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Dropping the 'H' in WHO

Air Force Microwave–Cancer Study Shrouded in Mystery

Fifteen years ago, Dr. James Toler of the Georgia Institute of Technology sent the U.S. Air Force (USAF) a proposal for a study on the effects of long-term, low-level microwaves. The animal exposures began in 1989 and were completed the following year. But today, more than six years later, the results have yet to be released officially.

In June 1995, Toler was expected to present his findings at a special workshop organized by the USAF, which was held in Boston the day before the start of the Bioelectromagnetics Society's (BEMS) annual meeting. But he declined to do so.

"I went to the meeting expecting to see some conclusive data and I am still waiting," Dr. Asher Sheppard, a consultant based in Redlands, CA, said in a recent interview.

In his Boston talk, Toler said that at one point in 1990 he had observed more mice with tumors among the exposed group than among the controls—42 versus 35—but that by the end of the experiment there were no differences in the numbers of tumors or survival rates between the two groups. He would not be more specific, promising instead to present the data during the BEMS meeting. Later that day, Toler went home to Atlanta and the results remained a mystery.

In an interview a month after the BEMS meeting, Toler still would not talk about the tumor counts, but he remained firm about the study's findings: "We saw no effects and the biostatistician saw no effects."

James Merritt, Toler's project officer at the USAF's Armstrong Laboratory

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Physicists and Biologists Butt Heads at First NIEHS EMF Risk Workshop

Once again, it was the biologists versus the physicists. This time they met at a symposium on cellular studies convened by the National Institute of Environmental Health Sciences (NIEHS) to help the agency assess health risks from exposures to electromagnetic fields (EMFs).

At the opening session on March 24 in Durham, NC, Dr. James Weaver, a physicist at the Massachusetts Institute of Technology (MIT) in Cambridge, MA, presented a model showing that the thresholds for EMF interactions have to be above 1 G. "I have a hard time understanding the experimental data for levels below that," he told *Microwave News*.

But the biologists were not buying it. "There appears to be wide acceptance of the existence of *in vitro* biological effects down to 10-20 mG," countered Dr. Martin Blank of Columbia University's medical school in New York City, who spoke for many of those at the meeting.

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« Power Line Talk »

The DOE plans to stop all EMF research in September 1998—the end of fiscal year 1998. The news came in a March 7 letter from **Christine Ervin**, DOE assistant secretary, to Dr. **Ken Olden**, the director of the NIEHS. “We believe that the federal government should base the decision of whether to support any further research on the results of your agency’s risk assessment, and that any research be managed by your agency,” Ervin wrote. If the DOE follows through on this decision, it will mean the end of the DOE’s core program, which began in 1978. DOE work on the EMF RAPID program would also come to a close, but Congress had originally designed RAPID to be a five-year effort. “If you are looking for public credibility on the EMF issue, the health agencies should be taking the lead on the research, risk assessment and communications,” commented the DOE’s **Bob Brewer**. **Lynne Gillette**, DOE RAPID research manager, stressed, “The DOE is clear that it wants to be out of the EMF research business. We are getting the message in many different ways.” Ervin’s letter sent shivers through the EMF community. “This is not the time for the DOE to say that the EMF issue has been finalized. All the questions have not been answered,” said Dr. **Richard Luben** of the University of California, Riverside, the president of the Bioelectromagnetics Society. Much, therefore, depends on the NIEHS risk assessment (see p.1). “We agree with Christine Ervin that decisions on further research should be based on a review of the risk assessment process,” said Dr. **Gary Boorman**, who heads the RAPID program at the NIEHS. Meanwhile, Ervin has announced that she will leave the DOE on May 1.

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Ervin’s letter also brought word that the EPA will stop managing its **EMF hot line** (see *MWN*, M/J94) on June 15, 1997. “The EPA has decided that it no longer has the ability to run the EMF infoline because of significant budget cuts and as a result of the Senate language,” said **Denise Settles**, EMF-ELF coordinator at the EPA in Washington. In 1995, the Senate Committee on Appropriations stated that it was cutting the EPA’s budget by \$350,000 because the “EPA should not engage in EMF activities” (see *MWN*, S/O95). The EPA’s decision caught many observers by surprise because the RAPID program has been paying for the hot line. As one close observer, who asked not to be named, noted, “The EPA is the only agency that refuses money.”

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A replication of a **breast cancer** study originally carried out in Dr. **Wolfgang Löscher**’s lab at the School of Veterinary Medicine in Hannover, Germany, has had to be repeated. Last year the U.S. NIEHS contracted with a team led by Dr. **Larry Anderson** at the **Battelle Pacific Northwest Labs** in Richland, WA, to test whether magnetic fields can promote the action of the carcinogen DMBA, as Löscher had previously reported (see *MWN*, M/A96). Löscher gave his rats four 5 mg doses of DMBA, which some toxicologists believe is so much that it masks the action of a cancer promoter. Indeed, when Anderson completed the 13-week magnetic field exposure study at the end of last year, the breast cancer tumor rates were above 80%, which are unlikely to allow

any conclusion about EMF effects. The experiment is being repeated with four 2 mg doses of DMBA—this should cut the tumor rates in half, according to a dose–response study. (Battelle also ran a 26-week exposure study using a single 10 mg dose of DMBA.) Dr. **Gary Boorman**, who negotiated the contract for the NIEHS, stands by his original decision. “What we did was right even though the dose was too high, because people were asking for an *exact* replication,” he told *Microwave News*. Results of both the Battelle breast cancer studies are expected to be announced at the DOE’s EMF review next November in San Diego.

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In December 1995 Dr. **Patricia Buffler**, dean of the School of Public Health at the University of California, Berkeley, published a meta-analysis of studies of **brain tumor** risk and occupational EMF exposure. Buffler and her coauthors concluded that the studies showed a “small but significant” increase in the risk, that biases were “unlikely” to be the cause and that “this meta-analysis provides some evidence against the hypothesis of no association between occupational exposure to EMF[s] and the risk of cancer” (see *MWN*, J/F96). But now Buffler has gone to court in an occupational brain tumor case to argue that “concerns about EMF[s]” are “essentially without scientific foundation.” In February Buffler and 11 other scientists intervened in the **Ford** EMF lawsuit in San Francisco, in a friend-of-the-court brief filed by the **Atlantic Legal Foundation** (ALF). Three of those signing the brief are Nobel Prize winners, but ALF general counsel **Martin Kaufman** told *Microwave News*, “The person we considered most significant was Pat Buffler, because she’s an epidemiologist, she’s in California and she’s an author of one of the articles that the plaintiffs relied on”—the brain tumor meta-analysis. “I believe my position is consistent,” Buffler told *Microwave News*. “The association noted in the meta-analysis...was with occupations or job titles presumably exposed to EMFs, not EMF exposures *per se*. In fact, in this publication, higher risk ratios were not observed for jobs with higher measured EMFs.” The ALF brief mainly discusses residential studies, but it contends that, “The findings of those studies would also apply to persons working near 60 Hz electric power lines, such as those involved in this case.” In fact, the bulk of the ALF’s brief in *Ford* is identical to one that it filed in a residential property devaluation suit, the **Covalt** case (see *MWN*, N/D95 and M/A96). Kaufman said this was appropriate “because the issue is quite similar.” The *Ford* lawsuit was filed in 1995 by the widow of a telephone line worker who died of a brain tumor; it charges that his cancer was due to EMF exposure from working next to power lines (see *MWN*, M/A95).

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Reports of **Doug Bannerman**’s retirement are greatly exaggerated—even though he was feted at two going-away parties. The National Electrical Manufacturers Association (NEMA), based in Rosslyn, VA, has asked him to continue to track the EMF issue. A 13-year NEMA veteran, Bannerman has agreed to stay on until at least the end of the year. He worked on various environmental issues in the past but will now focus only on EMFs.

Trying To Define the EMF–Melatonin Relationship: Data from Real-World and Lab Exposures Diverge

Recent studies of EMFs and melatonin continue to indicate that a relationship may exist—but provide little clarity about what it might be. Studies in the workplace have shown that EMF exposure is associated with a drop in melatonin levels, but this association has not always been supported by laboratory studies.

“Most natural observations appear to find melatonin changes, while controlled lab studies tend not to,” commented Dr. John Reif of Colorado State University in Fort Collins. “In a general way, I’m concerned that the controlled lab trials may not mimic exposures in the real world.”

Depressed Melatonin Levels in Garment Workers

A preliminary study of 60 workers at a Finnish garment factory found “a highly significant effect” of EMFs in reducing nocturnal melatonin levels, Dr. Jukka Juutilainen of Finland’s University of Kuopio told *Microwave News*.

Eye-level measurements of magnetic fields were taken for the two different types of sewing machines used in this plant, and seamstresses were assigned to high- or low-exposure groups based on the type of machine they used, with average exposures either above or below 10 mG. Unexposed nonindustrial workers were used as controls.

Through questionnaires, information was gathered on other possible factors such as age, smoking, light exposure and use of alcohol, coffee, home appliances, mobile phones and certain medications. Multiple-regression analysis found strong effects of both magnetic field exposure and smoking on nighttime levels of melatonin. Melatonin levels were not measured during the day.

No difference was found between melatonin levels on Thursday nights and those on Sunday nights, indicating “that the possible suppression caused by magnetic field exposure is chronic, with little recovery during the weekend,” according to the study. Juutilainen will present these results at the *5th Nordic Workshop on Biological Effects of Low Frequency EMFs*, to be held April 17-18 in Trondheim, Norway.

Daytime Melatonin Down in Utility Workers

In a study of 192 electric utility workers, Reif and Dr. James Burch, also of Colorado State University, found that some EMF exposures are associated with lower levels of melatonin. They presented their findings last November in San Antonio at the Department of Energy’s (DOE) annual EMF research review.

Electricity generation and distribution workers and other utility employees who served as controls wore EMDEX meters adapted to measure ambient light as well as magnetic field intensity. Adjusting for light exposure and other factors that can influence melatonin levels, Burch and Reif found a significant association between magnetic field exposures and lower daytime melatonin levels on the second and third of three days of measurement.

Some studies have suggested that EMF effects on melatonin may depend on whether the field is continuous or intermittent. Burch and Reif found that magnetic fields in the home that were

“temporally coherent” (that is, less intermittent) had a very significant association with lower melatonin levels at night. They concluded that, “The intensity and temporal characteristics of magnetic fields appear to be involved in melatonin suppression.”

“The time of day during which exposure occurs may be important,” Reif said in an interview. He suggested that future research examine this issue, as well as physical characteristics of EMFs such as transients and temporal coherence.

Continuous EMF Exposure Shows No Effect

A continuous 60 Hz, 200 mG magnetic field applied to people while they slept had no effect on nocturnal melatonin levels in an experiment conducted for the Electric Power Research Institute (EPRI) by Dr. Charles Graham and coworkers at their laboratory at the Midwest Research Institute (MRI) in Kansas City, MO. Blood was drawn every hour during an eight-hour period, but melatonin levels showed no difference for real and sham EMF exposures.

In a similar study published in 1994, Graham found no over-

New Book Surveys Melatonin, Breast Cancer and EMFs

This will be a hot year for the “melatonin hypothesis,” the idea that EMFs may increase breast cancer risks by lowering levels of melatonin.

