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## NIEHS Finds "Weak" Evidence That EMFs Pose Health Risks Prudent Avoidance Endorsed

The National Institute of Environmental Health Sciences (NIEHS) has concluded that the scientific evidence that exposures to power line electromagnetic fields (EMFs) pose a health risk is "weak."

The NIEHS stopped short of saying that EMFs are entirely safe, pointing to a "fairly consistent pattern" of a small increase in leukemia risk with increasing exposure—a pattern observed in epidemiological studies of both children exposed at home and workers exposed on the job. At the same time, the NIEHS noted that animal and mechanistic experiments tend not to support a cancer link.

These findings are contained in NIEHS Director Dr. Kenneth Olden's report to the U.S. Congress on the six-year RAPID research program on power line health effects, which was released on June 15.

Olden recommended a "continued emphasis" on educating the public and reducing EMF exposures because "virtually everyone in the U.S. uses electricity and therefore is routinely exposed." But he advised against "aggressive regulatory actions."

Olden's advice has been widely interpreted as an endorsement of a policy of "prudent avoidance," or taking simple and inexpensive steps to limit exposures. The policy was first put forward ten years ago in a report by the Congressional Office of Technology Assessment (see *MWN*, J/A89). The government of Sweden backed prudent avoidance of power frequency health risks four years ago (see *MWN*, N/D95).

(continued on p.9)

## Finding of Scientific Misconduct Against Robert Liburdy He Stands by EMF-Calcium Results

On June 18, the federal Office of Research Integrity (ORI) declared that Dr. Robert Liburdy had committed scientific misconduct. ORI charged Liburdy with "intentionally falsifying and fabricating data" in two papers about EMF effects on calcium changes in rat blood cells.

In a voluntary settlement with ORI, Liburdy agreed to retract three graphs: two in one paper and one in another. In addition, Liburdy agreed not to receive any federal grant money for the next three years.

"I admit no scientific wrongdoing," Liburdy stated in a letter published in *Science* (July 16), arguing that "the crux of the charges" center on his graphing techniques. "The raw data for my two calcium studies are valid. Thus, these papers are not being retracted, and my scientific conclusions stand as pub-

(continued on p.7)

## **European Union To Adopt ICNIRP-Based Guidelines; Italy Protests That Decision Ignores Long-Term Effects**

On June 8, the Council of Ministers of the European Union (EU) agreed on guidelines for public exposure to electromagnetic fields and radiation (EMF–EMR). Italy opposed the measure, arguing that it did not protect against possible long-term effects.

The recommended guidelines, based on those of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), will provide “a high level of protection [against] established health effects,” the Council of Ministers declared. The council noted that, “Concerns have been raised about possible health effects, primarily cancer,” from low-level, long-term exposure. But it argued that, “There is no convincing scientific evidence of EMFs causing cancer.”

German Health Minister Andrea Fischer called the council’s action “an important step towards ensuring better protection of the public,” according to a June 8 Reuters dispatch. Fischer chaired the meeting of EU health ministers, which was held in Luxembourg.

The council’s report noted that Italy had “expressed firm objections against the general approach” of the EC proposal, and had argued unsuccessfully for a policy based on “the precautionary principle.” Defeated Italian amendments called for efforts to reduce exposure, especially in “areas intended for children and health facilities.”

Italy also complained that the council decision did not take the full range of scientific studies into account. Its amendments would have explicitly stated that, “The induction of cancer from long-term effects cannot be ruled out,” and would have deleted both of the recommendation’s references to ICNIRP as an authoritative body. Italy did not, however, try to change the proposal’s ICNIRP-based numbers.

“The council’s recommendation has no legal force—but it does have moral force,” Ireland’s Dr. Tom McManus said at an IEEE meeting in Long Beach, CA, in June. He predicted that smaller countries such as Denmark and Ireland would translate the guidelines directly into national laws, while larger nations would probably modify them in light of their existing regulations. McManus is the chief technical adviser to Ireland’s Department of Public Enterprise, which deals with communications, energy and transportation policy.

The Council of Ministers approved the proposal advanced by the European Commission (EC) in June 1998 without major changes (see *MWN*, J/A98). The council rejected most of the amendments proposed by the European Parliament last March, which would have put more emphasis on a precautionary approach (see *MWN*, J/F99 and M/A99).

The European Parliament’s proposed amendments to the EC proposal had little influence on the council’s decisions. Though the council’s report stated that “nine of the 17 amendments proposed by the European Parliament have, completely or partially, been taken into account,” in many cases the council adopted only the weakest elements of a given amendment; the stronger provisions were often ignored.

### **Italian Who Won Euro Parliament Support for ALARA Loses Seat**

In elections on June 13, Gianni Tamino of Italy’s Green Party lost his seat in the European Parliament. Tamino led the recent parliamentary effort to press for reductions in EMF–EMR exposure.

Last year the parliament’s committee on the environment asked Tamino, a biology professor at the University of Padova, to review public exposure guidelines proposed by the EC (see *MWN*, J/F99). Tamino’s report proposed extremely strict numerical limits, but these were rejected by the full parliament in March (see *MWN*, M/A99). But the parliament did support Tamino’s call for a precautionary approach, known as ALARA, to possible long-term health effects.

The Italian Green Party saw its support drop by half in the European elections. With only 1.8% of the vote, it was entitled to send only two representatives to the EU’s parliament, and Tamino was not ranked high enough within his party to retain his seat.

The member of the European Parliament most likely to take the lead on EMF–EMR issues in the future is Paul Lannoye of the Belgian Greens. Lannoye is the author of a resolution which the European Parliament passed in 1994, *On Combating the Harmful Effects of Non-Ionizing Radiation* (see *MWN*, J/A94).

The council rejected the parliament’s support for a precautionary approach based on the “ALARA principle”—the idea that public exposure should be kept “as low as reasonably achievable.” It turned down a set of parliamentary amendments, supported by Italy, that would have required the EC to develop a system of regular scrutiny of devices that generate EMFs and EMR, to label such devices with information on field strengths at various distances and to revise the exposure guidelines by 2001 with an eye to possible long-term effects.

The council did, however, instruct the EC to keep the issue “under review,” including “possible effects which are currently the object of research,” and to prepare a report within five years. The council also supported research on health effects, and specified that this should be part of the EU’s “Fifth Framework Program” for scientific research (see p.4 and *MWN*, J/F99).

Though the council accepted ICNIRP’s numbers, McManus stressed that it had adopted the ICNIRP standard “in a modified way.” The council urged that regulations focus on places “where members of the public spend significant time,” and it stressed that limits on EMF–EMR exposure “should consider both the risks and benefits” of the technology concerned. These points responded to concerns raised by industry, which had argued that a strict application of the ICNIRP limits would be too expensive. For example, the U.K.’s electric power industry warned that it could be forced to spend up to \$1 billion to reduce short-

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term exposures of “a small number of agricultural workers, or ramblers on moorland” from high-tension lines (see *MWN*, J/F 99 and M/A99).

The limits recommended by the council do not apply to workers, or to patient exposure while undergoing medical treatment. They are also not intended to prevent EMI to medical devices.

The June 8 meeting of the council came to political agreement on its EMF–EMR recommendation, but did not formally

approve it. That will happen at a future meeting, after the recommendation has been translated into all of the EU’s official languages. Once the recommendation is officially approved it will be published in the *Official Journal of the European Communities*, available on the Web at: <europa.eu.int/eur-lex>. The European Parliament’s suggested amendments to the EC proposal, approved in March, were published in the June 21 issue of the *Journal*.

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## **French and German Studies on RF/MW Cancer Promotion: Widespread Interest, Inconclusive Results**

When the Mobile Manufacturers’ Forum (MMF) released a list of planned health studies in January, one topic sparked some curiosity: whether mobile phone radiation promotes the growth of cancer caused by the chemical DMBA.

The MMF said this animal study was needed “to address previous findings”—but most scientists familiar with cellular phone research did not know that such experiments had ever been conducted. What were these “previous findings”? MMF officials would not say.

So in June when results from one of the studies were slated for presentation at the annual meeting of the Bioelectromagnetics Society (BEMS), there was considerable interest. “This paper has attracted a lot of attention before the meeting, and I am expecting a controversial reaction,” said Switzerland’s Dr. Niels Kuster, the chair of that session, in his introductory remarks.

But results described by Dr. Rachid Anane, on behalf of Dr. Bernard Veyret’s group at the University of Bordeaux in France, were ambiguous. In the first of two experiments, rats were exposed to 1.4 W/Kg and above and there appeared to be some increase in cancer. But in a second experiment at lower exposures, the number of malignant tumors went down.

Motorola’s Dr. Mays Swicord, based in Plantation, FL, was skeptical about whether these apparent effects were real. “The question is whether these are statistical variations,” Swicord said in an interview. “It is difficult for me to believe that these systems are bimodal. I would be more comfortable if the data went one way or the other.”

“There is no doubt that the differences between the first and second experiments are statistical fluctuations,” commented Dr. Alexander Lerchl of Germany’s University of Münster. Lerchl argued that more animals and a lower dose of DMBA would be needed to clarify any possible RF/MW effects. Veyret countered that while the number of animals in his study was small, it should be enough to detect a difference of 40% or more between groups.

Another DMBA study on cellular phone radiation, by Drs. Christian and Hella Bartsch of the University of Tübingen in Germany, has not yet been released. Several scientists at the BEMS meeting told *Microwave News* that the Bartsches had at least some positive findings—but others said the data could be interpreted in various ways.

The German researchers have declined to discuss their experiments until the study is accepted for publication. “We plan

to submit our results...in the next month or so,” Christian Bartsch told *Microwave News*. “The final statistical analysis has not yet been completed.”

Nonetheless, wireless industry representatives agreed that this initial work deserves further attention. Dr. Torsten Gailus of Deutsche Telekom, which funded the Bartsches’ research, told *Microwave News* that both of the DMBA studies are “very interesting work.” He added that he is “not concerned by their results.”

“My personal opinion is that the Veyret study is a good study, and that it looks very important,” said Gerd Friedrich of FGF, the German wireless industry research group based in Bonn. In an interview, he noted that Veyret’s experiments were small and “still at an early stage.” Neither Gailus nor Friedrich would comment specifically on the Bartsches’ findings.

The MMF has selected Dr. Robert Hruby of the Austrian Research Center in Seibersdorf to try to replicate the DMBA studies (see p.4). Hruby is expected to use 100 animals per group, and thus achieve a statistically stronger result.

In both of his experiments, Veyret gave the rats one 10 mg dose of DMBA, which induces mammary tumors. Starting ten days later, the rats were exposed to 900 MHz GSM mobile phone radiation for two hours a day, five days a week, for nine weeks.

In the first experiment, three groups of 16 rats were exposed to 1.4 W/Kg, 2.2 W/Kg or 3.5 W/Kg. Another group of 16 was sham-exposed, while eight rats served as cage controls. Overall, exposed groups showed “a slight increase in the number of tumors, but it was not significant,” said Anane.

The second experiment was conducted at lower exposures: 0.1 W/Kg, 0.7 W/Kg and 1.4 W/Kg. In this case, the number of tumors per animal decreased as exposure went up, and in two out of three groups the decline was statistically significant. This experiment also used 16 rats per group.

