from a waterbed heater" caused her serious harm. In a suit filed on October 1, 1990, Kristen, James and Phyllis Pope charge that Kristen "suffered from and continues to suffer serious health problems," including joint and muscle soreness, discoloration of the legs, circulation problems and headaches. For an extended period, she could not walk without assistance. The Popes' attorney, David Smith of Kinnard & Smith in Nashville, said in a telephone interview that Kristen showed "dramatic improvement" after she stopped using the waterbed. Electrical engineers hired by the Popes measured 95-120 V on the waterbed, which they concluded was caused by the inverted insertion of the power plug into a wall socket, resulting in "improper polarization." The suit charges that the waterbed heater's manufacturer, Hakuto Co. Ltd. of Japan, and its subsidiary, Shigma, Inc., of Elk Grove Village, IL, should have provided polarized plugs or should have provided a written warning explaining proper insertion of the plug. The Popes are asking $1.25 million in damages. The trial is scheduled to begin in November.

MEETINGS

EBEA's First Congress... The European Bioelectromagnetics Association (EBEA) will hold its first congress January 23-25, 1992, in Brussels, Belgium. Abstracts are due by October 31, 1991. In addition to platform and poster presentations, roundtable discussions on specific topics are planned. Contact: Dr. M. Hinsenkamp, Hôpital Erasme, Service d'Orthopédie–Traumatologie, Route de Lennik, 808, B 1070 Brussels, Belgium, (32+2) 526-3640.

MM Waves in Moscow... An *International Scientific Meeting on Millimeter Waves of Non-Thermal Intensity in Medicine* will be held September 24-27 in Moscow, U.S.S.R. According to the announcement, Soviet researchers will present the results of 20 years of experience in theoretical and experimental research on non-thermal effects of high frequency radiation "on living systems of different level[s] of complexity." For more information, contact the meeting's organizing committee at: Marx Avenue 18, GSP-3, Moscow 103907, U.S.S.R. (7+095) 2033266.

Guy Festchrift... After 35 years at the University of Washington, Seattle, Dr. Bill Guy has retired, and a one-day symposium, sponsored by the USAF, will be held in his honor at the university on October 26. Guy is best known for his work on RF dosimetry, bioeffects and standards. Contact: Dorothy Pratt, Bioelectromagnetics Research Lab, RJ-30, University of Washington, Seattle, WA 98195, (206) 543-1071.

PEOPLE

Dr. **Om Gandhi** of the University of Utah, Salt Lake City, will be the new president of the Bioelectromagnetics Society. He will take over from FDA's Dr. **Mays Swicord** next year....Dr. **Allan Frey** has replaced Dr. **Andrew Marino** as president of the International Society of Bioelectricity. Marino also recently resigned as the editor of the society's journal (see *MWN*, M/J91). Frey reports that the society may change its name....**Greg Rauch** is leaving EPRI's electrical systems division to join **Bill Feero** at Electric Research and Management. Rauch will open a west coast office for the firm in Santa Cruz, CA....Drs. **Maria** and **Stan Stuchly** are moving to the University of Victoria's department of electrical and computer engineering in British Columbia, Canada. Stan has left the University of Ottawa and has taken up residence in Victoria as the department head. Maria will stay at Health and Welfare Canada until the end of the year before joining him....There has been a split at Environmental Research Information (ERI), the New York City consulting firm that has worked on EMFs for a number of utilities. **William Bailey** has set up Bailey Research Associates with former ERI staffers Drs. **Antonio Sastre, Deborah Weil** and **Linda Erdreich**; they will concentrate on EMF issues. Dr. **Jonathan Charry** said that ERI will continue to work on risk communication for corporate clients, but not on EMFs....Dr. **Russell Carpenter**, 89, who studied the effects of microwaves on the eye, died on July 28 in Williamstown, MA.

RADAR

Radar & Road Safety...A radar complex on the Yorkshire moors in the U.K. could cause traffic accidents on a nearby highway, according to a report by Tim Williams of ELMAC Services, a consulting firm. Williams measured electric fields of up to 30 V/m on a highway at Fylingdales in northern England, close to a Royal Air Force ballistic missile early warning system radar, which operates at a frequency of approximately 400 MHz. Williams notes that the peak fields, which are difficult to measure, may be two or three times higher than the average levels. These peak fields could interfere with electronically controlled vehicular safety systems, such as anti-lock brakes, which are designed to be immune to fields of up to 50 V/m. Measurements taken on footpaths near the complex also recorded fields of 30 V/m, which, though well below NRPB and IRPA safety standards, may expose hikers to "potentially hazardous levels" of RF radiation. The report, issued on June 17, was commissioned by Nuclear Free Local Authorities (NFLA), a Manchester-based coalition that monitors military activity. NFLA warns that areas presently not within the radar's 120° coverage may face a tenfold increase in exposure when a 360° phased array radar begins operation at the site in mid-1992. The group plans further measurements at that time. For a copy of *RAF Fylingdales EMR Survey*, contact: David Bamber, Nuclear Policy and Information Unit, Town Hall, Manchester M60 2LA, U.K., (44+061) 234 3244.

More on Police Radar...FDA's Center for Devices and Radiological Health (CDRH) has recommended that "users of police radar should not place the front surface of the radar unit (the antenna) within 15 cm (6 inches) of any part of the body, while the unit is transmitting." In a June 20 letter to Dr. James Lin, chairman of the IEEE's Committee on Man and Radiation (COMAR), Dr. Alan Anderson, director of CDRH's Office of Science and Technology, also advised that, "The FDA knows of no convincing evidence of a risk of cancer or other hazards from exposure to the level and type of microwave radiation produced by police radar units." Anderson was responding to Lin's March 19 request for an advisory opinion because COMAR had received several inquiries from police departments. Meanwhile, John

Sweeney, an Agoura Hills, CA, attorney, has filed two new suits claiming that police officers Eric Bendure and Leo Hutchison of Petaluma, CA, developed cancer after using police radar units (see *MWN*, M/A91). Both suits were filed on April 18 in the U.S. District Court for California's Northern District. Sweeney had previously filed a police radar–cancer suit on March 12. More litigation may follow, because, according to Ohio Highway Patrol Trooper Gary Poynter, more than 50 police officers have reported developing cancer after using radar.

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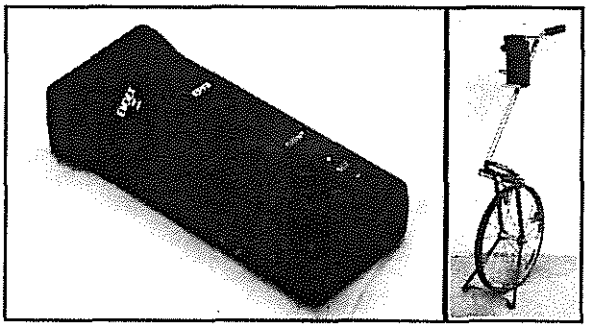
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ETC...

EMF on the Airwaves... Perhaps it's coincidence, perhaps it's synchronicity, but one of the hottest pop bands in the world is called EMF. In mid-July, the British group's single, "Unbelievable," was at the top of the charts. We're not exactly sure what EMF stands for, but we hear that the "E" is for ecstasy—a psychedelic drug popular in certain locales—and that the "MF" stands for something we cannot print here.

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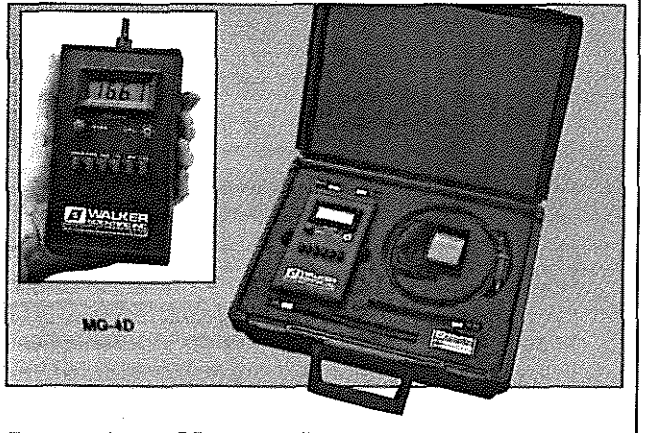
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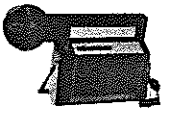
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Making the Economic Case for EMF Bioeffects Research

For the last six months, Dr. Keith Florig has been saying that dealing with perceived electromagnetic field (EMF) health risks—prudently or otherwise—is now costing the U.S. over $1 billion a year, and perhaps much more (see *MWN*, N/D91 and M/A92). The cost of *not* doing research, he says, is far greater than that of doing the work that might show, as some critics argue, that there are no low-level EMF risks.

Florig, a fellow at Resources for the Future in Washington, has just published the details of his analysis in the July 24 issue of *Science*, one of the country's most influential policy forums.

On the basis of a rough cost–benefit analysis, he estimates that if the cancer risks are as "large as suggested by some epidemiological evidence," the U.S. could "justify spending" on the order of $10 billion a year on EMF mitigation. "This may not be much more than the highly uncertain estimates of the costs of our current ad hoc efforts—and, if applied entirely to the electric power system, would increase electricity costs by only several percent," Florig told *Microwave News*.

Billions of dollars may be being wasted, Florig allows, but this can only become known "through additional bioeffects research." He rejects as politically unrealistic the call of those who would prefer to "quell 'irrational'

(continued on p.13)

Judge Extends Time for Filing RF/MW Radiation Exposure Claims

A New York trial judge has ruled that claims arising from exposure to radiofrequency and microwave (RF/MW) radiation are not subject to the usual statute of limitations. The June 30 decision from Judge Edward Lehner gives people more time to file lawsuits after they have been injured, a policy similar to the one followed in asbestos and DES cases.

"This decision will not be lightly disregarded," said the plaintiff's lawyer, John Sweeney of John E. Sweeney & Associates in Agoura Hills, CA.

The product liability suit was brought by Thomas Ford, who worked as a U.S. Navy radar technician between 1965 and 1967. Ford believes that his military exposure to RF/MW radiation caused his non-Hodgkin's lymphoma. He filed a claim in 1990, which he said was two years after he began to suspect the radar. Ford holds the manufacturers of the radar equipment responsible for negligently causing his injuries (see *MWN*, N/D90).

(continued on p.13)

« Power Line Talk »

A panel set up by the Committee on Interagency Radiation Research and Policy Coordination (**CIRRPC**) has completed its review of EMF health risks and is set to release its report. The panel argues strongly that there is no compelling evidence of adverse health effects from power line or VDT EMFs, *Microwave News* has learned, and it opposes any major expansion of EMF research funding. Commissioned in the fall of 1990 at the request of the Department of Labor in reaction to the series of articles in *The New Yorker*, the review was put in the hands of the Oak Ridge Associated Universities (**ORAU**) in mid-1991, after a false start (see *MWN*, N/D90, J/A91 and S/O91). The 450-page CIRRPC response has not yet been seen outside of ORAU, said Diane Flack, a technical adviser in ORAU's Washington office. It will be made available to the public and the federal agency representatives that make up CIRRPC at the same time, she told *Microwave News*, in an effort to assure the independence of the expert panel that conducted the review. Top administration officials were briefed on the findings on June 15—and were given explicit warnings that the briefing was confidential. The White House science adviser, Dr. **Allan Bromley**, did not attend. Among other key points reportedly made by the panel: epidemiological links to childhood leukemia are inconclusive; there is no strong evidence of carcinogenicity; there is no compelling evidence of developmental or teratogenic effects; and neurobehavioral effects are generally temporary and not severe.

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Dr. **Gerri Lee**'s epidemiological study of miscarriage risks among users of **electric blankets** has many people talking. Lee, who is with the California Department of Health in Berkeley, presented some preliminary results at a by-invitation-only workshop sponsored by **EPRI** and the **DOE** in early July—she reported an up-to-fivefold increased risk among women who use electric blankets. In an interview with *Microwave News*, Lee said that she would prefer not to discuss her results because "they are based on crude preliminary analyses of retrospective, incomplete data." Her study is much anticipated because it is the first prospective study of its kind, but Lee pointed out that she has only looked at the retrospective part of her data. "The final results could easily change," she cautioned. If Lee does conclude that electric blanket users suffered high rates of miscarriages, her study would be the fifth to indicate that EMFs can affect pregnancy. Lee's final results are not expected until next year.

«« »»

At the time the House of Representatives included a major EMF research initiative in the **national energy strategy bill** it passed earlier this year (see *MWN*, M/J92), many on Capitol Hill expected Congress to approve the energy legislation quickly. But it now seems that time is running out to reconcile differences between the House and Senate bills, as legislators are anxious to get on the campaign trail. The Senate version, which does not contain any EMF provisions, was approved on July 30, after a battle over coal miners' health benefits threatened to kill it. As we go to press, the legislation is in the hands of a House–Senate conference committee, only some of whose members have been named. The committee is expected to meet once in August and reconvene after Labor Day, according to a House aide. If the energy legislation fails, it will be a whole new ball game for congressional EMF research funding in 1993. Rep. **James Scheuer** (D-NY), chairman of the subcommittee that launched this year's EMF bill, will retire at the end of this session. Rep. **George Brown** (D-CA), the influential chairman of the House Science, Space and Technology Committee, who has shown a continuing interest in a national EMF program (see *MWN*, J/F92), is facing a tough reelection challenge from Republican Dick Rutan. Brown must run in a redrawn district—one that now favors a Republican, according to *Roll Call* (July 13), a Capitol Hill newspaper which lists Brown as one of the ten most vulnerable House Democrats.

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The prospects of the National EMF Research Program (**NERP**) Steering Committee that is being led by **John Coughlin** of the Wisconsin PSC have risen and fallen with the energy bill. If the EMF program contained in the energy legislation is enacted, Coughlin's committee will have little or no role, according to many observers. But if the energy bill fails, "We really will be the only game in town," Coughlin told *Microwave News*. Key utility groups agree. Rick Loughery of the Edison Electric Institute (**EEI**) said that EEI supports a legislated research program but added that if the EMF program dies in Congress, then "the NERP is probably where we're going to turn." Similarly, Anne Strauss of the New York Power Authority (**NYPA**) told us that, "We cannot afford to wait another two years" to start a major research effort. According to Loughery, "The next meeting for the NERP is going to be critical."...At the steering committee's July 14-15 meeting in Alexandria, VA, NIOSH's Dr. **Lawrence Fine** became a member. And a week later, Coughlin announced that DOE's **Marvin Gunn** would also join the committee, bringing to three—with EPA's **David Kleffman**—the number of federal government representatives. The committee also opened the door to more direct industry involvement by deciding to allow utility company officials to join as nonvoting members—a departure from a year-old practice meant to maintain distance between the NERP and industry. So long as the utility representatives are only observers, their involvement "doesn't compromise them or us," said Coughlin. The subject of credibility was on the agenda at the July meeting as the committee discussed a draft policy stating that the NERP "must identify and avoid situations that may result from real, perceived or potential conflicts of interest." The committee hopes

Commentary

Fear and Cowardice at EPA

Little has been resolved in the more than two years since the Environmental Protection Agency (EPA) stunned the country with its report, which labeled EMFs "probable" or "possible" carcinogens. While some reviews have cast doubt on the strength of EPA's conclusions, recent studies—notably, Peters on childhood cancer and McLean and Stuchly on EMF–chemical cancer copromotion in animals—have made the link all the more convincing.

Incredibly, EPA has failed to sponsor a single study of any kind to explore the EMF–cancer connection since it issued the report. The agency is pretending that the report does not exist and that it never sounded the alarm. Staffers at EPA's Office of Research and Development, which is headed by Dr. Erich Bretthauer, have even refused to spend the meager $1.9 million allocated by Congress for EMF research in 1992. With only a few weeks left in the fiscal year, this money will probably have to be returned to the treasury.

Last year, rather than fund any original work, Bretthauer gave most of his EMF money to the Health Effects Institute (HEI) in Cambridge, MA so that the institute could teach itself about EMFs in preparation for running a National EMF Research Program (NERP). That money was wasted. First, no one could understand why EPA was not using its own in-house experts. Then, Bretthauer and his aides, Dr. Ken Sexton and Dr. William Farland, got egg on their faces after word got around that HEI had a credibility problem over its work on asbestos. After all, the whole point of a NERP was that it be free from real or perceived biases. Otherwise, it would have been easier to let the electric utility industry handle the EMF question.

EPA's performance is no different than crying "Fire!" in a crowded theater. Having raised the alarm over EMFs, the agency has an obligation to try to allay public concerns or to adopt policies to control health risks. All sides agree that more research is needed—Dr. Keith Florig has now shown that EMF research also makes good economic sense (see p.1)—so why does EPA refuse to spend its few available dollars at a time when EMF scientists are begging for money to keep their labs open?

The answer lies at the highest levels of the Bush Administration. Dr. Allan Bromley, the President's science adviser, and the U.S. Air Force want to stifle the EMF issue—and, in many ways, they are succeeding. The about-to-be-released CIRRPC report promises to show their hand by taking an absurdly dismissive view of the possibility of EMF health risks (see item at left).

After having been called onto the White House carpet a few times, Bretthauer and his crew got the message and they now turn a deaf ear whenever the subject is raised. Things are so bad that Bretthauer won't even let the Office of Radiation Programs, in another part of EPA, issue a booklet to answer the public's questions about EMFs. As one EPA staffer told us, "Our managers are absolutely terrified about this issue."

There are rumors that EPA Administrator William Reilly made a deal with Bromley: Bromley would support EPA on greenhouse gases if Reilly ignored EMFs. If true, Bush's performance at the Rio environmental summit would indicate that Reilly sold out EMFs for nothing.

It may be too late, but EPA could salvage the $1.9 million by giving the money to the NERP Steering Committee, chaired by Wisconsin PSC Commissioner John Coughlin. This small amount of money would be a windfall for the committee, which is fighting for its life after more than a year of trying to get a research program off the ground.

If Bretthauer refuses to do EMF research, at least he could give the money to a group that *is* committed to doing it. The public deserves answers and it's time someone had the courage to give them some.

to insulate itself from potential conflicts by giving decision-making authority to a newly created board of directors and limiting the steering committee to an advisory role. Some current committee members will serve on the board. The committee is planning its fall meeting to coincide with either the EPRI science and communication seminar in San Francisco, October 13-16 or the annual DOE Contractors' Review in San Diego, November 9-12.

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On June 22, the **Connecticut** legislature overrode a veto by Governor Lowell Weicker, assuring that the state's EMF Interagency Task Force will continue to report to the General Assembly. "Even if the task force had lost its legislative mandate, we still would have followed the issue," Dr. **Peter Galbraith** of the Department of Health Services (DHS), cochair of the task force, told *Microwave News*. "But this way the DHS won't appear to have closed the book on EMFs." The new law—Public Act 92-169—essentially continues work begun under an earlier measure that Weicker signed in June of 1991 (see *MWN*, M/J91, J/A91 and M/A92). On July 28-30, the DHS and the task force sponsored a meeting, *Electromagnetic Fields: How Do We Deal with the Issues?* at which Drs. **Michael Bracken, David Carpenter** and **Jan Stolwijk** spoke. All three are members of the ad hoc committee that wrote the **Connecticut Academy of Science and Engineering**'s recent report, which found that it would be "inappropriate" for public authorities to recommend a policy of prudent avoidance (see *MWN*, M/J92). According to Don Michak's account of the meeting in the *Journal Inquirer* (July 29), Carpenter "threatened to quit the panel" because the report downplayed the EMF–cancer link. This fall, the task force plans to issue a study of prudent avoidance, and in January, Connecticut Health Commissioner Susan Addiss will advise the legislature on recent research on EMFs and health effects.

The Economics of Mitigation

Magnetic fields from power lines can be reduced substantially—depending on how much one wants to spend, according to a report commissioned by the Rhode Island EMF task force. The $81,500 study, financed by Rhode Island utilities, looks at the costs associated with different magnetic field-reducing techniques.

Burying power lines—the most effective option—costs nearly four times as much as traditional overhead designs, according to the report prepared by Commonwealth Associates of Jackson, MI. While a 345 kV H-frame configuration costs $390 per mile to build, putting the same line underground would cost $1,450 per mile. The cost and effectiveness of the other alternatives fall between those of the traditional and the underground designs.

"The task force will probably propose that the state Energy Facility Siting Board assume jurisdiction over the siting and construction of high voltage power lines, including those of 345 kV or below," Scott Wolf, chairman of the Governor's EMF Task Force, told *Microwave News*. He noted that the board now only regulates lines over 345 kV, of which there are "really none" in the state. The task force will issue its recommendations to the governor by the first week in August, he said.

The study, released to the public on June 24, features more than 90 pages of charts and diagrams. It focuses on mitigation techniques that "take advantage of the natural canceling effect of the three-phase circuit." Analysis is limited to 115 and 345 kV transmission lines—those planned for Rhode Island. Similar mitigation reports have been commissioned in Florida, New York and Washington State (see *MWN*, J/F92).

Florida's report will be completed by October, according to Ken Klein, of Energetics Inc., who is based in Washington and who manages the project (see *MWN*, M/A89 and M/J90). The study, which he said will cost less than $300,000, is looking at alternative designs for 230 kV and 500 kV lines.

In New York, two mitigation studies are under way and should also be completed by October, according to John Wilson of Con Edison, who is a member of the Empire State Electric Energy Research Corp.'s EMF Task Force (see *MWN*, M/J90).

Excerpts from the Rhode Island report, *Cost Effectiveness Analysis: Mitigation of Electromagnetic Fields*, follow:

- For 345 kV overhead transmission, magnetic fields at the edge of [the] right-of-way can be reduced by 45% (relative to existing H-frame structures) by designing support structures to result in a compact delta configuration of the phase conductors...the incremental increase in construction cost for this design is 21% and in life-cycle cost, 14%.
- Edge of right-of-way magnetic fields can be reduced by 75% over existing 345 kV H-frame designs by using a six-wire configuration. ...The incremental increase in construction cost for this design is 41%, and in life-cycle cost it is 27%.
- Underground 345 kV transmission provides the greatest reduction in magnetic fields. [The field] is estimated to be 1.7 mG [directly above a buried pipe] and 0.12 mG 25 feet from the pipe for 600 amp loading. The estimated construction cost...is 372% more than for existing overhead design and 266% more on the basis of life-cycle cost.
- For 115 kV overhead transmission, there is more opportunity for the designer to compact the phase spacing than at 345 kV. By decreasing the phase spacing and arranging the phases in a delta arrangement, the edge of right-of-way magnetic fields can be reduced by 57%....The construction cost and life-cycle cost of the compact design are nearly the same as for existing 115 kV H-Frame designs.

A limited number of copies of the Rhode Island report, for which there might be a charge, are available from: Scott Wolf, Chairman of the Governor's EMF Task Force, Statehouse, Room 111, Providence, RI 02903, (401) 277-2850. For more on six-wire configurations, see *MWN*, J/F92.

DOE Research Plan Draws Weak Public Response

The Department of Energy (DOE) has tried to solicit comments on its EMF research agenda but has been frustrated by a lack of involvement by grass-roots citizens groups.

Only a handful of power line critics spoke at two meetings—in Denver on June 29 and in Philadelphia on July 9—that were held to learn the public's opinion of DOE's national EMF program. Most who testified were from the utility industry, government or various research organizations—all of which have participated throughout the planning process that the DOE began last November (see *MWN*, N/D91, J/F92, M/A92 and M/J92).

DOE officials have said that the final research plan, which is due in September, must reflect a consensus of all interested parties. The agency has not scheduled any more public meetings but is accepting written comments through August 7.

The DOE's EMF staff was disappointed by the weak public turnout, Robert Brewer, director of the department's utility systems division, told *Microwave News*. He said that the DOE had expected the upswing in media coverage of EMFs and the growing number of citizens groups across the country to generate much greater involvement.

The DOE had picked Denver and Philadelphia for the hearings because both are focal points in the debate over power line EMFs. Two of the major epidemiological studies of EMF exposure and childhood cancer were carried out in Denver (see *MWN*, N/D86). And a well-organized citizens group is opposing a 230 kV transmission line built by Philadelphia Electric Co. (PECO) in suburban Philadelphia (see *MWN*, M/J91).

At the Denver meeting, only three people spoke—none on behalf of citizens groups. And, of the three, one came forward only after being encouraged to do so by DOE staff during the course of the meeting, according to Brewer. In Philadelphia, 12 people spoke; four were EMF activists, including Louise Young, the author of *Power over People*, first published in 1973 and recently reissued by Oxford University Press.

The group fighting the PECO line, Parents Against an Unsafe Environment (PAUSE), did not show up in Philadelphia. Although the DOE announced the meetings in the *Federal Register* on June 2, PAUSE's Dorothy English told *Microwave News* that she did not hear about it until late June. "We should have had more time," English said.

Other citizens groups made similar complaints. For instance,

Harry Kochenderfer of the York County (PA) Citizens' Action Group testified that he could not comment on DOE's *Draft Strategic Overview* because he had only seen it for the first time that day. His group and several others are opposing a proposed 500 kV line between Pittsburgh and Harrisburg (see p.6).

Michael Reed of DOE's Morgantown, WV Energy Technology Center criticized his own department for not informing its field offices about the ongoing EMF planning process. In Philadelphia, he said that he had learned about the development of DOE's research agenda just a few days before the meeting. "EMF is very important to us," Reed said.

Legal Notebook

$2.5 Million Power Line Relocation Delayed

On July 8, the Illinois Commerce Commission (ICC) agreed to reconsider an earlier decision which would have forced Commonwealth Edison Co. to relocate a 138 kV power line. Pending the outcome of its review, the commission granted the utility a stay—delaying the move, which the company estimates would cost $2.5 million.

On May 28, the ICC ordered Chicago-based Commonwealth Edison to move the power line within three years. It found that the utility violated the state Public Utilities Act when it failed to seek permission for an upgrade from 34 kV. The upgrade was completed in 1987.

The ICC discovered the violation after Nick Lazazzera of Westchester, a suburb of Chicago, complained in 1990 that the transmission line was too close to his house and that it threatened his health and the value of his property. The commission didn't rule on either of these claims, but did order the utility to try to get rid of Lazazzera's television interference, about which he had also complained.

A spokesman for Commonwealth Edison, John Hogan, who called ICC's decision to rehear the case "very good news," said that the power line in question is an emergency standby line that is only "minimally energized." He said that Commonwealth Edison never had to ask permission to upgrade a power line in the past, and that ICC's May order was "arbitrary and unnecessarily costly."

The commission said that it granted the rehearing to determine whether Commonwealth Edison needed to apply for a permit, according to ICC spokesman David Farrell. A hearing date has not been set.

Judge Excludes Testimony In EMF Case

An Alabama judge has excluded EMF testimony from a lawsuit, arguing that there is not enough scientific evidence that EMFs are a health threat.

Alabama Power Co. had asked the judge to take this position in its case against Western Pocahontas Properties Ltd. Partnership. In 1988, the Birmingham-based utility condemned a strip of land that runs through property owned by Western Pocahontas in Shelby County, outside of Birmingham, to build a 30-mile, 230 kV power line. The two sides disagreed over how much money the utility should pay for the condemnation, which Western Pocahontas claimed would devalue adjacent land. "Power lines devalue property," said Alan Baker of Balch & Bingham in Birmingham, which is representing Alabama Power, "but not as much as they say."

In his May 1 decision, Circuit Court Judge Al Crowson ruled that the testimony of Dr. Andrew Marino of the Louisiana State University Medical Center in Shreveport should not be admitted because of the speculative nature of EMF bioeffects—or, in legal terms, because it did not meet the Frye rule.

The Frye rule grew out of the 1923 case, *Frye v. U.S.*, in which the court considered the "admissibility of evidence derived from a crude precursor of the polygraph," according to *Weinstein's Evidence*, a leading legal treatise. The court stated that the subject of testimony must be "sufficiently established to have gained general acceptance in the particular field [to] which it belongs." The Federal Rules of Evidence—which were adopted in 1973 and govern proceedings in U.S. courts—have since overridden *Frye*, but some judges continue to use the rule in their decisions. In two previous cases in Alabama, for example, judges refused to allow scientific testimony on EMFs for this reason.

At the same time, the U.S. Third Circuit Court has rejected the Frye rule, calling it "vague and conservative, and easily manipulated by the courts, usually to reject novel scientific evidence."

"I disagree with the judge's decision," said Jeff Grantham of the Birmingham firm of Maynard, Cooper, Frierson & Gale,

DOE Issues Overview of EMF Research Plan

The DOE has released its *Draft Strategic Overview: National EMF Research and Communication Program*, a summary of the agency's work on a coordinated EMF plan. The 21-page document describes the need for national research and lists the goals of the program (see *MWN*, N/D91). The DOE designed the overview to brief the general public and to provide a basis for comments and criticisms from advocacy groups.

