**CELL PHONES MADE US BLIND, WE ARE SURE**, July 2).

## Digital Mobile Phone Radiation Causes Rise in Blood Pressure

Short-term exposure to digital cellular phone signals significantly increased the blood pressure of participants in a new German study, according to researchers at the University of Freiburg and at Deutsche Telekom.

Dr. Stefan Braune of the University Neurological Clinic in Freiburg told *Microwave News* that the increase in resting blood pressure was not due to stress. "There is accumulating evidence that these high frequency signals may influence the sympathetic nervous system," he said.

In a research letter published in the June 20 issue of the *Lancet* (351, pp.1,857-1,858, 1998), Braune and colleagues at Deutsche Telekom in Darmstadt report that they also observed a significant increase in constriction of the blood vessels, which may in turn have been responsible for the increase in blood pressure.

Braune noted that electrical stimulation of an area in the right side of the brain (the right side of the insula) produces a rise in blood pressure. Since the phones in this experiment were mounted on the right side of the head, Braune wants to investigate whether the insula is involved in the observed effects.

The researchers exposed ten healthy volunteers between 26 and 36 years old to GSM mobile phone radiation, which was on or off for 35 minutes at a time. The increase in blood pressure was 5-10 mm Hg (millimeters of mercury), which is not considered large.

"In general, an increase like that would not be clinically significant," said Dr. Richard Stein, spokesperson for the American Heart Association in New York City. "People normally vary by that much in the course of a day."

The *Lancet*, one of the world's leading medical journals, stated in its press release that, "Such an increase could have adverse effects on people with high blood pressure." But Braune himself is not urging people with high pressure to avoid mobile phones. "At present, we don't have a clue as to what effect cellular phones would have on these patients," he explained. "Their blood pressure might even decrease." He said it would be premature to give advice to mobile phone users.

The U.S. Cellular Telecommunications Industry Association (CTIA) discounted Braune's results as inconclusive. The CTIA

argued that stress, noise and heat from the telephones' circuitry were more likely causes of the reported rise in pressure. "In a 35-minute test, a normal cellular phone will increase in temperature by 4-5°C," CTIA spokesperson Tim Ayers said in an interview. "It's possible that this could result in increased blood pressure." But Ayers conceded that, "This is all speculation." The main point, he said, is that the study was too small to serve as the basis for any definite conclusions.

"Stress is certainly not the cause," Braune responded in a telephone interview, pointing out that heart rate showed a decrease, not an increase. He noted that the volunteers "were in a comfortable, supine position" and that there was "no evidence for the idea" that they experienced stress.

"As for noise—I don't know where they get this from," said Braune. "There was no noise." As the research letter and the *Lancet* press release both explained, the experiment was designed to expose the subjects to a radio signal without producing any sound from the phones. No phone conversations took place, and the volunteers did not know when the signal was being transmitted.

Heating also could not have been the cause, Braune contended. He noted that there was a 2.5 cm distance between the phone and the skin, "so we have no reason to believe that any heating of the skin would occur." In any case, he said, such heating would not cause blood pressure to rise: "What you'd expect would be just the opposite. If the skin gets hotter, you have a dilation of the blood vessels in response, which would tend to decrease blood pressure."

Braune said that the small number of subjects did not in itself cast doubt on his results. "If you have a high inter-individual variation, then you need a big group to see the effect; but our results were very consistent from one individual to another," he explained. "And the effect is strong enough that it shows up clearly even with a small number of people."

These results were observed in a pilot study designed to detect changes in the bowel reflex, which is also controlled by the sympathetic nervous system. No such changes occurred, but the consistency of the changes in blood pressure was striking and the researchers felt that the results should be published.

"Now we know better what to look at," Braune said. "In the pilot study, we had only electrophysiological evidence of the rise in blood pressure. In our ongoing research, we are looking at several biochemical markers as well."

### **A German Dairy Farmer's Complaints Prompt Major Health Study of Cows near Cell Phone Towers**

The Bavarian state government in Germany will investigate whether mobile phone antennas cause health problems in dairy cattle, announced Bavaria's Minister for Land Development and the Environment, Dr. Thomas Goppel, at a June 29 press briefing in Munich. The study will encompass 30 farms at a cost of nearly 650,000 marks (approximately \$360,000), according to the ministry.

The impetus for the research effort came from a preliminary inquiry that pointed to RF/MW radiation from a mobile phone base station as the cause of reduced milk yields, abnormal behavior and other ailments among cattle on a Bavarian farm.

The evidence suggests that RF/MW radiation is "the sole cause" of the health problems on the farm in Traunstein, Bavaria, concluded Dr. J. Schmid, a local veterinarian, in an internal report to the Bavarian government. But a follow-up investigation ordered by Goppel rejected Schmid's findings.

The farmer first suspected something was wrong with his herd of some 30 cows in the fall of 1995, soon after a mobile phone base station was installed on a 500-foot communications tower about 300 yards from his farm. The intensity of the resulting RF/MW radiation is very low, however, especially in comparison to the levels of the television signals being broadcast from the same tower.

The cattle's RF/MW exposure is more than 1,000 times below the limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), Rüdiger Matthes of the Federal Office of Radiation Protection in Oberschleißheim told *Microwave News*. Matthes, who is also ICNIRP's scientific secretary, joined Goppel at the June 29 press conference.

Dr. Wolfgang Löscher of the School of Veterinary Medicine in Hannover, who has investigated the complaints of the Traunstein farmer, is skeptical that radiation from the base station could be harming the cows. "I cannot believe that these weak fields could have caused these effects," he said in an interview.

But Dr. Theodore Litovitz of the Catholic University of America in Washington believes that the mobile phone signals could be to blame, because they are digital. "I am absolutely *not* surprised" by the observed effects in the cows, Litovitz told *Microwave News*. "They are predicted by our ODC work at RF frequencies." Last year, Litovitz reported that while analog cellular phone radiation did not affect ornithine decarboxylase (ODC) activity in cell cultures, digital signals did do so. These results appeared in *Bioelectromagnetics* (18, pp.132-141, 1997).

The animals began to behave abnormally in the spring of 1996, Schmid reported, and have continued to do so. Several animals turn their heads away from the tower. Some cattle constantly shift from side to side and lift their feet as if in pain and one cow swings her head constantly.

Löscher characterized the observed health and behavioral effects as "typical of cows under stress." In addition to lower milk yields, there have been five miscarriages with no known cause over a 15-month period and severe weight loss in two cows.