Gailus, who heads Deutsche Telekom’s research group on RF/MW bioeffects in Darmstadt, said that Christian and Hella Bartsch used a different exposure system than did Veyret. While both labs used whole-body, far-field exposures, in the German study the cages held several animals each with enough space for them to move about freely. In the French experiments, the rats were confined to individual compartments just large enough for a single animal.

The use of confined spaces in Veyret’s exposure system was criticized by Lerchl. He pointed out that in both experiments,

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the cage controls had consistently higher body weights than all other groups of animals. "The animals are stressed when they are constrained," Lerchl told *Microwave News*. Since both exposed and sham-exposed animals are stressed, he contended, "You will not see an effect [of RF/MW exposure] unless it is very strong." Lerchl believes that, "This is a guaranteed way not to see any results."

Anane stressed that no firm conclusions could be drawn from his group's study alone. Veyret's lab is also planning further

DMBA work, with a larger number of animals. Funded by the French service provider Bouygues Telecom, this study will use 1800 MHz exposures.

Another initiation/promotion study by Veyret's group, this one using benzo(a)pyrene instead of DMBA, found no effects at all from RF/MW radiation. This study, which used much lower level GSM exposures—0.075 W/Kg and 0.27 W/Kg—has been accepted for publication by the *International Journal of Radiation Biology*.

### **Wireless Industry Picks Studies for European Research Program**

The Mobile Manufacturers Forum (MMF) is supporting the proposals listed below for funding from the European Union (EU) under its Fifth Framework Program for Research and Technological Development, known as FP5 (see *MWN*, J/F99). Under FP5 rules, the EU will cover only 50% of the cost of projects done outside of universities. The MMF will pay half the costs of its projects which are chosen by the European Commission (EC).

Research labs submitted applications early this year in response to a request for proposals issued by the MMF that detailed a number of research needs (see *MWN*, J/F99). The applications were evaluated by two panels specially convened by the WHO EMF Project in Zurich, May 8-9. Both panels were chaired by Dr. Christopher Portier of the U.S. NIEHS.

A list of labs that were judged capable of doing the research was presented to the MMF, which then matched the labs with specific research projects. Three consortiums, each of which included labs from several different countries, were assembled to do animal, cellular and human research (see below).

Applications for FP5 funding were due on June 8 and are now under review by the EC's Directorate 12, on science, in Brussels. The EC's selections are expected in the fall.

The chair of the MMF is Peter Harrison of Nokia in Camberley, U.K. Its secretary is Matthias Meier of Motorola in Kassel, Germany. Dr. Mays Swicord, Motorola's director of biological research in Plantation, FL, is also playing an active role in this MMF initiative.

<b><i>In Vivo</i> Studies</b>	<b>Country</b>	<b>Principal Investigator and Affiliation</b>
Two-year bioassays in rats with 900 MHz & 1800 MHz digital radiation	Switzerland	Dr. Antonio Dotti, RCC Ltd., Itingen
Two-year bioassays in mice with 900 MHz & 1800 MHz digital radiation	Germany	Dr. Clemens Dasenbrock, Fraunhofer Institute, Hannover
Replication of DMBA-initiated breast cancer in rats with 900 MHz digital radiation	Austria	Dr. Robert Hruby, Austrian Research Center, Seibersdorf
Replication of <i>Pim1</i> transgenic mouse study	Italy	Dr. Germano Oberto, RBM Bioscience, Colletterto Giacosa
Radial arm and water maze ability in rats and mice	U.K. France	Dr. Rick Saunders, NRPB, Chilton Dr. Jean-Christophe Cassel, Louis Pasteur University, Strasbourg
<b><i>In Vitro</i> Studies</b>		
Ornithine decarboxylase (ODC) expression using 900 & 1800 MHz digital radiation	France Finland	Drs. Bernard Billaudel & Bernard Veyret, University of Bordeaux Drs. Jonne Naarala & Jukka Juutilainen, University of Kuopio
Genotoxicity and chromosome aberrations using 900 & 1800 MHz digital radiation	Italy U.K.	Dr. Carmela Marino, ENEA, Rome Dr. David Lloyd, NRPB, Chilton
<b>Human Studies</b>		
Hearing and inner ear pathology	Sweden Finland	Dr. Ilmari Pyykkö, Karolinska Institute, Stockholm Dr. Jukka Starck, Institute of Occupational Health, Vantaa
Skin hypersensitivity, headaches and blood pressure	Sweden	Drs. Bengt Arnetz & Lena Hillert, Karolinska Institute, Stockholm
Sleep and EEG recordings	Sweden	Dr. Torbjörn Åkerstedt, Karolinska Institute, Stockholm
Working memory	U.K.	Dr. Adrian Owen, University of Cambridge
<b>Exposure and Dosimetry Support</b>		
Drs. Niels Kuster, Swiss Federal Institute of Technology, Zurich; John Sahalos, University of Thessaloniki, Greece; Philippe Leveque, University of Limoges, France; and Kari Jokela, Center for Radiation and Nuclear Safety, Helsinki, Finland.		

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## **The Talk of Long Beach: Motorola Takes Center Stage as Carlo Makes His Exit**

On walking into the BEMS meeting\* it seemed as if someone had waved a magic wand and turned all the power line people into cell phone types—and got most of them jobs with Motorola.

Motorola was everywhere. Motorola scientists, engineers, consultants and administrators came to Long Beach from three continents. To keep order, the company sent a lawyer and a PR man. In all, there were about a dozen Motorola staffers at BEMS, not counting those actually doing Motorola-funded research.

Motorola has the largest mobile phone health research program in the world. In fact, it has the *only* research program. In contrast to Wireless Technology Research's (WTR) \$25 million effort for the cell phone industry, which never got off the ground, Motorola is actually getting something done.

This was most apparent at WTR's own two-day symposium† held immediately before the BEMS conference. WTR's meeting was designed to showcase WTR results, but it had funded so few studies that Motorola researchers had to be brought in to fill out the program. At WTR's own meeting, there was more science from Motorola than from WTR.

The symposium did feature some WTR research: findings that Dr. George Carlo, WTR's chair, had previously released to the media with much fanfare. Carlo argued strongly that Joshua Muscat's epidemiological study (see *MWN*, M/J99) and Dr. Ray Tice's genetic toxicological experiments (see *MWN*, M/A99) suggested a possible cell phone-cancer link.

Muscat did not say what he thinks about his own findings—perhaps to keep them fresh so that he can publish them somewhere prestigious like the *New England Journal of Medicine*.

Sweden's Dr. Lennart Hardell did not come to Long Beach, but his collaborator Dr. Kjell Hansson Mild presented their recent epidemiological results, which show that users of mobile phones were more likely to develop brain cancer on the side of the head where they held the phone (see p.6 and *MWN*, M/J99).

While many of those in the audience were skeptical that any of these new pieces of the cell phone health puzzle represented a breakthrough, Carlo clearly thought so. He called for an "immediate and comprehensive review" of RF/MW health standards.

"There is something going on that does not involve heating," Carlo told us. Carlo's "deathbed" conversion to the non-thermalist camp may have prompted France's Dr. René de Seze, who does research for Motorola, to reassure the audience at the end of the meeting that there is no health problem. And Norm Sandler, Motorola's spokesman, observed that the reviews of safety standards that Carlo is calling for "are being done all the time."

"It is clear to me that consumers are not being protected," Carlo warned. He predicted that the health controversy is not over: "I am not anticipating an end to this anytime soon," he said.

Carlo now believes that the cell phone industry has a duty to monitor consumer complaints, to do public health studies of

phone users and to continue biological research. This is "an on-going cost of doing business," he said. "Nothing less will protect the consumer." In the past, Carlo has suggested that WTR would be well-suited to run just such a surveillance effort, according to a proposal for a second five-year research plan which Carlo has been circulating.

The Cellular Telecommunications Industry Association (CTIA), which sponsored the WTR program, quickly distributed a press release stating that there are no cell phone health risks.

To no one's surprise, there was visible tension between WTR and the CTIA. Carlo could be seen in heated arguments with CTIA Vice President Jo-Anne Basile in the hall outside the meeting room. "You have caused us a few sleepless nights," Basile said from the floor as the WTR meeting closed.

Carlo told *Microwave News* that the CTIA had informed him last winter that it would no longer support WTR—although it had previously promised him a role in following up the epidemiological and genotoxic findings.

In fact, as far as the CTIA is concerned, Carlo is gone for good. It is a "final goodbye," reported *Wireless Week*, which can be counted on to reflect the industry's position. CTIA's board has made a new commitment to sponsor health research, though it has not been specific as to who will do it and who will run it.

But Motorola is not waiting around. It has taken a central role in coordinating responses to the new European research effort (see p.4). In addition to its ongoing U.S. and European research efforts, Motorola is helping with the exposure system for the replication of a key animal experiment in Australia.

There was a fair amount of discontent among European scientists with Motorola's role in the EC project: "How come some guy from America is telling us how to spend our money?" one commented.

Dr. Mays Swicord, Motorola's director of biological research in Plantation, FL, defended the company's initiative: "If we had not acted, there is a risk the high priority items would not have been addressed." He attributed some of the ill will to hurt feelings because "some people got left out of the process."

Carlo is telling people that Motorola has a nearly unlimited budget when it comes to microwave research. He claimed that the company had given the World Health Organization (WHO) EMF project \$10 million. "That's absolutely untrue," countered Dr. Michael Repacholi, the head of the project. He said that the WHO cannot accept direct industry support, but that Motorola has "at times picked up the costs of some meetings." For instance, Motorola paid for NIEHS' Dr. Christopher Portier's trip to Europe to evaluate the proposals for the EC program (see p.4).

Motorola's Sandler said that Motorola has contributed approximately \$50,000 a year for the last three years for general support of WHO's RF work, explaining that Motorola gives the money to Australia's Royal Adelaide Hospital, which forwards it to the WHO. Repacholi worked at the hospital before joining the WHO.

Few people seem to be shedding any tears over Carlo's exit from the cell phone scene. "George is having difficulty bowing out gracefully," Repacholi told us as he left Long Beach.

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\*21st Annual Meeting of the Bioelectromagnetics Society (BEMS), Long Beach, CA, June 20-24, 1999.

†2nd State of the Science Colloquium on the Public Health Impact of Wireless Technology, Long Beach, CA, June 19-20, 1999.

« **Wireless Notes** »

At the WTR symposium in Long Beach (see p.5), Dr. **Maria Feychting** of the Karolinska Institute in Stockholm raised a question about Dr. **Lennart Hardell's** study of brain cancer and mobile phone use. From a central tumor registry, Hardell identified 270 cases in the study area between 1994 and 1996. Feychting, however, identified 862. While some of the difference is due to the fact that Hardell used only cases who were still alive, she noted that about two-thirds should still be alive a year after diagnosis. "We need to investigate the selection procedure to evaluate possible selection bias," said Feychting, who is working on the International Agency for Research on Cancer's mobile phone study (see *MWN*, S/O98). "It's strange that he does not explain why he identified only 30% of the cases," she told *Microwave News*.