The overview lists three priorities:

- Development of a research plan that takes into account all sides of the EMF issue;
- Involvement by other federal and state agencies and trade associations, as well as representatives from other countries; and
- Establishment of safeguards to ensure that research is of the highest scientific quality and credibility and to avoid "real or perceived" conflicts of interest.

Comments will be considered by the DOE officials preparing the final national plan, which is due in September. The overview was published in the June 2 *Federal Register* (pp.23,206-23,213); to order a copy of the *Draft Strategic Overview*, contact: Advanced Industrial Concepts Division, CE-232, 5E-066, DOE, 1000 Independence Ave., SW, Washington, DC 20585, (202) 586-5377.

State EMF Actions

Colorado...A group of scientists has found no link between EMFs and human health effects. Yet the researchers are quick to point out that, "It is equally clear that the book is not closed. Several questions remain unanswered...." The Universities Consortium on EMFs—five scientists from three Colorado universities—screened more than 11,000 articles to find those which were most methodologically sound. Although several of the human studies showed a correlation between EMF exposure and disease, "careful analysis...revealed possible bias in selection of controls." *Investigations in Power Line Frequency EMF and Its Risks to Health: A Review of the Scientific Literature*, released in June, was prepared with a $160,000 grant from the Public Service Co. of Colorado. "The report was our first project," said Edward Dauer, professor of law at the University of Denver and chairman of the Governance Committee that oversees the consortium, which was formed in January 1991. "We plan to be research managers—in the business of helping utilities or public agencies administer research projects." To order a copy of the report, contact: Michelle Reynolds, UCHSC, 4200 East 9th Ave., B165, Denver, CO 80262, (303) 270-7545. Elsewhere in Colorado, the Supreme Court—which had reversed a ruling denying Public Service's request to upgrade transmission lines—has granted Douglas County's request for a new hearing, sending the case back to the district court (see *MWN*, N/D89, M/A91 and M/J92). A date has not been set.

Florida...On June 23, Hillsborough County mounted its latest attack on the Department of Environmental Regulation (DER), when it proposed a 3 mG limit at the edge of rights-of-way for power lines of at least 230 kV. "We wanted to offer a first step in reducing exposure to EMFs," Michael Skelton of de la Parte & Gilbert, the Tampa law firm representing the county, told *Microwave News*. Skelton also said the county chose to take action after the DER failed to reconsider state standards (see *MWN*, J/F92). "We shouldn't change the standard until we get more science," said DER's Buck Oven. "I don't know if 3 mG is good enough." The issue will be discussed at the Environmental Regulatory Commission's October meeting.

Illinois...Utilities should take "prudent measures" to reduce EMFs, write two state agencies in a March report to the legislature. The Department of Public Health (DPH) and the state Environmental Protection Agency stress that setting state standards would be premature—given that EMFs are not a proven health threat—yet note that uncertain scientific evidence "indicates cause for concern." The report recommends that utilities reduce EMFs by providing larger rights-of-way, avoiding population centers and using mitigation techniques in future transmission lines. For a free copy of the 70-page report, *Possible Health Effects of Extremely Low Frequency Electric and Magnetic Field Exposure: A Review*, contact: Louise Boyd, DPH, Division of Environmental Health, 525 West Jefferson, Springfield, IL 62761, (217) 782-5830.

Pennsylvania...A battle is shaping up as citizens are opposing plans for a 268-mile, 500 kV transmission line between Pittsburgh and Harrisburg. PUC Commissioner Wendell Holland has called the dispute "one of the biggest cases I've ever seen," noting that the two sides have submitted at least 9,000 statements and other documents. Three subsidiaries of General Public Utilities—Pennsylvania Electric Co. in Johnstown, Metropolitan Edison Co. in Reading and Jersey Central Power & Light Co. in Morristown, NJ—are working on the project with the Duquesne Light Co. of Pittsburgh. The PUC is considering the utilities' proposal but has not set a date to begin public hearings. Harry Kochenderfer of the York County Citizens' Action Group in Franklintown is leading the opposition, along with two other citizens groups. Meanwhile, HB 2273, drafted by Rep. Patricia Carone in response to the proposed power line, continues to await a hearing in the Conservation Committee (see *MWN*, M/A92).

Washington...An EMF task force in Spokane is proposing that utilities be required to publish annually a six-year plan identifying potential routes for future power lines and substations. The group said the requirement would be a good way to keep the public informed. In its June report, the task force also recommends that the city not adopt safety standards because "not enough is known about the health risks associated with EMF...." For a copy of the *Electric/Magnetic Field Task Force Report*, contact: Irving Reed, Manager, Engineering Services, City of Spokane, 808 West Spokane Falls Blvd., Spokane, WA 99201, (509) 625-6270.

which is representing Western Pocahontas. Grantham added that he would have liked Marino to testify, but that "he's just one part of our case." Western Pocahontas, based in Huntington, WV, is focusing on the effects of power lines on property values, not on health. A trial date has been set for September in the Shelby County Circuit Court.

Georgia Utility Agrees To Release EMF Documents

On July 10, the Oglethorpe Power Co. withdrew its request for confidentiality in an EMF personal injury case, assuring public access to relevant documents.

Nancy Jordan and her family filed a lawsuit against Georgia Power Co. and Oglethorpe in 1991, claiming that power line EMFs caused her non-Hodgkin's lymphoma (see *MWN*, S/O91 and M/J92). The case is pending in state court.

On May 8, Trial Lawyers for Public Justice (TLPJ), a public-interest legal group, filed a motion to block the protective order requested by Oglethorpe, which sought to keep certain documents from the public file. But the utility later agreed to release the information and TLPJ withdrew its motion. Oglethorpe is based in Tucker, GA.

"This is an important victory not only for the injured parties, but also for the public's right to know about the dangers of EMF," said TLPJ Foundation President Anthony Cunningham of Cunningham, Wagner, Vaughan & McLaughlin in Tampa, FL.

In withdrawing the request, attorneys for Oglethorpe wrote that most of the information the utility had wanted to keep confidential "did not relate to EMFs." James Orr of the Atlanta firm of Paul, Hastings, Janofsky & Walker, who is representing the utility, declined to comment further.

Georgia Power "took no position" on Oglethorpe's action, according to Robert Pennington of the Atlanta firm of Troutman & Sanders, which is representing Georgia Power in the case.

Scenes from the World Congress

The *1st World Congress for Electricity and Magnetism in Biology and Medicine*, held at Disneyworld in Orlando, FL, June 14-19, attracted some 733 participants from 30 countries. Here are some snapshots from the meeting.

Army v. Air Force on HPM Research

One of the most surprising—and tense—moments of the congress took place in a back room at a sparsely attended session on high-power microwaves (HPM). Dr. Edward Elson of the Walter Reed Army Institute of Research (WRAIR) in Washington was describing experiments showing that animals became confused and disoriented after exposure to various types of short, high-peak, pulsed HPMs with average power levels below those specified as safe by the IEEE standard (C95.1-1991).

The Department of Defense (DOD) supports the standard, so it was surprising to hear Elson, an Army colonel, cast doubt about its adequacy, but then he went even further. The safety question may be resolved by politics, not by science, he said, taking aim at Pentagon plans to consolidate all military nonionizing radiation research under Air Force control at Brooks Air Force Base in San Antonio, TX.

Elson's concern over what would happen to his research program if it were moved to Brooks is shared by some at the Naval Aerospace Medical Research Lab in Pensacola, FL.

Senior DOD officials favor the consolidation as a way of cutting costs, but those who actually do the research doubt the Air Force's scientific credibility. They believe that the Air Force puts a higher priority on promoting electronic gadgetry than on protecting health and safety.

Elson's message was clear: if the Army and Navy go to Brooks, the HPM work will stop. Spotting James Merritt, a longtime member of the Brooks team, in the audience, Elson challenged him to respond. A somewhat reluctant Merritt came to the microphone to say the work would indeed continue.

Understanding the effects of HPMs is important because the DOD plans to use microwaves—both defensively and offensively. For instance, in the battlefields of tomorrow, impulse radars, which emit ultrawide-band HPMs, will detect so-called stealth aircraft such as the B-2 bomber, and HPMs will zap the enemy's electronics. Elson's experiments suggest that pilots flying through HPM environments may become confused and unable to make the quick decisions that keep them aloft and alive.

Leakage Through the Blood–Brain Barrier

The history of efforts to investigate the effects of microwave radiation on the integrity of the blood–brain barrier (BBB) is a clear example of how politics can sidetrack an important line of research (see *MWN*, S/O86). In 1977, two Army scientists reported that pulsed 1.3 GHz radiation could cause BBB leakage at 30 $\mu W/cm^2$, but this finding has never been properly pursued.

Although scientists in the U.S. have essentially been barred from this kind of BBB study, those in other countries have dared to go forward. In Orlando, two Swedish researchers said they could increase the permeability of the BBB with extremely low levels of 915 MHz radiation.

Drs. Leif Salford and Bertil Persson of Lund University in Lund announced highly significant increases in leakage through the BBBs of rats at specific absorption rates (SARs) as low as 0.01-0.1 W/Kg. (Most standards assume that there are no health effects below 4 W/Kg.) They were surprised not to find a dose–response curve: they observed about the same leakage from 0.01 to 3 W/Kg (it increased above 3 W/Kg).

Some of those who heard their presentation suspected that the rats had experienced a thermal reaction. Not so, Persson told *Microwave News*, explaining that they had checked this possibility by measuring rectal temperatures immediately after exposure; they had used a fan to dissipate excess heat, he said.

Salford, a neurosurgeon, explained that he had become interested in microwaves as a way of treating brain tumors because the conventional therapies are woefully unsuccessful. If leakage through the BBB could be controlled, he reasons, perhaps drugs could one day be delivered directly to the tumors.

"The system we are using is very sensitive and we invite others to learn our techniques," Salford said in an interview. In the meantime, he and Persson said, their work will continue.

Protection from Melatonin Blocked by EMFs

Interest in the possible influence of EMFs on the pineal gland and the hormone melatonin continues to grow. Indeed, shortly after the congress, a number of those who were in Orlando flew to Palo Alto, CA for a two-day workshop on *EMFs and Melatonin*, jointly sponsored by the Electric Power Research Institute (EPRI) and the Department of Energy (see p.2).

At the congress, Margrit Wiesendanger, who works with Dr. Robert Liburdy at the Lawrence Berkeley Lab in Berkeley, CA, announced that extremely low frequency (ELF) magnetic fields can block melatonin's ability to control the growth of human breast cancer cells.

Wiesendanger first confirmed reports by Dr. David Blask, who has shown that melatonin can inhibit the growth of cancer cells *in vitro*. Using estrogen-positive MCF-7 human breast cancer cells, she then repeated the experiment in the presence of a 60 Hz field and found that melatonin's protective action was countered by the magnetic field.

The mechanism of interaction is unclear, Wiesendanger said. She offered two alternative explanations: the magnetic field may influence events at the membrane surface, possibly the way melatonin is bound to cancer cells; or the field may directly enhance the growth of the breast tumor cells.

"Our *in vitro* results suggest that direct cellular level interactions between ELF fields and melatonin and breast cancer cells are possible," Liburdy told *Microwave News*.

Future Directions for EMF Epi Studies

Some observers have a hard time making sense of the many EMF epidemiological studies that have appeared over the last few years. In her plenary address, Dr. Genevieve Matanoski of the Johns Hopkins University School of Hygiene and Public Health in Baltimore offered a guide for the perplexed by identifying some of the common threads of the research findings and outlining suggestions for future work.

Matanoski pointed out that for both childhood and adult studies the timing of the EMF exposure is emerging as a crucial variable. Exposures at an early age or repeated exposures over extended periods of time appear to enhance cancer risks, she said. As an example, she cited the male breast cancer study by Dr. Paul Demers and coworkers (see *MWN*, J/A90 and S/O91), which indicated a substantial increase in cancer among those workers who were first exposed before the age of 30 or first exposed 30 years prior to diagnosis. Indeed, Matanoski noted that her own study of telephone linemen indicated that the greatest risk of leukemia was among workers exposed at an early age (see *MWN*, J/A91).

Second, Matanoski stressed the importance of investigating the effects of combined exposures. "Instead of only thinking about confounders, we need to look at the combined risk of EMFs with both chemicals and ionizing radiation," she told *Microwave News* in an interview following her talk.

Depression and Power Lines

More than a decade has passed since Dr. Stephen Perry, an English general practitioner, published the first of a series of papers linking power line EMFs to depression and suicide. His work has been largely ignored—some people have been openly scornful—but one presentation at the congress breathed new life into Perry's ideas.

Drs. Charles Poole, an epidemiological consultant based in Cambridge, MA, and Robert Kavet of EPRI reported an association between depressive symptoms and proximity to the right-of-way (ROW) of a power line. The link was moderately strong and reasonably precise, and it did not appear to be biased by attitudes about power lines or environmental issues in general.

Overall, Poole and Kavet found that depression was twice as common among people who lived along a ROW or who could see a power line from their property—a statistically significant increase. They also found a weaker link between non-migraine headaches and proximity to power lines.

"Exposure assessment is the weakest part of the study, but it would be relatively easy to go back and get these data or to try to replicate the study," Poole told *Microwave News*. He pointed out that their study cost only one fourth that of a cancer epidemiological study, but he declined to reveal where their study was done or who paid for it.

But Perry's work is not yet in the mainstream. A second paper presented in Orlando contradicted Poole and Kavet's findings. Dr. Shari McMahan of the University of California, Irvine, failed to find more symptoms of depression among women living next to a high voltage power line than among women living a block away. Her paper was adapted from her recently completed doctoral thesis.

McMahan measured the magnetic fields at the front door of the women's homes: average fields were 4.86 mG among those adjacent to the line and 0.68 mG among the controls. McMahan controlled for potential biases by not telling the 152 participants that she was investigating EMFs—she also no doubt profited by the fact that most people are not aware that magnetic fields drop off with distance from a power line.

Epidemiology Roundup

Male Breast Cancer Among Workers Under 65

Dr. Dana Loomis has observed a doubling of breast cancer deaths among male electrical workers under the age of 65. This result is not statistically significant, but Loomis told *Microwave News* that, "It would certainly suggest that breast cancer among men *might* be caused by electrical exposures." Loomis, of the University of North Carolina (UNC), Chapel Hill, also noted a "substantial deficit" of breast cancer deaths among older electrical workers, however.

In a letter to *The Lancet* (339, pp.1482-1483, June 13, 1992), Loomis wrote, "The results are consistent with earlier reports of excess breast cancer among younger men, particularly those who have worked in electrical trades and telephone-related occupations."

He cautioned that his study had only a small number of cases and that it lacked information on EMF exposures and potential confounders.

In a survey of men from 24 states who died of breast cancer between 1985 and 1988, Loomis found four cases—the expected number—among electrical workers. However, three of the cases—one electric power worker, one electrical and electronics engineer-technician and one telephone worker—were younger than 65 years old at death. This finding is more than twice the expected rate.

This is the fourth study to link EMFs to male breast cancer. In 1989, Dr. Genevieve Matanoski and colleagues at the Johns Hopkins University School of Hygiene and Public Health in Baltimore reported an increased incidence of male breast cancer among young telephone company employees (see *MWN*, N/D 89 and M/A91). In 1990, Dr. Paul Demers and coworkers at the Fred Hutchinson Cancer Research Center in Seattle reported a sixfold increased risk among certain young electrical workers (see *MWN*, J/A90 and S/O91). Later that year, Drs. Tore Tynes

and Aage Andersen of the Cancer Registry of Norway in Oslo identified a significant doubling of risk among electrical transport workers (see *MWN*, J/F91).

Loomis and UNC's Dr. David Savitz reported an elevated rate of brain tumor deaths among electrical workers in 1989 (see *MWN*, N/D89).

Australian Study Finds CRT–Brain Tumor Risk

A new Australian study has found that women who worked at cathode ray tube (CRT) computer monitors developed brain tumors at close to five times the expected rate. This is the first study to investigate a link between video display terminal (VDT) use and cancer.

"We found a significantly increased risk for glioma [a type of primary brain tumor] associated with use of [CRTs] by females, although the number exposed was small," concluded a team led by Dr. Philip Ryan, a lecturer in public health at the University of Adelaide's Department of Community Medicine.

The team observed a nonsignificant *decreased* risk among men exposed to radiation in general. "I cannot explain the different estimates of risk between males and females," Ryan told *Microwave News*.

The researchers could not identify any other environmental hazard to explain their results. They cautioned, however, that their work shared the weaknesses of other brain tumor studies: a small number of cases, the potential for recall bias and an inadequate means of assessing cumulative exposures. In addition, their study was not based on any *a priori* hypotheses. "These factors may explain some of the present findings," they noted in their paper, which appeared in the *International Journal of Cancer (51*, pp.20-27, 1992).

More than a dozen studies have linked EMFs to brain tumors (see *MWN*, M/A90)—although none has specifically addressed VDTs.

While the researchers observed an increased risk for women exposed to sources of ionizing and non-ionizing radiation, the risk became more pronounced when limited to CRT use. There was a fourfold increase in risk for radiation exposure in general—and an almost fivefold increase for CRT work alone. Both findings are statistically significant. The risk was somewhat lower when the researchers excluded women who could not be interviewed in person.

There were six women with gliomas who worked at CRTs—three computer programmers, one computer operator, one office clerk and one road-transport supervisor.

The team investigated 170 cases of brain tumors diagnosed in adults aged 25-74 from 1987 to 1990 and 417 controls. Both

Epidemiology in Print

• In a series of letters in the May 1 *AJE (135*, pp.1069-1075) on the wire code–cancer link, two researchers took aim at the Savitz and the University of Southern California (USC) childhood cancer studies (see *MWN*, N/D86, and M/A91 and S/O91, respectively). Dr. Kenneth Mundt of the University of Massachusetts School of Public Health in Amherst argued that wire codes may be one of a number of interrelated surrogates for lower socioeconomic status, rather than an indicator of EMF exposure. He added that the controls may have been biased toward a higher socioeconomic level, thus skewing the results. Dr. David Savitz replied that, unlike those who dismiss the evidence on EMFs and cancer on "intuitive grounds," Mundt offered some valid criticism, which should be considered in the design of future studies. The USC team, led by Drs. Stephanie London and John Peters, responded that, "While Dr. Mundt raises interesting issues, we cannot conclude that his alternative explanation of our data is compelling." Raising some technical points, Dr. Michael Bracken of the Yale University School of Medicine in New Haven, CT expressed concern that the USC team's presentation of its data misled readers—particularly the media—about health effects. In response, the USC researchers pointed out that their paper was written "for the scientific literature, not the public media," and that very few of the reporters who contacted them had even read the abstract.

• A typographical error led to a misinterpretation in Dr. John Vena's study of electric blankets and female breast cancer (see *MWN*, S/O91). In a letter in the April 1 *AJE (135*, pp.834-835), Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA argued that if the pineal gland is the site of interaction, then electric blanket EMFs would not be significant since, according to calculations by Drs. Keith Florig and James Hoburg, they would be less than 1.0 mG at head level. Vena and Dr. Saxon Graham, both of SUNY, Buffalo, replied that their original paper relied on an abstract by Florig and Hoburg which contained a typographical error: it read 1.0-4.0 μT at head level instead of 1.0-4.0 mG. Vena and Graham conceded that although some evidence suggests that electric blanket use does not disrupt pineal function, they could not rule out other possible, more direct interactions.

• Two review papers on male breast cancer have recently appeared: a team led by Dr. David Thomas of the Fred Hutchinson Cancer Research Center in Seattle published "Breast Cancer in Men: Risk Factors with Hormonal Implications" in the *AJE (135*, pp.734-748, April 1, 1992); and the Italian–Swiss team of Drs. Carlo La Vecchia, Fabio Levi and Franca Lucchini published "Descriptive Epidemiology of Male Breast Cancer in Europe" in the *International Journal of Cancer (51*, pp.62-66, 1992)....In addition to breast and brain cancer, prostate cancer is also on the rise, according to the Centers for Disease Control in the June 12 *Morbidity and Mortality Weekly Report* (pp.401-404).

• Challenging prevailing opinions, two British scientists are each proposing that childhood leukemia is the result of viral infections. According to the June 19 *Science (256*, p.1633), Dr. Melvyn Greaves of the Leukaemia Research Fund Centre at London's Institute for Cancer Research suggests that exposures to common viruses may have compromised the immune systems of childhood leukemia sufferers. Dr. Leo Kinlen of Oxford University's Cancer Epidemiology Research Group lays the blame on as-yet-unidentified cancer-causing viruses.

cases and controls were from metropolitan Adelaide.

The study is one of ten on adult brain tumors being carried out in seven countries around the world. This international effort is being organized by the International Agency for Research on Cancer (IARC) in Lyon, France. The Adelaide study is the only one that has analyzed data on CRT exposure, Ryan said. He does not expect the complete results of all ten studies to be published before mid-1994, at the earliest.

No Birth Defects for Electric Blanket Users

Pregnant women who used electrically heated beds (EHBs) in their first trimester were at no increased risk of giving birth to infants with certain congenital defects, according to a new study.

"These results suggest that 60-cycle fields do not cause neural tube and oral defects," concluded a team led by Dr. Larry Dlugosz of the Department of Social and Preventive Medicine at the State University of New York (SUNY), Buffalo. The team included Dr. John Vena, also of SUNY, and Dr. Michael Bracken of the Yale University School of Medicine in New Haven, CT (see also p.9).

The researchers said that they selected neural tube and oral cleft defects because they are established before the second trimester, are obvious at birth and are influenced by environmental factors. There have been no reports of an excessive rate of neural tube or oral cleft defects in EMF–laboratory animal experiments, they noted in the May 1 *American Journal of Epidemiology (AJE, 135*, pp.1000-1011).

The researchers studied 1,070 women (535 cases and 535 controls) living in upstate New York who gave birth in 1983-1986. The women were asked about their use of EHBs for the period of one month before to three months after their estimated date of conception. EHB exposures were estimated to be approximately 3-5 mG.

Although the researchers called for additional study of EMFs and adverse pregnancy outcomes, they lamented that the advent of new "low field" EHBs (see *MWN*, M/J90) and the widespread publicity about potential EMF health effects "will make it difficult, if not impossible, to conduct an unbiased observational study of this type in the future."

Melanoma Linked to Fluorescent Lights

A new Canadian study has determined that men exposed at work to fluorescent lighting had a significantly elevated risk of developing melanoma, a type of skin cancer.

Dr. Stephen Walter and coworkers at McMaster University in Hamilton, Ontario also found that men exposed to fluorescent lighting at home had an increased cancer risk. There was no consistent risk increase among women, however.

"While the combined evidence is not sufficient for immediate alarm, we feel that fluorescent light should continue to be investigated," they concluded in the April 1 *AJE (135*, pp.749-762). "Because fluorescent light devices may generate a substantial portion of human exposure to ultraviolet B, they must be considered as a potential risk factor for melanoma."

For men who had cumulative occupational exposures of more than 20 years, the odds ratio (OR) was 1.77; for exposures of more than 30 years, the OR was 1.92. The dose–response relationship is statistically significant. The team investigated 583 cases (277 men and 306 women) diagnosed between 1984 and 1986 and 608 controls (283 men and 325 women). All were residents of southern Ontario.

In 1982, an Australian team reported a doubling of skin cancer risk among women and men exposed to fluorescent lighting at work (see *MWN*, S82).

Motion To Dismiss Police Radar Case Denied; Trial in November

The first trial in a police radar product liability case is scheduled to begin November 10. The path was cleared when, on July 23, U.S. District Judge Stanley Weigel denied a motion by the radar manufacturers to dismiss the lawsuit brought by Police Officer Eric Bendure, who has non-Hodgkin's lymphoma.

In their motion for summary judgment, Kustom Signals Inc. of Overland Park, KS and MPH Industries Inc. of Owensboro, KY had challenged the alleged link between police radar and cancer. They argued that there is no basis in the scientific literature to support claims of a health risk.

"The defendants contended that our case was based on 'junk science'," explained Bruce DeBoskey of the Denver firm of Silver & DeBoskey. But the judge's decision "showed that the claims of cancer causation are based on legitimate, accepted scientific methodologies," he said. DeBoskey is Bendure's co-counsel with John Sweeney of John E. Sweeney & Associates in Agoura Hills, CA.

Dexter Louie of the San Francisco firm of O'Connor, Cohn, Dillon & Barr, which represents Kustom, told *Microwave News* that, "The plaintiff's experts are not basing their opinions on generally accepted scientific principles"; he said that the motion for summary judgment was based on this argument, but he would not comment further. John Warner of Corte Madera, CA, who represents MPH Industries, said he would not discuss the case until after the trial.

Judge Weigel had originally scheduled the defendants' motion to be decided July 9, but he delayed the decision so he could review additional information that he requested from the plaintiff's attorneys. His questions focused on, among other things, the applicability of studies concerning exposure to non-ionizing electromagnetic radiation (NIER) at frequencies other than those used by the radar guns.

In response, DeBoskey and Sweeney wrote that, "There is simply no scientific evidence which supports [the] defendants'

Other Police Radar Developments

60 Minutes Airs Investigative Report

60 Minutes ran its segment on possible health risks associated with hand-held traffic radar as its lead story on June 21.

Correspondent Morley Safer began the piece by interviewing officers from across the U.S., who described how they used the radar. George Nelson of Grand Rapids, MI, for example, explained that he rested the unit in his lap while it was transmitting and he believed the radiation caused his testicular cancer. Toward the end of the piece, Safer included a shot of Nelson and the five other officers in Grand Rapids who have developed testicular cancer (see *MWN*, M/A92).

For two different views on research and regulation concerning health effects from microwave radiation, Safer relied primarily on interviews with Dr. Eleanor Adair of the John Pierce Foundation Laboratory in New Haven, CT and Dr. Louis Slesin of *Microwave News*. The last word, however, was given to Ohio State Trooper Gary Poynter: having described the database in which he records cases of cancer among traffic radar users (see *MWN*, M/A92), Poynter lamented the deaths of many of his fellow officers.

The producers had planned to air the piece in the fall, during the show's regular season, but moved the airdate up because the issue was gaining attention and they feared that others would beat them to the punch. Indeed, in an apparent effort to scoop the top-rated CBS program, *NBC Nightly News* ran a short piece on June 19 by reporter Robert Bazell.

IEEE Reaffirms COMAR's Stance

Even before the *60 Minutes* piece aired, the Institute of Electrical and Electronics Engineers (IEEE) issued a response to the concerns raised by "the allegations of Poynter [which] have been expanded in a series of media events...." The institute reaffirmed its views in an "Entity Position Statement," written by its Committee on Man and Radiation (COMAR), which argues that police radar guns are safe because the power levels are low.

The five-page statement relies primarily on the IEEE's own 1991 microwave exposure guidelines, written by SCC-28, and on the previous ANSI C95.1 limits. It notes that, "The vast majority of police radars operate between 10 and 25 mW, although a small number of 100 mW devices are still in service. By comparison, the power output of a child's walkie-talkie is 35 mW, and cellular hand-held radio-telephones operate at power levels of hundreds of milliwatts."

The IEEE concludes unambiguously that, "There is no scientific basis for worry that exposure to police radar may cause or promote cancer."

FDA: Advice for Police Officers

Also responding to "recent stories in the news media" about possible cancer risks from police radar use, the Food and Drug Administration (FDA) has published a two-page *Update on Possible Hazards of Traffic Radar Devices*.

Written as questions and answers for police officers, the information sheet states repeatedly that there are no proven health risks. But it is less categorical than the IEEE statement and avoids any conclusion that the devices are safe. Referring to a "preliminary comparison" of the number of cancer cases reported by police officers with cancer rates in the general population, the FDA states that this comparison "does not appear to show a greater cancer rate among the police, but it is too soon to conclude that there is no risk." This assessment is partially based on a review of Gary Poynter's database of police officers who developed cancer after using radar.

The update describes a number of precautions that go beyond simply keeping the radar units at least six inches from any part of the body—the advice given in an FDA letter to IEEE's COMAR in June 1991 (see *MWN*, J/A91). The FDA now suggests the following "simple steps" to reduce exposure:

- Pointing the hand-held radars away from the body when they are on;
- Pointing fixed antennas away from the occupants of a patrol car;
- Turning hand-held units off when they are not in use; and
- Not pointing the radars toward metal surfaces in a patrol car.

The FDA sent out copies to police officials across the U.S., urging them to "make this update available to the officers under your jurisdiction." The update also explains that the FDA will "continue to evaluate the research" on microwave radiation and asks police officers to report all cases of cancer among radar users to its toll-free number, (800) 638-6725.

Experts for the Bendure Case

Both sides in the Bendure case (see p.10) have designated their experts—including many who will be familiar to those who have followed previous EMF lawsuits and controversies. The following individuals, among others, have provided testimony or have been listed in court filings as experts who may be called during the trial.