The farmer and his family also began having unexplained

health problems when the mobile phone antennas were activated. Goppel also discounted the possibility that RF/MW radiation could be harming the health of the farmer and his family.

After details of the case became public earlier this year, Löscher noted, several other farmers complained of similar problems in other locations near communications towers.

In his report, Schmid cautioned that he was unable to establish a "definitive cause" of the herd's problems, although he had eliminated alternative explanations such as improper feeding or inadequate care. Especially compelling, he wrote, was the fact that when two of the cows with behavioral abnormalities were moved to a farm some 12 miles away, their symptoms disappeared within a few days. When they were brought back to the farm, the symptoms returned.

The farmer angrily denied suggestions that his herd's poor health is due to improper care: "I have run this operation for over 20 years. I had above-average milk yields with the highest quality. Now I have to listen to people saying I am too stupid to keep cows and milk them," he declared in the July 4 *Bayrisches Landwirtschaftliches Wochenblatt*, a leading agricultural newspaper.

Both Dr. Günter Käs, a radar electronics engineer formerly with the Federal Military University in Munich, and technicians from the Federal Office of Post and Telecommunications measured the power levels of RF/MW radiation on the property. Their findings are similar to those of Elekluft GmbH, which made new measurements at Goppel's request.

In a room on the upper floor of the farmhouse, with the window closed, Käs measured 0.3  $\mu\text{W}/\text{m}^2$  and 0.5  $\mu\text{W}/\text{m}^2$  for the 464 MHz analog and the 935 MHz digital telephone signals, respectively. At the same location, the power densities of the 512 MHz and 734 MHz TV signals were 0.44  $\text{mW}/\text{m}^2$  and 0.4  $\text{mW}/\text{m}^2$ , respectively. Outside the farmhouse, the levels were as high as 7  $\text{mW}/\text{m}^2$ , at 512 MHz.

Before announcing the 30-farm study, Bavarian officials had sought to avoid publicity about the Traunstein farmer's concerns. Schmid launched his investigation in November 1996 and submitted his report in April 1997, but state officials did not publicly acknowledge them until Germany's Green Party and the national news media, including the magazine *Der Spiegel*, began asking questions later last year.

Löscher told *Microwave News* that Bavarian officials asked him and Käs not to publish a paper documenting the Traunstein herd's problems until the government had completed its inquiry. They later approved its publication on condition that the farm could not be identified as being in Bavaria. The paper, "Striking Behavioral Disturbances in Cows in Proximity to Transmission Stations," appears in the April issue of the veterinary journal *Der Praktische Tierarzt* (79, pp.437-444, 1998).

The case has generated intense interest among anti-tower activists in Germany, the U.S. and elsewhere. An English translation of Schmid's report is posted on the Internet at: <[www.reach.net/~scherer/p/vetrepde.htm](http://www.reach.net/~scherer/p/vetrepde.htm)>. Information in German on the multi-farm study is at: <[www.bayern.de/stmlu](http://www.bayern.de/stmlu)>.

## Testicular & Skin Cancer Findings Put Spotlight on Police Radar

Elevated rates of testicular cancer and melanoma have been found in a study of police officers in Ontario, Canada.

These cancers have been a focus of concern over the possible effects of police radar, Dr. Murray Finkelstein writes in the August issue of the *American Journal of Industrial Medicine* (34, pp.157-162, 1998). "The important thing to emphasize, though," he said in an interview, "is that at the moment we have no information on exposure. So we can't draw any conclusions about causes."

Although the increase in melanoma was statistically significant, Finkelstein said that it may turn out to be a chance finding. He is currently reviewing pathology reports to determine where the melanomas were located. "The question is, which of these might plausibly be located in the beam from a traffic radar device," he said. "If it's on the back of the leg, that's different than if it's on the thigh."

Finkelstein is with the Ontario Ministry of Labor in Toronto, which conducted the research in response to a request from a police health and safety group. The study drew on employment records for 22,197 officers, from 83 out of the 91 police departments in the province, and on data from the Ontario Cancer Registry. Finkelstein found that the incidence of testicular cancer

### Hot New Papers

**Deborah Barnes and Lisa Bero, "Why Review Articles on the Health Effects of Passive Smoking Reach Different Conclusions," *Journal of the American Medical Association*, 279, pp.1,566-1,570, May 20, 1998.**

"The odds that a review article with tobacco industry-affiliated authors would conclude that passive smoking is not harmful were 88.4 times higher than the odds for a review article with non-tobacco-affiliated authors, when controlling for article quality, peer review status, article topic, and year of publication (95% CI, 16.4-476.5;  $p < 0.001$ )."

**Maria Feychting et al., "Magnetic Fields and Breast Cancer in Swedish Adults Residing near High Voltage Power Lines," *Epidemiology*, 9, pp.392-397, July 1998.**

"Our results indicated a higher relative risk for cases with ER-positive breast cancer, especially for younger women, but the number of cases in these analyses was small." (See *MWN*, N/D97.)

**C.M. Furse and O.P. Gandhi, "Calculation of Electric Fields and Currents Induced in a Millimeter-Resolution Human Model at 60 Hz Using the FDTD Method," *Bioelectromagnetics*, 19, pp.293-299, 1998.**

"Proposed safety guidelines would allow external electric fields of 10 kV/m and 25 kV/m for exposure to 60 Hz fields of the general public and workers, respectively. For this external electric field exposure of 10 kV/m, local induced current densities as high as 20 mA/m<sup>2</sup> are found in the head and trunk with even higher values (above 150 mA/m<sup>2</sup>) in the legs. These currents are considerably higher than the 4 or even 10 mA/m<sup>2</sup> that have been suggested in the various safety guidelines."

**S. Kwee and P. Raskmark, "Changes in Cell Proliferation Due to Environmental Non-Ionizing Radiation: Microwave Radiation," *Bioelectrochemistry and Bioenergetics*, 44, pp.251-255, 1998.**

"Contrary to popular assumptions, our results showed that there can be an effect at very low SAR values." (See *MWN*, J/A97.)

**Adam Lacy-Hulbert, James Metcalfe and Robin Hesketh, "Biological Responses to Electromagnetic Fields," *FASEB Journal*, 12, pp.395-420, 1998.**

"The absence of an identified mechanism whereby ELF EMFs can exert biological effects clearly constitutes a problem in that experimental protocols are devised and measurements are made on the basis of complete ignorance about the susceptibility of biological systems. The recurring theme of this review has been the overriding need to demonstrate a single, unequivocal ELF EMF-induced response that will be consistently reproducible in independent laboratories. Only then will the normal process of scientific development of the field become possible. Until this is achieved, the topic of biological responses to ELF EMFs will continue to be regarded with great skepticism by the scientific community at large." (See also p.3 and *MWN*, M/J95)

**Russell Owen, "MYC mRNA Abundance Is Unchanged in Subcultures**

**of HL60 Cells Exposed to Power Line Frequency Magnetic Fields," *Radiation Research*, 150, pp.23-30, July 1998.**

"Using either cells from a commercial source or cells supplied by the original investigators, no evidence was obtained to support the hypothesis that EMF exposure could induce *MYC* expression."