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"**Neil Whitehouse**, stubborn and arrogant airline passenger, was jailed for a year." That was the caption on a photo of Whitehouse in the July 22 *Daily Telegraph* (U.K.), after he was sentenced for repeatedly refusing to switch off his mobile phone on a flight from Madrid to Manchester. While the plane was airborne, flight attendants and the captain warned that the phone could interfere with the aircraft's sensitive navigational systems. "So what?" Whitehouse replied. "Are we going to get lost?" Britain's **Civil Aviation Authority** welcomed the verdict and emphasized that,

"Use of mobile phones on any aircraft is a definite safety risk." The sentence was intended "to act as a warning to others," stated **Judge Anthony Ensor**. "Proliferation of ownership of mobile phones and an increasing number of reports from pilots of electromagnetic interference makes this a priority."

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WTR's Dr. **George Carlo** has made peace with Drs. **Henry Lai** and **N.P. Singh** of the University of Washington, Seattle. In May, Carlo wrote to Dr. **Richard McCormick**, the president of the university, charging that they had written a "libelous" letter about WTR which was published in *Microwave News* (see *MWN*, M/A 99 and M/J99). Carlo requested a meeting so that the matter could be resolved "outside the courts." But by mid-June, Carlo had decided not to pursue the matter. "George told me 'Let's forget about it,' in Long Beach," Lai said (see p. 5). Carlo confirmed this to *Microwave News*. Then, on July 9, Dr. **Steven Olswang**, the vice provost of the university, responded to Carlo on behalf of McCormick, stating that, while Carlo's concerns "present legitimate differences of viewpoints about a topic of considerable academic importance," they "do not present investigatable issues of scientific integrity." Olswang added that, "The University of Washington encourages legitimate academic discourse, and as such, we are not prepared to intervene."

**Could a Cell Phone Call Spark a Gas Station Explosion?**

Is there a small but real danger that a cellular phone could spark a fuel explosion in a gas station? Or is this just "the latest urban legend," as the *Wall Street Journal* suggests?

This question got a burst of attention in the U.S. in June, after Exxon stations posted signs telling customers to turn off mobile phones before filling up. The signs are mandatory in company-owned stations, and "strongly encouraged" at independent Exxon dealers, CNN Financial Network reported on June 28.

BP Amoco has banned cellular phone use in its filling stations in Australia and the U.K., and will extend this policy to the U.S. in the next few months, according to the trade paper *RCR* (June 28). For several months, Japanese gas stations affiliated with Exxon and Shell have prohibited the use of wireless phones.

The wireless industry blames the fuss on an old British government rule requiring manufacturers of all electronic devices to warn customers to switch them off near potentially explosive atmospheres. Motorola's Norm Sandler told the *Wall Street Journal* (July 9) that the regulation was obsolete, and that cellular phone manufacturers may drop the warning from their manuals.

A recent Motorola patent application in the U.K., however, states that wireless phones can pose a danger of explosion in gas stations. It describes a Motorola system that would shut down all mobile phones within a given area. Sandler told *Microwave News* that this text does not reflect company policy, and was written by an individual engineer. He called the wording "unfortunate," and added that Motorola and oil industry experts are currently conferring "to clarify whether these precautions have any technical basis whatsoever."

An unconfirmed report from Indonesia of a gas station fire caused by a mobile phone is currently circulating on the Internet. But it is unclear whether such a fire or explosion has ever occurred, in Indonesia or anywhere else.

Dr. James Stuart, head of Franklin Applied Physics in Oaks, PA, told *Microwave News*, "I don't see any way you could get a spark out of a cell phone. They're designed *not* to cause sparks." Stuart, an expert on accidental discharge of the electro-explosive devices (EEDs) used in construction, noted that, "A two-way radio transmission can cause an EED to explode. But the only way to make an explosive vapor explode is with a spark."

An engineer for a major wireless technology firm, who asked not to be named, concurred. "Even if a wire to the battery breaks, the chances of that producing a spark, in the presence of enough gasoline vapors to matter—well, you'd be more likely to get hit by a meteorite," he said.

"The idea is kind of hard to believe," commented Dr. Motohisa Kanda of the National Institute of Standards and Technology in Boulder, CO. "Now, if you're using one of these pumps where you put in your credit card, the outgoing RF signal could maybe cause some kind of electromagnetic interference with the pump's computer chip and affect the billing," Kanda mused. "That *could* happen. So you might change your bill with a cell phone, but I don't think you can blow yourself up."

Exxon, however, is not taking any chances. In the company's refineries, using a mobile phone is banned in the same areas where using a welding torch would be restricted, spokesperson Crawford Bunkley in Houston told *Microwave News*.

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**Carlo** is currently in the midst of several suits and countersuits in a bitter divorce case. According to the trade publication *RCR*, his wife and former business partner **Patricia Carlo** has charged that he looted the assets of their consulting firm, **Health and Environmental Sciences Group Ltd.** (HES), by funneling its money to **WTR**. She has accused the head of the WTR audit committee, **Ronald Cavill** of Cavill & Co. of approving “false and fraudulent invoices” that were then submitted to HES, adding that WTR, HES, and Cavill’s company all shared the same Washington address. “Patricia Carlo alleges George Carlo improperly spent HES money on close friends and associates for travel, vacations, pleasure boats, country club dues and sporting events,” *RCR*’s Jeff Silva reported on July 19. George Carlo denies the charges, characterizing them as pressure tactics designed to get a better deal in the divorce.

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On June 15, **U.K. Members of Parliament** (MPs) heard from critics of tower siting policies and current RF/MW exposure guidelines. “There is widespread support for changing a system which does not protect the interests of the public,” said Graeme McAlister of **Friends of the Earth Scotland**, which organized the briefing along with Northern Ireland Families Against Telecommunication Transmitter Siting (**NIFATT**). Margaret Dean of NIFATT called for buffer zones “between masts and homes, schools and hospitals” as a precautionary measure, echoing a proposal of the Swiss environmental agency (see *MWN*, M/A99). U.S. activist **Libby Kelley** described the ongoing legal challenge to the FCC’s RF/MW exposure limits (see *MWN*, N/D97, N/D98 and J/F99). The scientific basis for current RF/MW exposure standards was addressed by Drs. **Gerard Hyland** of the U.K.’s University of Warwick, **Michael Kundi** of Austria’s University of Vienna and **Henry Lai** of the University of Washington, Seattle, in the U.S. All three focused on the limits’ failure to protect against possible nonthermal effects. To defend its guidelines, the U.K.’s National Radiological Protection Board (**NRPB**) in

Chilton sent Sir **Richard Doll** of Oxford University, who chairs **NRPB**’s Advisory Group on Non-Ionizing Radiation, and Dr. **Zenon Sienkiewicz**, who argued that nonthermal effects lack the “established and consistent scientific data” on which exposure limits must be based. The meeting was sponsored by **Phil Willis**, a Liberal Democrat MP from northern England. “There is a lot of cross-party concern and a significant number of MPs are interested” in the tower siting issue, Willis told the BBC. Willis said that MPs from several parties are forming a parliamentary group on tower siting questions and wireless phone safety.

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The **U.K. government** is looking into the placement of mobile telephone base stations on schools. In June, **Education Secretary David Blunkett** announced that he had requested an inquiry into such siting policies and their possible health implications. “This is an issue for the entire country and we need to examine it urgently,” said Blunkett, according to the *Daily Mail* (June 28). The *Mail* reported that the inquiry will be directed by the Department of Health. The announcement came as grassroots groups campaigned to ban cell towers on or near schools (see above) and as some local authorities—for example, in Edinburgh, Scotland—adopted precautionary measures restricting tower siting on public property. Dr. **Michael Clark** of the **NRPB** downplayed the risks posed by phone antennas on schools: “Invariably, checks taken in the school playground show that mobile phone transmitters give out far less power than nearby television and FM radio masts,” Clark told the *Sunday Telegraph* (June 27). “So if people were being logical, they would want those masts taken down as well.” Meanwhile, in another planned U.K. government inquiry, Sir **William Stewart** has been named the chair of an expert panel on mobile phone safety. Previously, Stewart was a chief scientific adviser to the government. **Tessa Jowell**, the minister for public health, promised a “definitive and rigorous assessment” of the health debate last April in response to a University of Bristol study showing faster response times among volunteers exposed to microwave radiation (see *MWN*, M/A99). The other members of the panel have yet to be named.

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### **Finding of Misconduct Against Robert Liburdy** (continued from p.1)

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lished.” He explained that he agreed to the settlement because he could not afford “a protracted legal battle with ORI.”

The acting director of ORI, Chris Pascal, told *Microwave News*, “There’s nothing in the voluntary agreement that says his conclusions were found to be invalid. We think scientists in the field are going to have to decide for themselves if his conclusions still hold up.” But, Pascal added, “We did find that there was falsification and fabrication in the three figures, and they were retracted—not corrected, but retracted.”

“It is unjustified to attempt to ruin a career over this,” Liburdy told *Microwave News*. “ORI could not force me to retract any of the conclusions of my papers, despite being scrutinized for years. How many research findings have been reviewed at that level of hostile scrutiny and found to be accurate?”

By late July the Liburdy story had sparked a minor media frenzy, with prominent coverage in the *New York Times*, *San*

*Francisco Chronicle*, and many other papers coast-to-coast. Most news stories described the three graphs of calcium data as central to the argument that there is a link between EMFs and cancer (see p.8). But researchers in the bioelectromagnetics community said that Liburdy’s disputed data is only tangentially related to the cancer debate, and one small piece of the overall work on EMFs and calcium.

Liburdy and ORI have conflicting views of nearly every issue in the dispute. For example, ORI staff contend that in two of the graphs,\* Liburdy’s “unreported algebraic manipulations” of his raw data exaggerated calcium responses by a factor of ten and

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\*Figures 6 and 7 in “Calcium Signaling in Lymphocytes and ELF Fields,” *FEBS Letters* (301, pp.53-59, 1992). The third graph is Figure 12 in “Biological Interactions of Cellular Systems with Time-Varying Magnetic Fields,” *Annals of the New York Academy of Sciences* (649, pp.74-95, 1992; see box, p.9).

## ***Finding of Misconduct Against Robert Liburdy***

“created an experimental difference...that did not exist in the original data.” But Liburdy insists that he simply applied accepted methods of normalization and baseline correction to his data—though he now concedes he should have described these procedures in the text. He plans to republish all three graphs, with a full explanation.

ORI staff accuse Liburdy of “a sustained pattern of deception over a period of several years,” while Liburdy maintains that, “All it should have taken to settle this dispute is a revised figure legend giving more details about graphing the data.”

ORI’s investigation of Liburdy was preceded by a 1995 investigation by Lawrence Berkeley National Laboratory (LBL), where he worked until this March. A complaint was filed against Liburdy by someone whose name has not been released, but who Liburdy characterizes as “a disgruntled employee.” An LBL committee accused Liburdy of “disrespect for the integrity of scientific data,” and found that he “has published data in a manner which exaggerates their statistical significance and scientific validity.”