For Kustom Signals and MPH Industries: Dr. Budd Appleton, an ophthalmologist formerly with the U.S. Army Medical Corps; Dr. Roswell Boutwell, McArdle Laboratory for Cancer Research, University of Wisconsin, Madison; Dr. Linda Erdreich, Bailey Research Associates Inc., New York City; Dr. Michael Fischman, Division of Occupational and Environmental Medicine, University of California, San Francisco; Dr. Bill Guy, Bioelectromagnetics Research Lab, University of Washington, Seattle; Dr. Don Justesen, VA Hospital, Kansas City, MO; Dr. Jack Mandel, an epidemiologist in Minneapolis; and Dr. Kristian Storm III, Comprehensive Cancer Center, University of Wisconsin, Madison.

For Bendure: Prof. Leo Birenbaum, Polytechnic University, New York City; Dr. Andrew Marino, Louisiana State University Medical Center, Shreveport; Dr. Samuel Milham Jr., recently retired from the Washington State Health Department; and Dr. Milton Zaret, an ophthalmologist in Scarsdale, NY.

Boutwell, Erdreich and Marino have previously testified in lawsuits concerning power line EMFs; Guy and Justesen have been called as experts in hearings on the siting of cellular and microwave towers. Appleton and Zaret have long held opposing views about the effects of microwaves on the eye. Storm was, for a time, the chairman of the SCC-28 subcommittee that wrote the C95.1-1991 standard.

Alternative Speed Enforcement Methods

Alternatives to traffic enforcement radar guns are discussed in "Improving on Police Radar," a six-page article in the July 1992 *IEEE Spectrum*. The author, Dr. David Fisher of the Michigan State University Radar Testing Laboratory in East Lansing, discusses radar, lasers, video cameras and Vascar (a device that calculates speed based on an officer's visual observations). The focus is on which technology is most effective for catching and prosecuting speeders. Fisher, who has done extensive testing of radar gun emissions (see *MWN*, N/D91), makes no mention of possible health risks from radar.

'divide and conquer' strategy to isolate the narrowest frequency band involved in police radar and ignore the great quantity of scientific evidence at other points along the [NIER] spectrum."

DeBoskey told *Microwave News* that the court had accepted their view that research on radiation at other frequencies is relevant to police radar cases, adding that this decision is in turn important for lawsuits that allege adverse health effects from other types of NIER. "The same types of attacks are going to be made in radiofrequency [RF] radiation cases, power line cases, and so on," DeBoskey said.

Indeed, many participants in the Bendure case have played a role in other legal battles over NIER (see box p.11). Sweeney, a veteran of several military radar cases (see *MWN*, D82), is currently working on two RF/microwave radiation injury claims (see p.1). DeBoskey represented Beryl Main, who alleged that her lymphoma was caused by exposure to RF radiation from an FM radio transmitter operated by Jefferson-Pilot Broadcasting Inc. The case was settled out of court in March 1990 (see *MWN*, M/A87, M/J87, S/O89 and M/J90). DeBoskey is also cocounsel for Nancy Jordan, who has sued Georgia Power Co. and Oglethorpe Power Co., claiming that EMFs from the companies' power lines caused her non-Hodgkin's lymphoma (see p.6 and *MWN*, S/O91).

Bendure worked for the San Anselmo (CA) Police Department from 1985 to 1988 and for the Petaluma (CA) Police Department from 1988 to 1990. During that time, he used several models of Kustom hand-held traffic radar extensively. He was diagnosed in early 1989 with non-Hodgkin's lymphoma. According to his attorneys, the cancer originated in his right groin area near where he rested the radar when it was transmitting but not being used to clock traffic.

Senate Hearing on Police Radar

Sen. Joseph Lieberman (D-CT) is planning to hold a hearing on the health effects of traffic radar on August 10 in Washington.

Those scheduled to testify include: Dr. Ross Adey, Veterans Administration Hospital, Loma Linda, CA; Dr. William Farland, Office of Health and Environmental Assessment, Environmental Protection Agency, Washington; Sam Franzo, International Brotherhood of Police Officers, Rocky Hill, CT; Dr. Brian Hardin, National Institute for Occupational Safety and Health, Washington; Henry Kues, Applied Physics Lab, Johns Hopkins University, Laurel, MD; John Kusek, Kustom Signals Inc., Overland Park, KS; Officer Thomas Malcolm, Windsor Locks (CT) Police Department; State Trooper Gary Poynter, Middleton, OH; and John Rankine, IEEE Standards Board, Washington.

Lieberman is chairman of the consumer and environmental affairs subcommittee of the Committee on Governmental Affairs. Sen. John Glenn (D-OH), the chairman of the committee, is expected to attend the hearing.

When he announced the hearing in May, Lieberman noted that there had been a dearth of research on radar. At the same time, Connecticut's other senator, Christopher Dodd (D), asked Dr. Kenneth Olden, head of the National Institute of Environmental Health Sciences, to urge an epidemiological study of police radar users (see *MWN*, M/J92).

International Commission on NIR Protection Launched

On May 20, the International Radiation Protection Association (IRPA) approved the charter for the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which will continue the work of IRPA's International Non-Ionizing Radiation Committee (INIRC). Dr. Michael Repacholi, chairman of the committee, will lead the commission.

"Non-ionizing radiation protection has come of age," Repacholi told *Microwave News*. Currently a visiting scientist at the Australian Radiation Laboratory in Yallambie, Repacholi said that ICNIRP will now have only a "loose association" with IRPA.

Dr. Mays Swicord, the chief of the radiation biology branch at the Food and Drug Administration's Center for Devices and Radiological Health and an ICNIRP member, predicted that the change "should elevate the status of the committee and provide for greater international coordination."

The commission has an ambitious work plan. Over the next four years, according to Repacholi, ICNIRP will issue separate guidelines for human exposures to static magnetic fields; lasers; ultraviolet (UV) radiation; infrared radiation (IR) and visible light; 0-100 kHz EMFs; and pulsed radiofrequency (RF) radiation. The commission will also publish shorter statements on police radar, mobile telephones (see *MWN*, M/J92) and medical ultrasound.

In association with the United Nations Environment Program (UNEP) and the World Health Organization (WHO), ICNIRP plans to update the volumes of *Environmental Health Criteria* on extremely low frequency (ELF) EMFs, UV radiation and visible light. Working with the International Labor Organization (ILO), ICNIRP plans to issue practical protection guides. These will cover UV and IR radiation for indoor workers, UV radiation for outdoor workers and RF radiation for operators of heat sealers. In addition, ICNIRP, the ILO and WHO hope to jointly publish manuals on the medical handling of accidental overexposures to NIR and on protecting health care workers from NIR.

Most of the members of INIRC have joined the commission. One exception is Sweden's Dr. Bengt Knave, who has stepped down and been replaced by his protégé, Dr. Ulf Bergqvist.

Annette Duchêne, who has served as INIRC's scientific secretary since it was founded in 1977, has announced that she will retire when a replacement is found—until then, she will continue to work with the commission.

In the past, INIRC has issued papers and reports on ELF EMFs (see *MWN*, D84, M/A88, M/J89 and J/F90); static and ELF magnetic fields (see *MWN*, My85 and M/A87); RF/MW radiation (see *MWN*, Mr84 and J/F88); VDTs (see *MWN*, M/A88); and MRI (see *MWN*, J/F92).

The commission members are: Drs. Michael Repacholi (chairman), Australia; Martino Grandolfo (vice chairman), Italy; Ulf Bergqvist, Sweden; Jürgen Bernhardt, Germany; Jean-Pierre Cesarini, France; Louis Court, France; Alastair McKinlay, U.K.; David Sliney, U.S.; Jan Stolwijk, U.S.; Mays Swicord, U.S.; Laszlo Szabo, Hungary; Tom Tenforde, U.S.; Henri Jammet (chairman emeritus), France.

EMF Bioeffects Research *(continued from p.1)*

public concerns"—at least until there is a "broad scientific consensus" that EMFs pose a negligible health threat.

"More bioeffects research is only part of the answer," Florig was quick to point out in a telephone interview. "The public has grown to distrust traditional risk management and is demanding to become more involved in the decision-making process. We must develop new ways to include the public in the resolution of EMF disputes, including the siting of power lines."

Florig outlines six types of economic impacts that are due to concerns about EMF health risks:

1. *Delays, cancellations and moratoriums on new transmission projects*—Industry statistics indicate that utilities are planning about 12,600 circuit-miles of new transmission lines through the year 2000.
2. *Loss of property value*—Florig estimates that a loss of even 1% in the value of homes and land close to transmission lines amounts to a market loss of about $1 billion.
3. *Litigation costs and awards in suits claiming EMF-induced health damage from power lines and appliances*—For instance, a Texas jury awarded a school $25 million (later reversed) in a dispute with Houston Light & Power Co. (see *MWN*, N/D85, N/D87 and M/J89).
4. *Low EMF designs implemented by utilities, such as burial or new line configurations*—Florig writes that these changes are adding up to $1 billion to the $13 billion a year that U.S. utilities are investing in transmission and distribution construction.
5. *Changes undertaken by the public and businesses to reduce EMF "hot spots"*—According to one estimate, reducing magnetic fields in offices can cost up to $400 per square meter.
6. *The production costs of low EMF household and office appliances*—Florig predicts that the $2 billion-a-year market for video display terminals and the $100 million-a-year market for electric blankets will soon be limited to low magnetic field models.

Even in the face of competing claims for federal research dollars for other environmental risks, Florig finds that, "The need for a stronger federal program of EMF research is particularly acute."

See Keith Florig, "Containing the Costs of the EMF Problem," *Science, 257*, pp.468-469, 488-490, July 24, 1992.

RF/MW Radiation Litigation *(continued from p.1)*

The defendants—AT&T, GTE Products Corp., Lockheed Electronics, GE and Raytheon—pushed to have Ford's suit dismissed, arguing that microwave radiation should not be classified as a toxic "substance." The court disagreed.

"The defendants' attempt to limit the statute...[flies] in the face of the legislative intent to expand the rights of persons injured by the latent effects of exposure to any substance," Lehner wrote in his decision.

If a chemical or physical agent is deemed a substance, a plaintiff has three years from the time an injury is *diagnosed* to determine the cause and file a claim, explained Kenneth Henrie of Henrie & O'Boyle in Wantagh, NY, Sweeney's local co-counsel. If the radiation had not been ruled a substance, Ford's case would have been subject to a statute of limitations giving him only three years from the time the exposure *occurred* in the 1960s to begin his suit.

A spokeswoman for AT&T said that the company is studying the June 30 decision and has not yet decided whether to appeal.

"This case could open up a real Pandora's box," Henrie said. "It's the beginning of the new wave of litigation for the 21st century." Sweeney told *Microwave News* that he thinks the ruling is "likely to resolve the same claim made by the defendants in the Dowgiallo case." Sweeney also represents Michael Dowgiallo, an electrician who filed a product liability lawsuit alleging that RF/MW radiation from an FM antenna and from a microwave transmitter caused his stomach cancer (see *MWN*, N/D90).

For more on RF/MW litigation, see *MWN*, M/J86, S/O86, M/A88, M/J89 and S/O89.

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FROM THE FIELD

EMFs and Cancer Rates

To the Editor:

In a paper published in the April 1992 *Proceedings of the National Academy of Sciences*, physicist J.D. Jackson asserts that there can be no cancer risk from exposure to power frequency electromagnetic fields (EMFs) because use of electrical power has increased markedly in the last 50 years while cancer risk apparently has not. Problems in his epidemiologic argument have already been noted (see *MWN*, M/J92). Perhaps less evident is his unfamiliarity with how power distribution practices affect the EMF exposure associated with power use.

Dr. Jackson unquestioningly assumes that power frequency EMF exposure increased proportionately with increasing power use over the last 50 years. The fact, however, is that numerous engineering changes have occurred over the years that markedly *decreased* the level of magnetic field exposure likely to accompany a given power use (and it is the magnetic field exposure that has been most clearly implicated by studies suggesting cancer risk). These changes include:

1. Use of higher voltage in primary distribution lines, allowing more power to be transmitted for the same amount of current (it is the current that produces a magnetic field);
2. Use of Romex instead of knob-and-tube wiring inside the home (greater cancellation of fields from current flow within the house);
3. Use of triplex rather than spaced secondary wires (greater field cancellation);
4. Increased use of 240-volt appliances, which generally use a lot of power, but have less potential for producing ground currents than do 120-volt appliances (ground currents within the house are a major source of magnetic field exposure);
5. Increased use of two secondary wires of opposite polarity, instead of only one "hot" wire, to serve homes (greater cancellation of in-house fields from ground currents);
6. Increased use of nonconductive elements (nonmetallic pipe, nonconductive joints, service insulators, etc.) in the plumbing system to which electric power is grounded. *This practice is especially important because it generally prevents injection of neutral currents into the plumbing system, which is arguably the most important underlying cause of magnetic field exposure within a house—both from ground currents flowing through the house and from the resulting net currents on distribution lines running past the house.*

These considerations (especially the last) seem largely to explain why, in the Savitz data, homes in newer suburban areas (where many people live today) clearly show *lower* magnetic field measurements than homes in older suburban areas. Thus, in spite of increased power use, it is likely that magnetic field exposures associated with power distribution have decreased, if anything, over the years for which reliable cancer data are available—at least in the Denver area, and probably nationwide.

Nancy Wertheimer, PhD
Ed Leeper, MA
Boulder, CO

UPDATES

CELLULAR COMMUNICATIONS

Court Blocks Cellular Transmission Tower... Opponents of a proposed 300-foot tower near Butler Township, PA are expressing confidence that they can stop the project. A Pennsylvania Common Pleas Court judge ruled in their favor on May 26, denying a request by Bell Atlantic Mobile Systems Inc. to reverse a decision by the Butler Township Board of Commissioners, which rejected the company's application for a development permit last January. The judge, George Kiester, believes an appeal is likely, according to an account in the May 28 *Butler Eagle*....A tower proposed by Cellular One is meeting with disapproval among residents of Old Chatham, NY. Three letters to the editor published in a local newspaper, *The Independent*, on May 28 expressed skepticism about the company's assurances that the tower would pose no health threat. The facility is aimed at improving cellular phone coverage for motorists on several major highways in the area, leading to the complaint in one letter that, "It seems to us that the main beneficiaries will be cars and trucks on I-90...."

MEASUREMENTS

RF/MW Standard Approved...ANSI has approved a new standard, ANSI/IEEE C95.3-1992, *Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields—RF and Microwave*. It is available for $54.00 from: IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08855, (800) 678-4333.

Swiss RF/MW Report... An advisory group to the Swiss Federal Office for Environment, Forests and Landscape has published *Non-Ionizing Electromagnetic Radiation Measurements—Part 1: Frequency Band 100 kHz to 300 GHz*, Environmental Protection Document No. 164. For a copy of the report, contact: P. Roch, OFEFP, Hallwylstrasse 4, 3003 Bern, Switzerland, (41+31) 616964; include a self-addressed mailing label with your request. The report is only available in French or German. In 1990, this advisory group endorsed IRPA's standards for human exposure to RF/MW radiation (see *MWN*, J/A90).

ELF and RF Body Current Meters... Holaday Industries Inc. has introduced two new products: a 3-axis ELF magnetic field meter and an induced body current meter. The ELF meter, HI-3627, measures 30 Hz to 2 kHz magnetic fields from 0.2 mG to 20 G. It is similar to the HI-3624, but can give a true rms reading, according to Holaday's Dave Baron. It costs $1,495. Holaday's HI-3701 meter can measure body currents induced by 3 kHz to 100 MHz radiation. The device, which looks like a bathroom scale, can be used to judge compliance with the 1992 IEEE/ANSI RF/MW exposure standard. Although the unit was based

on the research of Dr. Om Gandhi of the University of Utah (see *MWN*, J/A85), Holaday designed it independently, Baron said. The HI-3701 costs $3,495.

RADAR

NEXRAD Environmental Report... The WSR-88D radar—better known as NEXRAD—will have "no significant adverse environmental impacts," according to a draft environmental assessment issued by the National Oceanic and Atmospheric Administration (NOAA) in April. The report also asserts that transmission lines built to power the radar will not threaten public health. The study, prepared by SRI International in Menlo Park, CA—which has also prepared environmental assessments for the U.S. Air Force—concedes that RF radiation can cause biological changes by heating molecules in the body, but states that WSR-88D emissions "add heat at rates well below the human body's ability to dissipate heat." Studies that have shown that RF radiation can affect the blood–brain barrier, brain waves and the heart without exceeding this heating threshold were later found to have been "obtained erroneously," according to SRI. The WSR-88D radar will use microwaves in the 2.7-3.0 GHz frequency band, with a maximum peak radiated power of 475 kW and an average radiated power of 1 kW or less. Exposures will not exceed the guidelines adopted by the IEEE's SCC-28 in 1991 (see *MWN*, N/D91). Worldwide, 173 sites have been selected for the WSR-88D radars. Ten have been built, of which two are operating in a "testing mode," according to Andrew Anderson, a NOAA engineer. The agency is revising the draft assessment and a final report is expected by the fall, Anderson told *Microwave News*. To order a free copy of the draft *Supplemental Environmental Assessment of the Effects of Electromagnetic Radiation from the WSR-88D Radar*, contact: Andrew Anderson (15204), NOAA, NEXRAD JSPO, 1310 East West Highway, Silver Spring, MD 20910, (301) 713-0144. For more on NEXRAD, see *MWN*, M/A92.

STANDARDS

Puerto Rico Adopts RF/MW Rules... Responding to a "proliferation" of new radio, television, microwave and cellular telephone towers, Puerto Rico's planning board has developed new RF/MW exposure limits and criteria for siting telecommunications facilities. Signed by Governor Rafael Hernández-Colón on June 4, the new rules follow the outline of the National Council on Radiation Protection and Measurements (NCRP) standard for the general public—for example, 200 $\mu W/cm^2$ at 30-300 MHz and 1 mW/cm^2 at 1.5 GHz. A more stringent 10 $\mu W/cm^2$ limit had been included in a previous draft of the rules, but this had been sharply criticized by some in the cellular phone industry. "We impressed on [the planning board] that we preferred the ANSI or NCRP guidelines," said William King, president of CCPR Services Inc., an independent company that operates in Puerto Rico under the Cellular One name. King told *Microwave News* that 18 applications for new cellular transmission facilities filed by his company since 1990 had been held up pending enactment of the new rules.

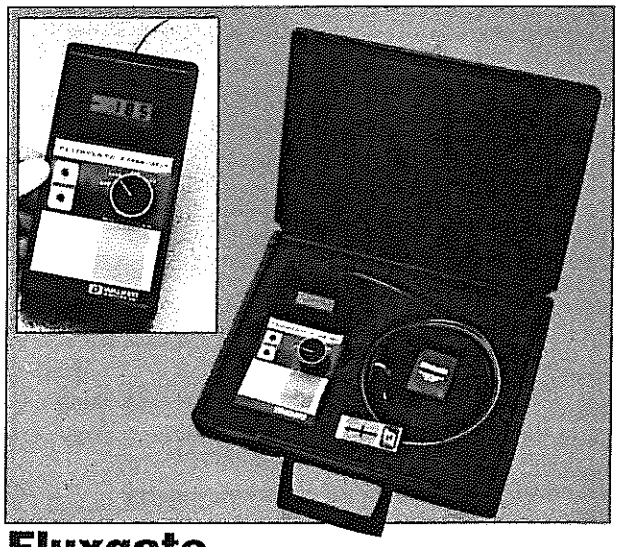
ETC...

The View from Hollywood... If anyone doubts that EMFs have yet to permeate American culture, take a trip to the local cineplex and see *Honey, I Blew Up the Kid*, one of this summer's biggest hits. After the "kid" is accidentally hit with a high-tech laser beam—which puts him on a fast-track growth curve—his condition is aggravated by EMFs from a microwave oven, a TV and, of course, a high voltage power line.

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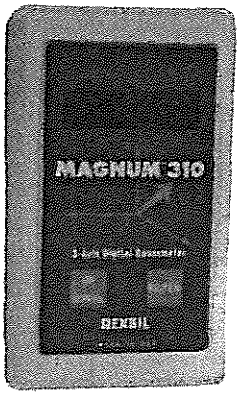
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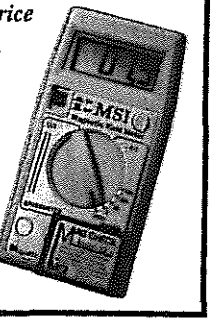


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German Animal Studies Support EMF–Breast Cancer Link

A Boost for the Melatonin Hypothesis

German scientists have found strong support for the proposition that electromagnetic fields (EMFs) can promote breast cancer. In a series of animal experiments, they have shown that magnetic fields can magnify the action of a chemical carcinogen, increasing the incidence of breast tumors. They have also thrown some light on a possible mechanism by showing that the EMFs reduced the animals' melatonin levels.

In a paper that appears in the July 30 issue of *Cancer Letters*, Dr. Wolfgang Löscher and coworkers at the School of Veterinary Medicine in Hannover report that long-term exposure to 50 Hz magnetic fields "promotes the growth and increases the incidence of mammary tumors." This finding, they say, "strongly [indicates] that magnetic field exposure exerts tumor-promoting and/or co-promoting effects."

Löscher continuously exposed 99 rats that had been treated with DMBA, a known carcinogen, to a 1 G magnetic field for three months and found that 50% more rats developed tumors than did others who were only treated with DMBA. The increase is statistically significant. Löscher is in the process of repeating the study using 100 mG. "If we find something, we'll try 10 mG," he told *Microwave News*.

(continued on p.13)

EPA Scales Back Cancer Review, To Eliminate EMF & RF/MW Programs

The Environmental Protection Agency (EPA) will not revise its 1990 report on the possible cancer risks associated with electromagnetic fields (EMFs). Instead, the agency will prepare a 30-page summary of the scientific data. This is scheduled for release at the end of 1993 or early in 1994.

At the same time, EPA's Office of Radiation and Indoor Air (ORIA) is proposing to phase out practically all work on non-ionizing electromagnetic radiation (NIER)—including both EMFs and radiofrequency and microwave (RF/MW) radiation—as part of the President's plan to reduce the budget deficit. If the ORIA budget is adopted, by fiscal year 1995, which begins on October 1, 1994, there will be only one staff position in the entire agency for these programs. They are vulnerable to budget cuts, according to EPA managers, because they are discretionary, with no specific congressional mandate.

"We thought it would be a duplication of effort to revise the cancer document," Dr. Robert McGaughy, a senior scientist at EPA's Office of Health and Environmental Assessment (OHEA) responsible for the report, told *Microwave News*. He cited the similar efforts under way by the National Council on Radiation Protection and Measurements and by the National Academy of

(continued on p.14)

« Power Line Talk »

What will it take to convince skeptics that there is indeed an EMF–cancer connection? Dr. **David Bates**, a highly regarded Canadian epidemiologist, says that only a prospective occupational study will do the trick. Countering the popular opinion that animal studies are the missing link, Bates points to Sir Richard Doll's prospective study of smokers as having turned the tide against cigarettes. In his opening address to the **Bioelectromagnetics Society**'s annual meeting, in Los Angeles in June, Bates said that the current EMF evidence is not strong enough to shift the burden of proof for establishing safety onto the electric utilities. On the other hand, he argued that it is entirely proper to take protective steps before understanding the mechanism of action. One should not have to wait until all the data is in hand, he said — after all, no one yet knows why cigarettes and asbestos act synergistically to magnify cancer risks. Bates, an emeritus professor of medicine at the University of British Columbia in Vancouver, Canada, recalled that he advocated taking the lead out of gasoline as early as 1972, long before this view became the prevailing public policy. He also urged people to be wary of those who sum up the epidemiological evidence with phrases such as "no scientific proof that..." or "no objective evidence of...." Whenever one hears such phrases, Bates advised, it is a good idea to seek some clarification. In an interview with *Microwave News*, Bates endorsed a policy of prudent avoidance—citing as an example a hospital in Seattle where exposures reached 100 mG. "That's too high," he said; he suggested converting the area into a storeroom. But, on further questioning, he declined to specify a level that he would consider safe. Bates said the epidemiological data have gained consistency and are more biologically plausible than in 1990 when the EPA released its EMF–cancer assessment. Bates was the vice chair of the committee that reviewed the document for the Science Advisory Board (see *MWN*, J/F 91). Bates cautioned that a prospective study of EMF-exposed workers would take a long time, but, he said, there really is no other choice because "no animal study can tell you enough." (Much of Bates's speech was drawn from a series of lectures he gave at the University of Washington, Seattle, last March, which will be published later this year by the University of Washington Press.)

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Somewhere in the budget process, the national EMF research and communications program (**NERP**) lost $5 million and no one seems to know how or why. Last year's Energy Policy Act mandated $13 million a year, for five years, for the NERP, but that amount has now shrunk to $8 million—and it could easily shrink further in the budget battles to come. When details of the President's 1994 budget first leaked out earlier this year, we were told that the NERP would get $12 million: $6 million from Congress, to be matched by $6 million from industry. At the same time, **DOE**'s ongoing research effort was to get $4 million. When the House passed its appropriations bill in June, the NERP and DOE figures were switched. Cutting $2 million from the NERP budget will cost the program another $2 million in industry matching funds. Last November, at the annual DOE EMF research review in San Diego, DOE's Robert Brewer told us emphatically that there would only be one EMF research effort, the NERP (see *MWN*, N/D92). The DOE program appears to have made a surprising comeback. It is now bigger than the much-touted national program. DOE officials say there never was a switch and that now nothing can be done to reallocate the money. After all, they argue, if anyone rocks the boat at a time when budgets are being slashed, they risk losing everything. In an interview, **James Cunningham** of the New York Power Authority, who lobbied hard to enact the NERP, expressed frustration over the budget cuts and the slow progress. "The intent of Congress was clear," he said. "The program should be fully funded." He warned that, "The public wants answers and wants them soon." Nothing is certain until the Senate acts and the House and Senate agree on a compromise. The Senate may in fact be sympathetic to the need for the NERP. Last August, 15 senators signed a joint letter calling the NERP "imperative." They also specifically supported the designation of NIEHS as the lead agency for carrying out EMF research. The new NERP advisory committee is writing a letter to the Senate Appropriations Committee stressing the need for a full program. At its first meeting on August 5-6, **Shirley Linde** of Citizens for Safer EMFs, in Los Angeles, was elected chair of the committee and **John Coughlin**, a commissioner at the Wisconsin PSC, was elected vice chair. The committee's next meeting is scheduled for November 4-5 in Savannah, GA, following the DOE contractors' review (see *MWN*, M/A93).

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A British couple has filed a suit alleging that their 13-year-old son's leukemia was caused by EMFs from a nearby substation, buried power lines and household wiring, according to British news reports. If brought to trial, this case would be the first of its kind in the **United Kingdom**. In mid-August, the family won legal aid to pursue the case—legal aid is provided to those who can demonstrate an economic need and can show that their claim has merit. **Simon Studholme**, who died last year, was diagnosed with leukemia 19 months after the family moved into a home near Manchester, in northern England. A survey of the family's home by Alasdair Philips, an electronics engineer, indicated that the magnetic fields in the boy's bedroom were "ten times the level[s] American and Swedish studies had linked to an increased risk of childhood leukemia," according to the August 23 *Daily Telegraph*. (Roger Coghill of Coghill Research Labs in Gwent, Wales, has also done measurements in the Studholme home.) Simon's father, Ray Studholme, is also seeking damages for his 12-year-old daughter's epilepsy, and he wants Norweb, the local electricity company, to reduce the EMFs in his home. On August 22 the *Sunday Times* reported that Norweb denies liability and refuses to mitigate the EMFs. Ray Studholme, who is being represented by attorney **Martyn Day** of the London firm of Leigh, Day & Co., argues that if his family had been warned, their son would not have slept so close to the household electric meter, which was located on the other side of the wall next to the boy's bed. In the past, Day has worked on ionizing radiation cases. The Studholmes' argument is similar to the

claim made by the **Zuidema** family in the U.S. The Zuidemas—whose daughter developed a rare kidney cancer—argued unsuccessfully that San Diego Gas & Electric had had a duty to warn its customers about the potential health effects of EMFs (see *MWN*, M/J93). On August 23 the London *Times* speculated that, "The case could lead to scores of similar claims, forcing electricity companies to monitor thousands of homes and eliminate any risk from pylons and substations, at huge expense."