The results of efforts to replicate key animal and cellular breast cancer studies should be announced in the months ahead (see *MWN*, M/A96). On the epidemiology front, the Karolinska Institute in Stockholm, Sweden, and Seattle’s Fred Hutchinson Cancer Research Center will report on the first two large studies to focus on EMFs and light at night.

A good source of current information on this debate is *The Melatonin Hypothesis: Breast Cancer and Use of Electric Power*, edited by Drs. Richard Stevens, Bary Wilson and Larry Anderson, all of the Battelle Pacific Northwest Labs in Richland, WA. The just-published volume includes contributions from the editors and almost all other key players in the field: Blackman, Blask, Graham, Haggren, Lerchl, Liburdy, Löscher, Matt, Reiter, Yellon and others. Among the authors are researchers from all of the much-anticipated ongoing studies, except for the Karolinska epidemiologists.

In an introductory chapter, the editors state, “The body of evidence is sufficient to bind electric power over for trial, but not nearly adequate to render a verdict.” For those who would like to be informed jurors, this 776-page book is essential.

The Melatonin Hypothesis can be ordered for \$87.50 (plus appropriate sales tax and \$3.50 shipping within the U.S.; \$12.50 for overseas airmail delivery) from: Battelle Press, 505 King Ave., Columbus, OH 43201, (800) 451-3543 or (614) 424-6393, Fax: (614) 424-3819, E-mail: <press@battelle.org>.

all effect for intermittent EMF exposure. However, data from that study showed that men with preexisting low levels of melatonin had even lower levels when exposed to EMFs, suggesting that a person's prior melatonin level may be an important factor. A 1995 study by Graham, also using intermittent EMF exposure, did not support this hypothesis. The most recent experiment used continuous magnetic fields instead, and still found no effect.

However, Graham states that it would be premature to conclude that EMFs do not affect human melatonin. He points out that all of the subjects in the three studies were "healthy young men," and that the types of EMFs with which people come in contact in an industrialized society are much more varied than those created in the carefully controlled MRI exposure facility. Specifically, Graham points to the possible biological effects of high-frequency transients, which are common in many homes (see also *MWN*, S/O95 and J/A96).

MRI's Dr. Antonio Sastre told *Microwave News* that in these three experiments, transients from switching the fields on and off would have been "minuscule to nonexistent." He said that he

and Graham are currently planning experiments to examine whether transients can influence human melatonin.

Details of Graham's study appear in his report to EPRI, *Melatonin Levels in Continuous Magnetic Fields* (TR-106178).

Rat Study Gives Mixed Results

Past experiments by Dr. Russel Reiter and colleagues showed a link between rapid changes in static magnetic field exposure and lowered nocturnal melatonin levels in rodents. Reiter suggested that induced electrical currents in the animals had caused a drop in melatonin production (see *MWN*, J/A90 and N/D93).

In a recent series of experiments conducted for EPRI, Reiter set out to verify these findings. Rats were subjected to the repeated rapid inversion of a strong DC magnetic field, ranging from 0.5 to 5 G, for various lengths of time. Reiter measured both pineal melatonin activity and melatonin levels in the blood.

In his report to EPRI, *Static Magnetic Field Perturbations and Pineal Melatonin Production* (TR-107238), Reiter states that magnetic field exposure produced a significant drop in serum melatonin in ten out of 23 rats. Pineal melatonin showed significant changes less often. Magnetic field strength did not show a dose-response relationship. Reiter notes one way in which these variable results were very consistent: "In the 17 cases where one of the [melatonin] parameters was modified by the magnetic field exposures, in every case a reduction was observed."

The fact that serum melatonin often went down while pineal melatonin was unaffected led Reiter to change his hypothesis about a possible mechanism of interaction: "It has been assumed that the fields...reduced the ability of the pineal gland to form melatonin." Instead, Reiter now proposes that melatonin is "more rapidly taken up into tissues during the exposure." He notes that others have suggested that EMFs may lead to higher levels of free radicals; if this is the case, an antioxidant like melatonin "would disappear from the blood more quickly than [is] normal because it would be required for the scavenging of free radicals."

VDT Work Seen To Lower Daytime Melatonin

Workers' circulating levels of melatonin decreased significantly over the course of a day of VDT work, report Swedish researchers Drs. Bengt Arnetz of the Karolinska Institute in Huddinge and Mats Berg of the Karolinska Hospital in Stockholm. No such change was observed during a day at the office without VDT use. "This suggests that there is direct impact from the electromagnetic environment of the [VDT] on levels of melatonin," Arnetz and Berg write in the November 1996 *Journal of Occupational and Environmental Medicine*. No measurements or estimates of EMF levels were attempted.

Levels of a different hormone, adrenocorticotrophic hormone (ACTH), went up during the working day, and this showed a strong correlation with workers' subjective assessment of mental strain. Arnetz and Berg note that ACTH is "known as a classic stress hormone that reacts to mental strain." But, in contrast, "occupational strain did not correlate with melatonin levels."

About half of the 47 experimental subjects were people who had reported symptoms of electromagnetic sensitivity, while the others had not. Arnetz and Berg found no differences in hormone levels between these two groups (see also p.16).

The Taxing Problem of EMFs

A Canadian ruling that EMFs from an electrical substation devalued an adjacent property led to a tax cut for the property's owner. The city of Toronto agreed to the reduction in late February. The real estate at issue is a gas station next to a set of transformers operated by Toronto Hydro.

"You're going to see a lot more cases like this," predicted U.S. attorney Randy Airst of American Land Recycling Corp. in Exton, PA, who represented the company that owns the gas station, Ontario Ltd.

Airst asked for a reduction in the station's property tax assessment on several grounds, including suspected leaks from its own gasoline storage tanks and EMFs from the Toronto Hydro substation. In November 1995, a provincial review board rejected the concerns about the storage tanks, but accepted the EMF claim.

The Assessment Review Board cited "the environmental concerns created by possible adverse effects of EMFs and the stigma attached to adjacent properties," and concluded that "this has an adverse impact on the value of the property. Certain types of business would be unable to operate in such a location." For this and other reasons, the assessment was ordered reduced from \$17,840 to \$7,500, in Canadian dollars. The city of Toronto appealed, but on February 20 of this year it agreed to settle at \$11,500.

Airst stressed that this will reduce the owner's tax bill by several thousand dollars for each and every year in the future. He also pointed out that a property tax case does not require showing any liability on the part of an electric utility. All that is needed, said Airst, is to show that public perceptions have affected the property's market value.

Airst is the author of *How To Avoid Environmental Liability: A Practical Guide for Real Estate Owners, Lenders, and Professionals*, which is published by Cahners in Des Plaines, IL.

No EMF—Skin Cancer Link in Canadian Mouse Studies

A set of experiments with mice do not support the idea that magnetic fields act as a cancer copromoter, according to a research team at Canada's Environmental Health Directorate in Ottawa.

Overall differences between mice exposed to magnetic fields and controls were minimal. In fact, taking all the experiments together, the incidence of skin tumors was slightly higher for the controls. The findings are described by Dr. Jack McLean and colleagues in the January 1997 issue of *Environmental Health Perspectives* (105, pp.94-96).

In 1991, McLean presented initial findings from the first of three experiments at the annual meeting of the Bioelectromagnetics Society (BEMS), in Salt Lake City, reporting a significantly higher incidence of tumors among magnetic field-exposed mice (see *MWN*, J/A91). McLean stressed that these data, from the first 17 weeks of exposure, were preliminary. And while the difference was still present after an additional six weeks of exposure, it was no longer statistically significant.

In an interview after the 1991 BEMS meeting, McLean said, "I'll breathe easier when our study is replicated." But when it was, the effect disappeared. In the second experiment, the number of mice with tumors was exactly the same in exposed and control groups. And in the third experiment, tumor incidence was significantly higher among controls. The principal reason for these differences in results, the researchers explain, is that tumor incidence in the control groups varied by a factor of two.

The strain of mouse that they used, the SENCAR mouse, was bred to be particularly susceptible to cancer. But skin tumor incidence among SENCAR mice in identical conditions can vary widely, and the paper cites one study that showed a sixfold variation. "This means there's too much noise in this model to pick out a weak effect," McLean told *Microwave News*. The paper states that using skin tumors in SENCAR mice as a model system thus "lacks the sensitivity to detect all but the most potent direct-acting carcinogens."

Dr. Maria Stuchly of the University of Victoria in British Columbia, Canada, agreed that this could be a problem: "The [EMF] effect is always on the border of detectability. The effect may be very subtle, or maybe it doesn't exist—it's an open question." Stuchly, who worked with McLean on the first of the three experiments, said in an interview that she was "not surprised" by the variability in the data, since this often occurs in skin tumor-promotion experiments with SENCAR mice.

A more recent copromotion experiment by Stuchly and Dr. Craig Byus of the University of California, Riverside, showed a statistically significant increase in tumor incidence among EMF-exposed SENCAR mice (see *MWN*, M/A96). In an interview this March, Byus said that the study has now been submitted for publication.

In McLean's three 23-week experiments, mice were treated on their skin with both the carcinogen DMBA and the tumor promoter TPA (also known as PMA) to test the idea that the action of the TPA might be enhanced by the application of a magnetic field. Half the mice were exposed to a continuous 60 Hz, 20 G

field for six hours a day, five days a week—a time schedule designed to mimic human occupational exposures. The coils generating the magnetic field were shielded with thin copper tape to reduce electric field levels.

Byus noted that McLean had applied TPA to the animals only once a week, and commented, "The reason most people apply it twice a week is to get a more consistent response." He said that he knows of no other EMF study in which the TPA was applied only once a week.

McLean's findings are consistent with those of a study published in 1993 by Dr. Bo Holmberg and coworkers at the National Institute for Working Life in Solna, Sweden; it found that continuous 50 Hz magnetic fields did not promote the growth of skin tumors in SENCAR mice. However, a later study by the same group found that an *intermittent* 50 Hz field, switched on and off every 15 seconds, appeared to produce "a weak promotional effect" (see *MWN*, M/A94).

McLean's just-published experiments did not examine the effects of intermittent exposures, and he said he does not plan to do so.

McLean is now planning a new series of experiments with a different strain of mice in collaboration with Dr. Barry Glickman of the University of Victoria and others. "We're going back to take a look at this idea of mechanisms," he explained, "and whether there's any plausible connection between EMFs and the concentration of free radicals—not just in a test tube, but in a biological system."

Manual on Prudent Avoidance in New Schools Is Too Hot for DOE

The California EMF Program has released a 41-page report recommending no- and low-cost strategies for minimizing EMF exposures in new schools. The Department of Energy (DOE), however, has been told not to distribute the report—even though the DOE helped sponsor it.

At a March 18 meeting, the federal EMF Interagency Advisory Committee (IAC) decided that the report's support for prudent avoidance is too controversial. "The committee is worried that the report will be interpreted as advocating a *de facto* standard if it is issued by the federal government," the DOE's Lynne Gillette told *Microwave News*.

In fact, the report itself advises against establishing specific magnetic field-strength standards because they may "foment discord." Nor does the report recommend using a gaussmeter to measure EMF levels within a school—at least partially because "there is no scientific consensus" regarding what EMF levels are acceptable.

California officials were amazed by the IAC's decision. "Our stakeholders did not find this report controversial," said Dr. Raymond Neutra, the head of the California program. "We were very careful to structure the checklist so that it could be incorporated into existing practices of school design and construction."