**Jerry Phillips et al., "DNA Damage in Molt-4 T-Lymphoblastoid Cells Exposed to Cellular Telephone Radiofrequency Fields In Vitro," *Bioelectrochemistry and Bioenergetics*, 45, pp.103-110, 1998.**

"It was found that: 1) exposure of cells to the iDEN<sup>®</sup> signal at an SAR of 2.4  $\mu$ W/g for 2 hours or 21 hours significantly decreased DNA damage; 2) exposure of cells to the TDMA signal at an SAR of 2.6  $\mu$ W/g for 2 hours and 21 hours significantly decreased DNA damage; 3) exposure of cells to the iDEN<sup>®</sup> signal at an SAR of 24  $\mu$ W/g for 2 hours and 21 hours significantly increased DNA damage; 4) exposure of cells to the TDMA signal at an SAR of 26  $\mu$ W/g for 2 hours significantly decreased DNA damage. The data indicate a need to study the effects of exposure to RF signals on direct DNA damage and on the rate at which DNA damage is repaired." (See *MWN*, J/F98.)

**David Savitz, Harvey Checkoway and Dana Loomis, "Magnetic Field Exposure and Neurodegenerative Disease Mortality Among Electric Utility Workers," *Epidemiology*, 9, pp.398-404, July 1998.**

"The accumulation in the literature of sporadic indications of an association between Alzheimer's disease and occupational magnetic field exposure may have reached a threshold for warranting a more rigorous study, but it does not provide a coherent body of research to suggest that an association is present." (See p.4 and *MWN*, M/J97.)

**Robert Tarone et al., "Residential Wire Codes: Reproducibility and Relation with Measured Magnetic Fields," *Occupational and Environmental Medicine*, 55, pp.333-339, 1998.**

"Wire codes provide a proxy measure of exposure to residential magnetic fields. If magnetic fields were a risk factor for leukemia, however, there would be some attenuation of risk estimates based on wire codes because of misclassification of exposure to magnetic fields at both extremes of the wire code range. The lack of an association between high categories of wire code and risk of leukemia cannot be explained by a failure of the wire code classification schemes to estimate exposure to magnetic fields in the study area." (A follow-up paper on the NCIEMF study; see *MWN*, J/A97.)

**Roger Yew-Siow Tay, Quirino Balzano and Niels Kuster, "Dipole Configurations with Strongly Improved Radiation Efficiency for Hand-Held Transceivers," *IEEE Transactions on Antennas and Propagation*, 46, pp.798-806, June 1998.**

"This paper demonstrates that reduction of the magnetic field strength at the surface of the user's head is the key parameter to improve the efficiency of the transmitter."

## HIGHLIGHTS

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was 30% higher than in the province as a whole, and that of melanoma was 45% higher.

These two elevated rates occurred even though the overall cancer rate among the police officers was lower than the provincial average, which Finkelstein cites as an example of the "healthy worker effect" (the tendency for those who are employed to have better-than-average health, since those who are ill often cannot hold a job).

Testicular cancer, leukemia and cancers of the brain, eye and skin were identified as the sites of greatest concern in a 1995 feasibility study on police radar health research by the U.S. National Institute for Occupational Safety and Health (NIOSH; see *MWN*, J/A95). The new Canadian study found no increases in leukemia or brain cancer, and only one case of ocular cancer among the officers.

The 1995 NIOSH report came in response to a 1992 Congressional inquiry (see *MWN*, S/O92). The report proposed a large cohort study that would broadly examine police officers' occupational health. "If disorders for which police appear to be at higher risk (e.g., testicular cancer) are identified," the report explained, studies of specific diseases could then follow. But no such study, either broad or narrow, was ever carried out.

"It was a matter of priorities," said Dr. Gregory Lotz, chief of NIOSH's Physical Agents Effects Branch in Cincinnati. "NIOSH has a small staff and wide responsibilities. Non-ioniz-

ing radiation continues to be a topic that we're interested in, but at the same time it's not a really high priority." Lotz said that people who worked on the 1995 report had hoped Congress might respond by allocating the funds for a police health study, but this did not occur.

In 1995, NIOSH put the cost of a cohort study of 10,000-30,000 officers at US\$1.4-\$2.6 million. Finkelstein said that his 22,000-person study had cost only C\$3,000 (about US\$2,000). Asked about the sharp discrepancy between the two cost figures, Lotz said that having a centralized cancer registry, like the one in Ontario, can make research less expensive. He also noted that NIOSH often hires outside contractors to gather data for large-scale studies, and this can be costly. This was especially true in this case, said Lotz, because interviews with cohort members would be needed to get information on radar usage.

Finkelstein plans to use interviews for exposure assessment in a smaller, nested case-control study that would follow up on his testicular cancer and melanoma findings. He has asked the U.S. National Institutes of Health for funding, and estimates that such a study would cost US\$80,000-\$100,000.

"If he can do it for \$100,000, that's still a significant cost difference," Lotz conceded. He said he did not think that the Canadian study's lower costs had compromised its quality in any way, and commented, "I'm encouraged that someone else was able to make some progress on this."

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## ***Magnetic Fields Seen as Possible Treatment for Malaria: In the Lab, EMFs Can Be Toxic to Parasites***

Researchers at the University of Washington, Seattle, believe that EMFs may prove to be an effective and low-cost treatment for malaria.

In preliminary experiments, a low frequency magnetic field had a potent antimalaria effect—comparable to that of chloroquine, the drug most often used to fight the disease. The oscillating field makes the iron in human blood vibrate, which ultimately kills the malaria parasite.

"It's a promising approach," Dr. Henry Lai told *Microwave News*. "With most drugs the parasite eventually develops resistance, but we don't think that will be the case for magnetic fields."

According to the World Health Organization, 300 million people are currently infected with the disease. Malaria kills more than one million people a year, and drug-resistant strains are becoming widespread.