After LBL completed its investigation in July 1995, internal review and appeals continued for two more years. ORI’s investigation began in the fall of 1997, after LBL notified ORI that it had found Liburdy guilty of misconduct.

During LBL’s proceedings, Liburdy chose three experts to review different aspects of his data: Drs. Carl Blackman of the Environmental Protection Agency, Richard Nuccitelli of the University of California, Davis, and James Putney of the National Institutes of Health. Liburdy’s July 16 letter to *Science* states that while each “constructively criticized” him on various points, all believe “there was no intent to deceive [and] the data supports the conclusions.”

ORI staff allege that Liburdy did not supply his own experts with all relevant data, a charge which he denies. Both Liburdy and ORI quote from the experts’ letters in support of their positions, but at press time neither had provided *Microwave News* with the complete text of the letters.

ORI declared that, “Liburdy’s claims were potentially very important when published in 1992 because they purported to link EMFs and calcium,” which plays an key role in many cellular processes. But such a link was in fact first reported fifteen years earlier, and has been the subject of many studies since.

“The critical observations on calcium were made decades ago,” Dr. Ross Adey of the University of California, Riverside, said in an interview. Adey noted that in his lab in the late 1960s, Dr. Suzanne Bawin observed that calcium in tissue was sensitive to modulated RF fields. This was a pioneering report of a nonthermal biological effect of non-ionizing radiation. Bawin followed this with work on calcium and extremely low frequency (ELF) EMFs, which was published in the mid-1970s and replicated by Blackman in 1979.

A report from a March 1997 NIEHS symposium on *in vitro* EMF bioeffects research lists 27 papers on EMFs and cellular calcium. Of the two Liburdy studies with data challenged by ORI, only one—the *FEBS Letters* paper—was considered important enough to be part of this list.

Liburdy’s best-known research is not his calcium studies, but his experiments on the effects of EMFs on the growth of

breast cancer cells. Liburdy has reported that in one line of human breast cancer cells, EMFs can block the anticancer effects of the hormone melatonin. This finding has now been replicated in four other labs, most recently by Drs. Masami Ishido and Michinori Kabuto of Japan’s National Institute for Environmental Studies in Ibaraki, who reported their results at this year’s BEMS meeting (on the other three labs, see *MWN*, J/A98). Liburdy also found that EMFs can neutralize the anti-breast cancer action of tamoxifen, and he told *Microwave News* that this work has been replicated by three labs in the U.S.

None of Liburdy’s cancer studies were at issue in the ORI investigation.

### ***Media Storm Over Liburdy Affair***

For over a month after ORI announced its misconduct finding against Dr. Robert Liburdy, the most prominent press coverage was a short piece in the July 2 issue of *Science*. But the story caught fire after an article appeared in the *San Francisco Chronicle* on July 23. In what soon became a theme throughout the media, the *Chronicle* asserted that the two calcium studies “were considered tantalizing evidence that [EMFs] could cause cancer.”

The next day a front-page story appeared in the *New York Times*, with the headline, DATA TYING CANCER TO ELECTRIC POWER WERE FAKED, U.S. SAYS. The graphs that ORI forced Liburdy to retract “had been considered crucial evidence of a tie between electric power lines and cancer,” wrote reporter William Broad. “If he hadn’t gotten these results, nobody would have paid any attention,” an anonymous government investigator was quoted as saying. According to the *Times*, Dr. Robert Park, a lobbyist for the American Physical Society, “said Dr. Liburdy’s deception was probably typical for the field.”

The *Times* article was picked up by many other papers across the country, often appearing on the front page. An Associated Press story ran in the *Wall Street Journal*, the *Washington Post*, and elsewhere.

The next week opinion pieces began to appear. In the *Wall Street Journal* (July 27), Dr. Elizabeth Whelan of the American Council on Science and Health, based in New York City, wrote that in the disputed studies, Liburdy “claimed to have identified a possible mechanism by which EMFs caused cancer” and called this “a new low in the annals of junk science.” On July 26, *Times* columnist William Safire complained that Liburdy “avoids prosecution by not contesting these [government] findings, though he admits nothing.”

On July 28, Liburdy and Park appeared together on a public radio talk show on New York’s WNYC. Responding to the media frenzy, Liburdy noted that his calcium experiments were not cancer studies. “He’s absolutely correct on that,” commented Park.

In a July 31 letter to the editor of the *Times*, Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, pointed out that concern over EMFs and cancer “is primarily a result of epidemiological studies that show an association between childhood cancer and power lines, not cell biology research.”



## **Opposing Views of a Contested Liburdy Graph**

ORI's case against Dr. Robert Liburdy is complex and not easily summarized. Below is a review of key arguments that have raged over one of the three graphs that Liburdy has agreed to retract (Figure 12 of his 1992 paper in *Annals of the New York Academy of Sciences*). The graph shows changes in calcium within blood cells exposed to EMFs.

An analysis by ORI lawyers, obtained by *Microwave News* under the Freedom of Information Act, contends that in Figure 12: a) Liburdy selected data that supported his hypothesis and discarded the rest; and b) He fabricated parts of the curves. The document claims that this created an EMF-calcium effect not supported by the data. Liburdy vehemently denies these charges.

"Liburdy simply chose data points to express his desired experimental outcome," according to the analysis. It stresses that Liburdy graphed "less than 7.1% of his full data set."

"I could not graph hundreds of calcium data points since I did not have the software to do this in 1991," Liburdy told *Microwave News*. He added that he used more like 15% of the data. While Liburdy said that he sampled "at about 33-second intervals," ORI's analysis contends that he did not sample "systematically, uniformly or even randomly." It states that his selected data were "often clumped in groups of two and three," citing examples separated by 4, 11 and 15 seconds.

"I sampled at shorter intervals where the data were changing rapidly—for example, after the addition of Con A" (which induces cell division), responded Liburdy. This was simply "good experimental design," he said. Liburdy insisted that there was "no overall intent to 'clump' data to distort the findings."

ORI staff further assert that when the full data set is graphed, the variation, or scatter, is larger than any calcium response. They allege that by picking and choosing the data he wanted, Liburdy "manufactured" a calcium response.

Liburdy does not deny that the scatter in his full data set may be larger than any calcium response, or that this is not reflected in the graph. But he rejects the accusation that this was intentional. "The data sampling took place without knowing what the curves would look like, and was done only once," Liburdy

said. "ORI analyzed my large data set with 1998-1999 software they knew was not available to me in 1991."

ORI staff also claim that, for one curve, there is physical evidence that Liburdy "rejected and erased data that contradicted the desired results."

"Like any normal person, I made some errors in plotting data points onto a graph with multiple axes," said Liburdy. "Occasionally I erased errors and replotted data. It is appalling to try to attach some other significance to this normal behavior."

Liburdy and the ORI analysis do agree that parts of the curves are not based on actual measurements, but disagree over what this means. The curves show a series of small jagged spikes, with peaks and valleys at intervals of 2-3 seconds—although the data points sampled by Liburdy are on average over 30 seconds apart. This "noise" was hand-drawn by Liburdy.

ORI's analysis says simply that, "Dr. Liburdy falsified the fluctuations in the traces shown in Figure 12," and stresses that the actual "noise" in Liburdy's full data set is much larger.

The 1995 LBL investigation also looked at this issue, concluding, "Liburdy's fabrication of the data noise is not a case of merely processing the results for better readability, but is at the level of tampering with the results in order to mislead the reader."

Liburdy maintains that the size of the fluctuations he drew was based on the observed level of noise. He said that one of the experts whom he had asked to review his data, Dr. Carl Blackman of the EPA, said that while Liburdy should have graphed the individual data points, his "line wiggles" do in fact match the extent of the scatter that Liburdy observed.

Liburdy's overriding defense is that his conclusions are supported not only by Figure 12, but also by a second assay, using calcium-45. "This calcium-45 data has not been challenged and it fully supports my scientific conclusions," he said.

The LBL investigation found that there had been no misconduct after it examined one of the calcium-45 graphs in Liburdy's 1992 paper in *FEBS Letters*. "We generally agree with his average values," LBL concluded. The ORI report does not challenge any of Liburdy's calcium-45 work.

### **NIEHS EMF RAPID Report to Congress** (continued from p.1)

The NIEHS report was greeted with widespread approval as an evenhanded summary of the existing state of knowledge. "It's a good report," said Dr. Maria Feychting of the Karolinska Institute in Stockholm, Sweden. Dr. Antonio Sastre of the Midwest Research Institute in Kansas City, MO, called it "fair and bal-

anced." Both Feychting and Sastre were on the 30-member working group assembled by the NIEHS last summer to review the EMF literature, which concluded that extremely low frequency (ELF) EMFs should be classified as "possible human carcinogens" (see *MWN*, J/A98).

The Environmental Protection Agency (EPA) reached a conclusion similar to that of the working group in 1990 (see *MWN*, M/J90). But Dr. Robert McGaughy, who drafted the EPA analysis, said "I would not have used the word 'weak'." He told *Microwave News* that, "I would have emphasized the consistency of the epidemiology, as is pointed out in the report."

On the other hand, the National Electrical Manufacturers Association (NEMA), based in Rosslyn, VA, questioned why EMFs should be regarded as possible carcinogens based only on limited epidemiological evidence.

#### **How To Order the NIEHS Report**

A copy of the NIEHS report, *Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields* (Publication No.99-4493), is available on the Internet at: <[www.niehs.nih.gov/emfrapid](http://www.niehs.nih.gov/emfrapid)>. Printed copies are available from: EMF RAPID Program, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, (919) 541-7534, Fax: (919) 541-0144, E-mail: <[emf-rapid@niehs.nih.gov](mailto:emf-rapid@niehs.nih.gov)>.

The NIEHS report comes at the end of the RAPID six-year research program mandated by Congress in 1992 (see *MWN*, S/O 92). The institute received \$30 million from the federal government and industry for RAPID health research and public education. The institute also contributed approximately \$14 million of its own funds for EMF research. RAPID had originally been designed to be a \$65 million program.

Some observers were pleasantly surprised by the report's conclusions. Last December, a group of institute staffers circulated a draft summary of federally funded EMF research, which dismissed the possibility of EMF health risks. This was seen as an indication of what would be in Olden's report to Congress (see *MWN*, J/F99). Shirley Linde, the chair of the National EMF Advisory Committee set up by Congress to monitor the RAPID program, said that she was "pleased, surprised and even amazed" by Olden's report. Linde lives in Los Angeles.

The report that was sent to Congress is seen as a compromise within the NIEHS between those who put the most emphasis on the animal studies, which have been largely negative, and those who argued that the human studies cannot be discounted.

The evidence linking EMFs to childhood leukemia and occupational chronic lymphocytic leukemia "cannot be dismissed as random," said Dr. Christopher Portier, the associate director of NIEHS' Environmental Toxicology Program and the principal author of the NIEHS report. (See also p.11.)

The report's endorsement of a national policy of prudent avoidance also received broad support. "The call for prudent avoidance without excessive regulation is appropriate," Dr. David Carpenter of the State University of New York's School of Public Health in Albany told *Microwave News*. Carpenter was the director of the New York Power Line Project in the 1980s.