Dr. Jack Sahl of Southern California Edison in Rosemead urged the DOE to distribute the report "in a timely manner." He noted that, "This type of precaution-based approach works in

EMFs, Risks and Cost-Benefit Analysis: U.K.'s NRPB Disputes Sweden's Quantification of Prudent Avoidance

Reprinted below is a commentary by Dr. John Stather, senior assistant director of the National Radiological Protection Board (NRPB) in the U.K., which first appeared in the February 1997 issue of Radiological Protection Bulletin, the board's monthly report. SSI News is published by Sweden's Radiation Protection Institute (RPI). In late 1996 five Swedish national agencies, including the RPI, issued a pamphlet entitled Low-Frequency Electric and Magnetic Fields: The Precautionary Principle for National Authorities, which is very similar to what appeared in SSI News. Microwave News featured excerpts from the pamphlet in its November/December 1996 issue.

National authorities in Sweden have recently recommended the application of the precautionary principle in relation to residential exposures to low-frequency electric and magnetic fields (EMFs) (*SSI News*, 4, No. 2, pp.1-4, 1996). The principle is advocated for decision making and planning for existing and new electrical facilities. It is proposed that when exposures from existing facilities deviate significantly from normal, measures to reduce exposure should be taken when they can be carried out at reasonable cost. For new facilities, their design and siting should be aimed at limiting exposures. The stated aim of these recommendations is "to reduce the risk of injury to human beings."

But what injury? And can the risk be quantified and the cost of avoidance justified? The current concern about effects of EMFs is largely the result of epidemiological studies. The Swedish authorities acknowledge that experimental studies have not so far yielded any results that clearly corroborate the epidemiological findings. Even the results of epidemiological studies are inconsistent, although the greatest concern relates to the possible risk of childhood leukemia.

Within Scandinavian countries the results of different studies have been quite variable and with considerable uncertainties. A study in Sweden suggested that children living close to transmission lines have a risk of developing leukemia some 2.7 times that in children living away from lines. Two studies from Denmark and Finland have suggested a 1.5-1.6-fold increase in the risk of childhood leukemia at higher exposures, but a more recent study in Norway has shown no increase in risk at all.

As described in the December issue of the *Bulletin*, a committee of the U.S. National Academy of Sciences has recently reported the results of a three-year study into the possible health effects of exposure to residential EMFs. It concluded, on the basis of reviews of experimental and epidemiological studies, that "the current body of evidence does not show that exposure to these fields presents a human-health hazard."

These conclusions are very similar to those by the NRPB Advisory Group on Non-Ionizing Radiation (*Documents of the NRPB*, 5, No. 2, 1994) which has said, "there is no persuasive biological evidence that ELF electromagnetic fields can influence any of the accepted stages in

carcinogenesis. There is no clear basis from which to derive a meaningful assessment of risk, nor is there any indication of how any putative risk might vary with exposure."

This lack of evidence for harmful effects of EMFs contrasts with the information on ionizing radiation, where a range of epidemiological studies have unequivocally demonstrated a cancer risk. There is also very strong supporting evidence from studies with experimental animals, while cellular and molecular studies have shown direct effects of ionizing radiation on DNA and are now serving to elucidate the mechanisms involved in carcinogenesis.

Examples have been given by the Swedish authorities of the application of a rudimentary cost-benefit analysis for avoiding cases of childhood leukemia resulting from exposure to EMFs by changes in the design and siting of electrical facilities. Exposure reduction measures were estimated to cost between about two million and several hundred million Swedish kronor (£1≈12 SEK) per "statistical" case of childhood leukemia avoided on the basis of a relative risk of 2.7 (as found in the Swedish study). With lower risks the costs would of course be increased and if there were no risk at all, then the costs would be infinite, with no benefit.

The application of cost-benefit analysis to possible risks of cancer from power-frequency EMFs is fraught with difficulty in the absence of information on a dose-response relationship. In any analysis of this type, whether for ionizing or non-ionizing radiation, the uncertainties need to be properly recognized. Cost-benefit analysis can only inform decisions, it should not drive them.

Meanwhile, for EMFs, experimental and epidemiological studies continue to be kept under constant review by the NRPB. We are supporting the National Study of Childhood Cancer, which is examining a number of factors that might be implicated in childhood cancer, including EMFs. We maintain an active involvement in research in this country and abroad and will not hesitate to advise government if further information becomes available to suggest that a causal relationship between exposure to EMFs and cancer has been established.

California." Sahl has argued that prudent avoidance can be practiced in a way that is consistent with utility interests (see *MWN*, N/D96).

Written by Brooks Cavin III, a professor of architecture at California Polytechnic Institute in Pomona, the report offers simple guidelines based on four general principles for construction of school buildings:

- Maximize the distance between EMF sources and high-occupancy areas.
- Maximize the cancellation of magnetic fields by minimizing the distance between conductors in the circuit and by strictly adhering to the National Electric Code.
- Avoid "net current" conditions by adhering to established electric codes and by using sound engineering practices to keep circuits balanced.

- Reduce electrical current.

"The approach of using *no- and low-cost techniques* should not appreciably increase construction costs and should not create controversy," the report states. The report also does not advocate applying its recommendations to existing schools: "The expense and time required to retrofit all existing schools in a district to reduce magnetic fields would generally be high. The uncertain benefits of these more expensive actions should be weighed against other educational priorities."

A copy of *EMF Checklist for School Buildings and Grounds Construction* is available for \$6.00 from: Copy Central, 5801 Christie Ave., Emeryville, CA 94608, (510) 547-7300. Copies of the report may be made if they are distributed at no charge. For more information, contact: M.A. Stevenson, California EMF Program, 5900 Hollis St., Emeryville, CA 94608, (510) 450-3818.

In fact, only a few have yet to take sides. "There are a lot of people who have made up their minds and who look for support for their particular point of view," observed Dr. Paul Gailey. "If you are in the middle, trying to be objective, it's a lonely place." Gailey, of the Oak Ridge National Lab in Oak Ridge, TN, maintains that there is no controversy about effects below 1 mG (there are none) and above 1 G (they clearly exist).

Dr. Robert Adair, a physicist at Yale University in New Haven, CT, endorsed Gailey's taxonomy—but reasserted his own well-known view: "I don't find effects above 500 mG impossible, but they are unlikely under 500 mG, with some extraordinary exceptions."

Dr. Charles Polk, who has degrees in electrical engineering and physics, urged everyone not to "lump all the physicists together, because many physicists believe it is quite possible to have low-level effects." Polk, an emeritus professor at the University of Rhode Island, Kingston, said that, "There is abundant evidence for biological effects down to 200 mG," and he does not reject the possibility of effects at even lower levels.

The NIEHS meeting on *in vitro* EMF research,* the first of at least three, is part of the risk analysis mandated by the U.S. Congress. At the end of next year, at the conclusion of the EMF RAPID research program, the NIEHS must offer its own opinion on possible EMF health hazards at environmental levels—that is, in Gailey's middle ground between 1 mG and 1 G.

"I am not at all convinced by the general assumptions that go into the physicists' models," said the NIEHS' Dr. Chris Portier, who is leading the risk assessment. "I continue to encourage the physicists to look at more complicated models that include a greater degree of biological detail," he said in an interview. As for the biological data, Portier said that he is not convinced, but is "sufficiently intrigued to spend a tremendous amount of effort to look at the 10-20 mG results." Portier is based in Research Triangle Park, NC.

At the heart of this dispute between two opposing camps is the adequacy of the theoretical models. MIT's Weaver limited his analysis to sinusoidal 60 Hz magnetic fields and two target systems, voltage-gated proteins and radical pair recombination.

Drs. Ross Adey of the VA Hospital in Loma Linda, CA, Richard Luben of the University of California, Riverside, and Indira Nair of Carnegie Mellon University in Pittsburgh all stressed the need to consider real-world exposures, which include intermittent exposures and complex waveforms such as transients.

"The problem is not with the physical theory but with the physicists' models," commented Dr. Imre Gyuk of the Department of Energy in Washington.

But perhaps the strongest criticism stemmed from some physicists' refusal to accept experimental data. "I am flabbergasted by the idea that if the data do not meet preconceived theories, the data must be wrong," said Dr. Eugene Sobel of the University of Southern California in Los Angeles.

Weaver stood firm. "More experiments will not do the job," he said at the closing session of the symposium. "We have tried hard to explain the effects and have failed."

* *EMF Science Review Symposium: Theoretical Mechanisms and In Vitro Research Findings*, Durham, NC, March 24-27, 1997.

The Power of Red Photons: What's the Mechanism?

Can low-level EMFs cause biological effects? Some physicists believe that there is no possible mechanism for EMF effects at the milligauss level. To believe otherwise, they say, is to ignore the laws of physics.

In one of the small-group discussions at the NIEHS symposium, Janie Blanchard of Bechtel Corp. argued that many physical mechanisms operate through surprising pathways. She got a skeptical response when she declared that low-energy photons could stop the motion of a two-ton mass traveling at 30 miles per hour.

"In fact," said Blanchard, "this effect can be reproduced consistently, even if the photon source is restricted to the lowest energy levels in the visible spectrum." The effect is so robust, she maintained, that even bright sunlight does not interfere with it.

"We have clear experimental confirmation of this phenomenon," said Blanchard. "All of us do—whenever we see a truck stop at a red traffic light."

Asked by *Microwave News* whether he finds the biological data convincing, Adair replied, "Not at all. A lot of people have done experiments that no one can replicate."

The physicists had their supporters. During an exchange on why it is difficult to find effects at environmental levels, Dr. James Wilson of Resources for the Future, an economics think tank in Washington, went to the microphone and said: "They are physically impossible, as Jim Weaver told us."

"Profound Health Implications"

The chasm between the physicists and biologists often appeared to be too wide to bridge. At one point, Adair called Dr. Carl Blackman and Janie Blanchard's ion parametric resonance model a "crackpot theory"—no different from creationism or mythology (see *MWN*, M/J94).

"You can't just say it's impossible," a frustrated Blanchard told Adair and Weaver at the end of a long panel discussion. "We need a dialogue," she said. Blanchard works at Bechtel Corp. in San Francisco and Blackman is with the Environmental Protection Agency in Research Triangle Park, NC.

Dr. Jack Sahl of Southern California Edison in Rosemead, CA, cautioned that, "If we cannot reach consensus soon, we will have lost an opportunity and undermine society's trust."

Dr. David Savitz of the University of North Carolina, Chapel Hill, pointed out how much is at stake in this debate: "If the physicists turn out to have been proven wrong, they will no longer be able to stop research grants from being funded." And even more importantly, Savitz said that, "The acceptance of the low-level *in vitro* work would have profound health importance, because it would affect the interpretation of the whole body of epidemiological literature."

The NIEHS has 18 months to issue its verdict. For the present, Portier will not offer his own opinion. "I refuse to get off the fence until the report is due," he said.