Malaria parasites feed on human blood. They split the hemoglobin molecule into protein (the globin) and an iron compound (the heme). The parasites break down the protein so they can consume its amino acids, but they find free heme to be highly toxic. To eliminate this danger, they turn the soluble heme molecules into hemozoin, an insoluble polymer formed by linking the iron of one heme molecule to the oxygen in the next.

"This arrangement makes the hemozoin molecule highly magnetic," said Lai. "It behaves like a small bar magnet." He pointed out that magnetic fields have been used to separate malaria-infected red blood cells and isolate hemozoin particles. "We proposed the use of an oscillating magnetic field to shake the hemo-

zoin in the parasites," Lai explained. The hypothesis was that this would disturb the process of polymerizing heme into hemozoin, resulting in an accumulation of free heme molecules that would poison the parasite.

Lai said that preliminary results show promise. In his first experiment, observations by microscope confirmed that the hemozoin particles can be made to oscillate according to the frequency of an applied magnetic field. In a second experiment, malaria parasites cultured in human blood were subjected to a 5 Hz, 15 G magnetic field for 48 hours, after which the percentage of blood cells infected with malaria was about half as great as in a non-EMF-exposed control.

The second experiment has been repeated by Dr. Jean Feagin, also of the University of Washington. In addition to examining the percentage of infected cells, Feagin measured the synthesis of a protein made by the malaria parasite. This was reduced by about the same proportion, further confirming the initial results.

"This antimalaria potency is equivalent to 1 micromolar of chloroquine in culture," Lai observed, "which suggests a rather potent effect of the magnetic fields."

Chloroquine is also thought to interfere with the parasite's processing of iron by inhibiting the enzyme heme polymerase. "But since EMFs act directly on the hemozoin," Lai said, "and not on an enzyme or other gene products, it is unlikely that the parasites could develop resistance to magnetic fields."

Although malaria is on the rise worldwide, research on the disease is not well-funded—in part because it is most virulent in

very poor countries. More effective treatments are costly to develop, and do not offer much opportunity for profit. But if EMFs can be used as effective treatment for humans, Lai said it could be very cost-effective.

“It is relatively easy and inexpensive to generate oscillating magnetic fields over a large area,” he noted. “Several patients

could be exposed at one time.”

Lai and Feagin now plan to try EMFs at different frequencies and intensities, with support from a \$15,000 grant from the Fetzer Institute in Kalamazoo, MI. “We want to see if we can find a more efficient exposure combination,” said Lai. “If this is promising, then we’ll try to get money to do animal studies.”

## WTR Gives Spending Summary, Specifics Still Hazy

This June, Wireless Technology Research (WTR) released a summary of its spending over the last five years. As of March 1998, WTR had spent about \$23.5 million of the \$28 million pledged by the Cellular Telecommunications Industry Association (CTIA). Both WTR and the CTIA are based in Washington.

WTR Chair Dr. George Carlo revealed the five-year spending summary in a poster presentation at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL, in June. While the figures are broken down into 16 categories (see below), the amount of money that went to research grants remains a mystery. WTR has consistently refused to disclose this information (see *MWN*, M/J96, M/J97 and N/D97).

Dr. Donald McRee, who heads WTR’s program of extramural research, explained that the “clinical” category consists of WTR’s pacemaker research, while “certification” refers to testing emissions from different models of phones (later taken over by the CTIA). “Scientific community,” “government” and “industry” refer to WTR’s coordination with these groups, while

“scientific outreach” includes such activities as travel to its 1995 Rome conference on wireless safety research (see *MWN*, S/O95).

WTR did not provide breakdowns of spending within each category, and only partial information was available from other sources. For example, two organizations are carrying out epidemiological studies for WTR: the American Health Foundation (AHF) in New York City and Epidemiology Resources Inc. (ERI) in Newton Lower Falls, MA. The head of the AHF project, Joshua Muscat, said in an interview that the AHF had received a total of \$469,000 from WTR, while ERI’s Dr. Nancy Dreyer told *Microwave News* that her group had received “well under \$2 million.” This leaves more than \$1.2 million in WTR’s epidemiology budget that has been spent elsewhere.

All of WTR’s clinical research has been devoted to the question of interference with implanted cardiac pacemakers, and total spending for this category is listed at about \$2 million. A total of \$353,000 in grants went to the Mayo Clinic in Rochester, MN, the New England Medical Center in Boston and the University of Oklahoma in Norman, which jointly carried out the WTR pacemaker study. Cost figures have never been released for other aspects of WTR’s pacemaker work, such as the development of research protocols and recommendations for pacemaker users.

### Where the Money Went: History of Spending at WTR

	1993	1994	1995	1996	1997*	1998*†	Totals	%
Ongoing Surveillance	\$46,000	\$269,171	\$294,251	\$157,028	\$69,852	\$18,004	\$854,307	3.63
Dosimetry	126,000	489,130	1,085,064	671,867	711,960	159,450	3,243,471	13.78
Toxicology	180,000	813,989	1,266,756	248,504	599,396	259,801	3,368,446	14.32
Epidemiology	149,000	637,139	1,284,827	641,134	754,617	273,784	3,740,501	15.90
Clinical	54,000	95,782	897,833	946,832	0	0	1,994,447	8.48
Base Stations	0	0	114,737	3,446	0	0	118,183	0.50
Certification	24,000	160,453	216,008	179,057	0	0	579,518	2.46
RMR‡ Other	0	0	12,191	198,192	38,544	4,033	252,960	1.08
Scientific Community	26,631	73,609	1,002,182	538,091	186,515	43,215	1,870,244	7.95
Government	52,439	144,942	430,745	287,281	144,742	37,727	1,092,876	4.64
Industry	15,241	42,125	148,350	129,026	143,167	29,265	507,174	2.16
Other Scientific Outreach	39,689	109,699	304,816	258,541	291,181	44,584	1,048,510	4.46
Program Management	56,000	73,935	793,702	1,014,748	1,341,475	277,791	3,557,651	15.12
Litigation	0	0	395,596	200,616	170,676	33,517	800,406	3.40
Audit Committee	0	0	4,355	44,091	33,054	550	82,051	0.35
PRB§	16,000	29,000	123,672	122,300	66,857	61,920	419,749	1.78
<b>Totals</b>	<b>\$785,000</b>	<b>\$2,938,974</b>	<b>\$8,375,087</b>	<b>\$5,640,756</b>	<b>\$4,552,036</b>	<b>\$1,238,641</b>	<b>\$23,530,494</b>	<b>100%</b>

\*Not audited. †As of March 1998. ‡RMR=Risk Management Research. §PRB=Peer Review Board, based at the Harvard Center for Risk Analysis, Boston. Source: WTR, June 1998.