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The **DOE** has declined to initiate a nationwide EMF survey of schools near power lines, as was requested by New York State Attorney General **Robert Abrams**. Instead, the question will be left to NERP policymakers. "Decisions to conduct nationwide surveys of particular field sources, such as transmission line fields near schools, will be made a part of this national effort," wrote DOE's Dr. **Robert San Martin**, acting assistant secretary of energy efficiency and renewable energy, in a July 7 reply to Abrams. The attorney general had written to Energy Secretary **Hazel O'Leary** on June 22, asking that she "use the power and influence" of her office to urge utilities across the country to conduct EMF surveys at schools. "The time is ripe for the DOE to take a strong national lead on this issue," Abrams wrote. The call for a national effort came as New York was finishing its own schools survey—a similar effort is under way in New Jersey and another has been proposed in Maryland by state Delegate **Joan Pitkin**. The California Department of Education's EMF–schools task force is considering a proposal by Dr. **Raymond Neutra** of the Department of Health Services and utility representatives to identify schools that are near transmission lines. Of the more than 6,000 schools in New York, 115 are near high voltage overhead power lines, and 24 are thought to have EMFs in excess of 2 mG, according to a report released by Abrams on July 22. The levels were calculated with computer models—on-site measurements have not yet been taken. The highest peak levels, 35 mG and 33 mG, were found at schools in Westchester and Erie Counties, respectively. School officials now have the option of requesting on-site measurements by the utilities that operate the lines, "so that the public may be fully informed about the potential for EMF exposure," according to Abrams. The majority of the 24 schools are located near power lines operated by Consolidated Edison Co., Long Island Lighting Co. or Niagara Mohawk Power Corp. (For more on New York's EMF survey, see *MWN*, N/D92, M/A93 and M/J93; for more on California and EMFs in schools, see *MWN*, M/J88 and M/J93.)

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An ad in the July/August issue of ***E Magazine***, an environmental bimonthly, introduces a new, bimonthly "consumer newsletter for electric and magnetic fields." Our interest piqued, we decided to find out who is behind the new publication, which has the provocative name ***EMF: Between the Lines***. Subscription inquiries are directed to the Center for Energy Information in Augusta, ME. At the bottom of the ad is this statement: *"EMF: Between the Lines* does not accept any form of advertising, endorsement, or sponsorship." It turns out that, such a statement of independence notwithstanding, the Center for Energy Information is a division of **Central Maine Power** Co. (CMP). The utility's name does not appear anywhere in the ad. It does appear, however, in a smaller ad that ran in the September/October issue of *E*. "It took us a while to put two and two together that it was CMP," the magazine's associate publisher, Deborah Kamlani, told *Microwave News*. But when payment for the first ad arrived, the check was from CMP, and Kamlani asked *EMF: Between the Lines* to name CMP in any future advertising. Judy Franke, editor of the newsletter, asserts that the utility was not mentioned in the initial ad because "the management of CMP has no say whatsoever in what we do." Franke described the Center for Energy Information, which also publishes a biweekly industry newsletter, *EMF Keeptrack* (see *MWN*, J/F92), as "an independent information brokerage company." CMP will probably not be mentioned anywhere in the newsletter itself, Franke said, though a final decision has not been made. The first issue will come out in September. If you read carefully—between the lines, one might say—there is a clue in the original ad in *E* that a utility is involved: the address for the Center for Energy Information is on Edison Drive.

"It's the Wires"

The following is excerpted from an article, "The Devil in Long Island: What's possessed this once-somnolent suburban realm and turned it into a tabloid pandemonium of spouse-slayers, serial killers and demented dungeon-builders?" It was written by Ron Rosenbaum and appeared in The New York Times Magazine *on August 22. Parts of New York City as well as Nassau and Suffolk Counties are on Long Island.*

Why is this Island different from all other islands? And why are so many Long Islanders suddenly running amok?

The question of Long Island uniqueness was posed in a particularly acute way by one of the characters on one of those three Amy Fisher-Joey Buttafuoco made-for-TV movies.

The scene: The interior of Joey's Complete Auto Body Shop. One of Joey's employees is theorizing about the deep, underlying source of the love triangle shooting. He's obviously given some thought to the vexing question, attributing it to "Mid-Island Syndrome."

"It's the wires," he declares. "The wires weren't buried underground like in other parts of the country, so with all this electricity in the air, it fries some people's brains."

Now there are some practical objections to this theory. A Lilco spokeswoman, after checking with the Long Island power company's electric service operations department, insisted that Long Island does not differ from the rest of the nation in the way it deploys its high-tension lines and that, in fact, more are buried than exposed. Still, the power line explanation at least attempts to offer a unified field theory of Long Island mania. And even the Lilco spokeswoman, perhaps attempting to divert attention from the power lines, offered an implicit endorsement of the quest for *some* explanation.

"Now the water—that's another story," she said.

Rhode Island Governor Vetoes Bills To Bury Power Lines

Rhode Island nearly became the first state to prohibit the construction of overhead transmission lines near homes and schools. At the last minute, the state senate reversed itself and decided not to override a veto by Democratic Governor Bruce Sundlun.

A bill introduced by Sen. Mike Lenihan (SB570) would have forced new power lines of at least 69 kV near residences and schools to be built underground. A companion measure in the house, sponsored by Rep. Russell Bramley (HB6882), would have required that *all* new lines of at least 69 kV be buried.

In his veto messages for both bills, Sundlun said that evidence of an EMF–cancer link is "weak, inconsistent and inconclusive," and that "most scientific studies do not support the findings that would be recognized and adopted" if the bills were to become law. He argued that high voltage transmission lines represent "a small fraction" of public exposure to EMFs, that the measures would not significantly reduce such exposure and that burying power lines would increase electricity costs in the state. Bramley's bill passed the house 78-7 and was vetoed on July 21. Lenihan's measure was vetoed on July 13, about a month after it had passed the senate 25-19.

On July 19, the senate voted 28-16 to override the veto of Lenihan's bill. But later that day, after a motion was made to reconsider, the senate fell short of the three-fifths majority necessary for an override and the veto held. Lenihan said that he thinks the reversal was unconstitutional and he attributed the switch to aggressive lobbyists "who got five or six people to change their minds" during a break after the first session. Ed Seiler of Rhode Islanders for Safe Power, which actively supported the bills, called the move "Rhode Island corruption at its worst," adding that opponents of the bill "didn't win [the decision], they stole it."

The Providence-based Narragansett Electric Co. does not claim credit for the override. After losing the first vote, its lobbyists went home, according to the utility's associate counsel, Ronald Gerwatowski. "But we were delighted with the result," he said, adding that the legislation is "unnecessary because the science to date doesn't support the conclusions that there are adverse health effects from power line EMFs, and [burying the lines] would add to the costs of electricity in Rhode Island, which are already high."

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Kevin Brubaker, an environmental policy analyst for the governor, said that Sundlun's legislative director and staff were present during both override votes, and that it would be "fair to conclude that they were communicating the governor's views on the issue." He argued that the switch was not unconstitutional.

On July 22, the house overrode Sundlun's veto of Bramley's bill, but the session ended before the senate could vote on it. The house bill was thought to have much less of a chance than Lenihan's, because it was the more far-reaching of the two bills. Bramley and Lenihan, both of whom are Democrats, said that they will introduce similar measures again next year. "We're going to keep knocking at the door until someone opens it," Lenihan said.

California PUC Judge Issues Long-Awaited EMF Proposal

After two and one-half years of workshops, meetings and paperwork, a California administrative law judge has decided that EMFs from new power lines should be reduced by at least 4%—as long as the cost of doing so is no more than 4% of a project's total budget.

The July 12 proposal by Public Utilities Commission (PUC) Judge Michael Galvin still must be approved by the four-member commission, which could elect to adopt all, part or none of the plan. The commissioners are scheduled to meet on September 17.

Galvin's 57-page decision is based, in part, on a set of proposals for a state EMF policy devised by a PUC consensus group made up of utility representatives, government health officials, ratepayers, environmentalists and union members. The plan was presented to the PUC on March 20, 1992 (see *MWN*, N/D91 and M/A92).

Galvin also recommended the following:

- A $5.6 million, four-year "nonexperimental" state research program to review policy options and mitigation strategies;
- A maximum $4.1 million contribution to the national EMF research and communications program;
- A $1.6 million, four-year California education program;
- An EMF "Stakeholder Advisory Committee" to monitor and report on the state research program.

Overall, the proposal received mixed reviews from members of the consensus group. But Galvin's plan to reduce EMFs by 4% faces widespread opposition.

Southern California Edison's Jack Sahl supports the decision to cap the cost of EMF reduction measures at 4%, but said that mitigating EMFs by at least 4% would be "administratively unwieldy, because of the burden of having to determine what 4% is." Sahl also criticized what he called a "cookbook" approach to controlling power line EMFs, advocating instead project-by-project evaluations, which would put greater emphasis on community input when deciding on reduction levels.

Ellen Stern Harris of the Fund for the Environment in Beverly Hills opposed the selection of the 4% cost and reduction thresholds, saying that they "make no sense" and represent

"tokenism at its worst." Harris also said that she was "shocked" that the proposal does not order retrofits to reduce EMFs on existing power lines.

The PUC's Division of Ratepayer Advocates (DRA) called Galvin's proposal to cut magnetic fields by 4% "confusing" because "there is no cost–benefit analysis in the record to support this number," according to its formal comments to the PUC. The DRA also recommended a policy that "explicitly requires the utilities to reduce EMF fields as much as possible, but at least by the adopted minimum."

DRA's Diana Brooks endorses Galvin's decision to deny the utilities' request that the PUC approve the way they choose to implement EMF reduction measures. "The bottom line is that the onus is still on the utility," she said, explaining that without validation by the PUC, utilities will have to answer to their local communities.

Galvin's order states that utilities will decide how to carry out the "low-cost" EMF reduction measures, and that they will be able to choose which projects should be exempt—for example, a new power line built in a rural area.

Fresno School EMF–Cancer Case Dropped, But More May Follow

The family of a former teacher at the Slater School in Fresno, CA, has dropped its suit against Pacific Gas & Electric Co. (PG&E), but another EMF–cancer case against the utility is pending and more may soon follow.

The Slater School was first put in the spotlight by Paul Brodeur in a December 7, 1992, article in *The New Yorker*. Brodeur drew a connection between a high rate of cancer among teachers and EMFs from power lines outside the school and criticized the cluster investigation by the California Department of Health Services (DHS) (see *MWN*, N/D92, J/F93 and M/A93).

The first suit, which was filed by the family of Katie Mae Alexander, a former teacher at the school, was dropped amid a shuffling of lawyers. Alexander died in April 1991 at the age of 53 from a brain tumor her family says was caused by EMFs from PG&E power lines. The teacher had worked in classrooms on the south side of the school, nearest the 115 and 230 kV lines.

The suit was filed on April 21, 1992, by Haskell Shapiro, now of Shapiro & Hickman in Los Angeles. But the family replaced Shapiro after learning that he had not prepared for the case and had missed several appointments and deadlines, according to Tommie Nellon, Alexander's son. The family also asked for a continuance while it searched for a new attorney. Shortly before the July 26 trial date, after a Fresno County Superior Court judge denied the request, the family accepted PG&E's offer to waive legal expenses in return for their dropping the suit permanently.

A second claim, filed by Shapiro in February 1993, was taken over by Joe Davis of the Los Angeles firm of Davis & Winston on August 6. This suit was brought on behalf of former assistant principal Curtis Hurd, who joined Slater in 1986 and died of colon cancer in February 1992 at the age of 43. In a telephone interview, Davis said that several more Slater staff, students and community members want to file similar suits against PG&E, and that their actions will most likely be consolidated with the Hurd case.

PG&E's lawyer, Roger Rizzo of Sedgwick, Detert, Moran & Arnold in San Francisco, said that the Alexander and Hurd claims are without merit, and that similar future cases will have little chance. "I don't think that anyone will be any more successful than Alexander was," he told *Microwave News*. Rizzo maintained that Alexander's claim was "completely inaccurate" and said that the utility's twelve expert witnesses were prepared to testify that EMFs do not cause cancer. PG&E had also taken depositions from four "neutral, unpaid" physicians who treated the teacher and who stated that her cancer was not caused by EMFs, Rizzo said.

Danish Government Finds No Need for EMF Exposure Limits

The Danish Ministry of Health has decided that there is "no scientific reason" to set standards limiting exposure to power line EMFs, according to a report published in May.

A group of experts convened by the ministry determined that while the Swedish and Danish epidemiological studies completed last year (see *MWN*, S/O92 and N/D92) "support the hypothesis of previous studies that children living near high-current [facilities] have an increased frequency of cancer," they do not provide strong enough evidence of an EMF–cancer link to merit setting exposure standards. "Neither the earlier nor the latest studies offer sufficient documentation to characterize 50 Hz magnetic fields in homes adjacent to high-current electricity supply [facilities] as a cancer-inducing factor among children," the report states, noting that the observed increased risk might be due to chance.

These conclusions stand in contrast to those reached by the Swedish government. Last fall, Sweden's National Board for Industrial and Technical Development, NUTEK, announced that it would "act on the assumption that there is a connection between exposure to power frequency magnetic fields and cancer." Officials are now in the process of drafting a proposal for a national magnetic field exposure limit for new power lines and substations (see *MWN*, S/O92 and M/J93).

In reaching its decision, the Danish group also focused on the review by the U.K.'s National Radiological Protection Board (see *MWN*, M/A92).

The group of experts was chaired by Professor Carl Wandel of Aarhus University in Aarhus, Denmark. To order a copy of the report, *Rapport om Risiko for Kraeft hos Born med Bopael Eksponeret for 50 Hz Magnetfelter fra Hojspaendingsanlaeg [Report on the Cancer Risk for Children in Homes Exposed to 50 Hz Magnetic Fields from High-Voltage Power Systems]*, contact the expert group at the health ministry at: Sundhedsstyrelsens 1. Afdeling, Amaliegade 13, 1012 Copenhagen, Denmark, fax: (45) 33 93 15 63.

With respect to Hurd's case, Rizzo said that the assistant principal had worked about twice as far away from the power lines as Alexander did. He was exposed to "very, very low levels of EMFs, not unlike what people across the country are exposed to every day," Rizzo said.

Early in 1991, the DHS was asked to evaluate a possible cancer cluster at the Slater School, after teachers there had raised concern about power line EMFs. The DHS released a report this June which concluded that 13 cases of different types of cancer among Slater School staff—about twice the expected number—were probably due to chance. "Past experience has been that in suspected cancer clusters for which a probable cause has been found, the cancers have all been of the same kind...[and] there was a large excess of cancer cases, twenty to thousands of times higher than the expected number," the report states. It also notes that there have been no reported cases among Slater staff of leukemia or lymphoma, "the types of cancer most commonly reported associated with EMFs." Eleven of the 13 staff members with cancer worked in classrooms on the south side of the school, near the power lines.

Davis argues that the DHS may have underestimated the number of cancer cases at the school because researchers failed to locate or contact half of the 195 teachers, aides and administrators who worked at Slater between 1972—when the school opened—and 1993. He also said that additional cancer cases have been reported in the short time since the study was published.

The report answers this criticism by stating that even if more cancer cases came to light, "there would still not be the 20 to thousandfold excess" characteristic of clusters with a known cause. In August, Dr. Eva Glazer of DHS's cancer surveillance section, who cowrote the report with Dr. Raymond Neutra, chief of the department's Environmental Health Investigations Branch, did confirm a 14th cancer case.

Investigators found that in the section of the building closest to the power lines, magnetic fields did not exceed 2 mG on most days and reached a long-term average of about 1 mG, according to the report. The study noted that there are "periods of time" when fields can reach up to 5 mG in these rooms. In the single classroom nearest the lines, levels were estimated to have been above 2 mG 29% of the time.

HEI Completes Research Plan

In June, the Health Effects Institute (HEI), based in Cambridge, MA, released its much-delayed EMF research plan. The 131-page document outlines a five-to-seven-year program with a price tag of about $60 million, detailing specific research areas.

"HEI is prepared to do the research," according to a statement from the HEI board included in the document. "But the important thing is that a carefully formulated strategy for five to seven years of interdisciplinary research be carried out under some central direction," the board concluded. HEI does not currently have any funding for EMF research. "If people say that the folks who put that research plan together ought to be the ones to carry it out, I guess they'll come to us," explained Dr. Charles Powers, founder and acting president of the institute.

HEI began developing this plan in 1990, with funding from the Environmental Protection Agency, the Large Public Power Council, the Los Angeles Department of Water and Power and Seattle City Light. A draft of the plan completed in 1990 was rejected by HEI's board, which asked for a revision with broader context and "clear expressions of priority," according to Andrew Sivak, then president of the institute (see *MWN*, N/D91).

For a copy of *Do Electric or Magnetic Fields Cause Adverse Health Effects? HEI's Research Plan to Narrow the Uncertainties*, contact: HEI, 141 Portland St., Cambridge, MA 02139, (617) 621-0266.

The following expert witnesses had been scheduled to testify for the Alexanders: Dr. Samuel Milham, formerly of the Washington State Department of Health in Olympia and Dr. Peter Wright of the Poly Clinic in Seattle. PG&E's expert witnesses were to have included: Dr. Edwin Carstensen of the University of Rochester, NY, Dr. Philip Cole of the University of Alabama, Birmingham, Dr. Mark Mandelkern of the University of California, Irvine, and Michael Silva of Enertech Consultants in Campbell, CA.

FROM THE FIELD

SCE Cancer Study of Electric Utility Workers: An Exchange

Earlier this year, a team of researchers led by Jack Sahl of Southern California Edison Co. (SCE) in Rosemead published an epidemiological study—J.D. Sahl, S. Greenland and M.A. Kelsh, "Cohort and Nested Case-Control Studies of Hematopoietic Cancers and Brain Cancer Among Electric Utility Workers," Epidemiology, 4, *pp.104-114, 1993—which found no consistent association between on-the-job EMF exposures and mortality from leukemia, brain cancer or lymphoma (see* MWN, *M/A93). Dr. Sam Milham has voiced concern over certain aspects of the study. His detailed argument is reprinted below, together with a response by Sahl and coworkers.*

To the Editor:

In the course of my recent EMF expert witness work, I have been questioned at length about the "negative" EMF–cancer study of the SCE utility workers cohort. There are a number of findings in the report which make me question its negativity.

1) On p.107, the last sentence of the case–control occupational history assignment section states, "Of the occupational assignments, 21% among cases and 17% among controls were 'electrical occupations.'" Cases were utility workers dying of leukemia, brain cancer and lymphoma.† There were 773 male cases (Table 1, p.106). The number of "electrical workers" dying of leukemia, brain cancer and lymphoma is simply calculated as 0.21 times 773 or 162.3, while the expected number is 0.17 times 773 or 131.4. The difference between the observed and expected electrical workers among the cases is statistically signifi-

cant ($x^2_1 = 7.3$; $p < 0.05$). This leads me to conclude that electrical workers are statistically significantly overrepresented among the leukemia, brain cancer and lymphoma deaths in this utility workers cohort.
2) From the first line of Table 1, I calculated that the case cancers (leukemia, brain cancer and lymphoma) made up 17.2%† of all cancer deaths in men in the cohort. In my experience with similar occupational cohorts, these cancers ordinarily make up about 12% of total cancers. For example, in my California amateur radio operator study§ (Table 1, p.52), there were 700.6 deaths expected in California due to all cancers and 77.6 deaths expected due to leukemia, brain cancer, lymphoma, Hodgkin's disease and multiple myeloma. The expected percentage of case cancers to total cancers was 11.1%.* Without detailed age data for this cohort (not shown in the paper), I cannot calculate a precise expected percentage.
3) In Table 7 of the Sahl study, an internal cohort analysis gave higher estimates of risk than did a case–control analysis for the same cause of death and job title. For example, in retired electricians, an internal cohort analysis gave a leukemia relative risk (RR) of 1.91, while a case–control analysis yielded an odds ratio (OR) of 1.11. Similarly, the RR of lymphoma in retired electricians was 1.65 in an internal cohort analysis vs. an OR of 0.87 in a case–control analysis. Variation in the definition of "exposure" seems to account for these differences, but I find it disconcerting that different methods of analysis of the same data give results that are this different.
4) Although the first word of the title of this paper is "cohort," no standardized mortality ratio (SMR) data are presented using local, California or U.S. death rates to calculate expected deaths. The first author of the paper assures me that these data will be presented in future reports.

For these reasons I feel justified in withholding a final decision on whether this study is negative or positive on the EMF–cancer question until I see more data.

Sincerely,

Samuel Milham Jr., MD, MPH
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Olympia, WA 98512

† The lymphoma group actually includes Hodgkin's disease and multiple myeloma in addition to the lymphomas.
‡ [(41 + 28 + 64) / 773] x 100 = 17.2%.
§ *American Journal of Epidemiology, 127,* pp.50-54, 1988.
* (77.6 / 700.6) x 100 = 11.1%.

Milham has identified four issues that cause him to question "the negativity" of our study of cancer mortality among electric utility workers. His comments, however, are based on inappropriate analyses or misinterpretations of our data.

Using data presented in our Methods section, Milham calculates expected versus observed exposure rates. This leads him to conclude that electrical workers are overrepresented among those who died of leukemia, brain cancer and lymphoma. However, his calculations are incorrect because they are based on data we used to assign occupational information for a subset of our cohort rather than the distribution of occupations within the total cohort. We described how there was missing occupational history data. Using a variety of decision rules, we imputed or assigned occupational data for a part of the total occupational history record. For cases and controls where we made occupational history assignments, 21% of the cases had an electrical occupation and 17% of the controls had an electrical occupation. These data do not refer to the relative numbers of electrical workers who are cases and controls. The data in Table 3 provide this information.

Secondly, Milham uses data from Table 1 in an attempt to calculate unadjusted proportional mortality ratios [PMRs]. This analysis highlights one of the limitations of PMR methods. Compared to another occupational cohort, Milham has suggested that our cohort has a proportional excess of leukemias, lymphomas and brain cancers. If it is appropriate to compare these two cohorts and if Milham's suggestion is true, then there are two possible interpretations. Either there was an excess of these cancers in our cohort, or the apparent relative excess is due to a deficit in other types of cancer. Our analysis is based on person-years† at risk for the denominator. Using person-years as a denominator for rate calculations is commonly accepted as the most appropriate method to estimate the proportion exposed in the study population that generated the cases.‡

Milham's third point raises interesting questions. Why are the results different when using different methods of analysis and why does the use of a single summary job title result in higher measures of association compared to analyses that include information from an entire occupational history? First, Milham incorrectly assumes that the different results are from the same data. They actually involve the use of different exposure data. Second, if there was a true risk, then using more complete and accurate job history information, coupled with magnetic fields measured in this work environment, should have provided higher measures of association. The lack of association observed when using stronger epidemiologic methods and more complete exposure data weakens the argument for a strong or moderate effect in this cohort. The specific bias that results from the use of a single occupational title has not been established. We have identified some candidates, some of which we discussed in the original paper.

Milham seems to criticize the use of the term "cohort" in our study title. He implies that without "standardized mortality ratio" analysis, this should not be considered a cohort study. Consulting the *Dictionary of Epidemiology,*§ we found no mention of an SMR analysis being a part of the definition of cohort (or cohort analysis or cohort study). Cohort refers to the well-defined group of people who were followed up over time, as in our study (36,221 people who had worked for SCE for at least one year between 1960 and 1988).

SMR analysis is not the method of choice in the analysis of cohort data.‡ Since we had collected complete demographic, occupational and mortality data on all SCE personnel, it would be inappropriate to use an external reference group in this analysis.‡ The use of an external comparison group introduces bias because of the lack of comparability on other important factors between the exposed and unexposed populations. The SMR can provide useful information when sufficient data are not available to generate a comparison group from within the cohort. Our intention is to publish results from PMR and SMR analyses to help us understand the potential bias introduced when using these analytical methods. In this forthcoming paper, we compare PMR/SMR results to the more appropriate results estimated from cohort person-time and nested case–control analyses.

Finally, it is an oversimplification to characterize our results as "negative." Because of the limited number of cases in our study, our results are compatible with weak EMF effects as well as no effect. We continue to follow up the SCE cohort to obtain more cases, which will eventually yield more precise results.

Sincerely,

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† In Table 3, the footnote for PY should read "person-years" rather than "proportion-years."
‡ K. Rothman, *Modern Epidemiology,* Boston: Little Brown, 1986.
§ J. Last, Ed., *Dictionary of Epidemiology,* First Edition, New York: Oxford University Press, 1983.

CTIA Drops FDA Role in Cellular Phone Research Program

The Cellular Telecommunications Industry Association (CTIA) is moving ahead with a three-to-five-year, $15 to $25 million research program, but the group has backed away from its plan to have the federal government oversee the studies. "This is going to be a scientific process that will stand on its own merits," said Dr. George Carlo, who has been put in charge of the initiative by CTIA.

At the same time, a senior official at the Food and Drug Administration (FDA)—the federal agency with the primary responsibility for regulating electronic products—has sharply criticized the industry association for presenting an overly rosy picture of cellular phone health risks. In a July 19 letter to CTIA President Thomas Wheeler, Dr. Elizabeth Jacobson, deputy director for science at FDA's Center for Devices and Radiological Health (CDRH), complains that Wheeler's confidence that cellular phones will be proved safe is "unwarranted." She also raises questions about the impartiality of the research initiative and about the way CTIA has portrayed the government's role. (The full text of the letter appears on p.9.)

CTIA has formed a three-person advisory group headed by Carlo, who is chairman of Health and Environmental Sciences Group, a consulting firm based in Washington. The advisory group is currently preparing an assessment of existing studies and a research agenda. Carlo has also set up a nine-member peer-review panel, which will comment on the research agenda and then work with the advisory group to develop requests for proposals (RFPs) for an initial six to eight studies. The RFPs should be issued in November, Carlo said, and funding should be in researchers' hands around the end of the year.

At a CTIA press conference in Washington on July 16, Carlo said that, so far, the advisory group's examination of the literature "has not yielded support for the cancer risk hypothesis." Wheeler, referring to "approximately 100" studies relevant to an evaluation of the safety of cellular phones, said that those analyzed so far "show that there is no relationship between exposure in cellular frequencies and cancer."

The research program was first announced last winter, in reaction to publicity about a lawsuit which alleges that cellular phone radiation caused a Florida woman's brain tumor (see *MWN*, M/J92 and J/F93). At a January 29 press conference, Wheeler announced that CTIA was "asking the federal government to appoint a blue-ribbon panel to review the methodology and findings of this research." No such committee has been formed, however.

Following a meeting between FDA and CTIA officials in mid-August, Dr. Mays Swicord, chief of the radiation biology branch at the CDRH in Rockville, MD, said that CTIA had "taken the offer off the table." FDA officials said that CTIA would not provide the agency with the control it requires to be directly involved in a research program. "We were ready to go ahead with it," Jacobson told *Microwave News*. "I thought it was a missed opportunity."

Carlo maintains that the process that CTIA has established "doesn't do away with the government role" that was initially described by Wheeler. But CTIA spokesman Ron Nessen said that, "Government regulations made it difficult or impossible to do a blue-ribbon panel." Although the FDA proposed a cooperative research agreement, Nessen said, "lawyers on both sides decided this was not a proper arrangement."

Swicord and Jacobson both said that they knew of no objections by FDA lawyers to a cooperative research agreement.

Both Carlo and Nessen emphasized that officials at the FDA, at the National Cancer Institute (NCI) and at other government agencies are being consulted regularly and will review the CTIA research. Carlo is organizing a symposium in Research Triangle Park, NC, on September 30 to discuss the research agenda. As many as 35 leading RF/MW researchers from government and academia are expected to attend, Carlo said.

In her letter to Wheeler, Jacobson wrote that CTIA's statements that the FDA would "review and validate" the research "did not accurately characterize the relationship between CTIA and the FDA." She continued: "It goes without saying that we would review your data."

Jacobson's letter also found fault with CTIA for displaying "an unwarranted confidence that these products will be found to be absolutely safe." She noted that some people "might also wonder how impartial the research can be when its stated goal is 'a determination to reassure consumers.'"

Asked about Jacobson's letter, Nessen said he had not seen it, adding, "I am not familiar with any such criticisms." Wheeler did not respond to repeated calls from *Microwave News*.

Reporters at CTIA's July press conference focused on how the advisory group had come to its conclusion that the existing research provides no cause for concern. Several questions addressed Dr. Stephen Cleary's work showing that brain tumor cells proliferated at an abnormal rate following an exposure to radiofrequency and microwave (RF/MW) radiation (see *MWN*, M/A90). Cleary, of Virginia Commonwealth University in Richmond, used frequencies above and below the 800-900 MHz radiation emitted by cellular phones, but he has said that he would expect to get similar results at cellular frequencies.

"There is a long stretch between being able to measure an effect and being able to identify an adverse process that will lead to cancer," Carlo told the reporters. When pressed to say whether his advisory group rejected Cleary's work, he said: "Those studies have not passed the test of scientific rigor." He added that scientists familiar with Cleary's research had reviewed it for him and had raised "serious questions about the laboratory methods."

Several weeks after the press conference, Carlo told *Microwave News* that "it is not clear-cut that there is something consistent going on" in Cleary's research. But he added, "I've read Cleary's work and it's very important. We may need to see whether or not it is replicable."

Carlo has invited Cleary to the September 30 symposium. Also invited are the other two members of Carlo's advisory group, Dr. Bill Guy, formerly of the University of Washington, Seattle, and Dr. Ian Munro, former director general of the Health Protection Branch of Health and Welfare Canada, along with

FDA to CTIA: There Isn't Enough Data To Gauge Cellular Phone Risks

The following is the full text of a letter, dated July 19, 1993, sent by FDA's Dr. Elizabeth Jacobson to CTIA President Thomas Wheeler.