« Wireless Notes »

“CELL PHONES: DO YOU REALLY NEED ONE?” asked *Consumer Reports* on the cover of its February issue, promising to tell readers “HOW TO DECIDE.” Apparently that decision does not require information on possible health risks, since the subject was not mentioned anywhere in the article. “Science really can’t tell us anything yet,” stated **Edward Groth**, technical policy director of **Consumers Union (CU)**, which publishes the magazine. “There’s no decent epidemiological evidence that there’s a health impact from the kind of microwaves that you would see with cellular phones,” Groth told *Microwave News*. He added that, “With levels that are thousands of times higher, such as with a microwave oven, there could be a heat impact”—but as for nonthermal effects, “the scientific community has been debating the effects of RF on health for 50 years.” As to why that debate was not mentioned in the pages of *Consumer Reports*, CU spokesperson **Linda Wagner** explained that, “This particular story was focused on the contracts, what are the financial terms when consumers get a cell phone. They wouldn’t include health questions in an article with this kind of focus.” Wagner said that the magazine would run other articles on cell phones in the future, and that articles on cellular phone hardware would be more likely to deal with the health controversy. She added that the magazine’s staff is “aware of the issue, and they’re continuing to follow the science.” An article in the January 1997 issue indicated that EMFs were not a reason to avoid the use of electric blankets—a change from the magazine’s previous stance (see *MWN*, J/F97).

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Talking on a cellular phone has long been considered a potential **driving hazard**. And a study published in the February 13, 1997, issue of the prestigious *New England Journal of Medicine* (336, pp.453-458) found that, in fact, drivers face a fourfold increase in the risk of a collision when using a phone—“similar to the hazard associated with driving with a blood alcohol level at the legal limit.” The researchers, Drs. Donald Redelmeier and Robert Tibshirani of the University of Toronto, Canada, looked at 699 drivers who owned cellular phones and were involved in accidents, comparing the times of the collisions with the times of incoming and outgoing calls. In light of the results, the authors recommend that unnecessary calls be avoided and that conversations be kept short, especially when driving in hazardous conditions. In a press statement, the **CTIA** voiced general agreement with these recommendations: “When you are behind the wheel, your most important responsibility is safe driving. Period.” However, the industry group noted that the researchers did not “contend that phones were the cause of accidents.” The results are similar to those of a 1996 study at the Rochester Institute of Technology in Rochester, NY, which looked at 100 drivers in New York who had been involved in accidents over a one-year period. They found that those drivers who used cell phones more than average stood a 5.5 times greater risk of having an accident. The CTIA had attacked that study as flawed and tried to deter the press from reporting it. The Canadian study featured an important new finding: Hands-free phones “offered no safety advan-

tage over hand-held units.” In an editorial on the Canadian study in the same issue of the journal, Drs. Malcolm Maclure of the Harvard School of Public Health and Murray Mittleman of Beth Israel Deaconess Medical Center, both in Boston, discount this finding because the study was “too small and had too little statistical power.” Regardless, the CTIA has announced that it is working with automobile manufacturers to incorporate phones into audio systems. Maclure and Mittleman argue that laws prohibiting the use of cell phones while driving—which are already in place in Brazil, Israel and Switzerland—may be premature. But they add that the industry “now has an ethical obligation to include warnings and advice with their products and mailed bills; to support and assist in further engineering, ergonomic and epidemiologic research; and to provide easy-to-dial toll-free numbers for reporting road hazards and unsafe driving.”

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IEEE SCC-34, the committee that develops performance standards for products that emit electromagnetic energy, has formed a new subcommittee to recommend how to certify that hand-held wireless phones meet the spatial peak specific absorption rates (SARs) mandated by the FCC. The FCC’s limits are a combination of the ANSI/IEEE and NCRP standards (see *MWN*, J/A96). **Howard Bassen** of the FDA is the chair of both the new Subcommittee 2 and one of its two working groups—WG-1, which deals with experimental dosimetry. **Kwok Chan** of the FCC Labs in Columbia, MD, is leading WG-2’s work on computational dosimetry. The basic objective of the two new groups is to develop protocols and models that will allow different labs to compare their results, according to **Ronald Petersen** of Lucent Technologies in Murray Hill, NJ, the chair of SCC-34. Petersen predicted that draft standards from both working groups will be ready by the year’s end. “The long-term trend is towards using computational techniques, but there are still many uncertainties that have to be resolved,” Petersen told *Microwave News*. A dosimetry workshop held at the FCC on February 4 (see *MWN*, J/F97) served as the first meeting of SCC-34’s Subcommittee 2. The next meeting is scheduled for May 2. For more information, contact Petersen at (908) 582-6442 or by e-mail at <rcp@whwpy.wh.lucnet.com>.

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Last December 3, the **CTIA**’s board of directors announced that it had “agreed to the outline of a contract” that would indemnify **WTR** and its researchers against the costs of any lawsuits (see *MWN*, N/D96). In early February, WTR’s Dr. **George Carlo** told *Microwave News*, “We have an agreement.” But as of the end of March, nothing had yet been signed. Asked why the indemnification issue was taking so long to resolve, Carlo responded, “WTR has and will continue to do everything in our power to reach an agreement that maintains the integrity of the research and the independence of WTR. Those are our only criteria.” CTIA spokesperson **Tim Ayers** responded, “Those are our goals, too.” Meanwhile, WTR’s research contracts are still on hold.

FDA Workshop on Biological Effects of Wireless Radiation: Politics and Lack of Research Funds Stymie Progress

The most intriguing finding presented at the February Food and Drug Administration (FDA) workshop* on wireless radiation was 30 years old. In a talk on "Headaches from Cell Phones: Are They Real?" Dr. Allan Frey reported that in the 1960s, while he was studying microwave hearing, a number of his subjects complained about headaches. "I was sufficiently concerned about the headaches to stop research with humans," said Frey, who is credited with discovering microwave hearing.

To make his point, Frey, a researcher and consultant based in Potomac, MD, distributed a paper presented at an FDA symposium in 1969, in which he had written:

...I noticed that headaches appeared to be induced at some frequencies at low power levels. A limited amount of exploration leads me to believe that the headache effect is probably real, but it requires verification. Thus, it is mentioned here only as a hypothesis for research.†

So far, no one has tested Frey's hypothesis. But he remains convinced that cellular phones can cause headaches because, as he reminded the audience, "You get penetration into the head at those frequencies." And his concerns run deeper. "Headaches may only be the most obvious indicator of what is going on biologically," he warned. Frey believes that the headaches may stem from microwave-induced leakage through the blood-brain barrier.

The FDA workshop was held four years after the Cellular Telecommunications Industry Association (CTIA) launched its five-year research program designed to show that its products are safe (see *MWN*, J/F93).

Wireless Technology Research (WTR), created by the CTIA to run the program, has yet to sponsor a single biological experiment. The program is now at a standstill due to concerns over legal liability (see p.8 and *MWN*, M/J96). Some at the FDA workshop were openly skeptical that any biological studies would emerge from the industry effort.

"It is ultimately frustrating that no one wants to fund this research," complained Dr. Stephen Cleary of Virginia Commonwealth University in Richmond at the end of his talk on *in vitro*, nonthermal effects.

Cleary's concerns were echoed by another veteran microwave researcher, Dr. Henry Lai of the University of Washington, Seattle. Lai and his collaborator, Dr. N.P. Singh, have been unable to find support to continue their studies. Though long promised WTR research funds, they are still empty-handed. "I am disappointed," Lai told *Microwave News*. "We have been waiting for money for more than two years."

* *Physical Characteristics and Possible Biological Effects of Microwaves as Applied to Wireless Communication*, held at the FDA, Rockville, MD, February 7, 1997. The abstracts of the talks are available at the *Microwave News* Web site, <www.microwavenews.com>.

† Allan Frey, "Effects of Microwave and Radiofrequency Energy on the Central Nervous System," *Biological Effects and Health Implications of Microwave Radiation: Symposium Proceedings*, Richmond, VA, September 17-19, 1969, pp.134-139.

The FDA's own contribution has been minimal. The agency has opted to watch WTR's effort from the sidelines—with a few exceptions. Howard Bassen of the FDA's Center for Devices and Radiological Health (CDRH) has been evaluating probes to measure RF electric fields and methods of estimating energy deposition in the brain.

And the CDRH's Dr. Ewa Czerska is attempting to replicate Cleary's experiments showing that RF/MW radiation can enhance the proliferation of human brain tumor cells (see *MWN*, M/A90). In contrast to Cleary, who used 27 MHz and 2450 MHz radiation, Czerska is using 827 MHz radiation signals designed to mimic the emissions from a digital cellular phone. Czerska announced that she had at least partial confirmation of Cleary's results, observing greater proliferation at specific absorption rates of 1.6 W/Kg and 4.8 W/Kg. "The increase also appeared to be dose-dependent," she said. Czerska noted that this could not have been due solely to a thermal response, since conventional heating did not stimulate a similar level of proliferation.

Lai's latest results, first publicly announced at the FDA workshop, add a new twist to the microwave-DNA story. He reported that the previously observed increases in DNA single- and double-strand breaks are blocked by melatonin.

The political dimension of cellular phone research came into focus with the presentations by Drs. Ross Adey of the VA Hospital in Loma Linda, CA, and Joseph Roti Roti of Washington University in St. Louis.

Adey reviewed the results of his long-term exposure study for Motorola, which indicated that digital (TDMA) cellular phone signals had a protective effect against brain tumor development in rats (see *MWN*, J/A96). But Adey has yet to publicly disclose that a second, parallel exposure using continuous-wave, frequency-modulated (FM) microwaves had absolutely no effect (see p.13).

The biological impacts of FM and TDMA radiation are quite different, Adey said, adding that he could not elaborate further because, "I have been interdicted from talking about FM." The take-home lesson, said Adey, is that, "Every signal may have a different effect."

Roti Roti said that he had not observed the DNA breaks reported by Lai and Singh. But he noted that he had used a different type of microwave radiation and an *in vitro* assay rather than live rats.

At that point, a heated discussion ensued as to whether Roti Roti had used an appropriate signal. "I did not make the decision about the signal," an exasperated Roti Roti finally exclaimed. "I did not pick it. Talk to the lawyers who wrote the contract."

Motorola had a lawyer as well as a public relations consultant from Burson-Marsteller at the workshop. The lawyer, Charles Eger, who had also been in Victoria, Canada, for Adey's presentation of the Motorola TDMA rat study last June, would not say who had picked the experimental conditions for Roti Roti's study. "I'm not familiar with the contract," Eger told *Microwave News*. "I'm not a practicing lawyer; I'm a policy guy."

EC Gets Wide-Ranging Proposal for Wireless Research; Industry Asked To Fund Independent \$20 Million Effort

There are over 25 million wireless phone users in Europe today, but “definitive answers about health hazards...are unlikely to come about in the short term.” That is one of the conclusions of the European Commission (EC) Expert Group on health effects of wireless telephones, which has recommended an extensive research program lasting five years or more. The program would be funded mainly by contributions from the telecommunications industry.

“The existing scientific literature...provides no convincing evidence that radiotelephones pose a long-term public health hazard,” the expert group states in its report. But it notes that there is far less data on health effects of RF/MW radiation than on the effects of EMFs, and that “a comprehensive health hazard assessment requires such data.”

The program would cost a total of 23.8 million European currency units, or ECUs—equivalent to over US\$20 million. The plan, developed in response to an EC request in October 1995, was completed last September 30 and released to the public some months later (see *MWN*, J/F97). EC telecommunications specialist Leo Koolen, based in Brussels, Belgium, told *Microwave News* in mid-March that the commission would respond to the proposal “shortly, in a matter of months.”

“We will be concentrating on nonthermal effects,” Dr. Kjell Hansson Mild, one of ten members of the expert group, told a U.S. workshop on wireless radiation and health (see p.9). He said that the program would fund about 50 different projects, and would consider proposals from anywhere in the world. “The objective is not to promote research in Europe, but to answer a question,” explained Mild, who is with the National Institute for Working Life in Umeå, Sweden.