## Memo from Moscow: East Meets West

*Dr. Ben Greenebaum, a professor of physics at the University of Wisconsin-Parkside in Kenosha and the editor of Bioelectromagnetics, recently returned to the university after spending a sabbatical year with the World Health Organization's (WHO) International EMF Project in Geneva, Switzerland. He filed this report after attending Bioelectromagnetic Research and Hygienic Standards in Eastern Europe in Moscow, May 18-22 (see MWN, N/D97 and M/J98). The meeting was hosted by the Russian Academy of Medical Sciences' (RAMS) Institute of Occupational Health (IOH) and jointly sponsored by the institute and the WHO project. The Russian Academy of Sciences' (RAS) Institute of Biophysics in Moscow, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the U.S. Air Force's (USAF) Armstrong Laboratory in San Antonio also helped arrange the meeting. Greenebaum may be reached on E-mail at: <greeneba@uwp.edu>.*

Research into the biological effects of electromagnetic fields (EMFs) by scientists in Russia and other parts of the former Soviet Union began in the late 1950s, predating many of the Western efforts. Since most of these results were published in Russian, however, they have not been easily accessible to scientists in other parts of the world. A major purpose of the meeting was to review this science and, by publishing the full proceedings in both English and Russian, to make this information more widely available.

Additional goals were to discuss the scientific basis for, and the procedural background of, the Russian exposure standards—as well as those in other parts of the world—and to facilitate international exchanges and collaborations for scientists from Eastern Europe, including the countries of the former Soviet Union.

Approximately 90 people from 17 countries, including about 25 from outside Eastern Europe, participated in four days of discussion, with interpreters providing simultaneous translation between Russian and English. Papers were presented by 20 Russian scientists, as well as three from the U.S., two from Germany and one from Bulgaria. There were an additional 25 poster presentations. One day was devoted to a visit to the RAS' Institute of Biophysics in Puschino.

The formal papers were a mixture of broad surveys of the work of an institute or a research group and detailed discussions of recent findings by individuals or teams of scientists. While the surveys were short on experimental details, the references in the published proceedings should fill these gaps. The posters presented more specifics, though many were in one language only; translations are planned for the proceedings.

Lively discussions ranged from dosimetry and other aspects of research design to the relationship between biological effects and hazards. (More often than not, the closest questioning came from one Russian colleague to another.) Although many Russian-language papers omit details on dosimetry, it was clear that this issue has long been a concern within this community.

At times, it was apparent that Eastern and Western scientists were laboring under different paradigms. Some of the health-related pathways identified by the Russians as being affected by EMFs were unfamiliar to the Western attendees. And ideas were sometimes invoked that were foreign to Western medicine, though they appeared to be related to those used in some types of "alternative medicine"—for example, the need to balance internal energies or fields within the human body.

One group presented experimental effects due to shielding of the Earth's magnetic field and argued that exposure standards should include a minimum level below which DC magnetic fields should not fall.

The latter part of the meeting focused on exposure standards. In Russia, standards are drafted by the IOH. The biological literature is examined for evidence of a threshold at which health-related effects begin to appear. Appropriate extrapolations and safety factors are then

applied. Drafts are circulated for comment.

The Ministry of Health then formulates formal rules that are considered for adoption by the Russian government. The health ministry is also responsible for monitoring and enforcing compliance. The current severe economic difficulties in Russia have jeopardized these efforts, however. The adequacy of its monitoring equipment was also questioned.

Dr. Martin Meltz of the University of Texas Health Science Center in San Antonio and Dr. Jürgen Bernhardt, chair of ICNIRP, talked about how standards are set in the West. The USAF's Armstrong Laboratory's Dr. Michael Murphy described its initiative for collaboration with Eastern European institutions.

As part of the concluding panel discussion—which featured significant audience participation—Dr. Michael Repacholi of the WHO compared the current Russian and ICNIRP exposure standards, expressing both in terms of both incident power and specific absorption rates (SARs). At RF/MW frequencies, the Russians rely on incident power densities, while ICNIRP emphasizes SARs.

The Russian standards call for integrating the amount of incident energy over a day (e.g., occupational ELF exposures of 5 kV/m for 8 hours or proportionately more for shorter time periods up to an absolute maximum of 25 kV/m). This approach was contrasted to the ICNIRP guidelines, which essentially only consider power absorbed over a short time. Reduced to the same practical situation, the Russian and ICNIRP limits are similar, except at the higher RF/MW frequencies.

There was some support for a single worldwide standard, which is one of the objectives of the International EMF Project. A number of members of the Russian standards community noted that, for both scientific and political reasons, the time was ripe for a reassessment of their current exposure standards.

Many times, Russian participants challenged the Western standards' emphasis on thermal impacts to the exclusion of other types of effects. While several speakers stated that the Western process is open to non-thermal effects, they concluded that, for practical purposes, the available evidence only allows standards to be based on short-term thermal effects—at least above 10-100 MHz. Everyone agreed that there had been little research into the health effects of long-term, low-level exposures.

In the end, the Russian researchers gained more appreciation of the need for giving a more prominent role to methodology in their reports, and the Western scientists were more aware of those issues that concerned their Russian colleagues. Those present agreed on the following recommendations for further action:

1. A Russian Commission on Non-Ionizing Radiation Protection with an interdisciplinary membership, as existed in the days of the Soviet Union, should be established. It would address the need for further research into possible EMF health effects, particularly with reference to the WHO project's research agenda.
2. That commission should help the WHO project develop internationally acceptable exposure guidelines and produce a glossary of EMF terminology, based on existing international usage.
3. Russian and Western collaboration should increase, in part to help complete the WHO research agenda. This would build on existing relationships between the WHO, the Armstrong Laboratory and the RAS' Institute of Biophysics in Moscow and take advantage of the new USAF collaboration initiative.

The scientific program was organized by Dr. Nikolai Izmerov, the head of the IOH, Dr. Yuri Grigoriev of the RAS' Institute of Biophysics in Moscow and the WHO's Repacholi. The IOH's Dr. Nina Rubtsova made all the necessary arrangements. All the Russians, scientists and administrative staff alike, gave their out-of-town visitors a most gracious welcome in the finest tradition of Russian hospitality.

## Clippings from All Over

“In Italy, each person has more of them. They keep three. One for the family calls, one for business. And the other one, well, that’s for the girlfriends.”