Dear Mr. Wheeler:

I am writing to let you know that we were concerned about two important aspects of your press conference on July 16 concerning the safety of cellular phones, and to ask that you carefully consider the following comments when you make future statements to the press.

First, both the written press statements and your verbal comments during the conference seemed to display an unwarranted confidence that these products will be found to be absolutely safe. In fact, the unremittingly upbeat tone of the press packet strongly implies that there can be no hazard, leading the reader to wonder why any further research would be needed at all. (Some readers might also wonder how impartial the research can be when its stated goal is "a determination to reassure consumers," and when the research sponsors predict in advance that "we expect the new research to reach the same conclusion, that cellular phones are safe.")

More specifically, your press packet selectively quotes from our Talk Paper of February 4 in order to imply that FDA believes that cellular phones are "safe." ("There is no proof at this point that cellular phones can be harmful.") In fact, the same Talk Paper also states, "There is not enough evidence to know for sure, either way." Our position, as we have stated it before, is this: Although there is no direct evidence linking cellular phones with harmful effects in humans, a few animal studies suggest that such effects could exist. It is simply too soon to assume that cellular phones are perfectly safe, or that they are hazardous—either assumption would be premature. This is precisely why additional research is needed.

We are even more concerned that your press statements did not accurately characterize the relationship between CTIA and the FDA. ("CTIA has asked the Food and Drug Administration to review and validate this new research to ensure its credibility.") It goes without saying that we would review your data and provide comment on it—we view that as part of our job as a regulatory agency. But since it is not yet clear whether we will help to direct the research program, it is premature to state that we will credential the research.

To sum up, Mr. Wheeler, our role as a public health agency is to protect health and safety, not to "reassure consumers." I think it is very important that the public understand where we stand in evaluating the possibility that cellular phones might pose a health risk. I am concerned that your July 16 press conference did not serve that end as well as it should have.

Sincerely yours,

Elizabeth D. Jacobson, PhD
Deputy Director for Science
Center for Devices and Radiological Health
Food and Drug Administration
Rockville, MD

several members of the peer-review panel, according to Carlo.

The members of the peer-review group are: Dr. Patricia Buffler, University of California, Berkeley; Dr. Philip Cole, University of Alabama, Birmingham; Sir Richard Doll, Oxford University, Oxford, U.K.; Dr. Om Gandhi, University of Utah, Salt Lake City; Dr. Saxon Graham, State University of New York, Buffalo; Dr. Don Justesen, VA Medical Center, Kansas City, MO; Dr. Richard Monson, Harvard University School of Public Health (SPH), Boston, MA; Dr. Dimitrios Trichopoulos, Harvard SPH; and Dr. Gary Williams, American Health Foundation, New York City.

Cellular Phone Class Action Suit Dismissed, New Complaint Filed

A judge in Chicago has dismissed a class action lawsuit which alleged that cellular phone manufacturers failed to warn their customers of the possible risks associated with the use of hand-held cellular phones. The attorneys who began the suit filed an amended complaint a week later, however, on behalf of cellular phone users with brain tumors.

The original complaint, filed in early February, shortly after cellular phone safety grabbed headlines nationwide, was a class action on behalf of all users of hand-held cellular phones. Anthony Bass, an attorney with the firm of Holstein, Mack & Klein in Chicago, which filed the suit, declined to say at the time whether any of the named plaintiffs were known to have injuries that might be linked to cellular phone use. "As it stands now, they will be getting tests," he told *Microwave News.* Among other claims, the suit alleged that the manufacturers had breached their implied and express warranties by failing to provide a safe product.

In an August 12 decision, Illinois Circuit Court Judge Edwin Berman rejected this reasoning. He wrote that the FCC and the FDA "have primary jurisdiction over the issues raised in this case" and that state law is preempted by federal law. He also found that the plaintiffs "had not alleged any compensable injury." Berman noted, however, that his decision "does not affect current motions by certain plaintiffs to amend by adding a subclass of persons allegedly physically injured as a result of cellular telephone usage."

The amended complaint, filed on August 20, is on behalf of all cellular telephone users who have diagnosed or undiagnosed brain tumors, according to attorney Gina Fietsam, also with Holstein, Mack & Klein. Two plaintiffs are named "on behalf of all others similarly situated." They are: William Pogue, who began using a cellular phone in November 1991 and was diagnosed with a brain tumor in June 1992; and Matthew Crist, who began using a cellular phone in January 1992 and was diagnosed with a brain tumor in November 1992. They used phones manufactured by NEC America Inc. and Motorola Inc., which are named as the defendants.

Getting a Fix on Maglev, Electric Train and Subway EMFs

A series of new Department of Transportation (DOT) assessments of EMFs from a half-dozen existing electric train systems and an experimental magnetic levitation (maglev) system provides the most comprehensive information yet compiled on the nature and extent of the magnetic fields in passenger coaches, in locomotives and along railroad corridors.

The goal is to create "a data base of EMF characteristics of various transportation technologies," said Dr. Aviva Brecher, EMF research program manager at DOT's Volpe National Transportation Systems Center in Cambridge, MA. Prior to this effort, Brecher added, there was "no information whatsoever," even for the train technologies now in use, making it difficult to compare the EMFs from existing and proposed transportation systems.

The measurements were taken by Electric Research and Management Inc. (ERM), a consulting firm based in State College, PA, under contract to DOT. Altogether, ERM completed five separate measurement reports. These cover: Amtrak and New Jersey Transit trains; Boston's mass transit system; Washington's Metro system; France's high-speed TGV train; and the TransRapid maglev system or TR07, which runs on a test track in Emsland, Germany.

In a summary report, which draws on the findings of the other five, ERM noted that—counter to expectations—the TR07's EMFs are not unique. "The [magnitudes] of the maglev magnetic fields are not only reasonably typical of magnetic fields found on electrified transportation systems, but their frequency characteristics are not greatly different from the frequency characteristics found when looking at...electrified rail technology as a whole," ERM explained. (For a discussion of several other reports assessing the possible health risks posed by maglev and high-speed railroad EMFs, see box on p.11)

Average magnetic field levels near the floor in the passenger compartment of the TR07 were about 100 mG for the frequency range of 2.5 Hz to over 2 kHz, and they dropped off to about 20 mG "at standing head level," according to the maglev measurement report. "Spectrally, the maglev EMFs are richer than those associated with existing electric rail technology," ERM's William Feero told *Microwave News,* "but in magnitude they are not the strongest." Both Brecher and Feero noted, however, that other maglev systems, including a Japanese maglev, for which EMFs have not been measured, use superconducting technology which is very different from that of the TR07 and would have different EMF characteristics.

On an Amtrak coach, average magnetic fields in the 5 Hz to 2.56 kHz frequency range were 134 mG and peak fields reached 628 mG while the train was operating between Washington and New York—a section that is powered by a 25 Hz electrical system. Between New York and New Haven, CT, the average and peak fields were 52 mG and 305 mG, respectively; in this stretch, trains operate on a 60 Hz system. In both cases, the predominant magnetic fields were at the fundamental frequencies of the power systems—25 Hz or 60 Hz—and their harmonics.

The Boston and Washington mass transit systems—which use direct current—generally had much smaller time-varying magnetic fields than the intercity trains, but there was a notable exception. One type of subway car used on the Washington Metro system, the Series 3000, generated an average magnetic field of 317 mG and a peak field of 2,987 mG at the center of the passenger compartment. These fields are due to the control circuitry, which uses a semiconductor system rather than the electromechanical technology used in the other Metro cars. The semiconductor system is an electronic "chopper" that turns the power

Ordering Information

The ERM reports for DOT are being distributed by the National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161, (800) 553-6847. The titles are: ***Safety of High Speed Magnetic Levitation Transportation Systems: Magnetic Field Testing of the TR07 Maglev Vehicle and System,*** April 1992, Vol.1, PB92224666, 190 pp., Vol.2, PB92224674, 366 pp.; ***Magnetic and Electric Field Testing of the Amtrak Northeast Corridor and New Jersey Transit/North Jersey Coast Line Rail Systems,*** April 1993, Vol.1, PB93219434, 318 pp., Vol.2, PB93219442, 632 pp.; ***Magnetic and Electric Field Testing of the French Train A Grande Vitesse (TGV) Rail Systems,*** May 1993, Vol.1, PB93223071, 220 pp., Vol.2, PB93223089, 422 pp.; ***Magnetic and Electric Field Testing of the Massachusetts Bay Transportation Authority (MBTA) Urban Transit System,*** June 1993, Vol.1, PB93227619, 236 pp., Vol.2, PB93227627, 630 pp.; ***Magnetic and Electric Field Testing of the Washington Metropolitan Area Transit Authority Metrorail System,*** June 1993, Vol.1, 208 pp., Vol.2, 546 pp.; and ***Comparison of Magnetic and Electric Field Tests of Existing and Advanced Rail Systems,*** June 1993, 56 pp. The last two reports are not yet listed by NTIS, but they should be available later this fall. Prices range from $27.00 to $77.00 for paperbacks and from $17.50 to $27.00 for microfiche. A limited number of copies of these reports are available at no cost from: Arne Bang, FRA's manager of special programs, (202) 366-0457, or Dr. Aviva Brecher, (617) 494-3470.

The measurement system used by ERM for this project is described in an EPRI report, ***Measurement of Power System Magnetic Fields by Waveform Capture,*** February 1992, Report No. TR-100061, $200. Contact: Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081. There is no charge for most reports requested by EPRI member utilities, universities, U.S. government agencies and the media.

See also, J. Hadden et al., ***Safety of High-Speed Guided Ground Transportation Systems: Shared Right-of-Way Safety Issues,*** September 1992, PB93126530, 202 pp., $27.00 for paperback, $12.50 for microfiche. Available from NTIS. Based on the premise that any new high-speed rail or maglev service will have to make use of existing transportation corridors, this report examines numerous mishap scenarios. These range from a power line falling on a high-speed train to a maglev leaving its guideway and crashing into traffic on an interstate. EMF effects are considered as a possible interference problem: the report states that maglev equipment is likely to generate stronger EMFs than conventional railroads, and it concludes that, "Electronic controls on highway vehicles that have been designed to present SAE [Society of Automotive Engineers] standards may not be able to tolerate these fields without a loss of service."

to the traction motors on and off at 273 Hz—273 times a second—the dominant frequency of the EMFs in the cars.

In addition to the assessments of the 25 Hz and 60 Hz systems, the Amtrak Northeast Corridor (NEC) report includes measurements taken on a section where diesel locomotives are still used and on an electric New Jersey Transit train. Amtrak is considering replacing its diesel locomotives with trains similar to those used by New Jersey Transit. The Federal Railroad Administration (FRA) is currently preparing a draft environmental impact statement for the electrification of the NEC between New Haven and Boston. It will include a discussion of EMFs, based in part on ERM's measurement reports, according to

Bioeffects Literature Sifted for Clues on Maglev Health Risks

EPA Report on Broadband EMFs

A new literature review prepared for the Environmental Protection Agency (EPA) addresses the potential hazards of maglev EMFs by focusing on "animal and human exposure to EMFs that have components over a range of frequencies." Fields with pulsed or intermittent characteristics are "of special interest," according to the report by Drs. Arthur Pilla of Mt. Sinai School of Medicine in New York City, Russel Reiter of the University of Texas, San Antonio, and Bary Wilson of the Battelle Pacific Northwest Labs in Richland, WA.

"Although a causal link between exposure to EMFs and increased health risk has not been established for humans, cellular and animal studies offer evidence that such links are at least plausible," the authors write. They do not, however, answer the key question raised by their effort: whether exposures to broadband magnetic fields—they note that they are using "broadband" to distinguish "the complex magnetic fields that are at issue" from "purely sinusoidal" power frequency fields—are more likely to produce adverse health effects. Instead, they conclude that the data "are insufficient to make any clear determination" of which field characteristics are the most important for human health effects.

The report cites a wide range of studies, noting that EMF effects on calcium ions may be frequency-dependent, for example, and that effects on human heart rate can be enhanced when the fields are intermittent. Pineal melatonin secretion—a primary area of research for both Reiter and Wilson—is given particular emphasis. A common characteristic of the cancers that have been associated with EMF exposure, they argue, is that melatonin "appears to be protective" for all except brain tumors. Echoing ERM's conclusions (see story on p.10), the report also states that "there is no evidence that the TR07 maglev vehicle is likely to represent any risk from magnetic field exposure that is greater than that associated with one or more of the presently operating electrically powered rail systems." One scenario they consider—based on the work of Dr. Theodore Litovitz of Catholic University in Washington—actually indicates that the 25 Hz and 60 Hz Amtrak systems could be more likely to produce effects than the maglev with its broadband signals. Litovitz has demonstrated that a coherent signal, such as a pure sinusoidal 60 Hz signal of a particular duration, is necessary to produce certain effects. "Maglev magnetic fields exhibit less coherence in ELF ranges than the AC powered rail systems," the authors point out. (Drawing on Litovitz's research, Honeywell has begun marketing a computer keyboard designed to neutralize the effects of VDT EMFs; see p.18).

The report, ***Broadband Magnetic Fields: Their Possible Role in EMF-Associated Bioeffects,*** was begun in February 1992 at the request of Norbert Hankin of EPA's Office of Radiation and Indoor Air in Washington. The focus on maglev was added later, after ERM's measurements of the fields from the TR07 made it clear that the report could be useful in assessing the safety of maglev EMFs. Prepared for EPA under a contract from DOT, the report will be published by Dr. Aviva Brecher's office at DOT—to avoid delays due to EPA's publication review process, Brecher said. It will be identified as an EPA contractor report, Hankin said, and it will not carry the authors' names, since it has not been through a formal review process.

Literature Reviews

Two other literature reviews addressing the possible effects of maglev and electric rail EMFs are also being published by DOT. Prepared by Information Ventures Inc. in Philadelphia, the two reports contain much overlapping material. The shorter of the two focuses more specifically on adverse health effects. The longer one—which was prepared under an EPA contract but, like the broadband report, is being distributed by DOT—is meant to be a more comprehensive overview of published and unpublished research.

The reports were written by Drs. Robert Goldberg and William Creasey, both of Information Ventures; Dr. Kenneth Foster of the University of Pennsylvania in Philadelphia provided an analysis of ERM's maglev and electric railroad measurement data, which is used in the longer report to compare the magnetic field strengths and frequencies used or identified in the research with those of the maglev and electric rail systems. The authors point out, however, that "these comparisons have limited value in assessing possible human risks from the maglev exposure," since they only reflect one exposure parameter—magnetic flux density. "The magnetic field environment of the TR07 maglev is characterized by large and rapid changes," they explain.

Drafts of both reports were completed in September 1992; they have now been revised to reflect "recent major publications," including the Swedish and Danish epidemiological studies of residential and occupational EMF exposures (see *MWN*, S/O92 and N/D 92) and the CIRRPC report (see *MWN*, N/D92), according to Bruce Kleinstein, president of Information Ventures. The shorter, more narrowly focused report, commissioned directly by DOT, is titled ***Potential Health Effects of Low Frequency Electromagnetic Fields Due to Maglev and Other Electric Rail Systems: A Review of the EMF Bioeffects Research Literature.*** The longer report is titled ***An Overview of Biological Effects and Bioeffects Mechanisms Relevant to Electromagnetic Field (EMF) Exposures Associated With Mass-Transit Electric Rail Systems.*** Both will be available from NTIS later this year, according to Brecher.

EPRI Workshop Proceedings

Meanwhile, EPRI has published a report based on a Chicago seminar it held for utility executives in October 1991 to consider the outlook for the development of maglev and high-speed rail systems. The participants concluded by identifying eight research tasks, including this one: "characterize electromagnetic radiation levels and define acceptable levels, controls, and mitigation measures." An unnamed person noted during a full-group discussion that EMFs could be a "showstopper" for maglev. Other than that, to judge by these proceedings, EMFs virtually were not discussed in the presentations given at this meeting.

Proceedings: High-Speed Rail and Maglev Workshop, Report No. TR-101700, $200, is available from EPRI's Research Reports Center (see ordering information on p.10).

Maglev Safety Workshop

Much of the work compiled in the reports discussed here will be presented in a session on EMF effects at an upcoming workshop on high-speed rail safety that is being cosponsored by the Federal Railroad Administration and the Transportation Research Board (TRB), part of the National Research Council.

The EMF session will be chaired by Janie Blanchard of Bechtel Corp. in San Francisco, who will also give a plenary talk. Other presenters are: EPA's Norbert Hankin and Lynne Gillette, ERM's William Feero, Information Ventures' Dr. Robert Goldberg, DOT's Dr. Aviva Brecher and Dr. Kenneth Groh of Argonne National Laboratory.

The meeting will be held October 18-20 in Itasca, IL, near Chicago's O'Hare Airport. Registration is $150. For more information, contact: Reggie Gillum, TRB, 2101 Constitution Ave., NW, Washington, DC 20418, (202) 334-2382.

Glenn Goulet, also of DOT's Volpe Center, and it should be available in late September.

For each system ERM evaluated, measurements were taken in a passenger coach, in a crew compartment, in a station and along a track right-of-way. "These are extremely complex sources," explained Brecher. Indeed, to collect their data, the ERM technicians used a computerized "waveform capture" system that they developed for the Electric Power Research Institute (EPRI). The reports present much of the data in three-dimensional graphs that show how the strength and frequency of the magnetic fields change over time. Each report is divided into two volumes, the first containing analysis and the second providing appendices with more detailed data.

Injured Microwave Technician To Collect $650,000 in Settlement

In the largest settlement of a microwave radiation injury case, a technician whose eyesight was damaged by an illegal satellite uplink operated by Multicomm Telecommunications Inc. will collect $650,000, according to his attorney, Roy Mason of Mason, Ketterman & Morgan in Baltimore.

Jon Stern of the Washington firm of Katten, Muchin, Zavis & Dombroff, who is representing National Union Fire Insurance Co. of Pittsburgh, said that the settlement between National Union and Keith Angstadt, the injured technician, seems likely, but that it is not yet final.

Angstadt was awarded $2 million in a May 4 judgment against Multicomm. But the company was bankrupt, and there was some question as to whether Angstadt would collect (see *MWN*, M/J93). On June 22, Mason filed a complaint in Baltimore City Circuit Court — which was later transferred to U.S. District Court in Maryland — charging that National Union and Atlantic Mutual Insurance Companies were responsible for the $2 million award because they had sold insurance policies to Multicomm and its parent company, Amway Corp. Amway has been dismissed from any liability, according to Mason.

Mason said that he now intends to collect the remainder of the award from Madison, NJ-based Atlantic Mutual, the primary insurer, which sold Multicomm a $1 million policy. Atlantic Mutual has already filed a "declaratory judgment action," arguing that it should not be held accountable, according to Atlantic Mutual's attorney, Allen Beasley of Breeden, MacMillan & Green in Norfolk, VA.

Angstadt is color-blind following his accidental exposure to 6 GHz microwaves from the transmitter (see *MWN*, N/D92).

Police Radar Health Research

Two new studies have been issued recently on the safety of police traffic radar units:

• Czech researchers have found that weak millimeter waves that simulate emissions from a radar gun can inhibit DNA synthesis in the corneas of mice. In an effort to investigate the possible health risks associated with the use of a new radar unit, the RAMER 7F, a team from the Czech Academy of Sciences and from the Czech Military Academy, both in Brno, exposed hairless mice to 34 GHz radiation with a power density of 20 $\mu W/cm^2$ for two weeks (17 hours per day, five days per week). The experiment was run twice, each time with 12 mice, and a total of 40 controls. Most of the parameters tested showed no changes; two notable exceptions were a statistically significant smaller number of leukocytes (white blood cells) and a significant increase in the mass of the spleens in the exposed mice. Even though the decrease in corneal DNA synthesis is not significant, the researchers commented that this finding is "noteworthy." While they recommended that the use of the RAMER 7F, which is made in the Czech Republic, be allowed, they asked that its instructions "contain a warning of the danger of long-term irradiation to the eyes." See: Dolores Rotkovska, "Evaluation of the Biological Effects of Police Radar RAMER 7F," *Environmental Health Perspectives, 101*, pp.134-136, June 1993.

• Dr. Robert Davis's analysis of a cluster of testicular cancer cases among police officers in Grand Rapids, MI, and in neighboring Wyoming, MI, has been published as a "Brief Communication" in the *American Journal of Industrial Medicine (AJIM)*. At least six cases that could be related to radar use have been identified at the two departments, which have a combined work force of 340 officers (see *MWN*, M/A92). Davis, who is with the University of Washington Medical Center in Seattle, had previously estimated that this was at least triple the expected number, but he now reports that it is a nearly sevenfold excess — a statistically significant finding. Davis and coauthor Dr. F. Kash Mostofi of the Armed Forces Institute of Pathology in Washington note that the analysis was designed to minimize the possibility of finding a cancer excess. To assess the total person-years of exposure for the work force, for example, they looked at 1963 to 1991, even though the first use of radar did not occur until 1970. The officers with testicular cancer were diagnosed between 1979 and 1991. Davis and Mostofi write that the use of radar guns has not been widely studied, concluding that "further research into a possible association with testicular cancer is warranted." See: Robert Davis and F. Kash Mostofi, "Cluster of Testicular Cancer in Police Officers Exposed to Hand-Held Radar," *AJIM, 24*, pp.231-233, 1993.

In previous experiments, when he had a smaller exposure facility, Löscher observed similar effects using stronger (150 and 300 G) and weaker (3-10 mG) magnetic fields. But because he used fewer animals, these results are less statistically reliable. Nevertheless, when the rats were exposed to the 3-10 mG variable fields, the animals developed tumors more quickly. Löscher described the effect as "the hallmark of promotion."

Looking across all the studies he has completed to date, Löscher said, "My impression is that there appears to be a dose–response relationship. Clearly, there is something going on here."

Löscher's team also measured significantly lower concentrations of nighttime melatonin in the blood of the rats exposed to 3-10 mG. This could be the key to explaining the tumor results because melatonin is an oncostatic agent—that is, it can keep cancer cells in check. Löscher's team is the first to show a reduction in melatonin in the same EMF-exposed animals that have elevated breast tumor rates. Löscher plans to continue to look at melatonin levels in future studies.

"While conclusive evidence is still lacking, the pieces of the mosaic are filling in and the picture is becoming clearer and clearer," Dr. Alexander Lerchl, who ran Löscher's melatonin assays, told *Microwave News*. Lerchl, a former postdoctoral fellow in Dr. Russel Reiter's lab at the University of Texas, San Antonio, is now at the Institute of Reproductive Medicine at the University of Münster in Germany.

American scientists agreed with Lerchl. "The data are still sparse, but the tide is turning and the EMF–breast cancer hypothesis is gaining credibility," Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA, said in an interview. Similarly, Dr. David Blask, a senior research scientist at the Mary Imogene Bassett Hospital Research Institute in Cooperstown, NY, who has demonstrated melatonin's oncostatic properties, told *Microwave News* that there are "provocative data" on EMFs and breast cancer that need to be followed up.

Both Stevens and Blask expressed frustration over the cancer research establishment's lack of interest in pursuing the EMF trail. "If Löscher's work is replicated," Stevens said, "you'll see all the NCI types and other naysayers begin speaking in more respectful tones about the EMF–breast cancer hypothesis."

In fact, there are indications that researchers' attitudes are already changing. A recent paper on "etiologic hypotheses" in *Epidemiologic Reviews*, a companion publication to the *American Journal of Epidemiology*, put EMFs at the top of the list and concluded that, "Further exploration of whether residential or occupational [EMF] exposure affects breast cancer risk is warranted."

While Löscher's breast cancer experiments are the most detailed to date, they corroborate a similar study, published in 1991, by a group from the Oncology Research Center in Tbilisi, Republic of Georgia. The Georgians reported a promotional effect when they used NMU as the cancer initiator and a 50 Hz magnetic field of 200 mG (see *MWN*, M/A92).

And a Canadian team from the Bureau of Radiation and Medical Devices at Health and Welfare Canada in Ottawa has previously reported that a 20 G magnetic field can act as a co-promoter (with TPA) in mice, whose skin cancers were initiated with DMBA (see *MWN*, J/A91).

On the other hand, in a paper published in *Carcinogenesis* earlier this year, a Swedish-American group reported that 500 mG and 5 G magnetic fields failed to promote skin tumors in mice initiated with DMBA. But Löscher pointed out that this study also used only a small number of animals.

Although Löscher's and the previous experiments point to a promotional effect, Löscher himself has not ruled out the possibility that EMFs can cause genetic effects. "There could be mutations," he said. "We will try our study without DMBA." Dr. Jack McLean, a member of the Canadian study team, also believes that magnetic fields may do more than act as a promoter. "The role of initiation needs a closer look," he said in an interview.

That EMFs can undo the protective action of melatonin was recently shown by Dr. Robert Liburdy and coworkers at the Lawrence Berkeley Lab in Berkeley, CA. They found that breast cancer cells, which did not grow in the presence of melatonin, resumed proliferating when also exposed to magnetic fields (see

EMF–Breast Cancer Sources

D. Sh. Beniashvili, V.G. Bilanishvili and M.Z. Menabde, "Low-Frequency Electromagnetic Radiation Enhances the Induction of Rat Mammary Tumors by Nitrosomethyl Urea [NMU]," *Cancer Letters, 61*, pp.75-79, 1991.

M. Gammon and E. John, "Recent Etiologic Hypotheses Concerning Breast Cancer," *Epidemiologic Reviews, 15*, pp.163-168, 1993.

R.P. Liburdy et al., "ELF Magnetic Fields, Breast Cancer and Melatonin: 60 Hz Fields Block Melatonin's Oncostatic Action on ER+ Breast Cancer Cell Proliferation," *Journal of Pineal Research, 14*, pp.89-97, 1993.

W. Löscher et al., "Tumor Promotion in a Breast Cancer Model by Exposure to a Weak Alternating Magnetic Field," *Cancer Letters, 71*, pp.75-81, 1993.

M. Mevissen et al. [including W. Löscher], "Effects of Magnetic Fields on Mammary Tumor Development Induced by 7,12-Dimethylbenz(a)anthracene [DMBA] in Rats," *Bioelectromagnetics, 14*, pp.131-143, 1993.

M. Mevissen et al. [including W. Löscher and A. Lerchl], "Effects of AC Magnetic Fields on DMBA-Induced Mammary Carcinogenesis in Sprague-Dawley Rats," in *Electricity and Magnetism in Biology and Medicine*, (Martin Blank, ed., San Francisco: San Francisco Press, 1993), pp.413-415.

A. Rannug et al., "A Study on Skin Tumor Formation in Mice with 50 Hz Magnetic Field Exposure," *Carcinogenesis, 14*, pp.573-578, 1993.

R.G. Stevens, "Electric Power Use and Breast Cancer: A Hypothesis," *American Journal of Epidemiology, 125*, pp.556-561, 1987.

R.G. Stevens et al., "Electric Power, Pineal Function and the Risk of Breast Cancer," *FASEB Journal, 6*, pp.853-860, 1992.

R.G. Stevens, "Biologically-Based Epidemiological Studies of Electric Power and Cancer," *Environmental Health Perspectives, 101*, Supplement 4, 1993, in press.

M.A. Stuchly, J.R.N. McLean et al., "Modification of Tumor Promotion in the Mouse Skin by Exposure to an Alternating Magnetic Field," *Cancer Letters, 65*, pp.1-7, 1992.

MWN, J/A92). Blask said that he would like to repeat Liburdy's experiment as well as do animal studies.

Four studies showing that men exposed to EMFs on the job had high rates of breast cancer—a very rare disease in males—prompted increased interest in pursuing the EMF–breast cancer link among women (see *MWN*, N/D89, J/A90, J/F91, M/A91 and J/A92). Stevens, who first proposed the link in 1987 (see *MWN*, J/F87), is now collaborating with Dr. Scott Davis of the Fred Hutchinson Cancer Research Center in Seattle to pursue this idea under a grant from the National Cancer Institute (NCI) (see *MWN*, N/D91).

In addition, Dr. Anders Ahlbom and Maria Feychting of the Karolinska Institute in Stockholm, Sweden, are looking at breast cancer risks with the data collected for their landmark power line study. And Dr. Genevieve Matanoski of the Johns Hopkins University School of Hygiene and Public Health in Baltimore recently received a small grant to plan an epidemiological study of cancer among women who use video display terminals (VDTs), with special emphasis on breast cancer.

Löscher is the chairman of the department of pharmacology, toxicology and pharmacy at the School of Veterinary Medicine. His group includes Dr. Meike Mevissen, a postdoctoral researcher.

EPA Eliminates NIER Program *(continued from p.1)*

Sciences (see *MWN*, M/J92 and M/J93, respectively), as well as those sponsored by a number of individual states. McGaughy added that a complete revision of the 367-page report could not have been ready until 1995.