The plan calls for spending 7.5 million ECUs on epidemiological research; 7.47 million on *in vivo* biological studies; 5.27 million on *in vitro* experiments; 1.44 million on research with human volunteers; and 1.44 million on biophysical interaction studies. It budgets 690,000 ECUs for overall project management.

Most studies would last between one and three years, with a fourth year expected for many live animal studies. A fifth year of funding is proposed for continuation of epidemiological work, and the report cautions that “by necessity, the epidemiological (cohort) program may extend beyond this period and further funding may be necessary.”

The expert group calls for the telecommunications industry to provide funding for the research, and Koolen said that the European telecom industry had expressed “broad support” for the idea.

In a section titled “Firewall,” the report stresses that industry “should neither have nor be seen to have any influence over the choice of research studies funded, the conduct or the outcome of such studies, or the publication of the results.” Funding awards should be made by a Proposals Assessment Panel “without consultation with industry or other funding bodies.”

Information about the program’s funding sources would, however, not necessarily be made public. The proposal provides that corporate and other contributors may remain anonymous:

“Public acknowledgment of individual contributions for funding and materials in kind should be at the mutual agreement of the funding body and the EC.”

The concept of a five-year, US\$20 million research effort funded by industry, yet independent of its influence, is similar to the declared aims of the U.S.’ Wireless Technology Research (WTR), which has been plagued by delays since its inception in 1993 (see p.9).

But while WTR has been entirely dependent on industry funding, the EC’s Koolen told *Microwave News* that the EC project would include some government funds as well: “We expect the program to be cofinanced by the European Community and industry. This is a precondition for making sure that the program is, and is seen to be, independent, and that the industry money is well spent.” While the details have yet to be worked out, Koolen stated that government money would make “a substantial contribution” towards the research effort.

Emphasis on Epidemiology

A significant emphasis is put on epidemiological research, which would receive over 30% of all funding. “Epidemiology is the only way to determine directly whether disease is caused in people,” the expert group contends, while animal and *in vitro* research provide “a very uncertain prediction of the human effects.” Indeed, the group argues that wireless phone use is an especially good candidate for epidemiological research, citing the large number of users and the ability to use billing records to estimate exposures.

The expert group acknowledges that “epidemiological studies are not likely to give the ‘first warning’ of any ill effects,” given that many carcinogens take as long as 15 to 40 years to cause disease. But the panel still assigns a relatively high priority to epidemiological work, pointing out that “a few years” is enough time to detect “many known instances of cancer causation, including certain effects of ionizing radiation.” Besides brain cancer, the plan calls for “at least one study each” of acoustic neuroma, salivary gland tumors and adult leukemia.

The epidemiological work would not examine cancer risks

Not Quite on the Same Wavelength

The ten members of the EC’s expert group on the health effects of wireless phones hold a wide range of opinions. This is often reflected in the language of the report, as in the following passage (with our emphasis):

Investigations on different cell systems provide evidence for a lack of direct genotoxic and mutagenic effects of continuous and pulsed MW radiation at different power densities. *Yet* there have been a number of reports showing genetic damage in cells or organisms following RF exposure, *but* most often they could be ascribed to heating...*However*, when RF exposure precedes [exposure to a] mutagen, a synergistic effect is sometimes found.

among those living near cellular base stations. The expert group concluded that there was “neither dosimetric, biological or epidemiological justification for such studies,” and that current epidemiological methods would be unlikely to provide clear results.

Cancer-related biological studies would focus on the possible role of RF/MW emissions as promoters or copromoters, as well as their possible impact on the immune system. Experiments on genetic effects would examine changes in the brains of animals exposed to RF/MW radiation, such as DNA damage.

Research on nervous system effects would not only examine such questions as headaches, the function of the inner ear and neurobehavioral issues, but also pineal melatonin secretion—with possible implications for both sleep patterns and carcinogenesis.

Working out possible mechanisms of interaction is also part of the proposed research effort, but is described as a lower priority. The same is true for human laboratory studies, which would examine headaches, sleep patterns and immune response.

Unlike the U.S. Food and Drug Administration (see below), the EC expert group does not call for any research on ocular effects. While a few past studies are briefly mentioned, this is not discussed as a possible area for further investigation. Nor does the research plan address electromagnetic interference (EMI) to medical devices. The report explains that, while EMI is important, it is “rather the responsibility of the EMI research and standards community.”

Sharing and Controlling Information

The expert group suggests several ways in which research findings could be shared with the EC, funders and the general public. These include “annual open meetings,” semiannual reports, a newsletter and a Web site on the Internet.

However, the report also calls for some restrictions on the sharing of information. While the expert group declares that results should be made public “without undue impediment,” it adds that “some editorial control may be necessary” in order to maintain a high standard of quality. Accordingly, the plan states that preliminary or interim results “should not be presented at public or scientific meetings without the prior approval of the Research Monitoring Panel.” Also, funding would be available only to researchers willing “to agree [to] mechanisms to prevent inappropriate preliminary publication.”

Many members of the expert group have themselves been involved in cellular phone research. For example, Dr. Jørgen Bach Andersen of Aalborg University in Aalborg, Denmark, has developed a design for handset antennas that minimizes the amount of radiation absorbed by the user’s head (see *MWN*, J/F95). Dr. Konstantin Hossman of the Max Planck Institute for Neurological Research in Köln, Germany, has conducted animal studies funded by Motorola (see *MWN*, J/A95). Mild is currently conducting an epidemiological study of cellular phones and headaches (see *MWN*, N/D96). Dr. Luc Verschaeve of the Flemish Technological Research Institute (VITO) in Brussels, Belgium, has found that close-range microwave exposure from a base station antenna can strengthen the effect of a chemical mutagen in human blood cells (see *MWN*, N/D96).

Three participants in the expert group are members of the International Commission on Non-Ionizing Radiation Protection (ICNIRP): Drs. Jürgen Bernhardt of the Institute for Radiation Hygiene in Neuherberg, Germany; Martino Grandolfo of the National Institute of Health in Rome, Italy; and the expert group’s chair, Dr. Alastair McKinlay of the U.K.’s National Radiological Protection Board (see *MWN*, S/O96). The remaining mem-

FDA Tells CTIA’s WTR Where To Focus

On March 13, Dr. Elizabeth Jacobson of the Food and Drug Administration (FDA) wrote to Dr. George Carlo, chair of Wireless Technology Research (WTR), to offer her agency’s “suggestions for research priorities” on health effects of cellular phone radiation. “Since your resources are limited,” she wrote, the FDA wanted to advise WTR “on how your program could be redirected...[to] answer the questions that the regulatory agencies believe are relevant to our concerns.” Jacobson is deputy director for science at the FDA’s Center for Devices and Radiological Health in Rockville, MD. Reprinted below are the FDA’s recommendations. Jacobson wrote that she hoped WTR would find them useful “as you enter the implementation stage of your biological research.” Established in 1993 by the Cellular Telecommunications Industry Association (CTIA), the WTR research program is at a standstill (see p.8).

- Chronic (lifetime) animal exposures should be given highest priority.
- Chronic animal exposures should be performed both with and without the application of chemical initiating agents to investigate tumor promotion in addition to tumorigenesis.
- Identification of potential risks should include end points other than brain cancer (e.g., ocular effects of RF radiation exposure).
- Replication of prior studies demonstrating positive biological effects work is needed. A careful replication of the Chou and Guy study (*Bioelectromagnetics*, 13, pp.469-496, 1992), which suggests that chronic exposure of rats to microwaves is associated with an increase in tumors, would contribute a great deal to the risk identification process for wireless communication products.
- Genetic toxicology studies should focus on single cell gel stud-

ies of DNA strand breakage and on induction of micronuclei. (These are the only direct genotoxic effects suggested at this time.) The need to replicate the Lai and Singh experiments used to demonstrate microwave-induced DNA strand breakage (*International Journal of Radiation Biology*, 69, pp.518-521, 1996) is strengthened by Dr. Lai’s recent reports in scientific meetings that this effort is suppressed by melatonin exposure.

- Epidemiology studies focused on approaches optimized for hazard identification are warranted (e.g., case-control studies are well suited to studying rare diseases such as brain cancer).

Due to the latency of some of the health effects that have been suggested to be associated with exposure to non-ionizing radiation, long-term study is essential to test such associations. Indeed, we believe that continuing postmarketing surveillance is important in ensuring the safety of wireless technologies.

HIGHLIGHTS

bers of the expert group are Drs. Anthony Swerdlow of the London School of Hygiene and Tropical Medicine in the U.K., Flora van Leeuwen of the Netherlands Cancer Institute in Amsterdam and Bernard Veyret of the University of Bordeaux in France.

The report includes descriptions of other RF/MW research programs around the world, sponsored by ICNIRP, the World Health Organization, WTR, the German telecommunications organiza-

tion FGF and others. Several tables provide extensive listings of previously published papers in the field, and an appendix gives thumbnail sketches of research projects currently under way.

Copies of the EC expert group's report, *Possible Health Effects Related to the Use of Radiotelephones*, can be ordered by faxing Ms. Anja Jansen of the European Commission in Brussels at (32+2) 296-8395.

Australia in Uproar Over New Zealander's Proposal: Nanowatt-Level RF/MW Public Exposure Limits

Dr. Neil Cherry of Lincoln University in Canterbury, New Zealand, is advocating an RF/MW exposure standard below 1 $\mu\text{W}/\text{cm}^2$. His public comments on the need for stricter limits have created a firestorm of controversy in Australia, which has reached all the way to the Australian Parliament.

On February 28, Cherry issued a report arguing that recent studies point to exposure limits "at 0.1 $\mu\text{W}/\text{cm}^2$ if cancer risk is to be reduced and 0.01 $\mu\text{W}/\text{cm}^2$ if miscarriage risk, sleep disruption, children's performance impairment and chronic fatigue symptoms are to be reduced." Most national and international standards specify exposure limits between 200 and 1,000 $\mu\text{W}/\text{cm}^2$ for the general public.

Four days later, as a keynote speaker at a conference in Sydney, Cherry criticized the Australian government for not adequately addressing RF/MW health concerns. "I seriously wonder how many children and adults will have to die before we will adopt proper public health protection standards," he said.

The next day Senator Richard Alston, minister for communications and the arts, called Cherry "a shameless charlatan" and "a snake oil merchant" in Parliament. He added that Cherry "is a rabid populist and totally uninterested in any considered scientific debate. His remarks are highly inflammatory."

Alston also questioned Cherry's scientific credibility and accused him of supporting a "public scare campaign" about RF/MW radiation.

In particular, Alston bristled at accusations that the Australian government was unresponsive to health concerns. He pointed to the \$3.5 million research project on wireless technology that was set up to advise the government on policy decisions (see *MWN*, N/D96).

Several senators rebuked Alston for the personal attack in Parliament, where he is immune to charges of libel. "Most of the remarks made by Senator Alston were highly defamatory....it would both be stupid and require more courage than he has to repeat those words outside this chamber," Senator Lyn Allison of Victoria said later that day in Parliament.

Because of the harsh nature of Alston's remarks, Cherry was granted a written right of reply to the Senate. "There is an immense amount of published scientific research showing many non-thermal effects of RF/MW radiation at the cellular level," he stated in the reply.