—An unidentified young man on his friends’ fondness for cellular phones, quoted by Monique Yazigi in “The Party Line: ‘What’s Your Cell?’,” *New York Times*, Sunday Styles, p.2, July 19, 1998

Since many research papers on the safety of mobile phones are conducted on behalf of the mobile phone companies, and not objective bodies, it is important to press the Government to run independent studies that take into consideration that the use of mobiles is a moving target. What was safe yesterday is not necessarily going to extrapolate for our mobile phone use of today.

—Eva Pascoe, columnist, in “Is Your Mobile Giving You a Real Ear-Bashing?” *Independent (U.K.)*, Monday Review, p.11, July 27, 1998

“It’s huge! It will scare people. If we had a campaign that featured our product, we’d lose.”

—John Windolph, executive director of marketing communications, Iridium LLC, reacting last fall to the new Iridium hand-held phones, with which users will be able to place and receive calls anywhere in the world, quoted by Quentin Hardy in “Iridium’s Orbit,” *Wall Street Journal*, p.A1, June 4, 1998

“You have a well-known American corporation that is renting space within one of the church’s most sacred symbols. The cross is a symbol of God’s life for the world and that’s exactly what we are trying to use the cross to do.”

—Rev. Ross Goodman, pastor, St. Paul Evangelical Lutheran Church, Arlington, MA, on the church’s contract with AT&T Wireless and Omnipoint to install cellular antennas on the 20-foot cross atop its steeple, quoted by Jennifer Babson in “Cell Phone Firms Target Higher Power,” *Boston Globe*, p.A1, June 8, 1998

Although research on this speculative hypothesis continues, our judgment is that this potential hazard is best regarded as a “phantom risk.”

—Dr. John Graham, Harvard Center for Risk Analysis, Boston, on possible health hazards of power line EMFs, in “Ranking Risks in the Home,” *Risk in Perspective* (the center’s newsletter), p.4, April 1998 (Graham’s EMF-related work is sponsored by the Electric Power Research Institute in Palo Alto, CA, and by the Edison Electric Institute in Washington.)

Yet despite an enormous number of studies conducted over the past three decades examining many possible putative relationships between environmental factors and cancer, few correlations have been found. From electromagnetic fields and pesticides to microwaves and smog, credible studies have shown little evidence of links between environment and cancer risk.

—Drs. Brian Henderson and Susan Preston-Martin, University of Southern California School of Medicine, Los Angeles, in an op-ed piece, “Real Risks of Cancer Are Not in Environment But in Ourselves,” *Los Angeles Times*, p.B5, June 8, 1998

“It was not a matter of replicating our experiments; rather, they were only similar experiments.”

—Dr. Wolfgang Löscher, Hannover School of Veterinary Medicine, Germany, on the differences between his animal studies on the promotion of breast cancer with 50 Hz magnetic fields and those led by Dr. Larry Anderson of the Battelle Pacific Northwest Labs in Richland, WA, quoted in “Replication of the Löscher Studies in the U.S.,” *Elektrosmog-Report* (Germany), p.7, June 1998 (translated from German; see below and *MWN*, M/A98 and M/J98)

“I pop melatonin like Tic-Tacs.”

—Michael Kors, head designer for Celine, the French fashion house, whose recent travels have “taken him to Japan, Paris, Milan, Dallas, Paris again,” quoted by William Norwich in “Style Diary,” *New York Observer*, p.28, July 20, 1998

### “MICROWAVE NEWS” FLASHBACK

#### Years 15 Ago

- A team led by Henry Kues of JHU–APL reports that pulsed 2450 MHz radiation damages tissue in the cornea at 10 mW/cm<sup>2</sup>, but that the effects first appear 24-72 hours after exposure.
- The state of Wisconsin sues the U.S. Navy to block its extremely low frequency submarine communications system, Project ELF, until the Navy updates its 1977 environmental impact statement.
- Dr. Herman Schwan, chair of the panel that wrote ANSI’s 1966 exposure standard (10 mW/cm<sup>2</sup>) for RF/MW radiation, rejects charges that the panel was tilted toward industry and the military.

#### Years 10 Ago

- In a class action suit against Boeing, where he worked for 27 years, electronics technician Robert Strom charges that the company failed to inform its workers of the hazards of electromagnetic pulse (EMP) radiation, which he believes caused his leukemia.
- Dr. David Lange finds that 2450 MHz radiation at specific absorption rates of 2 W/Kg causes significant leakage through the blood-

brain barrier. The finding parallels Henry Kues’s work showing similar leakage from blood vessels in the eyes.

- The U.S. Air Force considers relocating its high-power PAVE PAWS radar in Georgia, because its main beam may detonate munitions aboard aircraft approaching Robins Air Force Base.

#### Years 5 Ago

- The CTIA abandons its proposal to have the FDA lead the industry’s cell phone research program. The agency’s Dr. Elizabeth Jacobson criticizes the wireless industry for “unwarranted confidence” in the safety of cellular phones.
- Drs. Wolfgang Löscher and Meike Mevissen in Hannover, Germany, report on a series of experiments showing that 50 Hz magnetic fields promote breast cancer in rats. In one experiment, the exposed animals also had decreased melatonin levels.
- People should be wary when phrases such as “no scientific proof” or “no objective evidence” are used to sum up the epidemiological evidence of an EMF–cancer connection, advises Canadian epidemiologist Dr. David Bates.

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**BROADCAST RADIATION**

**Report on Cancer near Denver Antenna Farm...**The cancer rate in the census tract around the Lookout Mountain antenna farm outside of Denver is not significantly higher than in the rest of the metropolitan area, according to a study released on June 15 by the Colorado Department of Public Health and Environment (CDPHE). Between 1985 and 1995 the rate of brain and central nervous system cancers was about 50% higher than expected—but due to the small number of cases, this finding was far from statistically significant. For all other cancers, the risk ratios were lower than expected, sometimes significantly so. The report concluded that if it is possible to collect more precise exposure data, further study might be warranted. The CDPHE inquiry had been requested in April by a citizens group called Canyon Area Residents for the Environment (CARE), which includes 25 neighborhood groups in the Denver suburbs near the antenna farm. In a June 18 press release, CARE stressed that, because of the uneven terrain around the site, residents' exposures may vary widely. "Are these [brain cancers] clustered in areas receiving certain doses of electromagnetic radiation?" CARE asked. "We do not know but would like to find out." Dr. John Reif of Colorado State University in Fort Collins, who helped prepare the report, told *Microwave News* that he would be collecting additional exposure data along with Dr. Frank Barnes of the University of Colorado, Boulder. Reif said he would like to carry out some additional pilot studies, but these would require new funding. CARE called on the CDPHE and county officials to support such research and "fill the funding void left at the national level." Lookout Mountain is home to a dozen high-power radio and TV broadcast towers and to 400-500 other antennas, with another half-dozen large towers planned for the introduction of digital TV. About 10,000 people live in the surrounding area. "From what I know about antenna farms elsewhere in the world, it's a rather unique situation," said Reif. *Cancer Incidence in Residents Adjacent to the Lookout Mountain Antenna Farm* is available from the CDPHE's Executive Director, Dr. Richard Hoffman, in Denver at: (303) 692-2662, Fax: (303) 691-7702.