"It's good customer relations," commented Robert McCourt, the EMF issue manager at Public Service Electric and Gas Co. in Newark, NJ. McCourt added, however, that prudent avoidance is sometimes "hard to define" and that is why the utility "does not formally embrace it."

"The more sophisticated utilities have been practicing prudent avoidance for many years—since 1989, shortly after the OTA report was released," said Thomas Watson of Watson &

### **NIEHS: Recommended Actions**

- The power industry should continue the practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards.
- U.S. electric utility companies should continue the practice of measuring EMFs in their customers' homes and of helping them identify sources of high fields.
- Manufacturers of household and office appliances should consider alternatives that reduce magnetic fields at a minimal cost.
- NIOSH and OSHA should evaluate whether EMF exposure standards for workers are adequate.

Renner, a Washington law firm. Watson represents the Utility Health Sciences Group, which includes over 100 companies in the U.S., Australia, Canada and the U.K.

The NIEHS report specifically encourages "manufacturers of household and office appliances to consider alternatives that reduce magnetic fields at a minimal cost." NEMA's Douglas Bannerman told *Microwave News* that, "We are examining what that means for our products."

With the end of the RAPID program and the shutdown of the Department of Energy's EMF research program, the federal government, including the NIEHS, will no longer set aside any money specifically for EMF research.

The NIEHS stated, however, that it "will continue to support research in this area" through "carefully designed, hypothesis-driven studies." It cited a number of specific areas that warrant attention, including possible EMF links to cardiovascular and neurodegenerative diseases, as well as studies, first performed by Dr. Robert Liburdy (see also p.1), showing that EMFs can offset the beneficial effects of melatonin and tamoxifen.

In addition, the NIEHS concluded that, "More remains to be learned about the physics of magnetic field interactions with biological systems."

EMF researchers were disappointed that directed research will not continue. "Because we do not understand the basic mechanisms of interaction, it is very difficult to make any type of judgment on risk," Dr. Mats-Olof Mattsson of Sweden's Örebro University told *Microwave News*. Mattsson, president-elect of BEMS (see p.17), said that he would have liked to have seen "money specifically targeted for hypothesis-driven EMF research."

The only remaining directed research effort is that of the electric utility industry, through EPRI, which is based in Palo Alto, CA. Dr. Leeka Kheifets, the manager of EPRI's EMF program, declined to comment on the NIEHS report.

One more report on the RAPID program is required by Congress. The Interagency Advisory Committee will issue its evaluation of the NIEHS report. Dr. Michael Marron of the Office of Naval Research in Arlington, VA, said that he is planning to have a draft of the committee's report completed by early September and to release the full report by the end of the year.

Last spring, the National Academy of Sciences issued a critical report on the RAPID program which argued that there is no need for a new EMF health effects program (see *MWN*, M/J99).

### **Excerpts from the Report**

"The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the 'right' species, are tied to 'real life' exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF-EMF has been identified...."

"The NIEHS concludes that ELF-EMF exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted...."

## **NIEHS' Dr. Christopher Portier Talks with Microwave News**

*In July, Microwave News chatted with NIEHS' Dr. Christopher Portier, the principal author of the RAPID report to Congress.*

**MWN:** The NIEHS report concludes that there is only weak evidence of an EMF health risk. Can you put EMFs in the context of other environmental health risks?

**CP:** There is widespread public exposure to ELF EMFs, which is also true of dioxins and fine particulate air pollutants. But the strength of evidence for a hazard from ELF EMFs is much weaker than that for dioxin, where there is both animal and human evidence. It is similar to that for Atrazine, the most widely used herbicide in the U.S. and the world, for which there is only limited evidence for carcinogenicity in humans and an ongoing controversy over the interpretation of the animal data.

**MWN:** The Mary McBride childhood leukemia epidemiological study, showing no EMF–cancer link, was published on May 1, as the NIEHS was completing its report. Did it influence your final conclusions?

**CP:** We made some changes after the release of the McBride study. Initially, we were going to weaken our conclusions because of her 48-hour exposure results. But then we asked McBride for the unpublished analysis of her 24-hour data and we saw that her results were not inconsistent with previous findings. The 24-hour data show nonsignificant adjusted odds ratios of 1.18 in the 75th to 90th percentile exposure group and 1.27 in the top 10% exposure group. So we decided to leave our overall conclusions intact.

**MWN:** And then on the same day that your report was released, Canada's Dr. Lois Green announced that she had found the highest EMF–leukemia risks ever reported. For children who were less than six years old, the odds ratio was 5.7. Were you surprised by her results?

**CP:** No. Dr. Green had kindly given me a copy of her results a week before the release of our report. They were interesting, but she used a unique way of looking at the data which does not allow direct comparison with previous studies. The analysis of all the children was not remarkably different from what has been reported in the past for 24-hour field measurements, but was very different from what McBride saw with 48-hour measurements. Basically, besides the one analysis for the under six-year-old group, this study was consistent with the associations we have been seeing. I hope this analysis for young children will be repeated by the authors of the other childhood leukemia studies.

**MWN:** You have said that the association between EMF exposure and childhood and occupational leukemias “cannot be dismissed as random.” What kind of data would it take to convince you otherwise?

**CP:** At the least, it would take a better understanding of the risk factors for these leukemias—especially those which might have misled us into concluding that EMFs can lead to leukemia. In other words, we would need to find specific confounders in the existing studies that could explain away the link to EMFs. But I should add that many people have looked for such missing confounders and have failed. A new study that is similar to existing ones would be unlikely to alter the current view.

**MWN:** On the other hand, which would do more to convince you that there is definitely an EMF cancer risk: stronger epidemiological evidence or confirmation from animal studies?

**CP:** Clearly, confirmation from animal studies would carry the greater weight. These studies would be free of many of the problems that have clouded the epidemiological studies. With an animal model, we could plan in-depth, mechanistic studies on the role ELF EMFs may be playing in the development of disease.

**MWN:** In the cover letter to his report, Dr. Olden makes the point that the human data “are tied to ‘real-world’ exposures.” Is it possible that the reason many of the human and animal studies have been inconsis-

tent is that the electromagnetic environment in the real world is more complex than simple 60 Hz EMFs?

**CP:** This is always a possibility. The debate over whether to use real-world or simpler laboratory exposures has raged for many years on both chemical and physical environmental agents. The very few studies that have used real-world or mixed-field ELF EMF exposures have had similar contradictory results. If I had to choose a reason for the discrepancy, this would not be my choice.

**MWN:** What would be your top pick?

**CP:** There is no single top pick. There are two possibilities. The epidemiology is wrong or, alternatively, the laboratory data are wrong. If I had to choose one reason why the epidemiology data might be wrong, it is that we do not yet understand leukemia very well. As for the animal data, the inconsistencies may be due to genetic variations in strains and/or species. There are of course other possibilities.

**MWN:** As you know, there is a near infinite variety of EMFs in the real world. Could the epi findings be due to particular types of EMFs, such as high frequency transients “contaminating” power line fields in the real world, but to which experimental animals are not exposed?

**CP:** I do not have any data to support such a contention. It is true, however, that there are many examples of confounders misleading the epidemiology. For instance, aflatoxin appears to be a powerful liver carcinogen, but when you take into account the action of hepatitis-B virus, the aflatoxin effect gets much weaker. Also, in animal studies the type of species exposed can determine the result you see. Take arsenic for example: We knew for a long time that it is a human carcinogen, but all the animal studies were negative. Then someone tried a transgenic strain of mice and confirmed that arsenic is also an animal carcinogen. Later, another team saw the cancer effects in a second mouse strain.

**MWN:** Another aspect of high frequency transients is that the amount of EMF delivered varies over time, with some intermittent high levels.

**CP:** This could conceivably be a problem. One of the major flaws with the way we do toxicological testing is that we usually use continuous, lifetime exposures and seldom study peaks or other types of doses.

**MWN:** The report points to two potentially important noncancer EMF health areas: Alzheimer's and heart disease. Which of these (or any others) would you most like to see addressed in future studies?

**CP:** My choice would be Alzheimer's disease. While the theoretical basis for a possible link to heart disease is a bit more solid, a better understanding of Alzheimer's is a priority for the NIH and we could learn a lot by simply adding on to existing studies.

**MWN:** Most of the attention has been on general public exposures to EMFs. Do you think there should be more concern over occupational exposures, which are usually higher?

**CP:** The focus of the NIEHS is on general environmental exposures and our concern is for the general public. While occupational exposures were of interest in our analysis since they can provide dose-response data, this question is better answered by the experts at NIOSH.

**MWN:** The RAPID program is now over and there are no funds set aside for EMF research. The NIEHS states in its report that the institute “will continue to support research in this area” but it is also clear that this field will have to compete with all other environmental agents for a piece of the research pie. Wouldn't it be wise to earmark some money for EMF research so that we do not lose the expertise we have developed over the last six years on an agent to which we are *all* exposed?

**CP:** Most scientists are in favor of more money for research in every field; this one is no different. The NIEHS has no special program for UV radiation, dioxins, arsenic, fine particulates, low-level ozone and many other environmental agents with similar widespread exposure.

## New Canadian Epi Study Points To Risk Among Young Children

Young children's exposures to power frequency EMFs are associated with significantly elevated risks of leukemia in a new study from Canada. The increases are the largest to date for magnetic fields and childhood cancer, using personal measurements. There was no increased risk based on wire codes.

"As exposure assessment is refined, the possible role of magnetic fields in the etiology of childhood leukemia becomes more evident," concludes Dr. Lois Green of the University of Toronto, writing in the June issue of *Cancer Causes and Control* (10, pp. 233-243, 1999). Ontario Hydro funded the study.

Led by Green, a team at the university and at the Hospital for Sick Children in Toronto had 88 children with cancer and 133 controls wear Positron meters for two days to monitor their EMF exposures. The leukemia risk of children in the highest exposure group was 4.5 times higher, after adjusting for possible confounders, than that of children in the least-exposed group—a statistically significant difference.

One of the study's most striking findings was the difference in risk between younger and older children. For children less than six years old at the time of diagnosis and with average exposures over 1.4 mG, the risk was 5.7 times higher than for those with exposures of less than 0.3 mG, a statistically significant difference. The corresponding risk ratio among older children was a nonsignificant 1.6.

Green and coworkers suggest that the greater risk in younger children may reflect a greater susceptibility to EMFs. But they also note that younger children in the study had spent more of their lives in one residence than had older children. As a result, they write, measurements for younger children may be "a better representation of the exposure received during the relevant etiologic time period."

For 201 children with cancer and 406 controls, the team estimated current and past residential EMF levels with spot measurements. In a second paper, which appears in the *International Journal of Cancer* (82, pp.161-170, 1999), they report finding a nonsignificant, 50% risk increase for the most-exposed of these children, compared to the least-exposed.

The team found no increase in risk associated with proximity to high-current wiring as identified by each of three methods: the Wertheimer-Leeper codes, the Savitz-Kaune codes and a modified version of the Wertheimer-Leeper scheme. "We know from our study that wire code is not a good estimator of exposure," Green told *Microwave News*.