"We will write a scientific statement of knowledge detailing what is known and what is uncertain," McGaughy said. The review will cover the EMF–cancer literature through mid-1993, but will not address RF/MW radiation.

The EPA report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*, has been at the center of the EMF controversy since a draft was released three years ago. The report concluded that EMFs from power lines and appliances are a "possible, but not proven, cause of cancer in humans" (see *MWN*, N/D90). An earlier draft had classified EMFs as "probable human carcinogens" but this statement was deleted before the document was circulated for comment (see *MWN*, M/J90). A subsequent review by EPA's Science Advisory Board (SAB) concluded that the document had "serious deficiencies and should be rewritten" (see *MWN*, J/A91).

Senior EPA managers were reluctant to discuss the decision not to rewrite the report. OHEA Director Dr. William Farland, McGaughy's superior, did not respond to repeated calls for comment. And David Kleffman, the deputy director of the EPA Office of Health Research and a member of the original National EMF Research Program Steering Committee set up by New York State, would only say that he "was not involved in the decision."

McGaughy announced the change in plans at a meeting of the SAB's Radiation Advisory Committee (RAC) on July 19. The move came as a surprise since as recently as the previous month McGaughy was still saying that the rewrite of the original report was going forward.

"The decision makes sense," Dr. Genevieve Matanoski, the chair of the RAC, said in a telephone interview from her office at the Johns Hopkins University School of Hygiene and Public Health in Baltimore, referring to the agency's budget constraints. But, she added, "EPA has to do something for the public. This is an important health issue for the public and the public needs some guidance." Matanoski was also the chair of the SAB subcommittee that reviewed the EMF–cancer document in 1991.

McGaughy said that the summary report will address can-

Off EPA's Agenda, Onto Vice President Gore's

On July 13, Vice President Al Gore fielded questions on C-SPAN's Live Viewer Call-In Program, *which was moderated by Brian Lamb. Here is one exchange:*

Moderator: Rockland County, New York—
Caller: Mr. Vice President, would you please listen to me for a moment. In 1990, the Bush Administration killed an EPA report stating that the electromagnetic field is a probable carcinogen. We lost a grandchild at the age of five due to cancer. She suffered for two and half years.
Gore: I'm so sorry.
Caller: Since then, Mr Vice President, I have been begging and pleading that the electric blanket manufacturers please put a warning label on their product. My daughter went down to Sloan-Kettering Hospital and when she at random checked six out of six parents, that she checked with, all had this factor in common—that they all used an electric blanket when they were pregnant. I understand the government of Sweden just came out with long-term cause and effect on leukemia and power lines.
Moderator: Caller, what do you want the Vice President to do?
Caller: I want him to please make sure that he sees that we get a lot of research and that warning labels are put on these products because there are other governments that are doing—taking a strong stand and our government has been doing nothing.
Moderator: All right, thanks for your call. Mr. Vice President—
Gore: This is a really interesting topic, Brian. First of all, thank you very much, caller, for sharing that personal tragedy that your family has experienced. I know how painful it must be for you. And I know that you have probably experienced a great deal of frustration in trying to talk with officials about electromagnetic fields. I know just a little about this because I tried to study it and what I found was, Brian, that the state of the science is such that they don't really have answers for a lot of the questions posed by people who are worried about electromagnetic fields. The consensus in the scientific community right now, I think, is that the concerns about the power lines probably are much less than concerns about devices such as electric blankets for women who are pregnant and that is one of the worst cases that you can talk about because there the data apparently shows that there can be a health threat from electromagnetic fields in some cases. And so I don't want to minimize this at all. In cases like that, I think that more is required. And I have made notes here as a result of what the caller has said and I think that does warrant further action.

Gore held a hearing on NIER from VDTs and from RF heaters and sealers in 1981 when he was in the House of Representatives (see MWN, *Jun81). When he was in the Senate, Gore asked the EPA to measure the magnetic fields in his office.*

cer causation. "This is the central question of the new document," he said. But he stressed that the report will not deal with risk assessment. "What EPA should say to the public in the face of the scientific uncertainties will be left to [ORIA]."

Lynne Gillette, who works on EMFs at ORIA, questioned who will answer public inquiries after the cutbacks. "We get 10,000 calls a year—we counted," she said. "That's much more than for radon." She added that members of Congress are "always asking about EMFs."

Marty Halper, who until recently was the director of ORIA's radiation studies division, noted that the phones always ring after the news media highlight new research findings. "What happens when you get Swedish-type results? Who will keep up with the science? Who will answer the questions?" Halper is now a senior science adviser to EPA's environmental equity program.

Gene Durman, the acting director of Halper's former division and the deputy director of ORIA, said that the agency was considering developing a hot line to answer calls from the public.

In addition to responding to public inquiries, EPA's NIER staff does measurement surveys, sponsors literature reviews and publishes reports and booklets (see p.11 and *MWN*, M/J93). In addition, it has the authority to develop exposure guidelines, though it has never done so.

Most of those interviewed at EPA thought the NIER program should continue because EMFs could evolve into a major public health issue. Halper, for instance, said, "I believe that there is a 50-50 chance that EMFs could turn out to be a risk that dwarfs radon." He contrasted the lone EMF staff position to the approximately 90 people currently working on radon in EPA offices across the country. "It's a little bit ominous," said another staffer, who asked for anonymity. "They may regret the decision."

There is a general consensus within the agency that the EMF epidemiological cancer data have become stronger and more consistent since the 1990 draft was released—largely due to last year's Swedish cancer studies (see *MWN*, S/O92 and N/D92). When asked if the agency would be prepared if McGaughy's summary report pointed to a cancer problem, one senior official commented, "That will be a dilemma for us."

It is unlikely that EPA will return to RF/MW radiation issues, as was requested by the SAB (see *MWN*, J/A91). "Don't be surprised if we don't do anything on RF for the time being," Margo Oge, director of ORIA, said in an interview. "We would have to take resources from other programs. We must prioritize."

In what might be one of its last actions on RF/MW radiation, EPA is preparing detailed comments on the Federal Communications Commission's proposal to adopt the 1992 ANSI/IEEE limits (see *MWN*, M/A93).

EPA's Office of Research and Development stopped working on NIER in the mid-1980s (see *MWN*, N/D85 and S/O86). Since then it has refused to sponsor any health-related research. Earlier this year, EPA transferred all of its EMF research funds to the National Institute of Environmental Health Sciences (see *MWN*, J/F93).

UPDATES

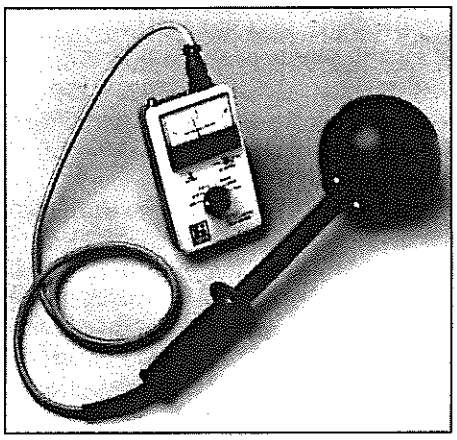
COMPATIBILITY & INTERFERENCE

Uncontrolled Wheelchair Movements... Tests conducted by the FDA have shown that certain electric wheelchairs are susceptible to EMI. The agency found that some electronically controlled wheelchairs would unexpectedly stop, start or turn when exposed to RF/MW radiation at strengths of 10 V/m or less, said Howard Bassen of FDA's Center for Devices and Radiological Health in Rockville, MD. Such field levels could occur in "real-world situations," such as near a police car radio or a hand-held walkie-talkie, he said. "There are numerous reports of injuries due to unintended wheelchair movement," Bassen explained, but he cautioned that there was no definitive proof that EMI was responsible, because tests were not performed on the actual chairs in the environments where the incidents occurred. But, Bassen noted: "Laboratory tests on the same wheelchair models did show that they were susceptible to low levels of RF/MW radiation." In a May 10 letter alerting wheelchair manufacturers, the agency explained that, "The chairs tested were found to be susceptible to interference from many different RF/MW frequencies." The agency asked the wheelchair makers to share any studies or reports of incidents that they have gathered. A similar notice, seeking reports of EMI problems directly from wheelchair users, was sent out on July 7. The FDA has proposed adding EMC testing requirements to the Rehabilitation Society of North America (RESNA) wheelchair standard. Approvals for a number of new wheelchairs—which are regulated by the FDA as medical devices—are being held up until the manufacturers provide adequate EMC testing results, Bassen said. This is the first time the FDA has addressed EMI susceptibility prior to approving a wheelchair for market.

MEASUREMENTS

TriField Meter Under Review... A new, inexpensive meter designed to measure 60 Hz magnetic and electric fields and RF fields "gives misleading results," according to a review in the May issue of *QST*, the magazine of the American Radio Relay League (ARRL). The TriField meter, made by AlphaLab Inc. in Salt Lake City, was put through its paces by Dr. Wayne Overbeck, a member of ARRL's Bioeffects Committee. He used the TriField to assess a low emission NEC computer monitor and found that it recorded magnetic fields of 5 mG 12 inches from the front of the display. "When the fields...were measured with a professional meter," he writes, "the 60 Hz magnetic fields turned out to be below 0.3 mG 12 inches from the monitor." For measuring RF fields, Overbeck also found the meter wanting. In a field stronger than 0.3 mW/cm^2, the meter fluctuated wildly. "Even in weaker fields, its accuracy leaves something to be desired," he adds. The manufacturer does address some accuracy issues in the meter's instruction sheet—which Overbeck compliments as "well written." The instructions warn that the meter is "frequency weighted," so that a field at other than 60 Hz will give higher readings: a 3 mG 120 Hz field will read 6 mG, Over-

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beck explains by way of illustration. Bill Lee, AlphaLab's president, suggested that the frequency-weighted meter serves a useful purpose: "I don't believe it's a good idea to only measure 60 Hz," he told *Microwave News.* A flat frequency response version is also available, he added, and might be more appropriate for VDT measurements. A more positive review of the TriField appeared in the January/February issue of *Scanning (15,* p.48, 1993), a journal devoted to scanning electron microscopy. The reviewer, David Joy of the University of Tennessee, Knoxville, notes that the meter "provides a convenient and realistically priced alternative" to the much more complex equipment commonly used to track down the source of magnetic fields that are interfering with the operation of an electron microscope. Joy also describes how the RF meter led to the discovery of a faulty seal on a microwave oven in his lab. Overbeck warns, however, that the TriField could cause undue alarm, and he suggests that the adage, "You get what you pay for," is applicable. The meter sells for $150. (For EPA's assessment of a number of other magnetic field meters, see *MWN,* M/A93.)

MEETINGS

Russian Symposium... On June 21-25, 100 experts from the former Soviet Union attended the *1st International Symposium on Electromagnetic Pollution of the Environment* at the Forest Technical Academy in St. Petersburg, Russia. In a letter to *Microwave News,* Dr. Eugene Lyskov of the Institute of the Human Brain at the Russian Academy of Science in St. Petersburg reports that papers addressed four general areas: (1) regulation and control of EMFs; (2) analysis, models and prediction of the electromagnetic environment; (3) the influence of EMFs on human beings and biosystems; (4) methods and devices for measuring EMFs. NIER from static fields up to microwaves were covered, with special attention on the influence of "EMFs on behavior, neuronal activity, immune and generative functions and cytogenesis." Surveys of residential and occupational EMF measurements were also discussed: for example, a map of EMFs from St. Petersburg's power lines developed by the Navy Research Institute was presented, as were data showing high EMF levels from subway engines. The proceedings of the conference will be published in the near future. A regional interdisciplinary council on EMF safety and compatibility is being established under the aegis of the municipality of St. Petersburg. A second conference will probably be held in St. Petersburg in 1995. For more information, contact: Dr. Eugene Lyskov, Institute of the Human Brain, Pavlov 9, St. Petersburg, 197376, Russia, fax: (7+812) 234-3247.

EBEA's Second Congress... The European Bioelectromagnetics Association (EBEA) will hold its second congress December 9-11, 1993, in Bled, Slovenia, about 20 miles from the international airport in Ljubljana. The site was selected to make it easy for researchers from Eastern European countries to participate. Topics to be covered include mechanisms, epidemiology, biological effects and medical applications. Invited talks will be given by Dr. Lojze Vodovnik of the University of Ljubljana on therapeutic applications of EMFs; by Dr. Clay Easterly of the

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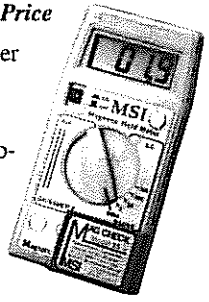
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Oak Ridge National Laboratory in Oak Ridge, TN, on EMF epidemiological studies; and by Dr. Niels Kuster of the Swiss Federal Institute of Technology in Zurich on dosimetry. Contact: Dr. Renata Karba, Faculty of Electrical and Computer Engineering, University of Ljubljana, Trzaska 25, 61000 Ljubljana, Slovenia, (38+61) 265-161.

PEOPLE

Dr. **Brian Maddock**, head of the "EMF Function" for research at the U.K.'s National Grid has retired. No replacement has been named. "It's a consolidation of management," Dr. **John Male** told *Microwave News*.....**John Adams**, an electrical engineer with the Fields and Metrology Group at NIST's EMF Division in Boulder, CO, died after an automobile accident on July 15.

SHIELDING

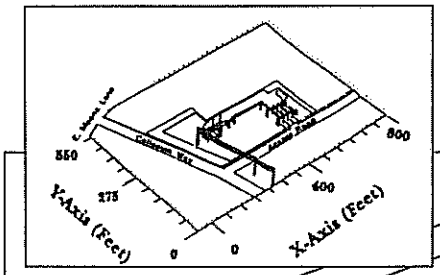
Microwave-Absorbing Concrete... Smart concrete may sound like an oxymoron but it is serious business at the State University of New York, Buffalo. Professor Deborah Chung of the university's department of mechanical and aerospace engineering has shown that adding carbon fibers to concrete increases its electrical conductivity, a property which can be harnessed to detect flaws and thereby give an early warning of the impending collapse of a bridge or a highway. An added benefit is that the carbon fibers also dramatically increase the concrete's ability to shield microwave radiation. A few millimeters of plain cement attenuate 1 GHz radiation by 0.4 dB, but when carbon fibers are added to the mix, the same thickness cuts the radiation by about 19.5 dB. In other words, the cement can reduce microwaves 80 times more effectively when doped with slivers of carbon. Chemicals such as sodium sulfate and potassium aluminum sulfate can be substituted for the carbon fibers, though they are not as effective, according to Chung. She published a paper on the electromagnetic shielding properties of reinforced concrete in the July 1989 issue of *Composites (20,* pp.379-381); see also, her forthcoming paper in *Smart Materials and Structures.*

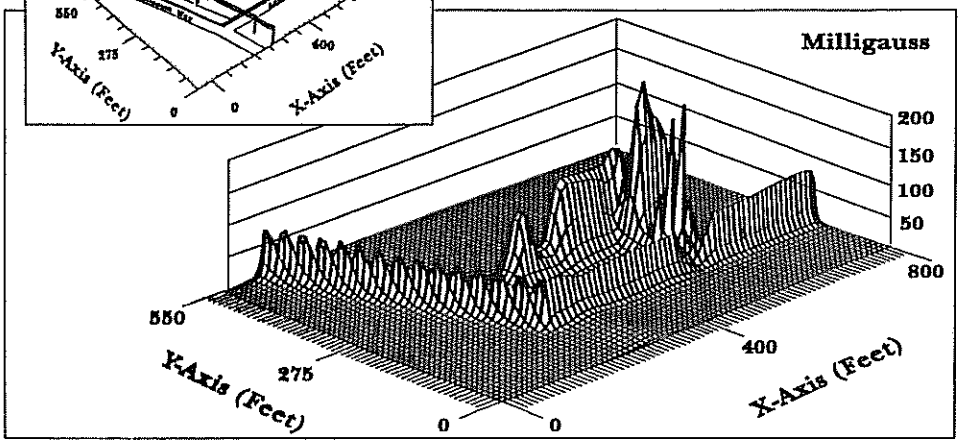
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EMX Keyboard... Honeywell Inc.'s keyboard division is preparing to market a keyboard that can "neutralize EMF emissions from computers." The keyboard, to be called the 101 EMX, is based on techniques devised by Dr. Ted Litovitz of Catholic University in Washington. It contains a coil that emits random EMFs, known as "noise," that the manufacturer claims can block the action of a constant EMF signal from a VDT or any other source. Honeywell notes that a "growing body of evidence" links weak EMFs to cancer, reproductive problems and mood disorders. Litovitz has shown that biological effects of EMFs—in certain well-defined systems—can be blocked by superimposing electromagnetic noise. Litovitz has applied for a patent and licensed the technique to EMX Corp. of New York City. EMX is a private company, formed in 1991, to commercialize technology developed at Catholic University. For more information, contact: Lou Vasquez of Honeywell at (800) 445-6939, or Robert Blessey of EMX at (800) 508-4040.

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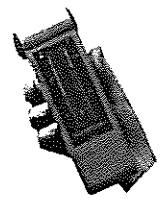
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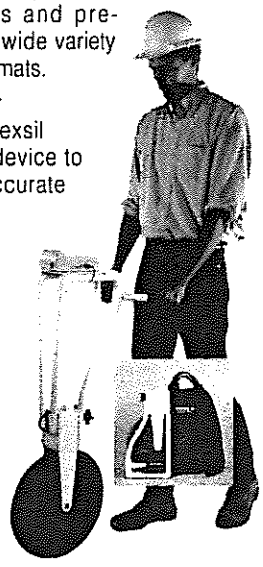
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Draft NCRP Report Seeks Strong Action To Curb EMFs

Committee Cites 2 mG Limit as Goal

The National Council on Radiation Protection and Measurements (NCRP) committee charged with evaluating the potential health effects of electromagnetic fields (EMFs) has completed a draft report that calls for strong action to curtail the exposure of the U.S. population. "It took us nine years but we finally reached agreement," committee chair Dr. Ross Adey, of the Veterans Administration Hospital in Loma Linda, CA, told *Microwave News.*

The draft report generally endorses a 2 mG exposure limit. It would take effect immediately for new day care centers, schools and playgrounds, as well as for new transmission lines near existing housing. A somewhat more flexible policy would be applied to new housing and offices.

For existing facilities, the committee recommends a more gradual approach, with stronger restrictions phased in over time if the evidence of a health risk continues to grow.

The report was funded by the Environmental Protection Agency (EPA). Dr. Joe Elder, EPA's program officer for the NCRP study in Research Triangle Park, NC, called the committee's report "the first comprehensive review of the world's literature on EMF health effects."

In sharp contrast to the NCRP report's conclusions, public television's "Frontline" sees no need for even a policy of prudent avoidance; see Commentary pp.6-10.

The EPA will release its own review this fall, limited to an analysis of the cancer risk. Dr. Robert McGaughy, the chief author of the EPA review, who has read the NCRP draft, said that, on the question of cancer, the two drafts "appear to be heading in the same direction."

Copies of the report's conclusions and recommendations (see pp.12-15) have already been widely circulated. In a letter to *Microwave News,* Dr. Charles Meinhold, the president of the NCRP, emphasized that the draft report is an internal document and that it has "no standing at this time."

"It's unfortunate that the report has been leaked," said Dr. Richard Lovely of the Battelle Pacific Northwest Labs (PNL) in Seattle, a member of the committee. "There is a process by which this document should have been reviewed and that process has been seriously compromised."

The 800-page draft will now undergo the NCRP review process. First a half-dozen "critical reviewers" will go over it and recommend changes, according to Dr. Constantine Maletskos, NCRP's liaison for the report. After the necessary revisions are made, it will be sent to the 75 members of the council. "We are aiming to complete it later this year," Maletskos said, "but that's unlikely." He predicted that the final report would be publicly available in the first half of 1996.

(continued on p.11)

« Power Line Talk »

The **American Medical Association** (AMA) doesn't believe in prudent avoidance any more—or does it? The AMA appeared to abandon its support for prudent avoidance in December 1994, but today no one can say exactly why. In mid-1994, the AMA's Council on Scientific Affairs (CSA) approved a report on EMFs containing the following recommendation:

> That the AMA urge manufacturers, home-builders, and employers to begin planning to reduce the exposures of workers and the public to electromagnetic fields, including those from power lines, appliances and equipment. The focus should be on strategies and techniques that are cost-neutral, or will not greatly increase costs.

This was not a new stand for the AMA, which in a 1990 report held that "prudent measures should be taken to reduce people's EMF exposures." But by the time the new report emerged from the AMA's House of Delegates in December 1994 (see *MWN,* J/F95), this recommendation had been deleted. Dr. **Douglas Skelton**, former chair of the CSA, confirmed in an interview that the CSA had approved the recommendation, as worded above, prior to the December House of Delegates meeting. Skelton added that this language was softer than in the staff's initial draft: "We felt the staff had too strongly urged expenditures to reduce exposures that might not be a very efficient use of resources. We'd support prudent and *economic* efforts to reduce exposures—but not putting demands on people to spend millions of dollars. That was the line we were trying to draw." When asked how the support for prudent avoidance came to be removed entirely, Skelton said, "I don't right now have any idea how that came about." In fact, the change was made by Reference Committee E, one of several working committees that hear testimony and report to the House of Delegates. Reference Committee E's report urged the House of Delegates to delete the recommendation on prudent avoidance, explaining that in testimony before the committee, "a general consensus was expressed that recommending specific 'preventive measures' when no health risks have been demonstrated might be premature and inconsistent." Who gave this testimony, which changed the policy of the AMA? The chair of Reference Committee E, Dr. **Richard Tompkins** of the Mayo Clinic in Rochester, MN, told *Microwave News* this July that he did not remember the name of a single person who had spoken, and that he did not think there was any way to find out. The committee's secretary, Dr. **Sona Kalousdian**, confirmed that there was no record of who had testified and also said that she did not remember. Dr. Tompkins said there was no discussion among the members of Reference Committee E about the fact that this represented a change in AMA policy. The committee's report said that "the CSA concurred with the proposed changes." However, Dr. **Theodore Doege**, who first drafted the report for the CSA, said that he did not learn of the change until two weeks after the December meeting of the House of Delegates. Even then, he told *Microwave News,* the rationale was not explained: "I thought it was fine the way it stood, and saw no reason at the time to change anything." Before being approved by the CSA, the report was reviewed by Drs. **David Brill**, **Jeffrey Greenawalt**, **John Peters** and **Thomas Tenforde**, with Tenforde as the major reviewer. But Doege said that none of their comments addressed the issue of prudent avoidance. Asked why Reference Committee E deleted this recommendation, Doege said, "I really don't know."

«« »»

Massachusetts Electric, a subsidiary of New England Electric System, has agreed to an out-of-court financial settlement to avoid a lawsuit by the family of a child stricken with leukemia. **Scot David** and his wife reached the settlement after their son contracted acute myeloid leukemia (AML), which is unusual in children. According to a report by a Wayland, MA, consultant, magnetic fields inside the front bedroom of the Davids' home reached as high as 37 mG (they have since moved). The report attributes this strong field mainly to the way the house was connected to the power distribution system. Also involved in the settlement was the case of the child's cousin, who regularly slept near the Davids' son and developed idiopathic thrombocytopenia, a deficiency of platelets with no known cause. Attorney Michael Mattchen of **Dangel & Fine** in Boston said that no lawsuit was ever filed, and that beyond that he could not "confirm or deny" anything. Susan Stevens, a spokesperson for Mass. Electric, said, "It's the company's long-standing policy not to comment on matters like this."

«« »»

With fiscal year 1995 (FY95) almost over, industry contributions to the national EMF research program, known as **RAPID**, have barely passed the halfway mark. The federal government has given $8 million, which is supposed to be matched dollar-for-dollar with industry funds. At the end of July, the nonfederal contributions totaled $4.3 million. **Rick Loughery** of the **Edison Electric Institute** in Washington said that, "I am confident that the electric utility industry and the **National Electrical Manufacturers Association** will reach roughly $5.7 million" by September 30, the end of FY95. The balance must come from non-utility sources, he said, adding that, "The health of the program is of interest to us, but we cannot make a further contribution for FY95 at this time." The utility industry is maintaining that it is only responsible for two-thirds of the nonfederal funds (see *MWN,* N/D93). The DOE has waged "a pretty intensive campaign" to solicit funds from other sources but so far without success, according to **Lynne Gillette**, DOE program manager for the RAPID program. Gillette said that the DOE has targeted 18 associations that should have an interest in EMFs. Six of the groups have said that they would not be contributing, including the **American Electronics Association**, the **Electromagnetic Energy Association** and the **Association of Home Appliance Manufacturers**. "We are still talking to the other 12," she said.

«« »»

The **Camas, WA, City Council** has set 4 mG as the target for maximum EMF exposures permitted for new transmission facili-

ties. The ceiling was established as one of several restrictions in a new ordinance which was approved 5-2 on July 10 in response to constituents' concerns about EMF health effects and property devaluation. Camas, a suburban community across the Columbia River from Portland, OR, is also requiring utilities to use prudent avoidance measures in constructing new transmission facilities and has established setbacks for new power lines near schools, churches, day care centers and playgrounds. It also has banned overhead power lines in residential areas. Violators may be fined or imprisoned. "I believe a lot of communities are looking into similar regulations," said Gwen Hahn, the Camas council member who proposed the restrictions. The ordinance grew out of a moratorium, approved in December 1994, imposed because of concerns that new power lines would be built on a right-of-way owned by Portland-based **PacifiCorp.**, which is working with **Clark Public Utilities**, headquartered in Vancouver, WA, to provide power for the area. The moratorium was in effect until the ordinance was approved. "We did not oppose the ordinance. We did not endorse it. We have some concerns that we may not be able to serve future growth in that area, but that's something we will address as time goes on," said Mike Shutt, a spokesperson for Clark Public Utilities. David Kvamme, a PacifiCorp. spokesperson, added, "Currently we have no plans to build, although we wanted to keep our options open." **Cindy Sage** of Sage Associates in Montecito, CA, who advised an *ad hoc* council committee studying the issue, supports the ordinance and sees it as "very mainstream." The 4 mG target was actually a compromise, she said. The proposed limit initially was 1 mG. As for the ordinance's overall effect, Sage said, "We all know that the utilities are worried about a patchwork of local regulations. I would expect this to set a precedent and give other communities the political will to establish good EMF land-planning principles in spite of utility opposition." Another community not far from Camas is also taking action to control power lines. On May 16, **Umatilla, OR**, in the northeastern part of the state, imposed a 90-day moratorium on new power line construction and is now reviewing a local utility's application for construction of two transmission lines that would pass through the city. "Our community is inundated with power lines," said Umatilla Administrator Bonnie Parker.

Mothers' Use of Sewing Machines Linked to Children's Leukemia

A McGill University professor believes that EMFs may have been a factor in an observed up-to-sevenfold increase in leukemia among children whose mothers used sewing machines during pregnancy. Her hypothesis follows a 1994 joint U.S.-Finnish report that showed a strong association between EMF exposures on the job and Alzheimer's disease among sewing machine operators and others.

Dr. Claire Infante-Rivard, a professor in McGill University's Department of Occupational Health in Montreal, Canada, said that it was Dr. Eugene Sobel's paper linking EMFs to Alzheimer's disease (see *MWN,* J/A94) that prompted her to consider the possible role of EMFs in her 1991 study of leukemia among children in Spain.

Infante-Rivard had studied 128 cases of acute lymphoblastic leukemia in children less than 15 years old. She found the highest risk for children of mothers working at home during pregnancy, most of whom sewed cotton, wool and synthetic fibers. In her original paper, published in the *Journal of Epidemiology and Community Health* (*45,* pp.11-15, 1991), Infante-Rivard and her colleagues suggested that exposure to organic dust and synthetic fibers could be responsible for the excess risk.

"Our findings...could be reinterpreted as being EMF-related," Infante-Rivard wrote in a letter appearing in the July 15, 1995, issue of *The Lancet*. "Given the ergonomic features of work on sewing machines, fetal exposure is likely. Of course, continued exposure throughout childhood is also possible."

"We should look at this issue more closely. It might make a lot of sense," Infante-Rivard told *Microwave News.*

Sobel reported a "consistent" pattern of increased incidence of Alzheimer's among workers with "medium" and "high" EMF exposures in three different data sets—two Finnish and one American. Dressmakers and sewers were overrepresented among the cases in the study. Subsequent surveys showed that EMFs at the operators' heads were 2.7-5.2 mG for home sewing machines and 2-11 mG for industrial units, according to Dr. Joseph Bowman of the National Institute for Occupational Safety and Health, who worked on the study. The levels were about 200 mG at knee level, he said.

Infante-Rivard said that most of the women in her study used home sewing machines, not industrial models, but used them extensively.

Sobel, of the University of Southern California School of Medicine in Los Angeles, told *Microwave News* that his paper on the Alzheimer's–EMF link will appear in the September 1 issue of the *American Journal of Epidemiology*.