Cherry also noted that in 1996 a New Zealand planning tribunal—after hearing from Cherry and Israel's Drs. John Goldsmith of Ben Gurion University of the Negev in Beer Sheva and Richard Luben of the University of California, Riverside in the

U.S.—allowed BellSouth to build a mobile-phone tower in Ilam, a suburb of Christchurch, under the condition that the power densities at nearby residences not exceed 2 $\mu\text{W}/\text{cm}^2$.

Alston claimed that Cherry had been discredited by the court since BellSouth had been permitted to go ahead with its plans. Cherry replied that the decision was "a major step forward" because it called for a limit far below the 200 $\mu\text{W}/\text{cm}^2$ advisory guideline New Zealand adopted in 1990.

Indeed, Cherry used the tribunal's decision as a basis for the proposed nanowatt standard in his February report, *Potential and Actual Adverse Effects of Radiofrequency and Microwave Radiation at Levels Near and Below 2 $\mu\text{W}/\text{cm}^2$* . Cherry stated that recent papers on shortwave radio transmitters in Schwarzenburg, Switzerland, on a radar system in Skrunda, Latvia, and on broadcast towers in Sydney, by Dr. Bruce Hocking, and in the U.K., by Dr. Helen Dolk (see *MWN*, N/D93, J/F96, S/O96 and J/F97), showed the need for even lower exposure limits.

In a 1995 report, Cherry had concluded that transmitters should be kept away from schools and residences "by such a distance that the intensity of the microwaves, when averaged over a year, does not exceed 0.1 $\mu\text{W}/\text{cm}^2$."

The situation in Australia has become especially tense because the telecommunications industry is preparing for deregulation in July. According to the March 12 *Australian Financial Review*, the process is expected to create a "\$140 million-plus tidal wave of advertising, marketing and sponsorship," as new companies strive to compete with the current providers, Optus and Telstra.

At the same time, the Australian Local Government Association (ALGA) is seeking to disallow the 1996 telecommunications code, which was developed under the leadership of Senator Alston. According to ALGA President John Campbell, the code "largely ignores potential health impacts" and "perpetuates a system under which the carriers are their own judge and jury."

In his efforts at reform, Campbell has won the support of Senator Allison, telecommunications spokesperson for the Australian Democrats. "The government's response to Dr. Cherry's views is of concern to us," Allison said in a prepared statement. "It shows that the government has a closed mind about the health effects of EMR [electromagnetic radiation] and appears unwilling to listen to anything other than the 'industry line.'"

For information on obtaining a copy of the report, contact: Dr. Neil Cherry, Department of Natural Resources Engineering, Lincoln University, Canterbury, New Zealand, Fax: (64+3) 343-3693, E-mail: <cherry@kea.lincoln.ac.nz>.

Adey Finds No Effect, Detrimental or Protective, Among Rats Exposed to Analog Wireless Phone Radiation

Reprinted below is the abstract of a paper, "Brain Tumor Incidence in Rats Chronically Exposed to Frequency-Modulated (FM) Cellular Phone Fields," which will be presented by Dr. Ross Adey on June 9 at the 2nd World Congress for Electricity and Magnetism in Biology and Medicine in Bologna, Italy (see p.18).

Adey, who is with the VA Hospital in Loma Linda, CA, reported last summer that a similar experiment designed to mimic the signals from a TDMA digital mobile phone appeared to show a protective effect. That is, the animals exposed to pulsed radiation had fewer tumors than did controls (see MWN, M/J96 and J/A96).

Adey's more recent experiment used FM signals patterned after the radiation from an analog cellular phone. Both the FM and TDMA animal studies were sponsored by Motorola Corp.

One observer, who was aware of Adey's new results, commented that, "It's the low-frequency modulation that makes all the difference," referring to the 50 Hz modulation associated with the TDMA signals.

Frequency-modulated mobile phone systems have been the dominant technology for many years. Their continuing use worldwide appears certain in many applications, with typical RF carrier frequencies in the range from 0.1-1.5 GHz. Body tissues, specifically in the head and hand of the user, absorb up to 40% of the radiated signal. Portable FM phones, with average output powers of 0.6 W in the 800 MHz frequency band, induce field strengths in the most exposed tissues equivalent to 1 W/Kg±6db, depending on the device's position and design. Although occupational exposures of certain microwave workers to radar and other pulsed fields have been reported to carry an increased risk of brain tumors (e.g., Thomas et al., 1987), no comparable data have been reported for FM mobile phone users.

OBJECTIVE: Previous universal use of FM technology in mobile communication systems, as well as its continuing availability, suggest [the] need for assessment of possible human brain tumor risks in a suitable animal model; and to compare findings with our previous study in rats exposed to North American Digital Cellular (NADC) signals (Adey et al., *Proceedings of the Bioelectromagnetics Society*, 18th Annual Meeting, 1996). We have sought evidence for perturbation by FM phone fields of spontaneous brain tumor incidence, and in rats exposed to single doses of the short-lived carcinogen ENU *in utero*, and thereafter exposed intermittently to FM phone fields for 24 months (mean life span 26 months). Low ENU dosage was selected to give maximum sensitivity to possible tumor modulation by FM phone fields over the lifetime of the animal[s].

METHODS: We tested a frequency-modulated 836.55 MHz signal, with ±12.5 kHz maximum deviation. Modulation was by a recorded pattern of "balanced speech" that generated all major speech components in a 2-minute epoch that recycled continuously. Pregnant Fischer 344 rats were randomly assigned to 6 groups. They received either a single tail-vein injection of the carcinogen ethylnitrosourea (ENU, 4 mg/Kg) or inert buffer solution on gestational day 18. Far-

field exposures (horn radiator, 836 MHz, circularly polarized) began on day 19 and continued after parturition until weaning at age 23 days. Offspring (n=540) of the 6 maternal groups then became treatment cohorts: Sham/Control (SC), n=90, 45M, 45F; ENU/Control (EC), n=90, 45M, 45F; Sham/Sham (SS), n=90, 45M, 45F; Sham/Field (SF), n=90, 45M, 45F; ENU/Sham (ES), n=90, 45M, 45F; ENU/Field (EF), n=90, 38M, 52F. Exposures simulating near-fields at a phone user's head began at 35 days, and continued for the next 23 months. Exposures were for 2 hours daily, antenna power 2.5 W, field-on 7.5 minutes, field-off 7.5 minutes. Far-field averaged SARs (modeled): pregnant dam (uterus) 1.0 W/Kg; fetus (brain) 0.9 W/Kg; isolated pup (brain) 0.1 W/Kg; young rat (brain) 0.4 W/Kg. Averaged near-field brain thermographic SARs: average males 2.3 W/Kg; average females 1.8 W/Kg. Survivors of the original 540 rats (n=372, 69%) were sacrificed at 730-733 days.

RESULTS: There were no effects on brain tumor incidence attributable to the FM fields in either the control or the ENU groups. There was the expected higher incidence of brain tumors in the ENU-exposed groups (EC, 15; ES, 17; EF, 15), in comparison with the low incidence of spontaneous brain tumors in the sham and control groups (SC, 2; SS, 1; SF, 3), $p < 0.001$. Comparing survival rates, lifetimes of ENU-exposed animals were significantly shorter than [those of] controls ($p < 0.0005$), but these differences were not influenced by FM field exposures.

DISCUSSION: The findings here are consistent with our previous study in rats exposed to NADC signals. The apparent "protective" effect in the NADC study, which did not gain statistical support, was not detected with FM fields. These effects have been modeled in the normal homeostatic balance between mechanisms regulating damage and repair in cell growth. They may indicate sensitivities to the 50/second pulsed characteristics of TDMA fields. Other packet frequencies in current use or proposed for cell phone use (GSM=217, iDEN=22, Iridium=11) may therefore merit specific study.

Air Force Microwave-Cancer Study Shrouded in Mystery (continued from p.1)

at Brooks Air Force Base in San Antonio, told *Microwave News* during the Boston BEMS meeting that Toler had never finished writing a final report and explained that Toler's abrupt departure was due to a lack of funds.

In fact, Toler had sent the USAF his final report a full year before the BEMS meeting.

For close to a year after the 1995 meeting, the USAF refused to release the report to *Microwave News* despite repeated requests under the Freedom of Information Act. When the USAF finally conceded, the report was stamped "Do NOT CITE OR QUOTE."

Those within the military have also been denied access to the results. "I was trying to get the article from [Toler] for over two years before I gave up," said Dr. Edward Elson. At the time, Elson was working on radiofrequency and microwave (RF/MW) bioeffects at the Walter Reed Army Institute for Research in Washington. He is now studying Gulf War illnesses for the Army.

Even members of the Armstrong Lab have been denied access to the Toler data—as Dr. Richard Albanese of the Occupational and Environmental Health Directorate found out when he asked to see the report.

The Guy Study

In 1984, Dr. Bill Guy released results from his long-term, low-level exposure study which showed that rats exposed to pulsed microwave radiation had a statistically significant increase in malignant tumors. The five-year, \$5 million project, which was sponsored by the USAF, was the first long-term RF/MW study ever done in the U.S. (see *MWN*, J/A 84 and Mar85).

Guy exposed 100 male rats to 0.48 mW/cm², 2,450 MHz pulsed microwaves (10 microsecond pulses, 800 pulses per second) 21 hours per day for up to 25 months. The specific absorption rate, or SAR, was 0.4 W/Kg or less. A second set of 100 unexposed rats were used as controls. All the rats were housed in a pathogen-free environment.

Guy found a total of 18 malignancies among the exposed group and 5 among the controls. In particular, there were 9 endocrine tumors in the exposed group and 2 in the control group.

Although the study did not turn up an excess of benign tumors, there were 6 pheochromocytomas—benign adrenal tumors—all in the exposed rats.

Results from the study were first presented at the 1984 BEMS meeting in Atlanta. They were published eight years later in a special issue of *Bioelectromagnetics*, commemorating Guy's retirement from the University of Washington, Seattle (see *MWN*, J/F93).

"It's unfortunate that the data have not been released sooner, especially since it is a chronic exposure study. We should have had it a long while ago," said Dr. Stephen Cleary of Virginia Commonwealth University in Richmond.

Toler's \$600,000 study is widely seen as a small-scale follow-up to Dr. Bill Guy's \$5 million, long-term exposure study—also sponsored by the USAF and thought by many to show an elevated risk of cancer (see box above). As Dr. Samuel Milham, now a consultant based in Olympia, WA, commented more than ten years ago: "The findings are so suggestive of potential microwave effects that the portions of Dr. Guy's study dealing with immune status and neoplasia should, at a minimum, be replicated" (see *MWN*, N/D86).

Guy himself agrees. "I thought it should be repeated from the beginning," he told *Microwave News* in mid-March.

Dr. C.K. Chou, Guy's collaborator on the long-term exposure study, also favors more research. "The biological significance of these effects needs to be explored," he said at the 1995 USAF workshop. After leaving Guy's lab, Chou joined the City of Hope National Medical Center in Duarte, CA.

Guy's results continue to be cited as showing a positive effect. In a March 13 letter to Wireless Technology Research (WTR), Dr. Elizabeth Jacobson of the U.S. Food and Drug Administration (FDA) recommended that WTR perform a "careful replication of the Chou and Guy study which suggests that chronic exposure of rats to microwaves is associated with an increase in tumors" (see p.11).

The USAF, however, maintains that Guy's results do not point

to adverse health effects. "His findings were that there were no effects of radiation—I mean, that's well known," Merritt said in an interview.