The new study follows the release, last spring, of a similar study of EMFs and childhood cancer in other parts of Canada, which found little or no evidence of increased risk (see *MWN*, M/J99). In an interview, Mary McBride of the British Columbia Cancer Agency in Vancouver, the study's leader, said she was "a little surprised" by the new findings.

As a possible explanation for the two studies' divergent results, McBride noted that her group identified cases as they were diagnosed, while the Toronto team drew on cases reported to the children's cancer registry of the Hospital for Sick Children from

## Long Delayed, NCRP ELF Report Due at the End of the Year

The National Council on Radiation Protection and Measurements (NCRP) will release a draft of its long-awaited report on the potential health effects of extremely low frequency (ELF) EMFs by the end of the year, according to Dr. Charles Meinhold, the president of the council. The report was submitted for review to the council in June 1995 and the NCRP has had little to say about its status since then.

"We are making rapid progress in resolving the review process," Meinhold said in a talk at the annual meeting of the Bioelectromagnetics Society in Long Beach, CA, on June 22. He explained that the sticking point was "how to handle the recommendations in the report."

The committee that wrote the report endorsed a 2 mG exposure limit, which would take immediate effect for new day care centers, schools and playgrounds, as well as new transmission lines near existing housing (see *MWN*, J/A95). For existing electrical facilities, the committee recommended that restrictions be phased in over time.

The NCRP never released the committee's draft, which was completed in 1995. A copy was obtained by *Microwave News*, which published its conclusions (see *MWN*, J/A95). The committee's recommendations were widely reported by the popular media.

This July, the committee was still working on its revised draft. "We agreed that we would not discuss recommendations until the report is completed," the chair of the committee, Dr. Ross Adey told *Microwave News*. Adey, who is now at the University of California, Riverside, said that his committee would consider the most recent published papers in its latest revision.

Dr. Thomas Tenforde of the Battelle Pacific Northwest Labs in Richland, WA, who is an NCRP scientific vice president on non-ionizing radiation, explained in an interview that an initial review of the draft by 25 experts was completed in 1995. Adey noted that the panel had incorporated the suggestions from these reviewers in subsequent drafts.

The Environmental Protection Agency first requested the ELF report from the council 16 years ago (see *MWN*, N/D83).

1985 through 1993, and was prospective only for the last two years of this period. As a result, the average time between diagnosis and exposure assessment was nearly two years shorter for the 399 children with cancer and 399 controls in the McBride study.

Green and coworkers assigned the cases and controls to four exposure groups, drawing the cutpoints between exposure levels so that the controls were divided into quartiles. The lowest exposure group comprised children with personal readings of less than 0.3 mG, and the highest had exposures of 1.4 mG and above.

Green maintains that the cutpoints used in previous studies result in smaller high exposure groups, which are more prone to error: "The potential for exposure misclassification is greatest at the highest levels," she noted.

# FROM THE FIELD

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## U.S. Government Group Identifies 14 Issues To Be Addressed in Revision of ANSI/IEEE RF/MW Exposure Standard

On June 17, 1999, Dr. Gregory Lotz of the National Institute for Occupational Safety and Health (NIOSH) wrote to Richard Tell, the chair of the Institute of Electrical and Electronics Engineers' (IEEE) SCC-28 Subcommittee 4 Risk Assessment Work Group, to identify "certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines." Lotz, the chief of the Physical Agents Effects Branch at NIOSH in Cincinnati, was writing on behalf of the federal government's Radiofrequency Interagency Work Group (RFAIWG).

SCC-28 is developing a complete revision of the C95.1 exposure standard, which was approved by the IEEE in 1991 and by the American National Standards Institute (ANSI) in 1992 (see MWN, N/D91 and N/D92). The guidelines were updated earlier this year (see MWN, M/J99). Tell's working group has been asked to "assess and characterize the potential risks to human health and safety" from exposure to EMFs of less than 300 GHz. Tell is a consultant based in Las Vegas.

In addition to Lotz, the other members of the RFAIWG are: Dr. Robert Cleveland, Federal Communications Commission, Washington; Robert Curtis, Occupational Safety and Health Administration, Salt Lake City; Dr. Joseph Elder, Environmental Protection Agency (EPA), Research Triangle Park, NC; Janet Healer, National Telecommunication and Information Administration, Washington; Norbert Hankin, EPA, Washington; Dr. Russell Owen, Food and Drug Administration, Rockville, MD. Lotz noted that, "No particular priority is ascribed to the order in which the issues are listed" and that, "The views expressed...are those of the members of the RFAIWG and do not represent the official policy or position of the respective agencies."

Reprinted below are extended excerpts of the RFAIWG's RF Guidelines Statement.

### Biological Basis for Local SAR Limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR; that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle)...

### Selection of an Adverse Effect Level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale?...

### Acute and Chronic Exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions. The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic. There is an extensive data base on acute effects....For lower level ("nonthermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms)....If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed....[A] clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure.

### One-Tier vs. Two-Tier Guidelines

A one-tier guideline must incorporate all exposure conditions and subject possibilities (e.g., acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two-tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e.g., healthy workers) and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.)....

### Controlled vs. Uncontrolled (Applicability of 2 IEEE Exposure Tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition. The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e.g., workers), along the lines of the existing ANSI laser safety standards.... [I]f it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multitiered standard, applicable only to those specific populations, may be considered....

### Uncertainty Factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but noncancer) effects include: 1) extrapolation of acute effects data to chronic exposure conditions; 2) uncertainty in extrapolating animal data to humans in prolonged exposure situations; 3) variation in the susceptibility (response/sensitivity) among individuals; 4) incomplete data bases; 5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes. If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used; how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects? There is a need to provide a clear rationale for the use of uncertainty factors.

### Pulsed (Intensity) or Frequency-Modulated RF Radiation

Studies continue to be published describing biological responses to non-thermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR; time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect. Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines?...

### Time Averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach

## FROM THE FIELD

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historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure....If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

### Lack of Peak (or Ceiling) Limits for Induced and Contact Current

A recent change in the IEEE guidelines allows for 6-minute, rather than 1-second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents....

### Criteria for Preventing Hazards Caused by Transient Discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge)?

### Limits for Exposure at Microwave Frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current guideline references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical ra-

diation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for continuous exposure of 10 mW/cm<sup>2</sup> at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical....

### Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived. The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that are scientifically valid but are not an exact replication/validation of specific experimental procedures and results. Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information....

### Important Health Effects Literature Areas

Documentation should be provided that the literature review process included a comprehensive review of the following three areas: 1) long-term, low-level exposure studies...; 2) neurological/behavioral effects...; 3) micronucleus assay studies (because of their relevance to carcinogenesis).

### Compatibility of RFR Guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines....

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## Hot New Papers

Jolanta Kliukiene, Tore Tynes, Jan Martinsen, Karl Blaasaas and Aage Andersen, "Incidence of Breast Cancer in a Norwegian Cohort of Women with Potential Workplace Exposure to 50 Hz Magnetic Fields," *American Journal of Industrial Medicine*, 36, pp.147-154, July 1999.

"The main finding in our study is the increased risk shown for breast cancer among women potentially exposed to EMFs at the workplace, and also after adjustment for age at first birth....The present large population-based study, which does not contain selection or information bias, gives some support to the hypothesis that exposure to 50 Hz magnetic fields may increase the risk of breast cancer. However, since we had no direct information on exposures, the results should be interpreted with caution."

Torbjörn Åkerstedt, Bengt Arnetz, Gianluca Ficca, Lars-Erik Paulsson and Anders Kallner, "A 50 Hz Magnetic Field Impairs Sleep," *Journal of Sleep Research*, 8, pp.77-81, March 1999.

"Clearly, sleep was affected by the low frequency [1 µT (10 mG)] EMF. The reductions of [total sleep time] and sleep efficiency suggest a slight disturbance....Considering that the present experiment is the first of its kind and that the issue of EMF effects is sensitive, one needs to carefully consider possible confounders....We feel confident in concluding that the effects must have been caused by the EMF influences on the sleep process. It should be emphasized that, even if significant effects were observed, the absolute levels are still within the range of normal sleep values, and far from clinical significance. Conversely, the present study used healthy subjects, only one night of exposure and rather moderate intensity. However, patient groups might be more sensitive and it is conceivable that increased intensity of the field or of duration of exposure might yield larger effects. This remains to be demonstrated."

Charles Graham and Mary Cook, "Human Sleep in 60 Hz Magnetic Fields," *Bioelectromagnetics*, 20, pp.277-283, 1999.

"Human volunteers exposed during night sleep to an intermittent, circularly polarized magnetic field (60 Hz, 28.3 µT [283 mG]) exhibited statistically significant alterations in traditional EEG sleep parameters (less total sleep time, reduced sleep efficiency, increased time in Stage II sleep and decreased REM sleep). Volunteers in the intermittent exposure group also reported sleeping less well and feeling less rested in the morning. These effects were not found in the group continuously exposed to the same magnetic field or in the sham exposure control group....Little is known about possible biological mechanisms that could provide the necessary link between exposure to ELF fields and sleep regulatory systems in the brain. A biophysically plausible hypothesis is that the electric field induced in the brain by the 60 Hz magnetic field is able to modulate the activity of cortical neurons....In other words, exposure to a 60 Hz magnetic field at the flux density used in the present study could induce a unique electric field 'signal' in the brain, one not easily confused with the endogenous fields....A second possible mechanism can be derived from the 'melatonin hypothesis' developed by [Dr. Richard] Stevens." (See also *MWN*, N/D97.)

Paul Héroux, "The ELF Health Effects Olympics" (invited editorial), *Annals of Occupational Hygiene*, 43, pp.217-219, 1999.

"I was working in a power utility research facility in 1972 when our managers returned from the CIGRÉ [International Conference on Large High Voltage Electric Systems] in London, where the Soviets had first reported neurological disturbances in workers exposed to high-intensity electric fields. Statements were made that these reports were an attempt by the Soviets to slow the development of Western technol-

## EMF Bioassays: No Effects

Gary Boorman, David McCormick et al., "Chronic Toxicity/Oncogenicity Evaluation of 60 Hz (Power Frequency) Magnetic Fields in F344/N Rats," *Toxicologic Pathology*, 27, pp.267-278, May-June 1999.

"Long-term animal studies are expensive, time-consuming and may be relatively insensitive as a mechanism to identify weak carcinogens. However, when considered together, long-term exposure of rodents to power frequency magnetic fields that are 5,000- to 10,000-fold (the present study), 10,000- to 20,000-fold [Mandeville et al., 1997] and 50,000- to 100,000-fold [Yasui et al., 1997] higher than field levels that are routinely encountered in residential environments has demonstrated no pattern of increased cancer risk. These data, when considered as a whole, provide little or no evidence that exposure to pure 60 Hz linear magnetic fields at up to 10 G field intensities for up to 2 yr can affect neoplastic development in the F344/N rat."

David McCormick, Gary Boorman et al., "Chronic Toxicity/Oncogenicity Evaluation of 60 Hz (Power Frequency) Magnetic Fields in B6C3F<sub>1</sub> Mice," *Toxicologic Pathology*, 27, pp.279-285, May-June 1999.