The McGill study supports an earlier report by Dr. David Savitz and colleagues at the University of North Carolina, Chapel Hill (see *MWN,* M/J90). In the Savitz study, children whose mothers used electric blankets during pregnancy were found to have higher risks of leukemia and brain tumors. Savitz reported that the incidence of brain tumors among the offspring had increased 250%. There was a 70% increase for leukemia and a 30% increase for all cancers. "Our findings for prenatal exposures to electric blankets are directly relevant to Infante-Rivard's observations," Savitz told *Microwave News.*

NAS-NRC Committee Reviews Navy's Project ELF Studies

The National Academy of Sciences' National Research Council (NAS-NRC) has formed a committee to evaluate studies that monitored the effects of EMFs from Project ELF. The controversial Navy system, which transmits 72-80 Hz signals to communicate with submerged submarines, uses a 56-mile-long antenna system in Michigan and one half as long in Wisconsin.

The Navy commissioned the NRC last fall to analyze 11 studies on the biological and ecological effects in the forests

around the antennas (research on soil amoebae is not completed). The 11-member committee met for the first time July 6-7.

"Our job is not to summarize but to critically assess the studies," said Raymond Wassel, an NRC program director working with the committee. Wassel said the group would write a report, expected by May 1996, that will review the objectives and design of the monitoring program, as well as data collection methods, analyses and interpretations.

The chair of the committee is Dr. Duncan Patten of Arizona State University, Tempe. The other members are: Drs. Om Gandhi, University of Utah, Salt Lake City; Thomas Getty, Michigan State University, Hickory Corners; William Gordon, Rice University, Houston; Woodland Hastings, Harvard University, Cambridge, MA; Peter Karieva, University of Washington, Seattle; James Lin, University of Illinois, Chicago; Robert Olsen, Washington State University, Pullman; John Pastor, University of Minnesota, Duluth; Beverly Rathcke, University of Michigan, Ann Arbor; and Antonio Sastre, AS Consulting and Research Inc., Suffern, NY.

Hastings served as the chair of a 1977 NAS study on the potential effects of ELF fields. One of the concerns at that time was whether the ELF antenna would have a serious effect on nearby vegetation and "in an extreme...cause a 'wasteland' throughout an area of several square miles." But the study concluded, in part, that available data on EMF effects on plants, though meager, indicated that there would not be any effect on vegetation growing near the antenna.

Hastings's participation with the 1977 review group is "one of the reasons he is on the NRC committee," said Bonnie Scarborough, an NRC research assistant working with Wassel.

The ELF communications system was built in the 1980s after years of dispute over its safety. Originally known as Project Sanguine (later Seafarer), the system, as proposed in the mid-1970s, would have used 6,000 miles of antennas. The target of a lawsuit, Project Sanguine/Seafarer was later scaled back. The 1977 NAS study recommended that a monitoring program be initiated if the system was ever built. In 1982, shortly after the Michigan site had begun initial operations, a monitoring program was started at both sites. The program has been managed by the IIT Research Institute (IITRI) in Chicago (see *MWN,* My81, J/A83, J/F84, Mr84, J/A84, My85 and J/F90).

One of the monitoring studies already has gained some publicity. Scientists at Michigan Technological University's School of Forestry and Wood Products in Houghton monitored vegetation in the region from 1985 to 1994. They recorded enhanced growth—as high as 74%—in some red maples. The increases occurred at magnetic field levels of 1-7 mG among trees growing within 50-150 meters of the antenna (see *MWN,* J/F95).

HIGHLIGHTS

NIOSH Urges Caution on Police Radar Use—But No Epi Study

The National Institute for Occupational Safety and Health (NIOSH) is calling for police radar to be used in ways that would "virtually eliminate" officers' exposure to microwave radiation. The recommendations are contained in a feasibility study that argues against attempting an epidemiological study of cancer among police officers who have used radar.

The NIOSH report, *Occupational Exposure of Police Officers to Microwave Radiation from Traffic Radar Devices,* does call for a broader study of health problems of police officers, which might lay the basis for a later examination of police radar. But funding of such research does not seem likely.

"It's not what we had hoped for," Gary Poynter, research officer of the National Fraternal Order of Police in Cincinnati, told *Microwave News*. "We wanted a recommendation for an epi study and some stronger recommendations for antenna use." Still, he said, "It's definitely a step forward."

NIOSH describes its recommendations on radar antennas as "prudent public health practice even in the absence of an identified health risk." It suggests that hand-held radar guns have a "dead-man switch"—in which the radar beam shuts off when it is not gripped by the user's hand—to avoid accidental exposure. As for two-piece radar units, the study states that antennas should be mounted so that they do not point at police officers inside the car, and that "the preferred mounting location would be outside the vehicle altogether."

Poynter found this guidance too weak: "We thought it should require that all antennas be placed outside the vehicle." On radar guns, Poynter said, *"My* recommendation is, if it doesn't have a dead-man switch, don't use it."

Dr. Gregory Lotz, chief of NIOSH's Physical Agents Effects Branch in Cincinnati and one of the report's authors, responded that, "A lot of small police departments don't have the resources to modify existing radar guns. If they take precautions, they can keep exposure to a minimum."

Lotz and his coauthors conclude that "conducting a definitive epidemiological study of health risks associated with traffic radar devices does not seem feasible at this time." They explain that the low incidence rate of the relevant cancers would require

EPA's EMR Programs Face Budget Ax

The House Appropriations Committee wants to cut the Environmental Protection Agency's (EPA) "low-priority radiation programs" from the agency's fiscal year 1996 (FY96) budget. This would eliminate EPA's EMF and RF/MW programs, according to Dennis O'Connor, EMF team leader at EPA headquarters in Washington.

Among the many budget cuts specified in the committee's report is $11,876,000 for radiation programs "involving criteria, standards, guidelines, program implementation and environmental impact assessments." The committee is trying to reduce the overall EPA FY96 budget to $4.9 billion, 34% less than President Clinton's request for $7.3 billion. The Senate will make its own recommendations when it returns from its recess in mid-August.

a large population of radar-exposed officers, combining those from several states. However, they found "that law enforcement agencies do not record traffic radar use in any systematic manner." Lotz told *Microwave News* that, "We have some genuine scientific concerns about whether we could come up with anything other than an equivocal result."

NIOSH's feasibility study is its response to a three-year-old congressional request, coming after hearings on police radar and cancer chaired by Sen. Joseph Lieberman (D-CT) (see *MWN,* S/O92). This July, Sen. Lieberman told *Microwave News* that while he was "disappointed" that NIOSH decided against an epidemiological study, he was "pleased that they nonetheless chose to make specific, practical recommendations" to limit exposure.

In late 1992, the then-head of NIOSH, Dr. Donald Millar, wrote to Lieberman, pledging, "We will [also] attempt to identify other occupational groups whose exposures to radar may be higher or better quantified. It is possible that such a group may provide the opportunity for a more precise epidemiologic evaluation of the biologic effects of radar."

This point is not addressed in the feasibility study. The report does note, however, that "there is very little epidemiologic data on the effects of RF/MW radiation on humans." Lotz added that, "There is a need for epi studies of people who may be microwave-exposed."

"I plan to follow up with NIOSH," Lieberman said, expressing hope that the agency would follow through on a study of other radar-exposed workers.

The NIOSH report does call for a broader study of occupational health risks for police officers, involving between 10,000 and 30,000 officers at a total cost of $1.4-2.6 million. Lotz said that this could lead to a follow-up investigation of radar use, but "would have value for the occupational health of police officers whether or not we could clarify the radar question."

Two studies involving police radar are now under way in Canada. Dr. Maurice Bitran of the Ontario Ministry of Labor said that the ministry is doing research along these lines, first looking at the overall health of police and later investigating radar exposure. The second study, coordinated by Ottawa Civic Hospital and the Canadian Police Research Center, is an initial investigation of radar use and illness among members of the Royal Canadian Mounted Police. Dr. George Wells of Civic Hospital said that the results will determine whether they move on to a full-scale epidemiological survey.

In the U.S., prospects appear dim for funding a general study of police health issues. The Clinton Administration's budget request for fiscal year 1996 does not include funding for such research, while the House of Representatives is seeking a 25% cut in NIOSH funding and the eventual elimination of the agency.

FDA's Swicord To Run EMR Research Program at Motorola

After 26 years at the Food and Drug Administration (FDA), Dr. Mays Swicord is leaving to become the director of Motorola's electromagnetic radiation (EMR) biological effects research program. Swicord will join Motorola on October 1 and will report to Dr. Quirino Balzano, a corporate vice president.

"The appointment of Dr. Swicord to our research team testifies to Motorola's ongoing commitment to bring the best possible science and scientists to bear on the issues related to the safety of our products," Balzano told *Microwave News*.

Swicord, chief of FDA's radiation biology branch, has led the agency's efforts to monitor the safety of cellular phones. "Appropriate steps will be taken by the FDA to make sure that the agency will continue its electromagnetic radiation programs," he said in an interview.

Motorola's research program, which focuses on cellular phones and other wireless technology, is made up of at least seven major projects that are now under way (see table below). In addition, the company sponsors other research through its membership in the Cellular Telecommunications Industry Association and in Germany's Research Association for Radio Applications (FGF).

Norman Sandler, a Motorola spokesperson, said the seven ongoing projects are those "we are in a position to acknowledge at this time with the consent of the principal investigators." He stressed that, "Our policy is to have *all* Motorola-sponsored research published in open, peer-reviewed literature upon completion."

Motorola's Ongoing Cellular Phone Health Studies

Principal Investigator	Location	Signal*	Type	Due Date
Dr. Ross Adey	VA Medical Center, Loma Linda, CA, U.S.	TDMA	Animals & Cells	1996
Professor Konstantin Hossman	Max Planck Institute, Cologne, Germany	GSM	Animals	1995
Professor Marika Kiessling	University of Heidelberg, Heidelberg, Germany	GSM	Animals	1995
Professor Niels Kuster	ETH, Zurich, Switzerland	GSM	Dosimetry	Open-Ended
Dr. Robert Morgan	Environmental Health Strategies, Redwood City, CA, U.S.	—	Epidemiology	Not Available
Dr. Joseph Roti Roti	Washington University, St. Louis, MO, U.S.	CDMA	Animals & Cells	1996
Dr. Bernard Zook	George Washington University, Washington, DC, U.S.	MIRS	Animals	1996

*CDMA = Code Division Multiple Access; GSM = Global System for Mobile Communications; MIRS = Motorola Integrated Radio Services; TDMA = Time Division Multiple Access.

COMMENTARY

Commentary from the Bioelectromagnetics Society Annual Meeting

The Science and Politics of the EMF Puzzle; The Missing Pieces in the "Frontline" Story

The irony is astonishing. On the very day that a committee of the National Council on Radiation Protection and Measurements (NCRP) completed its 800-page draft report asking regulatory agencies to pay "serious attention" to EMFs, public television station WGBH aired a one-hour show across the country comparing EMFs to cold fusion. While the NCRP committee called for "a national commitment to further research," the June 13 *Frontline,* "Currents of Fear," asked whether it was time to close down the research effort.

Of course, *Frontline* dominated the gossip circles at the annual meeting of the Bioelectromagnetics Society (BEMS) held later that same week in Boston, WGBH's hometown. Only a few insiders knew about the NCRP report.

It's too bad that Jon Palfreman, WGBH's producer of this show, did not bother to go across town to attend the BEMS meeting. If he had listened to some of the presentations and talked to members of the NCRP committee, he might have realized that his documentary for the *Frontline* series left out key facts —facts that conflict with his thesis that concern over EMF health effects has no scientific basis.

Then again, it might not have made a difference. There are good reasons to think that Palfreman never approached the EMF puzzle with an open mind. Much like Gary Taubes, whose own attack on EMFs appeared in last November's *Atlantic Monthly,* Palfreman started with an idée fixe and then went looking for like-minded people.

In a nutshell, Palfreman's thesis is that the animal studies show no effects, the cellular experiments are irreproducible, the best epidemiological evidence is specious and the postulated biophysical mechanisms of interaction contradict the laws of physics. Unfortunately, it isn't quite that simple.

* * *

Let's begin with what Palfreman left out:

Animal Studies

Palfreman only cited those experiments being carried out at Chicago's IIT Research Institute (IITRI) by Dr. David McCormick, whose first cancer study failed to show any effect. McCormick's results are so new that they have not yet been peer-reviewed or published. Even so, they already have their share of critics, who have raised questions about the study design.

Palfreman built up IITRI's exposure study as the definitive, best-controlled experiment ever. He let Dr. Gary Boorman of the National Institute of Environmental Health Sciences (NIEHS) make the case:

> As you refine your studies, if there really is an effect, the effect should increase, it should become stronger, it should become more focused, and if you cannot, with repeated studies and with better studies, you continue not to find an effect or find only marginal effects, then it becomes obvious that there's really nothing there.

Boorman's scientific logic is of course rational and correct, but, in this particular context, it makes no sense. Very few animal cancer studies have been done to date and McCormick has only completed a *single* experiment. It's hard to make a case for a trend with IITRI's one data point.

In a press release posted on the Internet, the WGBH public affairs office lost all control of the facts:

> Dozens of animal experiments have been carried out in which rats and mice are exposed to very large magnetic fields for long periods—some for their entire lives—but no animal has ever been proven to contract cancer due to this exposure.

If you add up all the animal–cancer studies ever done, you do not reach "dozens" and some of those that have been done show some adverse effects. What did Palfreman say when asked about this? Only that he did not write the press release. No apologies, no excuses, no interest in setting the record straight.

At BEMS, both Dr. Craig Byus[1] of the University of California, Riverside, and a Finnish team[2] reported seeing higher-than-expected rates of cancer in animals exposed to EMFs. For one set of exposures, Byus said that he found a "very, very significant" increase in tumor incidence. Byus's study is being sponsored by the NIEHS, where Boorman works.

But the most riveting talk on animal experiments was that given by Dr. Wolfgang Löscher of the School of Veterinary Medicine in Hannover, Germany. He and Dr. Meike Mevissen have completed a *series* of studies at four different exposure levels—much of which has already been published in respected peer-reviewed journals.[3] In Boston, Löscher concluded that the magnetic field "promotes the growth and increases the incidence of tumors in a dose-dependent fashion."

Boorman said that he is impressed by Löscher's animal studies not only because they show clear and reproducible effects but because Löscher also has confirming experimental evidence on the hormone melatonin and the growth enzyme ODC. It all adds up to a consistent and solid picture of EMF effects on a living organism.

Indeed, Boorman is so impressed with Löscher's work that he recently issued a request for proposals to repeat the animal studies at a cost well in excess of $1 million. Does this sound

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like a scientist who thinks that there is "nothing there," as Palfreman would have us believe? The Department of Energy (DOE) is so favorably impressed by Löscher that it will sponsor his work directly—one of the very few times the DOE has ever funded EMF research outside the U.S.

"The animal studies were incompletely and too simply presented" on *Frontline,* Boorman said in an interview. If Palfreman had used Löscher's studies as his example instead of IITRI's, he said, the audience would have reached a "very different conclusion."

Cellular Studies

Here again, Palfreman based his argument on one study—Battelle's Dr. Jeffrey Saffer's unsuccessful attempts to repeat Drs. Reba Goodman and Ann Henderson's experiments showing changes in gene expression in HL-60 cells. At this point, no one knows why the two (three, counting a British team that also found no response) labs got different results. But looking beyond this particular experiment, another picture emerges.

A number of researchers have shown that EMFs can affect gene expression. Among them is Saffer himself. At last November's EMF review in Albuquerque, NM, Saffer reported that he had turned his attention to another cell line, JB6, and found preliminary evidence of a response.[4] Saffer later parlayed that finding into a research grant of more than $1 million from the NIEHS.

As it turns out, at BEMS, Saffer said that so far he has been unable to reproduce the effect.[5] Nevertheless, another lab, at the Food and Drug Administration, has been seeing a robust response in JB6 cells.[6]

When asked about the JB6 work, Palfreman said that he knew nothing about it and that Saffer had never mentioned it. Saffer must have gone through a TV interview—never a short affair—without a word about his new million-dollar project on gene expression.

One of the best-known scientists at the BEMS meeting was struck by this omission: "If Saffer does not think there is anything there and doesn't have the scientific imagination to know where to look, why doesn't he give the money back?" he asked, expressing his own frustration on how hard research money is to find.

Epidemiological Studies

Most of the data supporting a cancer risk comes from studies of human populations, and many leading epidemiologists—including Drs. Anders Ahlbom, Birgitta Floderus, Sam Milham and Gilles Thériault—have found strong evidence for a link. They are all internationally known and respected and each has led large EMF studies.

Palfreman is unconvinced. He says that "most epidemiologists" regard the EMF field "as something of an embarrassment to their profession," but does not cite any sources. If he were right, why couldn't he find a single epidemiologist other than a longtime utility consultant to say this to the camera? And why are so many epidemiologists still working on the EMF puzzle if it so stigmatizes them?

Palfreman's experts on epidemiology were two electric utility consultants: Dr. John Moulder of the Medical College of Wisconsin in Milwaukee, an expert on using radiation to treat cancer, and, to a lesser extent, Dr. Patricia Buffler, an epidemiologist at the University of California, Berkeley. He used them to disparage the Swedish childhood cancer study by Drs. Maria Feychting and Anders Ahlbom. Moulder said that the Swedes made a fundamental error: They made so many comparisons that, by chance alone, they had to come up with some positive associations. Buffler agreed. The Swedish study, they argued, was simply an exercise in data dredging.

Ahlbom dismissed Moulder's and Buffler's criticisms. "It is absolutely necessary to look at a large number of analyses in any epidemiological study to look for consistencies and inconsistencies in the data," he said in an interview.

In a review[7] published earlier this year, Feychting and Ahlbom concluded, "The evidence on leukemia in children appears rather consistent." They went on to say that the hypothesis that EMFs lead to the development of cancer cannot yet be considered proven and that we "have to accept the uncertainty."

The *Frontline* interview with Dr. David Savitz made it clear that Palfreman is not interested in uncertainties. After talking to Savitz for more than an hour on camera, Palfreman only gave him some 20-30 seconds of airtime—and even then Savitz never got to say a word about epidemiology, only exposure assessment. Savitz thinks he knows why he was not allowed to say more: "Palfreman had his point of view and looked for quotes to support it," he said in an interview.

The data-dredging argument is "completely unsatisfying—it's no explanation at all," Savitz said, adding that, "It is a strength of the study to have investigated so many possibilities." As Ahlbom pointed out, "Suppose that we had not done this, but had been asked to do so after publication, should we have answered: 'This is an interesting question, but unfortunately we cannot do this because it is not in the study protocol'?"

The contribution of the Swedish study is not that it gave a definitive answer, but that it provided a new and persuasive piece of the EMF puzzle that fits neatly into the existing mosaic. But Palfreman has no patience for anything short of absolute proof.

The earlier Wertheimer-Leeper, Savitz and London-Peters studies all showed a link between childhood cancer and EMF exposures, as defined by the Wertheimer-Leeper wire codes. When measured fields were used, however, the link was weaker. Some observers, especially those from the utility industry, jumped on this apparent discrepancy and dismissed the studies as being internally inconsistent.

Using historical records of the current loads on Sweden's power lines, Feychting and Ahlbom calculated the magnetic fields when a child got sick—as well as one, five and ten years prior to diagnosis. (This partly explains why they made so many comparisons, which led to the charges of data dredging.) The Swedes found that the calculated historical fields did show a link to cancer. Making their case even stronger, they found a dose–response relationship. Further, like their predecessors, Feychting and Ahlbom did not see an association between present-day magnetic fields and leukemia. This suggested, as many epidemiologists had long speculated, that wire codes

are good indicators of long-term EMF exposures.

In short, the Swedes set out to see whether there was a link between power line magnetic fields and leukemia and that is exactly what they found. They improved on past studies and the link grew stronger: precisely the type of evidence that skeptics say they want to see. Feychting and Ahlbom did not answer all the questions, but epidemiology never does.

Biophysical Mechanisms of Interaction

This is the most important part of Palfreman's argument. Whether an experiment shows an EMF effect in humans, animals or cells becomes moot if it is possible to show that such interactions are theoretically impossible: Yale University physicists Drs. Robert Adair and William Bennett believe this, and, it appears, so does Palfreman. To use the metaphor conjured up by Adair on *Frontline,* worrying about EMF health effects is akin to being concerned that a cat will damage a tree by breathing on it during a howling wind storm.

Given the recent statement[8] by the American Physical Society (APS) that EMFs are of no concern—also cited by Palfreman on the show—one might conclude that all physicists agree with Adair and Bennett. But that would be a mistake.

There are many physicists working in the field of bioelectromagnetics. As Dr. Bill Kaune, a consultant based in Richland, WA, who has a doctorate in physics, put it: "We physicists who do research on EMFs have long been aware of the signal-to-noise problem, but, regardless of our concerns, experiments seem to show that EMFs affect living tissues. I don't see how one can justify flatly discounting the work of a large number of epidemiologists and laboratory biologists solely on the basis of signal-to-noise calculations on highly simplified models of living tissues."

A couple of years ago, Adair had the opportunity to make his case to the JASONs, a high-level group of physicists, whose advice is routinely sought by the Department of Defense. In his report on behalf of the JASONs, Dr. Steven Koonin of Caltech concluded: "The essential point to take away...is that a cellular-level coupling of magnetic fields to biological systems is physically plausible and does *not violate any physical principles.*"[9]

Koonin was a member of the APS council that approved the statement, and may well believe that "no plausible biophysical mechanisms" have been identified. But this does not mean, as Adair and Bennett (and Palfreman) contend, that such interactions are impossible.

As for the APS statement itself, it is as much a political as a scientific document. A look at Dr. David Hafemeister's slipshod background paper[10] that served as the basis for the statement is convincing evidence of his and the APS' political agenda. Hafemeister is well attuned to the world of politics and the power of a press release given to a responsive reporter, having spent many years in Washington working for the federal government and congressional committees.

Adair was at the BEMS meeting, and when asked how he could explain an organism's ability to sense magnetic fields as weak as 0.2 mG against the background of the earth's 500 mG field, Adair replied: perhaps if you have enough cats and enough trees....

Or to put it another way, biological systems are complex and are not easily captured by a simple model or a colorful analogy.

Implicit in these discussions is that when we talk about EMFs we are referring to one physical phenomenon. In fact, there are a huge variety of EMFs, each of which may have a different effect. Among the most intriguing are transients—short intense pulses of energy.

At BEMS, Dr. Antonio Sastre, a consultant based in Suffern, NY, and his colleagues showed that when it comes to EMF transients—common occurrences on power lines—the signal can rise above the background noise.[11] "The objection that environmental fields are too weak with respect to thermal noise need not apply to transients," Sastre said in an interview, pointing out that one needs to invoke only "pedestrian physics applied to realistic models of cells" to show this. Sastre's work is sponsored by the Electric Power Research Institute (EPRI).

Sastre's work on transients follows last fall's announcement by Thériault that he and his colleagues at McGill University in Montreal, Canada, had found a very strong association between exposure to transients and lung cancer among utility workers. Hydro-Québec's first reaction on learning of this result was to take the data away from the McGill research group.[12] Seven months later, the conflict remains unresolved and Thériault's team is still barred from probing further into this risk—one of the largest ever observed for any EMF-exposed population.

* * *

Palfreman is a serious journalist. He has won two AAAS science writing prizes, as he is not too bashful to tell his critics. But he clearly came to EMFs with his mind made up. He might have salvaged the show had he taken the trouble to talk to those whose work he is disputing.

Palfreman never interviewed Drs. Anders Ahlbom or Reba Goodman, two of the scientists he skewered on the program. He said that he exchanged faxes with Ahlbom and has the faxes to prove it. This made no impression on Ahlbom, who cannot remember Palfreman among the many reporters who have called him.

The Goodman story is different and more troubling. Palfreman said that Goodman refused to be interviewed, while Goodman maintained that no one from *Frontline* ever called her. Goodman is right. Palfreman let one of his assistants, Michaela Barnes, contact Goodman, but she conceded that she never did. When asked why not, Barnes cited "political reasons."

One set of *Frontline* interviews, left on the cutting room floor, involved the controversy over health problems among those living next to an electrical substation in Guilford, CT. Paul Brodeur used this as a case study in a 1990 article published in *The New Yorker,*[13] with Bob Hemstock serving as the protagonist. In the course of his interview with *Frontline,* Hemstock offered to contact Goodman on the program's behalf, since he was going to be talking to Goodman about a project of his own.

Goodman told Hemstock that it would not be a good idea for him to visit her lab with a television crew. Goodman was swayed, at least in part, by Hemstock's theories on EMFs, which

are somewhat idiosyncratic. In any case, by the time Hemstock relayed this message to Barnes, he had himself decided, for his own reasons, that he did not want to take the *Frontline* crew to Goodman's lab.

Hemstock never knew and therefore could not tell Goodman about *Frontline's* interest in Saffer's experiment. Nor did Goodman know that the public television crew Hemstock mentioned was from *Frontline*.

No one from *Frontline* ever called Goodman directly—even though Palfreman planned to tell the world that her results are worthless. Neither Palfreman nor anyone else from *Frontline* was interested in hearing Goodman's side of the gene expression story—a violation of one of the most basic rules of journalism. The omission is striking given Palfreman's statement that he is "interested in finding the truth in a world where, increasingly, scientific data is being abused and distorted for political ends."

* * *

One of the most revealing aspects of the *Frontline* episode is that so few members of the bioelectromagnetics community have spoken out to correct the obvious errors in the program. Palfreman said that the vast majority—approximately 95%—of the comments have been favorable. The reason for the silence is an important part of the EMF story.

EMF research is an underfunded backwater of the scientific community. Before the congressionally mandated $65 million RAPID program got under way last year, most of the available research funds came from the electric utility industry through EPRI and from the DOE, an agency not known for putting radiation safety ahead of its other program objectives. EPRI and the DOE do not look kindly on those who publicly highlight possible health risks.

This is the grubby side of science, where many researchers are as interested in securing contracts and grants—even if it means making compromises along the way—as they are in doing the actual scientific work.

This also explains why there has been no outcry—indeed we have yet to hear a single word of public protest—at Hydro-Québec's outrageous behavior in blocking Thériault's access to millions of dollars worth of data that could explain part of the EMF puzzle.

Among the possible casualties of this silence are the emerging biomedical applications of EMFs, for instance the use of pulsed EMFs to heal nonunion fractures. If low-level, nonthermal effects fall into disrepute, then, by definition, such medical devices are ineffective and should not be on the market. But even those who see a bright future for EMF therapies are not speaking up.

Before the New York Power Lines Project began in the early 1980s, neither EPRI nor the DOE moved to confirm or refute the Wertheimer-Leeper cancer study. As a result, it took nine years to repeat it. And as soon as Savitz had done so, EPRI, still unconvinced, decided that it had to be done all over again. This took another five years. Critics of the Feychting-Ahlbom study should not wonder why we don't know more, but rather should marvel that we know as much as we do.

When the Feychting-Ahlbom results were released in 1992, the Swedish government said that it believed that, more likely than not, the cancer link existed.[14] Two years later, the Swedes did not reject this conclusion, but decided that they could not rationalize the high economic costs of regulating EMFs given the rarity of childhood leukemia. Swedish government officials have made it clear that if the hypothesized EMF role in breast cancer were to be confirmed they would reconsider the decision.[15] Feychting and Ahlbom are now working on an epidemiological study of EMFs and breast cancer.

The significance of the epidemiological studies is not that they point to a cancer epidemic. But they raise the question: If EMFs can cause even a small change in cancer rates, what other biological effects could they have?

In the absence of detailed studies on breast cancer, Alzheimer's disease and depression, among other common health problems, no one knows how great the EMF health risk really is. Those who argue that we now have enough research to conclude that the risk is small, if it exists at all—as Dr. Jack Sahl of Southern California Edison does in a recent report[16]—are engaging in wishful thinking.

The reason the EMF problem has attracted so much attention is not because of pressure from the scientific community. It is the public that has propelled EMFs into the limelight. The Omaha housewives whose children have cancer want answers, as was shown on *Frontline*. Palfreman portrayed them as naïfs who have been brainwashed by Paul Brodeur. This is unfair because they have legitimate concerns and because they are victims of the scientific uncertainty that is a result, in large measure, of years of industry and government foot-dragging.

* * *

So, the animal, cellular and human studies all point to real risks. And physics does not put them out of the realm of possibility. To be sure, these risks have not been conclusively proven—but neither have they been convincingly dismissed.

As the NCRP committee concluded in its draft report: "[F]indings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health."

Yet Palfreman is sure he already has the answers. After a quick breeze through the literature and talking to a few like-minded scientists, Palfreman thinks he knows better than the expert NCRP committee that studied the issue for a decade. "The thesis is mine," he said in an interview. "It's very clear-cut, I don't feel any doubt."