**ELECTRICAL APPLIANCES**

**U.K. Review of Field Levels...**Research on EMFs from home appliances is reviewed in a new report from the British government. *A Review of EMFs Associated with Motorized Appliances* (CRR No.172), prepared by the National Radiological Protection Board for the Health and Safety Executive (HSE), is based mostly on U.S. studies and, to a lesser extent, on European and U.K. research. The report states that, "Lower field levels can generally be expected in European appliances, where the supply current is about half" that in the U.S. Data on the relationship between EMF levels and distance are provided for a range of appliances. Priced at £15 (approximately \$25), the report is available from: HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS, U.K., (44+1787) 881165, Fax: (44+1787) 313995.

**EMI AND RADIO ASTRONOMY**

**Iridium's Negotiations with Radio Astronomers...**Iridium, whose satellite-based mobile phone system is scheduled to be-



gin operation this fall, announced that it is on the verge of agreements to limit its interference with radio astronomy in Europe and India. Iridium reached an “agreement in principle” on July 7 with the European Science Foundation’s Committee for Radio Astronomy Frequencies and government regulators from France, Germany, Holland, Norway and the U.K., according to spokesperson Michelle Lyle. The details of agreements with individual European observatories have yet to be worked out, Lyle told *Microwave News*, but she does not expect these negotiations to be difficult. On May 19, a tentative pact was reached with India’s National Center for Radio Astrophysics, which operates a radio telescope in Pune, and Iridium expects this to be finalized by early August. At issue is the part of the spectrum between 1610.6 MHz and 1613.8 MHz, the emission frequency of the hydroxyl molecule. Since this is one of the most common interstellar molecules, radio astronomers rely heavily on observations in this band. Iridium satellites do not broadcast below 1621.35 MHz, but their powerful signals are expected to “bleed” into neighboring frequencies, drowning out the faint signals from stars that are light-years away. In March Iridium completed negotiations with the world’s largest radio observatory, in Arecibo, Puerto Rico, promising to limit interference with the giant antenna for eight hours a day. Arecibo had held out for a longer quiet period than was granted to other U.S. radio telescopes, and it was the last one in North America to settle with Iridium. But this agreement does not guarantee Arecibo a complete elimination of static—only that it will be reduced by a factor of 30, according to *Science* (March 27). As a result, observations will take longer than in the past. Astronomers in other countries have taken a harder line than their U.S. colleagues (see *MWN*, J/A96), and the wireless trade paper *RCR* reports that some have accused the Americans of “dancing with the devil” (April 13). With more and more satellite-based wireless technologies expected in the future, the stakes are high. Tomas Gergely, in charge of spectrum management issues at the U.S. National Science Foundation, told *Nature* (March 26), “We must be very vigilant, so that radio astronomy as a discipline survives.”

**The Future of Spectrum Management...***Radio Astronomy Spectrum Planning Options*, a report released in April by the U.S. National Telecommunications and Information Administration (NTIA) in Washington, examines the conflict between science and commerce in spectrum allocation. The report calls for increased sharing of different parts of the radio spectrum, through time-sharing agreements, better filtering of unwanted signals and “geographic and topographic isolation of sensitive receivers.” Other options described in the report include increased use of fiber-optic cable and other wireline technologies, shifting existing users to other frequencies and commercial use of the spectrum above 20 GHz. The report can be found on the NTIA’s Web site at: <[www.ntia.doc.gov](http://www.ntia.doc.gov)>. Printed copies can be requested from the NTIA’s Mary Wallach at (202) 482-3999.

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**ICNIRP**

**Exposure Limits Updated...**The International Commission on Non-Ionizing Radiation Protection’s (ICNIRP) exposure guidelines are only designed to protect against “known adverse health

## Stay Ahead with Microwave News

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**Microwave News breaks the story:**

*Microwave News*, July/August 1995

**“Draft NCRP Report Seeks  
Strong Action To Curb EMFs”**

**“Leak Links Power Lines to Cancer”**

*New Scientist* (U.K.), October 7, 1995



*Microwave News*, July/August 1994

**“Digital Cellular Phones Can Disrupt  
Implanted Pacemakers”**

**“Cellular Phones May Affect  
Use of Pacemakers”**

*Wall Street Journal*, April 28, 1995



*Microwave News*, November/December 1995

**“Higher Leukemia Rates Among Those  
Living Near Australian TV Towers”**

**“Living Near TV Towers a Leukemia  
Risk for Children, Claims Researcher”**

*Sydney Morning Herald* (Australia), December 10, 1996

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impacts,” according to Dr. Jürgen Bernhardt, ICNIRP’s chairman. Bernhardt reviewed the updated limits, which cover the spectrum from 1 Hz to 300 GHz, in a presentation at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL, on June 10. The limits protect against “short-term, immediate health effects” such as nerve stimulation, contact shocks and thermal insults, according to the guidelines, which appear in the April issue of *Health Physics* (74, pp.494-522, 1998). Despite “suggestive” evidence that power frequency magnetic fields can be carcinogenic, ICNIRP has concluded that this and other nonthermal health effects have not been “established.” ICNIRP has long followed this approach to standard-setting (see *MWN*, Mr84, M/A87, J/F88, M/J88, M/J89 and J/F90). In his talk, Bernhardt noted that the guidelines include “no consideration regarding prudent avoidance” for health effects for which evidence is less than conclusive. The exposure limits are expressed in two ways: as basic restrictions and as more readily measured reference levels. For example, ICNIRP’s basic restriction for public exposures to 50 Hz magnetic fields is a maximum induced current of 2 mA/m<sup>2</sup> in the head and trunk, and its reference level is 1 G. (At 60 Hz, the level is 833 mG.) “Compliance with the reference level will ensure compliance with the relevant basic restriction,” ICNIRP states. For radiation in the 10 MHz-10 GHz range, ICNIRP specifies its basic restriction in terms of specific absorption rates (SARs). For the general public, the maximum allowable whole-body SAR is 0.08 W/Kg. For workers, the maximum SAR is 0.4 W/Kg. The reference level for public exposures is 200 μW/cm<sup>2</sup> from 10 MHz to 400 MHz. Above 400 MHz, it increases with frequency to a maximum of 1 mW/cm<sup>2</sup> at 2 GHz. To clarify aspects of the guidelines, ICNIRP has prepared a paper in a question-and-answer format, which will appear in the October issue of *Health Physics*.