"The results of this study provide no evidence of increased cancer incidence in male and female B6C3F<sub>1</sub> mice exposed (for 2 yr) continuously to pure, linearly polarized 60 Hz magnetic field strengths of 20 mG, 2 G or 10 G, or intermittently to the same 10 G fields. The mouse results are similar to the results of our parallel study in rats [see above], to the results of a Canadian study in which female rats were exposed to 60 Hz magnetic fields at up to 20 G [Mandeville et al., 1997] and to results of a Japanese study in which rats were exposed to 50 Hz magnetic field intensities of up to 50 G [Yasui et al., 1997]. When considered together, these long-term animal studies provide no evidence to support the hypothesis that magnetic field exposure is a significant risk factor for human cancer."

For more on the Mandeville and Yasui studies, see MWN, J/F98. For more on the two two-year bioassays, see MWN, M/A98.

ogy!...When the Soviet reports appeared, electrical engineers rapidly polarized into two groups: skeptics and believers....It was amazing how early the lines were drawn and how unyielding both sides remained."

Martha Linet et al., "Cancer Surveillance Series: Recent Trends in Childhood Cancer Incidence and Mortality in the United States," *Journal of the National Cancer Institute*, 91, pp.1,051-1,058, June 16, 1999.

"In summary, there were no consistent large increases or decreases in incidence for the major categories of cancer among children aged 0-14 years during 1975 through 1995, based on data from the nine long-standing registries in the SEER [Surveillance, Epidemiology and End Results] program. The modest increases for childhood CNS cancers, leukemias and infant neuroblastomas were confined to short intervals in the mid-1980s. This pattern suggests that the increase likely reflected reporting or diagnostic changes rather than effects of environmental influences. The short-term jump in CNS tumors in the geographic areas covered by the SEER program registries has been ascribed to preceding developments in diagnostic technology, new neurosurgical procedures and classification changes. However, it is not apparent what specific diagnostic, reporting or classification changes account for the abrupt jump from 1983 to 1984 in leukemia rates or the increase during the mid-1980s for adrenal neuroblastomas."

Werner Irnich and Rolf Tobisch, "Mobile Phones in Hospitals," *Biomedical Instrumentation and Technology*, pp.28-34, January-February 1999.

"Four devices (two apnea monitors, two respirators) of 224 investigated devices proved to experience interference caused by mobile phones at distances of more than 1 m....Although the walkie-talkie proved to cause the most interference at distances more than 10 m, dangerous situations are normally rare because its use is restricted to short times.... Walkie-talkies in hospitals and in emergency situations should be handled with care, because they are more powerful than hand-held phones. A safety distance from life-saving or life-supporting devices of 1.5 m is sufficient." (See also Irnich and Tobisch's book, *Mobilfunk im Krankenhaus: Einfluß von Mobiltelefonen auf Lebensrettende und Lebenserhaltende Medizintechnik* (Mobile Communications in the Hospital: Influence of Mobile Phones on Life-Saving and Life-Support Medical Technology) Berlin: Schiele und Schön, 1999. Drs. Irnich and Tobisch are with the Institute for Medical Technology at the University of Gießen in Germany.)

## "MICROWAVE NEWS" FLASHBACK

### Years 15 Ago

- Researchers at the University of Washington report on a five-year study led by Dr. Bill Guy, in which rats exposed to pulsed 2450 MHz radiation at a maximum specific absorption rate (SAR) of 0.4 W/Kg had significantly more malignant tumors than did controls—primarily in their endocrine systems. An independent assessment of the study for the U.S. Air Force calls the findings "provocative."
- For a "very substantial" sum, Stanley Burgis, a former U.S. Army radar technician, settles his suit against Western Electric, which alleged that radiation from its M-33 military radar ruined his vision.

### Years 10 Ago

- A report by the congressional Office of Technology Assessment (OTA) concludes that there are "legitimate reasons for concern" about EMF exposures as a possible health hazard, and proposes that risks could be addressed with a policy of "prudent avoidance."

- In response to the OTA's report, an editorial in *Science* by Philip Abelson, the magazine's deputy editor, calls for increased support of research on health effects of EMFs.
- The Soviet Union says that high frequency radio waves beamed at its embassy in London may have caused the deaths of two Soviet citizens. The U.K. government denies the charge.

### Years 5 Ago

- Implanted cardiac pacemakers are vulnerable to electromagnetic interference from mobile phones, researchers in Switzerland and in Italy report at a conference in Copenhagen.
- The EMF exposure standard adopted in 1990 by IRPA (now ICNIRP) is "unethical," says Dr. Indira Nair of Carnegie Mellon University, because it is "the truth, but not the whole truth."
- Dr. Eugene Sobel of the University of Southern California links "medium" and "high" workplace EMF exposures to an increased risk of Alzheimer's disease.

## Across the Spectrum

At Motorola's strategic-issues department, director Norm Sandler requests that we all please *relax*. "At the power levels and frequencies of existing cellular phones, there is no established evidence of any biological effects, much less any health effects." [Dr. Ross] Adey [of the University of California, Riverside]: "That is simply not true. Over and over, cell phone fields have produced effects. Industry is lying and lying and lying."

—David Kirkpatrick, "Static? Or Frying Brain Cells?" *Fortune*, p.40, July 5, 1999

#9: Cell phones may be hazardous to your health.

—Michael Kaplan, "Ten Things Your Cell Phone Company Won't Tell You," *Smart Money*, p.138, July 1999

The telecommunications industry poured money into research. Results have been all over the map. Some studies have hinted there might be unhealthful effects. Others are inconclusive. Still others have found no effects....But this is all too familiar. The Beef Industry Council funds research into red meat. "Igor, look! Our experiments! They show T-bone steaks LOWER cholesterol AND make you a hunk, a hunk of burning love! The Nobel is ours!"

—Kevin Maney, "Cell Phones and Cancer: Denial Isn't Just a River in Egypt," *USA Today*, p.3B, July 14, 1999

TEENAGERS AND CELL PHONES: A MATCH MADE IN GAB HEAVEN

—Headline, *New York Times*, p.A1, August 2, 1999

During the past year, several new issues have been raised in the scientific community regarding the link between EMF and health effects. Two results in particular merit closer examination: an epidemiologic study that suggests electrical workers exposed to magnetic fields might have increased risk of acute heart disease and laboratory studies of breast cancer cells that show antagonism to the potential beneficial effects of Tamoxifen and melatonin with exposure to EMF....Plainly, these findings need to be replicated and fully understood. A strongly focused, high-quality research program, similar to EPRI's earlier EMF efforts, should be mounted to address these issues.

—Stephen Peck, vice president, environment division, EPRI, in a letter "To Our Readers" inserted in *EPRI Environment Newsletter*, May 1999

"There is no way to actually protect your children from exposure."

—Dr. Mark Greenberg, Hospital for Sick Children, Toronto, Canada, quoted by Carolyn Abraham in "Scientists Link Magnetic Fields to Leukemia," *Globe and Mail* (Canada), p.A3, June 16, 1999 (see p.12)

"As long as you don't touch the wire, it's okay."

—Ken Hall, Edison Electric Institute, quoted by Bob Pool in "Neighbors Object to Development Below Power Lines," *Los Angeles Times*, p.B5, July 29, 1999

"Get plenty of sleep, use thick blinds to block out stray light and if you need to get up in the middle of the night for any reason, don't turn on a bright light."

—Dr. Russel Reiter, University of Texas Health Science Center, San Antonio, quoted by Kathleen McAuliffe in "Researchers Shine a Night Light on a Possible Link to Cancer," *New York Times*, Special Section on Women's Health, p.22, June 13, 1999

Iridium is looking more like Icarus with each passing day.

—Christian Hill and David Hamilton, "After Lofty Hopes, Iridium Is Falling to Earth," *Wall Street Journal*, p.B1, July 15, 1999

### Nancy Wertheimer: You Must Remember This

In studying environmental magnetic field exposures, the exposure assessment problems are formidable. Too often we forget this, and proceed to think of whatever metric a study chooses as if that metric were indeed an accurate reflection of the true historic exposure of interest. That confusion of intent with fact has led some to conclude that risks from magnetic field exposure, "if real, are very small." But this should be understood as a leap of faith.

We need to remember:

- First, that we don't know exactly what to measure;
- Second, that even at best our exposure assessment probably includes considerable random misassignment of exposure, which will null our estimates of any true risk that exists;
- Third, that our hypothetically "unexposed" referent group is, in fact, *always* exposed to a number of unexamined sources of magnetic field, thus further nulling evidence of real risks; and
- Fourth, that magnetic fields may well act only in conjunction with specific cofactors, as some laboratory work has suggested. If so, then only the part of the study population having those cofactors will be at risk from magnetic fields at any given time—still further nulling evidence of any real risk.

Thus in interpreting epidemiologic studies we must stay aware that, while associations based on systematic bias are always possible, and must be guarded against, bias toward a null result is *always* likely in *all* studies. So if the modestly elevated risk ratios that have been repeatedly reported can't be attributed to systematic bias—and so far they haven't been—they are very likely to be *underestimates* of a substantial risk.

—Dr. Nancy Wertheimer, Boulder, CO, in an address on receiving the Bioelectromagnetic Society's d'Arsonval award for "extraordinary accomplishments" at the society's 21st annual meeting, in Long Beach, CA, June 21, 1999 (the full text of her talk will be published in a future issue of *Bioelectromagnetics*, the society's bimonthly journal)

59%: Proportion of Americans who say they would rather visit a dentist than sit next to anyone using a cell phone.

—"Numbers," *Time*, p.19, August 9, 1999

The *New Yorker* can now be counted on to champion the infallibility of U.S. products such as electromagnetic radiation, breast implants and psychoactive drugs.

—Cynthia Cotts, "Press Clips: Spin the Coke Bottle," *Village Voice* (NY), p.40, July 20, 1999

"Don't lean, don't linger, don't worry."

—Dr. Douglas Zipes, Indiana University School of Medicine, Indianapolis, on EMI to implanted defibrillators, quoted by Merritt McKinney, Medical Tribune News Service, in "Anti-Theft Devices No Shock to Heart," posted on *MSNBC* (<[www.msnbc.com/news](http://www.msnbc.com/news)>), July 26, 1999 (see *MWN*, N/D98)



## MICROWAVE WEAPONS

**Ready, But Still Under Wraps...**In the near future, the U.S. will be ready to use high-power microwave (HPM) weapons in the field, military officials say. "There's real stuff happening, both in high-energy lasers and in microwave systems," Earl Good of the U.S. Air Force told *Aviation Week* (July 5). "We're delivering products, and there are lots of demonstrations. It's not just 'viewgraph' technology." Good is the head of the Air Force Research Laboratory's Directed Energy Directorate, which has a yearly budget of about \$100 million and is based at Phillips Laboratory in New Mexico. U.S. forces were rumored to have used an electromagnetic pulse (EMP) bomb, one type of HPM weapon, in the NATO air campaign against Serbia earlier this year, according to *Jane's Defence Weekly* (April 7). But Pentagon officials told *Aviation Week* (June 7) that although the U.S. had an EMP weapon ready, it probably would not use it in the Balkan conflict because the military did not want to reveal its capabilities. When detonated, an EMP device emits an intense pulse of electromagnetic energy that can disable sensitive electronics such as computers and communications equipment. Although the weapon is designed to simulate the EMP generated by an atomic bomb, the military claims that this and other HPM devices will not cause the extensive physical damage and loss of life associated with traditional weapons. HPMs are "what this country is looking for to fill the gaps between diplomacy and blowing things up," Good said. (See also *MWN*, J/F97 and M/A98.)