Toler's study differed from Guy's in several key respects. First, although Toler had initially set out to expose rats as Guy had done, the USAF amended the study design in 1987, stipulating instead the use of breast cancer-prone mice.

Also, Toler exposed 200 mice to radiation at 435 MHz rather than 100 rats at 2.45 GHz as Guy had done (see box below). According to Merritt, the lower frequency was designed to mimic the signal of a USAF early-warning radar system, PAVE PAWS.

Blood chemistry indices were monitored by Guy and were part of Toler's original study design. But they were later rejected by the USAF. When asked why, Toler responded, "As I recall, we could have done a whole lot more analyses. The primary interest was in mammary tumors."

In the report he wrote for the USAF, Toler did not give the final, overall tumor counts, but stated, "There was no evidence to suggest differences in tumor rates between sham-exposed and exposed animals." He stated that the final survival rates were the same for both groups.

Toler looked at a variety of tissues for cancer but did not examine the mice for leukemia. An appendix to the report with results of tissue analyses conducted by Pathology Associates Inc. (PAI) in Frederick, MD, appears to show that 178 of the exposed mice had cancer, as compared to 158 of the sham-exposed. There were also more total malignancies among the exposed mice (297) than among the sham-exposed mice (261). Some animals had more than one tumor. (These totals were added up by *Microwave News* from the data in the report by PAI.)

Liver cancer was the most prevalent type of malignant tumor, with 104 cases among the exposed mice and 98 among the controls. Toler did find a statistically significant increase ($p=0.033$) in hemangioma, a cancer of the blood vessels. But he dismissed the result as not significant because of "the absence of evidence of a difference between exposed and sham-exposed animals with

The Toler Study

Beginning in March 1989, Dr. James Toler exposed 200 female, mammary tumor-prone mice to 1 mW/cm², 435 MHz pulsed microwaves. The pulses had a width of 1 microsecond and a repetition rate of 1 kHz. The specific absorption rate, or SAR, was 0.32 W/Kg.

A second group of 200 mice served as controls. And an additional 25 mice were included among both the exposed mice and the controls to serve as "sentinels"—to be sacrificed in the course of the study to monitor the health of the entire colony.

The mice were exposed starting when they were approximately five weeks old for an average of 20 hours a day, seven days a week for 21 months. Once a week the animals were palpated for tumors and weighed.

In December 1990, the mice that were still alive were killed. Samples of 22 different tissues from all the animals were analyzed by Pathology Associates Inc. in Frederick, MD.

respect to combined hemangioma or hemangiosarcoma.”

As expected, cases of mammary gland adenocarcinomas were high, but the exposed mice had only three more tumors than did the controls, 85 compared to 82. The median tumor onset time for these adenocarcinomas was nine days earlier for the exposed mice, though this finding was not statistically significant at the 0.05 level, according to Toler’s report.

A year after the experiment began in March 1989, Toler indicated a consistent trend of a higher tumor incidence among exposed animals. By the end of May 1990, he had observed 42 exposed mice with tumors and 34 controls with tumors, a slightly different figure from what he reported in Boston in 1995.

In a July 20, 1990, memo to Merritt, Toler suggested extending the experiment by three months into December to avoid accusations of not exposing the mice for an adequate length of time. Merritt agreed with the proposal, scribbling in response at the bottom of the memo: “This has been a very well run study so far. It will become a landmark study in time.”

At the end of that July, Toler reported finding 76 exposed mice with tumors and 67 sham-exposed mice with tumors. The following month, Toler reported to the USAF that the total number of animals with tumors, including possible tumors, was 109 for the exposed group and 87 for the sham-exposed group.

That September, when the experiment had originally been scheduled to end, Toler stopped reporting tumor counts to the USAF. He explained that he had “difficulty in assuring that observed abnormalities [were] actually tumors when the examinations [were] based solely on palpation.”

Nonetheless, the health status updates for each animal continued to note, on the basis of palpation, those that appeared to have tumors. Based on these figures, the total of exposed animals with tumors at the end of September rose to 115, with 88

tumors among the controls.

The USAF recently submitted Toler’s paper to *Radiation Research*. In an effort to explain the delay in publication, Toler said that the USAF had sent his paper to other journals before, but was told that the paper would have to be shortened. “At any rate, it was a sizable effort to trim it down to get it published,” he said.

Merritt said that he would not comment on the results until they are published and was reluctant to say whether such research was worthy of further investigation. “You never close the door on studies. You’ll always get complaints—you didn’t do this, you didn’t do that,” he said in a recent interview. “I don’t know whether this should be continued.”

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“MICROWAVE NEWS” FLASHBACK

Years 15 Ago

- Two-way radios attached to workers’ suits interfere with gas monitors, causing an eight and a half hour alert at the Three Mile Island nuclear plant in Middletown, PA.
- The Navy announces a \$49.8 million plan to upgrade its ELF submarine communications system, with most of the money to be spent in Michigan and Wisconsin, and says it will monitor the ecological effects of the plan in Michigan but not in Wisconsin.
- Two legal secretaries in Rhode Island reach an undisclosed settlement with Amana Refrigeration Co., makers of the Radarange microwave oven, after only one day of testimony in the U.S. District Court in Providence. The two claimed to have developed cataracts after being exposed to radiation from a faulty oven in their lunchroom.
- Occupational Safety and Health Administration officials decide to stop citing companies for violating the RF/MW exposure standard, saying that the limits are meant only as an “advisory” guideline.

Years 10 Ago

- A committee assembled by the World Health Organization and the International Radiation Protection Association recommends mag-

netic field safety limits based on short-term health effects, not cancer risks.

- Two British researchers publish a paper in *Clinical Ecology* showing that weak EMFs can cause allergic reactions such as migraines and convulsions.
- A joint EPA–FCC study finds RF “hot spots,” as much as ten times above the ANSI exposure limits, in public areas near some FM broadcast towers.

Years 5 Ago

- A Finnish study concludes that women exposed to ELF magnetic fields of more than 3 mG (rms) from video display terminals (VDTs) are more likely to have miscarriages, but does not find a link between the number of hours spent using VDTs and miscarriages.
- The U.K.’s Coordinating Committee for Cancer Research launches a £6 million study of the possible causes of childhood leukemia, including the role of EMFs.
- Traffic radar units are blamed in seven testicular cancer cases among police officers in Grand Rapids, MI, three times more than would be expected, according to a study by the University of Washington.

FROM THE FIELD

Clippings from All Over

Several committee members felt that the press release issued by the NRC in conjunction with the publication of the report did not reflect well the content of the report. These members solicited support from the rest of the committee to request that [the] NRC issue a new press release which, in their opinion, might be more reflective of the report. I declined to participate in this request, not because arguments could be constructed to place more or less emphasis on components of the report, but because I felt the original press release was a vehicle of the NRC, not of our committee. I always believed, during the duration of our deliberations, that the report, whatever its content, would be interpreted by different parties enjoined in EMF deliberations to reflect a particular viewpoint. I felt that the press release by the NRC was within the range of interpretations that a thoughtful individual or organization could infer from the report. I stand by the report completely. I believe it is an accurate description and analysis of current data on the possible health effects of EMF.

—Dr. Jerry Williams, Johns Hopkins Medical Institutions, Baltimore, “Is It Safe? A Discussion of the Report from the National Research Council (NRC) on Possible Health Effects of Exposure to Residential Electric and Magnetic Fields,” presented at the 1997 EPRI EMF Seminar: *New Research Horizons*, New Orleans, March 2-5, 1997 (see also *MWN*, J/F97)

“It’s the conflict between the biological and epidemiological evidence and the difficulty of getting firm epidemiological evidence that makes [EMFs] so interesting. It would have a considerable impact on society if it were shown to produce a hazard—or if it didn’t—because then we could stop worrying about it.”

—Sir Richard Doll, chair of the UK’s National Radiological Protection Board’s (NRPB) Advisory Group on Non-Ionizing Radiation, quoted by Hilary Bower in “No Sign of Slowing Down” (a profile of Doll), *British Medical Journal*, p.700, March 8, 1997

Medical science has paid little attention to the health hazards of electromagnetic pollution, and it is difficult to establish causal connections between exposure and diseases that might not show up until years later. Scientific evidence here is scant and contradictory, making the whole topic “controversial”; still, I think it would be foolish to take no action while waiting for the evidence to be uncovered.

— Dr. Andrew Weil, *Eight Weeks to Optimum Health* (New York: Alfred Knopf, 1997), p.86

According to [Cellular Telecommunications Industry Association Presi-

dent Tom] Wheeler, the lawyers want to stop the research so there’ll be less evidence to disprove claims of cellular phone-based ills. “They want to have a chilling effect,” he observed.

—Edward Warner, “Cancer Research Heads Toward Main Event,” *Wireless Week*, p.32, February 24, 1997

“In fact, the SAG and WTR have repeatedly made public statements which confirm the contention that existing data and studies do not rule out the possibility that cellular telephones cause ill health effects such as brain cancer.”

—Michael Volpe, spokesperson for WTR, quoted by Jeffrey Silva in “Motorola Memo Raises Questions About WTR Research,” *Radio Communications Report (RCR)*, p.66, March 3, 1997

Many stations are looking to their towers to produce additional income streams. With cellular, PCS, SMR, two-way paging and a host of other new radio services, demand for tower space is exploding. Couple this with the public’s general disdain for towers, and existing sites become very attractive to radio service providers. A broadcast tower that has room available can become a valuable piece of “vertical real estate.”

—W.C. Alexander, “Make Money From Your Tower,” *Radio World*, p.33, March 19, 1997

“This whole concept of electromagnetic warfare [needs to be] publicly debated.”

—Dr. Richard Williams of the David Sarnoff Institute, Princeton, NJ

“I see this as a tremendous opportunity to educate the public about physics and auroral studies.”

—Dr. Joseph Kan, University of Alaska, Fairbanks

Quoted by Lisa Busch in “Ionosphere Research Lab Sparks Fears in Alaska,” on the HAARP Program, *Science*, p.1060, February 21, 1997

Most adults won’t realize they’re being affected by these new digital systems that are emitting microwave radiation. Me, I get nauseated and dizzy. My thyroid swells and my throat starts to close. My throat, neck, and ears ache. My insides feel scraped up and down.

—Pelda Levey of Bloomfield, CT, in an opinion column, “FCC Ignoring Health Effects of Cell Phone Antenna Towers,” *Hartford Courant* (CT), p.A17, February 12, 1997

“I don’t want to be a guinea pig.”