### INTERNATIONAL STANDARDS

**Proposed EC Rules Follow ICNIRP...**The European Commission (EC) has drafted new guidelines for the general public’s exposure to non-ionizing radiation (NIR). The proposal is intended to replace the current patchwork of national and European regulations with a single coherent framework, but must still be voted on by the ministerial council of the European Union (EU). The draft rules “are based on the best scientific advice, notably from the International Commission on Non-Ionizing Radiation Protection (ICNIRP),” according to a June 22 press release from the EC in Brussels, Belgium. The EC noted that the proposed standard does not address “the so-called ‘athermal’ effects of NIR, such as cancer, for which there is no conclusive scientific evidence.” Specific regulations to enforce the guidelines would be left to individual governments. EC Employment and Social Affairs Commissioner Pdraig Flynn said that the rules are needed because, “The absence of requirements or guidelines at the EU level in this area is having a negative effect on the attitudes of consumers with regard to equipment emitting NIR.” The EU had been urged to develop “a wider international consensus” on public exposure to NIR in a 1996 report from the EC’s directorate for employment, industrial relations and social affairs (see *MWN*, S/O97; also S/O96). The new proposal has been endorsed by the EC’s Scientific Steering Committee.

That Gallo was giving advice on EMFs was in itself surprising. He is new to the EMF debate, as he often remarked over the ten days of meetings. “I am agnostic” on this issue, he said.

Nor did Gallo learn much about risk during the working sessions—because risk was never discussed in Minneapolis. The panel was told to ignore risk and concentrate on the science. (Translated into jargon, the assigned task was “hazard identification,” not “risk characterization.” The idea is that you must first identify what risks, if any, exist, before you can judge their size.)

“We don’t care what the outcome is,” Dr. Kenneth Olden, the director of the NIEHS, instructed the working group on the opening evening of the meeting. “We just want it to be based on good science.” Risk analysis would come later.

But, evidently, Gallo and NIEHS’ senior managers felt they had to offer their risk assessment without the benefit of the formal risk analysis that Dr. Christopher Portier is preparing for them.

Why was the NIEHS trying to downplay public concern over EMFs? It is puzzling, especially given that the most likely result of the panel’s decision would be to prompt more health research, which, after all, is the NIEHS’ *raison d’être*. Why not accept the recommendation of its panel and ask Congress to keep funding EMF studies?

Part of the answer has to do with the current climate for environmental research. The RAPID program is coming to an end, and Congress is not in any rush to renew it. So any future EMF studies would be at the expense of other NIEHS projects.

But there’s more than money involved. NIEHS managers long ago decided that EMFs are not worth their attention. In the press release, Gallo did recommend more “hypothesis-driven, focused research,” but, in a telling omission, there was no endorsement from the NIEHS. Not from Dr. Gary Boorman, the head of the institute’s EMF studies; not from Dr. George Lucier, the director of its Environmental Toxicology Program, who flew in for the concluding sessions of the meeting; nor from institute director Olden himself. The NIEHS does not want to make any commitments to EMFs.

The NIEHS’ ambivalence over EMFs is not new. Three years ago, when the institute’s long-term animal studies were just getting under way, Boorman said on national public television that, in all probability, it would soon be obvious that “there’s really nothing there” (see *MWN*, J/A95).

Boorman’s comments were remarkable. Here was a government scientist who had just committed some \$10 million of NIEHS (not RAPID) funds for a set of animal studies—and he thought there was little evidence of any real risk. For Boorman, it appeared as if their real value was to quell what he perceives to be the public’s groundless fears.

As it turned out, the animal studies were not as clearly negative as Boorman had predicted. Earlier this year, the National Toxicology Program found that they showed an “equivocal” cancer risk in male rats (see *MWN*, M/A98).

The \$10 million animal data did not play a major role in the NIEHS working group’s decision. The epidemiology was the dominant basis for listing EMFs as possible carcinogens. It had to be: There are simply too many high-quality childhood and worker studies to ignore. It makes sense that studies of *human beings* in real EMF environments should be given more weight

than experiments on animals exposed to idealized magnetic fields.

In the real world, people rarely encounter the type of EMFs to which Boorman’s animals were exposed—pure 60 Hz sine waves. In retrospect, it was probably a gross mistake to bet the whole \$10 million on one artificial type of EMFs.

Which brings us back to the question of risk. How much of a threat do EMFs really pose? Do they pose only a small health risk, as Gallo and the NIEHS would have us all believe?

When asked to put his quote in context, Gallo explained that he was comparing EMFs to AIDS and TB. But we did not need a multimillion-dollar research project to tell us that EMFs are not the cause of a global plague. No one has ever argued that.

The idea that EMFs pose a small risk (at worst) comes largely from industry propaganda (see p.15). It has been repeated so many times that it is now accepted as dogma.

Even those who should be more skeptical are buying into the low-risk assumption. Jocelyn Kaiser’s report on the NIEHS meeting for *Science* (July 3) included this sentence: “Experts are quick to point out that any cancer risk from EMFs is slight.” She treated the statement as so self-evident that she did not even bother to name any of the experts.

The risks may indeed turn out to be small, but, at this point, that is still very much an assumption. No one will know the true dimensions of the EMF problem until the active biological agent has been identified. It could be high frequency transients, but that too is a guess.

We are all exposed to EMFs all the time. This means that epidemiological studies give at best a minimal estimate of the real risks, because it is impossible to find a truly unexposed group to serve as controls. EMF studies may be the equivalent of comparing two-pack-a-day smokers with those who smoke three packs a day.

As Dr. Raymond Neutra of the California Department of Health Services pointed out at the BEMS conference this June, “EMF risks could be large compared to lifetime theoretical risks for most regulated chemicals.” Neutra argued that, “If you are not willing to do EMF research, you should not be doing any environmental research.”

Anyone who has grappled with the inexact science of estimating risk knows that the numbers are easily manipulated to fit a desired objective—especially with agents like EMFs, for which there are large holes in the data. When the NIEHS releases Portier’s risk analysis, his assumptions should be examined closely. After all, his superiors have already made clear how it should turn out: not much risk, not much need for research.

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