## PEOPLE

Dr. **Mats-Olof Mattsson** of Sweden's Örebro University is the new president-elect of the Bioelectromagnetics Society (BEMS). He takes over as president next June. Two other Swedes have also been named to the BEMS board: Dr. **Maria Feychting** of the Karolinska Institute in Stockholm and **Monica Sandström** of the National Institute for Working Life in Umeå....Dr. **William Wisecup** of W/L Associates in Frederick, MD, the executive director of BEMS and organizer of the DOE annual reviews, has announced that he will retire at the end of 2000. He plans to spend more time on photography and will continue to show Border collies and corgis....Dr. **Paul Gailey** is leaving Oak Ridge National Lab to join the physics department at Ohio University in Athens, where he will start a new interdisciplinary program in biology, mathematics and physics....Dr. **Richard Stevens**, long of Battelle Pacific Northwest Labs in Richland, WA, is now on the faculty at the University of Connecticut Health Center in Farmington, where he is teaching and doing cancer research....Dr. **Charles Rafferty** has left EPRI. He is consulting out of Menlo Park, CA....NIEHS' Dr. **Michael Galvin**, who was a member of the RAPID team, has joined NIOSH in Atlanta....Formerly a member of Dr. **Ross Adey's** lab in Loma Linda, CA, Dr. **Christopher Cain** has helped start Phytoanalytics in nearby Riverside. The company offers quality-control testing of vitamins and herbal supplements as well as assays of pesticide residues....**Katja Pokovic** of Dr. **Niels Kuster's** lab at the ETH in Zurich, Switzerland, won the best student paper award at the BEMS meeting in June. This is two in a row for Kuster: last year (now Dr.) **Michael Burkhardt** of his lab won the prize.

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## More 1999 Conferences & Courses

August 11: **Avian Mortality at Communications Towers (in conjunction with the 117th Meeting of the American Ornithologists' Union)**, Statler Hotel, Ithaca, NY. Contact: Dr. Albert Manville, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Dr., Arlington, VA 22301, E-mail: <Albert\_Manville@fws.gov>, Web: <www.fws.gov/r9mbmo/homepg.html>.

September 13-16: **Directed Energy Weapons** (short course), Alexandria, VA. Contact: Association of Old Crows, 1000 N. Payne St., Alexandria, VA 22314, (703) 549-1600, Fax: (703) 549-2589, Web: <www.aochq.org>. (Optional final day is classified.)

September 20-22: **Safety Issues and Requirements for PCS and Wireless Communications Devices** (short course), George Washington University, Washington. Contact: P.J. Mondin, (202) 496-8449, E-mail: <pj@ceep.vpaa.gwu.edu>.

September 28-30: **Power Distribution System Grounding and Transients** (short course), Georgia Institute of Technology, Atlanta. Contact: Georgia Institute of Technology, Continuing Education, PO Box 93686, Atlanta, GA 30377, (404) 894-2400, Fax: (404) 894-8925, E-mail: <register@conted.swann.gatech.edu>, Web: <www.conted.gatech.edu>.

November 15-16: **Potential Therapeutic Applications of Magnetic Fields**, Vanderbilt University Medical Center, Nashville, TN. Contact: PTAMF 99, Symposium Secretariat, PO Box 5940, Buena Park, CA 90622, (714) 562-7530, Fax: (714) 736-7605, E-mail: <PTAMF99@mindspring.com>.

November 19-21: **4th European Bioelectromagnetics Association Congress**, University of Zagreb, Croatia. Contact: Congress Secretariat, (385+1) 6129 606, Fax: (385+1) 6129 717, E-mail: <4thebea@fer.hr>, Web: <www.ebea.org/EBEA/generalinfo.htm>.

December 5-8: **Society for Risk Analysis (SRA) Annual Meeting**, Marriott Marquis Hotel, Atlanta. Contact: SRA, 1313 Dolley Madison Blvd., McLean, VA 22101, (703) 790-1745, Fax: (703) 790-2672, E-mail: <SRA@BurkInc.com>, Web: <www.sra.org>.

## Keeping Current: Follow-Up on the News

◆ Sony announced in July that it is leaving the North American wireless handset market. Last December, Sony recalled 60,000 of its phones that violated radiation standards (see *MWN*, J/F99).

◆ A paper on personal EMF measurements taken in the Mary McBride childhood leukemia study has been delayed and is now slated to appear in the August issue of the *Scandinavian Journal of Work, Environment & Health*. The corrected McBride table we ran in our last issue has been published in the July 15 *American Journal of Epidemiology* (see p.12 and *MWN*, M/J99).

◆ TVB Pearl, a Hong Kong TV station, decided not to air a Canadian documentary on potential cell phone health risks (see *MWN*, J/F99). The *South China Morning Post* (July 7) pointed to a surge in mobile phone advertising. “We are worried the viewers will be misled because the information in the program hasn’t been confirmed as accurate,” a TVB spokeswoman said.

◆ Rep. George Brown (D-CA) died on July 16 at age 79. As chair of the House science committee, Brown was instrumental in allocating federal funds for research on EMF health effects, including the RAPID program (see *MWN*, J/F92). *Nature* (July 22) called Brown “science’s best friend in Congress.”

◆ Dr. Lennart Hardell and coworkers’ paper on mobile phone

use and brain cancer is now in print: *International Journal of Radiation Oncology*, 15, pp.113-116, July 1999 (see *MWN*, M/J99).

◆ The town of Brooklyn, OH, is the first in the U.S. to outlaw using a mobile phone while driving. In 1966, Brooklyn, with a current population of 11,000, was the first in the nation to require the use of seat belts (see also *MWN*, J/F98).

◆ Crossing the Rubicon into the Internet Age: In a June 10 advisory, the CTIA noted that, in an earlier statement, “due to an editorial error, Rubicon was misspelled as Rubicom.”

◆ Construction of a digital TV broadcast tower at the antenna farm on Lookout Mountain, outside Denver, was blocked on July 13 by a 3-0 vote of the Jefferson County, CO, commissioners, after months of protest by local residents concerned about RF cancer risks (see *MWN*, J/A98 and M/A99).

◆ New Zealand’s health and environment ministers have asked for public comment on a discussion document on RF/MW health effects, *Towards National Guidelines for Managing the Effects of RF Transmitters*. The deadline for submitting comments is September 30. For more information, contact Sally Gilbert at the Ministry of Health in Wellington, (64+4) 496-2000, Fax: (64+4) 496-2340.

## Something Is Terribly Wrong

In June 1999, these three events happen in just three days:

- The NIEHS issues its report to Congress, which concludes that the evidence that EMFs pose a cancer risk cannot be dismissed. Though this evidence is weak, the NIEHS says, it is reason enough for prudent avoidance (see p.1).
- EMFs are linked to as much as a sixfold increase in the risk of leukemia among young children, in a new study released by the University of Toronto (see p.12).
- Dr. Robert Liburdy agrees to withdraw three graphs in seven-year-old papers on EMF effects on cellular calcium (see p.1).

Which of these stories makes page-one headlines across the country? The Liburdy affair. And what is the lesson that the *New York Times* draws from the Liburdy business? That “electric power is safe.”

Liburdy’s calcium experiments were not cancer studies and had only the most speculative relationship to cancer biology. When they were published in 1992, anyone who had said, “This shows that EMFs cause cancer” would have been laughed out of the room. It would have been a ridiculous thing to say, and no one ever did.

Yet now these three Liburdy graphs seem to become more powerful each time they are mentioned in the media. The Associated Press (July 23) claimed that Liburdy’s calcium work “was thought to be the first plausible biological explanation” of an EMF–cancer connection. Not one cancer researcher, biologist or biophysicist was quoted in support of this assertion, perhaps because it is not true.

The AP conceded that concerns about EMFs “had been raised well before Liburdy’s study,” but the *New York Times* (July 24) wasted no space on such qualifications. In the *Times*’ hands, Liburdy’s graphs became “crucial evidence of a tie between electric power lines and cancer”—which had been “faked.” Soon the *Cleveland Plain Dealer* (July 30) was writing that Liburdy “managed to scare the bejabbers out of a lot of people by spinning a yarn about electrical transmission lines causing cancer,” and applauded government fraud-busters for exposing this “hoax.”

The power of the Liburdy graphs continued to grow. It was in fact “Liburdy’s deception” which “sparked a campaign of ‘prudent avoidance’,” according to Dr. Elizabeth Whelan of the pro-industry American Council on Science and Health, writing in the *Wall Street Journal* (July 27). “We now know” that the EMF issue “is a phony health risk,” added Whelan. Ken Hall of the Edison Electric Institute seems to agree: “As long as you don’t touch the wire, it’s okay,” Hall told the *Los Angeles Times* (July 29), in a story about commercial development directly beneath high-voltage power lines. The paper estimated that EMFs in the proposed development would average about 60 mG.

What’s ironic is that of the three June events, only two have much to do with EMFs and cancer: the NIEHS report and the Canadian study. Yet those were precisely the two that the media ignored.

There is a serious double standard at work here. The stories on the Liburdy affair are full of false statements—which are repeated so often, without rebuttal, that they are already accepted

### **Memo to Motorola: The Burden of Leadership**

The take-home lesson of the recent WTR and BEMS meetings is that Motorola is taking control of worldwide wireless research (see p.5).

On the one hand, we want to give the company credit for developing and funding its own research plan, when it could have simply left it to WTR. Motorola money has produced scientific results.

But we must also note that Motorola can be slow to make information public and does not always tolerate the type of open exchange that normally settles scientific controversies, which are endemic in the wireless world. (Lawyers and non-disclosure agreements, for example, don’t mix well with public health.)

Motorola’s support of research is of course not totally altruistic. The company has bet its future on wireless technology, and funding safety research is insurance against suffering the fate of the asbestos industry. And it also buys Motorola’s PR team a first look at the latest findings.

To those who complain about Motorola’s dominant role, the company answers, “If we don’t do this work, no one else will.” Unfortunately, at this point that is often true. Public health agencies have largely dropped the ball on wireless safety.

But leadership has its responsibilities. To have credibility, the company must be more open—even with its critics.

as fact. Where are the moderating voices of public health, of epidemiologists, of consumer advocates?

We don’t believe in conspiracies. But at times the influence of corporate power in both science and the media is so overwhelming that it starts to resemble one. Industries worth hundreds of billions of dollars defend their interests, and they do so in many ways.

Recently, a leading epidemiologist at a world-famous medical institution wrote to us on the Liburdy media blitz. He said, “One reason I left this field was that I saw it was virtually impossible to get decent science funded or done without interference in the face of such massive commercial interest.” But we can’t tell you who he is. His next sentence was, “Don’t quote me.”

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