—Chris Colonna, a telecommunications executive, on the use of the hormone melatonin to combat jet lag, quoted by Nancy Keats in “Sleepless in the Sky—Some New Tactics,” *Wall Street Journal*, p.B4, March 14, 1997

UPDATES

ELECTROMAGNETIC SENSITIVITY

Linked to Flickering Light?...In Sweden and other countries around the world, a growing number of people have reported adverse reactions to VDTs, fluorescent light, household appliances and other devices that produce EMFs. The symptoms of such “electrical hypersensitivity” include itching or burning sensations in the skin of the face, eyes that feel dry or gritty and headache, dizziness or fatigue. Now a Swedish-Russian research team has found that people who have complained of this problem appear more sensitive to flickering light—at frequencies that overlap with the flicker produced by VDTs and fluorescent lighting. Writing in the January 1997 *Journal of Occupational and Envi-*

ronmental Medicine, Monica Sandström and colleagues from the National Institute for Working Life in Umeå, Sweden, and from the Institute of the Human Brain in St. Petersburg, Russia, indicate that the difference between subjects and controls was consistent and statistically significant. But the difference was in the reactions of their brains, not their eyes: While the subjects’ cortical responses to flickering light were stronger, their retinal responses were not. The researchers note that three previous studies of people reporting sensitivity to electromagnetic devices have tried to provoke the symptoms with controlled exposures to EMFs. Two studies could not, while the third did so only with a small minority of subjects. Thus, Sandström and her colleagues

suggest, other factors may well be involved. They stress that their research does not prove that sensitivity to flickering light is linked to the subjective symptoms; it does, however, indicate "that patients with perceived electrical hypersensitivity are hyperreactive in their nervous system." A member of Sandström's team, Dr. Kjell Hansson Mild, told *Microwave News* that they are planning follow-up studies, both with the same group of people and with 15-20 new subjects.

Linked to Nothing?...A skeptical perspective on electromagnetic sensitivity is advanced by Dr. Sture Lidén in a recent review article in *Allergy* (51, pp.519-524, 1996). Although "sensitivity to electricity" is a recent and ongoing epidemic in Sweden," Lidén writes, "the weight of evidence so far favors a psychosomatic explanation." He cites several provocation studies with a total of 140 participants, and asserts that "none of these subjects have been able to tell when the EMFs were turned on or off." A major part of Lidén's article is devoted to a history of psychosomatic disease, lumping together 19th-century diagnoses such as "pelvic madness," controversial modern diagnoses including chronic fatigue syndrome and occupational diseases such as "the so-called writer's cramp" of the early 1800s, "telegraphist's spasm" of the 1890s and repetition strain injury from computer use in the 1970s and 1980s. Lidén argues that all of these ailments are essentially psychosomatic.

EPIDEMIOLOGY

Occupational Leukemia Review..."There is some evidence for an association between occupational magnetic field exposure and leukemia, especially for chronic lymphocytic leukemia [CLL], but the inconsistencies between and within studies weaken the evidence," according to Dr. Maria Feychting. In a review paper published in the November 1996 issue of the *Journal of Radiation and Environmental Biophysics* (35, pp.237-242, 1996), Feychting, of the Karolinska Institute in Stockholm, Sweden, reported that, "Currently, no firm conclusions can be drawn regarding the association between occupational magnetic field exposure and adult leukemia." She reviewed 20 early "first generation" studies that used "crude" methods to assess EMF exposures (primarily job titles) and eight later efforts that included magnetic field measurements. Feychting summarized the results of these eight studies—"not an easy task": "For all leukemia diagnoses combined, half of the studies noted moderately elevated risk estimates, while the other half found no association. For leukemia subtypes the results are inconsistent, even if some trend can be seen for [CLL]." There "are no obvious explanations for the discrepancies among the results," she added. For future studies, she called for better exposure assessment, including magnetic field exposures for each subject as well as for possible exposures outside the workplace. Specifically, Feychting recommended that, "New studies should be designed to study [CLL], as well as other subtypes of leukemia."

MEETINGS

ICNIRP 1996 Workshop and 1997 Seminars...The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has published a book of papers that were presented at its 3rd

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



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

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International Non-Ionizing Radiation Workshop, held last April in Baden, Austria. The volume covers the electromagnetic spectrum from static and ELF fields to UV radiation and has an introduction by Dr. Michael Repacholi, a former chairman of ICNIRP and current director of the WHO's EMF project. Authors include Dr. Anders Ahlbom of the Karolinska Institute in Stockholm, Sweden, on "Cancer and Exposure to Weak ELF Magnetic Fields," Dr. R.D. Saunders of the NRPB in Oxfordshire, U.K., on "Biological Effects of RF Radiation" and Dr. Thomas Tenforde of the Battelle Pacific Northwest Labs in Richland, WA, on "Interaction of ELF EMFs with Living Systems." In addition, ICNIRP and WHO are together sponsoring two upcoming seminars: *Biological Effects of Static and ELF Electric and Magnetic Fields and Related Health Risks* on June 4-5 in Bologna, Italy (immediately before the *2nd World Congress for Electricity and Magnetism in Biology and Medicine*), and *Risk Perception, Risk Communication and Its Application to EMF Exposure* on October 22-23 in Vienna, Austria. To order *Non-Ionizing Radiation: Proceedings of the 3rd International Non-Ionizing Radiation Workshop*, send \$60.00 plus shipping to: ICNIRP, c/o Roger Matthes, Institute of Radiation Hygiene, Federal Office for Radiation Protection, Ingolstädter Landstraße 1, D-85764 Oberschleißheim, Germany; for more information on the ICNIRP-WHO seminars, contact Matthes at (49+89) 3160-3288, Fax: (49+89) 3160-3289, E-mail: <matthes@bfs.de>.

World Congress Preview... There are a number of events planned in conjunction with the *2nd World Congress*, to be held June 8-13 in Bologna. On Sunday afternoon June 8, the U.S. DOE and NIEHS will present a progress report on the EMF RAPID research program. At the same time, the U.S. Air Force will host a workshop on thermal effects of RF/MW radiation. After the close of the congress, Italian officials will participate in a workshop and roundtable discussion on "Electromagnetic Risks and Public Concern"—simultaneous English-Italian translations will be provided. For more information, contact: Dr. William Wisecup, W/L Associates, 7519 Ridge Rd., Frederick, MD 21702, (301) 663-4252, Fax: (301) 371-8955, E-mail: <75230.1222@compuserve.com>.

POLICE RADAR

Workers' Comp Winner Drops Lawsuit... Franklin Chappell, a police officer in Portsmouth, VA, is no longer seeking damages from traffic radar manufacturer Kustom Signals Inc. In November 1995, the Virginia Workers' Compensation Commission found that Chappell's testicular cancer was caused by the radar unit he used on the job, and shortly afterwards Chappell reached a settlement with the city of Portsmouth (see *MWN*, M/A96). Chappell then sued Kustom, but the case was withdrawn this February 28. "Mr. Chappell and his attorney apparently decided that neither a trial judge nor a jury could be convinced that Mr. Chappell's testicular cancer was caused by his use of a traffic radar device," Kustom's attorney, Mark Oium of O'Connor, Cohn, Dillon & Barr in San Francisco, told *Microwave News*. But Chappell offered a different rationale. "The biggest reason was financial," he explained. "I'd have to take a chance on [legal costs of] about \$200,000, and I just don't have that kind of money."

VIEWS ON THE NEWS

Dropping the “H” in WHO The EC Must Not Delegate Wireless Health Research to WHO

The U.S. Air Force’s handling of the Toler cancer study, as detailed on p.1, should stop anyone from ever looking to its Armstrong Lab for a fair appraisal of RF/MW health hazards.

Sadly, this is nothing new. Most veterans of the RF/MW scene have similar stories. The Armstrong Lab has long been known for its dogmatic denial of anything that could be construed as a nonthermal biological effect. Its real mission has *not* been to protect military personnel, but to protect the Pentagon’s freedom to use its radars and communications systems.

Dr. Michael Repacholi, who runs the World Health Organization’s (WHO) EMF Project in Geneva, Switzerland, does not see it that way. At a November seminar* on RF health risks held in Munich, Germany, Repacholi appointed three members of the Armstrong Laboratory to the working groups. A representative from the U.S. Army was also present. Absent was every U.S. government health agency knowledgeable about RF radiation: the EPA, FDA, NIEHS and NIOSH.

Of the seven other Americans participating in the seminar, two have publicly advocated ending all RF/MW research (see *MWN*, J/F88). Drs. Kenneth Foster and William Pickard have called RF/MW radiation “one of the most thoroughly studied of all potential environmental hazards.” This conclusion runs counter to more recent reviews from Australia, the EC, New Zealand and even the U.S. cellular phone industry.

Amazingly, Repacholi appointed Pickard to chair the *in vivo* research panel. To analyze the animal studies, the WHO turned to a physicist who openly dismisses health risks and who has had scant training in biology.

Only two of the American participants actually do biological research. Repacholi sees no need to rely on biologists and physicians when it comes to health data.

The WHO does not allow industry representatives on its committees, so the gaggle of Motorola staffers who came to the Munich seminar sat on the sidelines while the military and other skeptics called the shots. If private corporations are thought to be too biased to take part, it is unclear how anyone can argue that the military is a disinterested seeker of truth. As the Toler study and countless other examples show, military institutions have their own vested interests in downplaying RF/MW health risks.

But Repacholi’s only hope to raise funds for the WHO project in the U.S. lies with the military (see *MWN*, J/F97). So perhaps the selection of speakers reflects an old adage: “Money talks.”

Repacholi is not new to controversy. To wit:

- He advocates loosening the Australian exposure standard at a time when the country is in the throes of an intense RF–health

* *Biological Effects of Nonthermal Pulsed and Amplitude-Modulated RF Electromagnetic Fields and Related Health Hazards*, November 20–21, 1996, Munich, Germany. The seminar was jointly sponsored by the WHO, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the German and Austrian governments. When a conference summary was submitted to *Bioelectromagnetics* in March, the title had been changed to *Low-Level Exposure to Radiofrequency Fields: Health Effects and Research Needs*—omitting the words “non-thermal” and “hazards.” Repacholi edited the text for publication.

debate—even though Telstra and Optus, the country’s leading telecom companies, favor the status quo. Asked why, Repacholi said that he wants the Australian standard to be consistent with the international limits adopted by ICNIRP. But the ICNIRP limits were shepherded to approval by Repacholi himself, when he chaired the commission.

- He told an Australian television news program: “The worst aspect of mobile phones is that they probably interrupt my meals in restaurants” (see *MWN*, J/A95).

- He advised an Australian Senate committee to ignore the U.S. National Council on Radiation Protection and Measurements’ EMF report, drafted by an expert committee over a ten-year period, “because it is a nothing report” (see *MWN*, J/F96 and M/J96).

- Repacholi has been all too willing to serve as an expert witness for industry—for instance, he testified for BellSouth on cellular phone tower health risks in New Zealand.

- Earlier this year, Repacholi chaired an EMF conference sponsored by French and Belgian electrical utilities. Here again, Repacholi made no effort to present a balanced program, choosing instead to cater to the “no effect” views of his sponsors (see *MWN*, J/F97).

Then there is Repacholi’s long-term animal study. In a late March interview, he refused to discuss his results, which, he said, are scheduled to appear in the May issue of *Radiation Research*. How could Repacholi fail to disclose RF/MW cancer data at his own seminar? He said that the contract with his sponsors, Australian telecom companies, barred him from revealing the results until three months after they were accepted for publication.

Given how few such studies have been done, Repacholi should have asked to be freed from his commitment for reasons of public health or delayed his seminar until the gag order had expired. Why should the telecom companies have advance notice of his results, and not those at the seminar? If he has found evidence of a cancer risk, Repacholi’s secrecy would be scandalous.

Informed sources say that Repacholi is angling for a major role in the EC’s RF/MW research program (see p.10). Indeed, Repacholi told *Microwave News* that his project will soon have “buckets of money.” The EC should find another way.

The worldwide RF/MW controversy can only be resolved with a program that is perceived as fair and objective. The EC must not repeat the CTIA-WTR fiasco, with little to show after four years and \$15 million but a fistful of frequent-flier miles.

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