Palfreman's show was simply an exercise in hubris. Only this can explain why Palfreman is willing to follow in Buffler's footsteps in waging a holy war against prudent avoidance. Neither sees the point, for instance, in telling parents that they may be protecting their kids simply by moving a bed across a room out of a 10 mG field. As Julie Larm, one of the mothers on the show, wrote to Palfreman on behalf of Omaha Parents for the Prevention of Cancer after the June 13 broadcast, "May God help you if you're wrong."

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9. Emphasis added. See *MWN,* S/O93.
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14. See *MWN,* S/O92.
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FROM THE FIELD

Clippings from All Over

In 1988, shortly before he died, Andrei Sakharov commented on the fate of the earth. Interestingly enough, rather than comment on the hydrogen bombs that he coinvented, he stated: "...in fact, I am now inclined to regard the many-faceted ecological threat to our environment as our most serious long-term problem." Because I agree with this very long-term assessment, it is troubling to me to see environmental funds and political capital wasted on false threats. In particular, I am concerned that the quasi-legalistic concept of "prudent avoidance" is being used to chase the phantom risk of cancer caused by extremely low frequency (ELF) [EMFs] from power lines. This needless chase costs some $1 billion to $3 billion per year and unnecessarily frightens the public with "electrophobia." The burden of these fiscal and emotional costs placed on the American public are incommensurate with the risk, if any, being mitigated. This outcome is not a use of science for the public good.

—David Hafemeister, "The Imprudence of 'Prudent Avoidance'," *Physics & Society,* a publication of the American Physical Society, p.9, July 1995

[B]ut it is only a matter of time before a jury returns a favorable verdict to plaintiffs in an EMR case.

—Bruce DeBoskey, "Electromagnetic Radiation and Cancer: Recent Developments," *Trial,* a publication of the Association of Trial Lawyers of America (ATLA), p.21, July 1995

In March of 1994, alliance member Julie Larm met with President Bill Clinton and asked him to execute an executive order creating a buffer zone between homes, schools, day care centers and nursing homes and any electrical generating facility, such as transmission and distribution lines and electrical substations. The alliance has continued a year-long letter campaign urging Clinton to sign this executive order with hope that the White House would focus on this issue. However, over a year has passed since the White House promised to look into the health hazards surrounding exposure to EMF. The cover story of our spring 1995 issue of *Network News* was entitled "The White House White Wash: Clinton Ignores the EMF Issue" and prompted a letter from President Clinton to me a few weeks ago assuring me that the EPA was continuing to review the EMF issue. Although I am not from Missouri—I'll stand by Missouri's "Show Me" state motto. Show me, then I'll believe it. The Clinton Administration has continually taken the "ostrich" position on EMF, as did the Bush Administration before it. It has fallen to the shoulders of the citizen activist to resolve this issue at a grassroots level.

—Cathy Bergman-Venezia, "Introducing the EMR Alliance: Grassroots Group Looks for a Safe Environment," *1995 ATLA Annual Convention*, New York City, p.8, July 17, 1995

"We [epidemiologists] are fast becoming a nuisance to society," says Dr. Dimitrios Trichopoulos. "People don't take us seriously anymore, and when they do take us seriously, we may unintentionally do more harm than good." As a solution, epidemiologists interviewed by *Science* could suggest only that the press become more skeptical of epidemiologic findings, that epidemiologists become more skeptical about their own findings—or both.

— Gary Taubes, "Epidemiology Faces Its Limits," *Science,* p.164, July 14, 1995

"The worst aspect of mobile phones is that they probably interrupt my meal in restaurants."

—Dr. Michael Repacholi, chairman, International Commission on Non-Ionizing Radiation Protection, appearing on ABC-TV's (Australia) *Four Corners* in "Waves of Fear," aired July 10, 1995

"Don't put the antenna right against your head. Now that is the sort of information that should be imparted to the user [of cell phones]."

—Dr. Ross Adey, associate chief of staff for R&D, VA Hospital, Loma Linda, CA, also on *Four Corners,* July 10, 1995

The draft emphasizes that "mitigation of existing exposures...is likely to prove complex and costly." But with regard to new construction, committee members argue for "exercising these options now at a time when their implementation will carry minimal societal impact or fiscal burden." They underline the importance of "planning for the future of a society wherein use of electric power will continue to grow at every turn."

The committee concludes that "neither laboratory studies nor epidemiological findings...can yet establish well-defined thresholds for safety guidelines." Still, it contends:

> From available epidemiological and laboratory data, it appears both prudent and responsible to set limits on permissible future exposures.

Therefore it calls for "interim exposure guides," measures that "fall short of establishing either a standard or guideline, but offer guidance to limit exposure."

ALARA Policy Endorsed

While the report notes that committee members were not unanimous, it recommends a policy in which exposures would be "as low as reasonably achievable," known as ALARA. Over a three-year period, ambient exposures in homes, schools and offices would be reduced to 10 mG. After six years, there would be an option to establish a guideline of 5 mG. Each of these decisions would be based on whatever epidemiological and laboratory studies were then available. After ten years, a goal of 2 mG would be considered. The report stipulates that mitigation of the existing EMF environment to this level should be adopted only after "a careful evaluation of its socioeconomic impact, as well as its cost-effectiveness."

"We worked very hard to come up with a statement where we could say, these are the committee's recommendations, even though we don't agree on everything," said Dr. Mary Ellen O'Connor of the University of Tulsa, OK, a member of the committee. As another committee member, who asked not to be identified, said, "Some members felt it was important to set numerical limits, while others felt it was inappropriate at this time."

The committee rejected the option of not issuing any specific recommendations on exposures. It also rejected another option—to set a 2 mG exposure guideline immediately—on the grounds that "general compliance would appear impractical at this time." As Adey pointed out, "We must be realistic that we are not going to give up electric power. Its use will continue to grow in a civilized society."

Committee member Dr. David Carpenter, of the School of Public Health at the State University of New York, Albany, said, "In almost any other type of environmental exposures, if the evidence were as strong as the association between EMFs and cancer, there would be extensive government regulation. The major reason that many members of the committee were unwilling to set more rigorous standards was that it would be horrendously expensive and unrealistic to enforce them."

With respect to future construction, the report recommends observing a 2 mG exposure limit for schools and for new transmission lines near existing housing, with somewhat less strict guidelines for new housing and offices.

The report notes that its proposed benchmarks can serve as "a vehicle for public instruction." While large-scale education of individuals "may be difficult to achieve," the document stresses the importance of changing institutional practices "on such topics as grounding in electrical distribution systems [and] manufacturing of appliances."

Adey described the committee's members as "carefully selected to cover the great majority of societal interests on this scientific problem, including power industry engineers, epidemiologists, public health specialists as well as molecular and cellular biologists" (see box above for a list of members). Dr. Richard Stevens of the Battelle PNL in Richland, WA, commented that, "There were some differences of opinion on the weight of the evidence, but my impression is that there was agreement on the importance of the issue and that it deserves continued attention."

EPA Cancer Report Due Soon

The draft report is the culmination of work that began in 1983, when the EPA contracted with the congressionally chartered NCRP for a review of the biological effects of extremely low frequency (ELF) EMFs (see *MWN,* D83). Work was discontinued in 1986 because of funding cuts at the EPA, but resumed in 1991, according to EPA's Elder. "It took a million years," said O'Connor.

Adey noted that, "The committee's position evolved each year with the growing body of credible laboratory and epidemiological studies." In its review of the research, the report examines evidence for EMF effects on cancer growth, reproduction and embryo development, and neurobiology.

The NCRP committee's conclusions bolster the findings of a 1990 draft on EMFs developed by the EPA (see *MWN,* M/J90). That EPA report is now being revised, but the agency does not appear to be backing away from its most important conclusions (see *MWN,* S/O94). McGaughy, of EPA's Office of Health and Environmental Assessment in Washington, said that it would probably be completed by October or November and would be reviewed by EPA's Science Advisory Board after a 60-day public comment period.

Committee Members

The members of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and Magnetic Fields are: Dr. Ross Adey (chair), VA Hospital, Loma Linda, CA; Dr. Larry Anderson, Battelle Pacific Northwest Labs (PNL), Richland, WA; Dr. Carl Blackman, EPA, Research Triangle Park, NC; Dr. David Carpenter, State University of New York, Albany; William Feero, Electric Research and Management Inc., State College, PA; Dr. Marvin Frazier, Department of Energy, Washington; Dr. Richard Lovely, Battelle PNL, Seattle; Dr. Richard Luben, University of California, Riverside; Dr. Martin Misakian, National Institute of Standards and Technology, Gaithersburg, MD; Dr. Mary Ellen O'Connor, University of Tulsa, OK; and Dr. Richard Stevens, Battelle PNL, Richland.

SPECIAL REPORT

NCRP Draft Recommendations on EMF Exposure Guidelines

Reprinted below is Section 8 of the June 13, 1995, draft of the report of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and Magnetic Fields, which contains its conclusions and recommendations.

8.1.0 Conclusions and Recommendations for Interim Exposure Guidelines

In 1989, the International Radiation Protection Association (IRPA) approved interim EMF exposure guidelines prepared by its International Non-Ionizing Radiation Committee. The guidelines recommended the following limits for occupational exposure and for exposure of the general public:

Table 1

Exposure	Electric Field Strength	Magnetic Flux Density
Occupational:		
Whole Working Day	10 kV/m	0.5 mT (= 5,000 mG)
Short Term	30 kV/m	5.0 mT (= 50,000 mG)
Restricted to Limbs	—	25.0 mT (= 250,000 mG)
General Public:		
Up to 24 hours/day	5 kV/m	0.1 mT (= 1,000 mG)
Few hours/day	10 kV/m	1.0 mT (= 10,000 mG)

The IRPA committee based its recommendations on the premise that the existing literature does not provide evidence that EMF exposures at present-day levels have a public health impact that would require corrective action. Its summary position was that "although some epidemiological studies suggest an association between exposure to 50/60 Hz fields and cancer, others do not. Not only is this association not proven, but present data do not provide any basis for health assessment useful for the development of exposure limits."

Further, the IRPA guidelines were developed "primarily on established or predicted health effects produced by currents induced in the body by external [EMFs]," and those limits correspond to induced current densities that are generally at, or slightly above, those attributable to normal excitation currents occurring physiologically in the body. Thus, the IRPA-recommended exposure limits are orders of magnitude greater than field levels that may create a risk, in the light of extensive evidence reviewed in this report. Concerns about inadequacies of IRPA guidelines have been summarized in a review of international standards (Gibbs, 1991)[1]:

> Since the guidelines proceed on the basis that adverse human health effects from exposure to ELF electric fields at strengths normally encountered in the environment or in the workplace have not been established, it is apparent that they are not intended to provide protection against any adverse health effects that may be caused by such exposure, and they would not do so. The levels of exposure recommended are many times greater than the levels at which it has been suggested that the fields may create a risk.

In the U.K., the National Radiological Protection Board (1989) also set exposure guidelines for 50/60 Hz fields on the same basis as the IRPA committee in fixing its interim guidelines. For occupational exposures and for the general public, the recommended 50 Hz field levels were the same: for electric fields: 12 kV/m; for magnetic fields: 2 mT (20,000 mG).

In the USA, some states have established limits for electric field strengths on or at the edge of the rights-of-way for high voltage transmission lines. Only Montana has established magnetic field limits (Table 2).

Exposure criteria at these levels do not reflect epidemiological findings that suggest significantly enhanced cancer risks, particularly for childhood leukemia, in ambient power frequency fields exceeding 2 mG. This level is proposed for a Swedish general population guideline, based on correlates of incidence of childhood leukemia with annualized magnetic field levels in dwellings adjacent to high voltage transmission lines.

8.2.0 Rationale for Interim Exposure Guides

In reviewing available evidence, neither laboratory studies nor epidemiological findings, whether considered separately or jointly, can yet establish well-defined thresholds for safety guidelines that would encompass the temporal spectrum from short-term to lifelong ELF exposures. Although it might thus be justified to offer no specific guidelines, nevertheless it would appear prudent to offer interim guidance.

Population exposure to EMFs at power line frequencies involves not only the basic sine wave fields at 50 or 60 Hz, but also harmonics at higher frequencies. Secondary fields generated in the use of electric power are substantially more complex due to their harmonic content. Although this report focuses on the ELF spectrum from near-DC to 300 Hz, information has been included on studies as high as the kilohertz range, because of their widespread environmental occurrence and because they have not been reviewed elsewhere.

In key areas of bioelectromagnetic research, findings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health. These specific areas of research are briefly reviewed.

8.2.1 Carcinogenesis

Epidemiological studies in the USA and Europe cited elsewhere indicate a positive association between childhood cancers and exposure to magnetic fields, on the order of 0.2 $\propto$T, generated by electric power transmission and distribution systems. Evidence has accumulated in other epidemiological studies implicating exposure to ELF EMFs as a factor common to an increased incidence of leukemia and brain cancer in occupationally exposed adults.

In laboratory research, further studies will be necessary to determine existence of an unequivocal link between exposure to ELF EMFs and cancer. Nevertheless, reported EMF effects in animal and tissue models at critical steps in cell growth regulation are consistent with an initiation-promotion (epigenetic) model of tumor formation, and are consistent with results of epidemiological studies.

Table 2*

State	On ROW**	Edge of ROW
Florida§	8 kV/m	2 kV/m
Florida†	10 kV/m	2 kV/m
Minnesota	8 kV/m	—
Montana	7 kV/m	1 kV/m
Montana§	—	150 mG
Montana†	—	200 mG
Montana‡	—	250 mG
New Jersey	—	3 kV/m
New York	11.8 kV/m	1.6 kV/m
North Dakota	9 kV/m	—
Oregon	9 kV/m	—

*After Gibbs[1] ** ROW = Right-of-Way
§lines ≤ 230 kV †500 kV lines ‡500 kV double circuit lines

[1] H. Gibbs, *Inquiry into Community Needs and High-Voltage Transmission Line Development,* Report to Minister for Minerals and Energy, New South Wales State Government, Australia. 163 pp., 1991.

8.2.1.1 Gene induction: There is no evidence of gross chromosomal damage or sister-chromatid exchanges following exposure to ELF EMFs, interpreted as an indication that field exposure does not cause initiation as the first step in the initiation-promotion cancer model. However, ELF magnetic fields have been shown to alter gene transcriptional processes, with repression and derepression of portions of the genetic code, thus leading to changes in expression of proteins in cells. This process may represent an abnormal cell function, leading to reduced control of cell growth, and ultimately to unregulated growth. Such a loss of growth regulation would be consistent with a promotional role (or copromotional with other promoting agents) in the cancer process.

8.2.1.2 Biochemical changes: Intracellular biochemical changes following ELF magnetic field exposures. They include responses of messenger and cell growth-related enzymes, and alterations in gene expression, including modulation of activity of proto-oncogenes. These changes are consistent with actions of chemical cancer promoters, suggesting the possibility of combined actions of chemicals and ELF EMFs as cancer promoters.

8.2.1.3 Enhanced cell tumorigenicity: Increased tumor incidence and decreased tumor latencies have been reported in animal tumor models when 50/60 Hz magnetic fields at intensities of 0.1 mT or less were presented as promoters or copromoters. Increased concentrations of transferrin receptors have been reported on the surface of human colon cancer cells when exposed to 60 Hz magnetic fields, or to combined electric and magnetic ELF fields. A relationship to increased tumorigenicity may be suggested, since raised serum iron levels and an associated decrease in levels of transferrin iron binding have been described in human cancer. These findings are consistent with the possibility that prolonged exposures to ELF fields may progressively lead to recloning of already transformed cells to a more cancerous state.

8.2.1.4 Immune deficiencies: Accumulating epidemiological evidence from population studies and from the workplace now correlates environmental ELF EMF exposures with increased risks for leukemia in children and adults. Certain of these studies have suggested a dose-dependence in long-term exposures. In laboratory studies, the natural defense response of T-lymphocytes taken from the immune system of mice is reduced by exposure to ELF electric fields, and after exposure to combinations of electric and magnetic fields. It may be argued that if these exposures mitigate normal immune defense responses in the intact subject, there may ensue less efficient detection and elimination of aberrant cells, including cells undergoing recloning to more malignant states.

8.2.2 Reproduction/Teratology

Unlike the growing and increasingly consistent evidence linking ELF EMF exposure to increased risks of certain cancers, epidemiological evidence on human reproduction has remained limited. A single preliminary study has described a modest increased risk of pregnancy termination associated with use of electric blankets.

A series of studies in Scandinavia and the USA have reported increased risks of miscarriage associated with VDT use, including evidence of dose-dependency. Studies in mice, rats and swine have all reported teratological effects, but many lack consistency in site and type of teratology. Several independent studies have noted growth abnormalities in chick embryos exposed to similar types of magnetic fields. A single study in rats of neuroendocrine and psychosexual responses following intrauterine ELF magnetic field exposure in late pregnancy has described defective territorial marking in adult male offspring and increased gonadal organ weights.

Available evidence from these epidemiological and laboratory studies indicates needs for further research on possible reproductive anomalies, including studies of subtle neurobehavioral effects that may be revealed only after puberty and in later development.

8.2.3 Neurobiology

Limited human studies have addressed a spectrum of altered physiological responses that appear correlated with ELF electric and magnetic field exposures. This spectrum of bioeffects shades progressively into certain neuroendocrine and autonomic responses which, separately or collectively, may have pathophysiological implications. These human observations are supported and extended by a much larger body of laboratory animal research, with responses to ELF fields in species from fish to man. These fields may influence development of the nervous system. In the adult organism, they elicit neurochemical, physiological, behavioral and chronobiological responses.

There has been a strong focus on ELF field actions in the pineal gland, relating to effects on synthesis and secretion of the pineal hormone *melatonin,* and on a broad series of regulatory functions mediated by this hormone. Melatonin plays a key role in controlling the 24-hour daily biological rhythm. Disturbance of the normal diurnal melatonin rhythm is associated with altered estrogen receptor formation in the breast, a line of experimental evidence now under study for possible links between ELF field exposure and human breast cancer. Further, melatonin has general properties as a free radical scavenger, with the possibility of a preventative role in oxidative stress, recognized as a basic factor in a broad spectrum of human degenerative disorders, including coronary artery disease, Parkinson's and Alzheimer's diseases, and aging.

8.3.0 Conclusion

Although incomplete, available epidemiological and laboratory data share certain consistencies that would link ELF environmental EMFs with increased health risks. These findings appear to warrant a substantive national commitment to further research, and the serious attention of cognate regulatory agencies and of the general public. Some epidemiological studies relate health effects to broad measures of exposure levels. From these measures, there is an implication that a significant proportion of the world's population may be subjected to a low level of risk, but a risk factor with significant societal consequences, by reason of its pervasive nature and the serious consequences for affected individuals. Much additional research will be necessary to determine the complex nature of dose-response relationships, and the specific contributions of field frequency, intensity and waveforms. A deeper knowledge of mechanisms is needed to elucidate observed differences between intermittent and chronic ELF field exposures. In establishing safety guidelines, there may also be a need to identify populations with specific sensitivities, as is customary with certain chemical toxins. As yet, no research has examined possible synergisms between EMFs and other environmental agents. Further, many electrically operated appliances, such as television receivers, computer display terminals and certain types of electric motors, may generate substantial magnetic fields in their immediate vicinity at frequencies above the ELF spectrum. Although beyond the scope of this report, these fields may also be biologically active. A broader base of experimental data will be required before there can be regulatory implementation of comprehensive safety guidelines; but this considered approach in no way diminishes the desirability of interim standards.

8.4.0 Interim Exposure Guides

Based on available evidence, the committee concludes that it is desirable to reduce human exposure to electric and particularly to magnetic fields over the frequency range from near-zero to 3 kHz. This may be accomplished, particularly in areas with frequent and prolonged human occupancy, by recommending an exposure standard, or a set of safety guidelines; or by recommendations that fall short of establishing either a standard or guideline, but offer guidance to limit exposure.

The past century has seen exponential growth in the universal

use of electric power in every facet of civilized society. With this universal acceptance, engineering considerations have driven the developing technologies of power generation and distribution in ways offering few options for possible changes dictated in the hindsight of either environmental or medical concerns. The burden of fiscal investment alone may make unfeasible drastic modifications of existing systems in the short term.

The committee has therefore addressed these questions of safety in an historical perspective. What safety issues may arise from continuing exposure to existing environmental fields? And for the future, should these exposures be mitigated, and if so, to what levels? Beyond an evaluation of existing exposures, a more pressing issue involves planning for the future of a society wherein use of electric power will continue to grow at every turn.

On the one hand, mitigation of existing exposures may be appropriate in certain instances where exposures may be deemed excessive, based on available epidemiological and laboratory data. In planning for the future, societal impact of this mitigation is likely to prove complex and costly. Prior to implementing major mitigation programs, they will require rigorous evaluation of their risk/benefit ratios. An approach developed by cognizant federal agencies in handling some environmental toxic agents has involved incremental safety guidelines that reflect growth of medical knowledge and availability of improved or more cost-effective mitigation techniques over a period of years.

By contrast with deep-rooted problems inherent in mitigation of many existing exposures, plans for the future should address exposure guidelines in new construction of housing, schooling and industrial plants, with specification of acceptable interior electromagnetic environments, as well as proximity to existing electric power transmission and distribution systems. A second concern addresses construction of new power transmission and distribution systems, and their permissible proximity to existing houses, schools and industrial developments

Although precise numerical levels in safety guidelines covering current environmental exposures may require further research, there is a different perspective on needed guidelines for the future of an increasingly electrified society. From available epidemiological and laboratory data, it appears both prudent and responsible to set limits on permissible future exposures, exercising these options now at a time when their implementation will carry minimal societal impact or fiscal burden.

8.4.1 The Existing ELF Electromagnetic Environment

With respect to the existing electromagnetic environment, four options were considered:

8.4.1.1 Option 1: No recommendation for use of specific field levels to define an exposure safety guideline: *EMFs from distribution and use of electric power have created new exposures in the human environment. Virtually no one in Western society escapes some form of exposure. For that reason, there should be a continuing aggressive pursuit of possible adverse health effects from these exposures. However, the existing evidence bearing on health effects is inadequate to offer exposure guidelines at this time. There is not sufficient consistency among epidemiological studies, and with very few animal studies reported, it is premature to assume a causal relationship between EMF exposure and cancer risk.*

Though not sufficient to conclude causality, the epidemiological studies have raised concern. In addition, animal models for skin and breast cancer are in the early stages of evaluation and preliminary results have been provocative. Despite their logical complexity, further rigorous testing of animal models may offer one of the few options for full elucidation of a possible role of EMFs in tumor formation, since it is unlikely that these data will be derived from epidemiological studies alone.

It must be emphasized that epidemiological studies completed to date do not rule out effects of EMFs on cancer risk, even large ones. This is because of limitations in exposure assessment and undoubted misclassification of exposure, as well as the absence of truly unexposed subjects.

8.4.1.2 Option 2: An exposure guideline of 0.2 ∝T and 10 V/m: *Epidemiological evidence points to human health hazards in exposure to ambient power frequency magnetic field environments exceeding 0.2 ∝T. A dose-dependence for childhood leukemia is suggested for power frequency fields in the range 0.2-0.4 ∝T. Assessment of the ambient magnetic environment in these studies at sites near power transmission and distribution lines has generally not taken account of much higher but more focal fields in the immediate vicinity of operating devices in the home and workplace. Resulting risk estimates may thus underestimate the true exposure levels from all sources. Although largely neglected in the emphasis on magnetic field bioeffects, there is also a body of laboratory evidence relating biologically significant effects, particularly in cerebral tissue calcium binding, to ELF electric field exposures in the range 10-100 V/m. Neurobehavioral effects, including a regulatory role in biological rhythms of man and animals, have been attributed to ELF environmental electric fields at intensities in the range 10-100 V/m.*

Safety guidelines established at the low levels of Option 2 could be expected to have a major impact on lifestyles and working conditions in homes and in most occupational settings. Mitigation of existing fields needed to achieve general compliance would appear impractical at this time.

8.4.1.3 Option 3: An exposure guideline of 1 ∝T and 100 V/m: *A considerable body of observations has documented bioeffects of fields at these strengths across the gamut from isolated cells to animals, and in man. Although the majority of these reported effects do not fall directly in the category of hazards, many may be regarded as potentially hazardous. Since epidemiological studies point to increased cancer risks at even lower levels, a case can be made for recommending 1 ∝T and 100 V/m as levels not to be exceeded in prolonged human exposures. Most homes and occupational environments are within these values, but it would be prudent to assume that higher levels may constitute a health risk.*

In the short term, a safety guideline set at this level would have significant consequences, particularly in occupational settings and close to high voltage transmission and distribution systems, but it is unlikely to disrupt the present pattern of electricity usage. These levels may be exceeded in homes close to transmission lines, distribution lines and transformer substations, in some occupational environments, and for users of devices that operate close to the body, such as hair dryers and electric blankets. From a different perspective, adoption of such a guideline would serve a dual purpose: first, as a vehicle for public instruction on potential health hazards of existing systems that generate fields above these levels, as a basis for "prudent avoidance"; and second, as a point of departure in planning for acceptable field levels in future developments in housing, schooling, and the workplace, and in transportation systems, both public and private, that will be increasingly dependent on electric propulsion.

8.4.1.4 Option 4: The ALARA concept (as low as reasonably achievable): *The ALARA concept derives from guidelines for exposure to ionizing radiation. In that context, it first requires acceptance of a specific numerical guideline, and thereafter, due diligence in seeking progressive exposure reduction to levels at or below the guideline. Although the aggregate evidence suggests a significant health risk from these fields, there is as yet inadequate information to establish thresholds that would implicate specific field levels as safe or hazardous. Therefore, in the interval required for further research, individuals, industries and govern-*

ment agencies would have responsibilities to make human exposures as low as reasonably achievable in meeting a postulated numerical exposure guideline developed as part of an ALARA scheme.

An ALARA approach also offers an avenue to safety guidelines to be implemented incrementally. An incremental approach to dealing with potential environmental hazards is a model successfully employed by the Environmental Protection Agency, in joint actions with other federal agencies, in dealing with toxic waste cleanup. Appropriate benchmarks are established that project realizable goals at stated future times. An incremental approach on a large scale has been applied by EPA to the control of automobile emissions in Southern California, under the federal Clean Air Act.

Based on Option 3, a set of ALARA goals may be defined with benchmarks projected over a minimum of six and a maximum of ten years, as a template for an incremental guideline. In homes, schools, nonindustrial workplaces, and in suburban environments, *a first ALARA benchmark* at three years should reduce ambient exposures to 1.0 ∝T [and] 100 V/m (Option 3). Thereafter, *a second benchmark* at six years would set a goal at 0.5 ∝T [and] 50 V/m. Beyond this point, implementation of the *third benchmark* in an incremental safety guideline for the general public at a further sharply reduced level (as in Option 2) at 0.2 ∝T [and] 10 V/m will require a careful evaluation of its socioeconomic impact, as well as its cost-effectiveness. It would not be expected to occur until about seven years after implementation of benchmark 1. Its justification would also be based on new correlated laboratory and epidemiological data expected to be available over the next decade.

For individuals, educational requirements inherent in this ALARA scheme may be difficult to achieve; but at the societal level, there should be a technological focus on such topics as grounding in electrical distribution systems, manufacturing of appliances designed to reduce stray field levels, and elevation of consumer awareness of possible hazards associated with particular appliances.

8.4.2 Conclusion on an Interim Exposure Guideline for the Existing Electromagnetic Environment

Though not unanimous, the predominant view of the committee is to recommend the ALARA approach. It is proposed that this ALARA guideline be progressively implemented over a ten-year period. It is recommended that specific field levels cited here be regularly reviewed as more information becomes available that might suggest either more or less stringent figures as the basis for a continuing ALARA policy. Specifically, the pathophysiology of cumulative dose has yet to be defined, and with it, the relevant parameters in long-term EMF exposure.

The proposed initial benchmark for a safety guideline would be developed under Option 3. After three years, maximum acceptable field levels would not exceed 1.0 ∝T and 100 V/m over the spectrum from near-zero to 3.0 kHz in homes, schools, and other nonindustrial environments. In a review after six years, there would be an option to establish a guideline at 0.5 ∝T and 50 V/m. Thereafter, at ten years, and only after full review of socioeconomic as well as its technical implications, there would be an option to establish a guideline at 0.2 ∝T [and] 10 V/m. There would be options to truncate both lead times and acceptable field parameters if favored by availability of appropriate laboratory or epidemiological evidence.

With respect to occupational exposures, the committee reviewed the composite nature of exposures in the workplace, where EMFs, often at high levels, coexist with a variety of chemical factors known to be hazardous, including neurotoxins, pesticides, herbicides and organic solvents. Although there is evidence that EMFs may promote actions of these chemical factors in pathogenesis of human disease, particularly in relation to joint exposures over many years, these data are insufficient for evaluation of their joint or separate roles. Moreover, in most instances, economic considerations would render unfeasible a major reduction in existing industrial field levels through engineering approaches. These exposures may also involve high levels of static magnetic fields, for which there is very little relevant laboratory or epidemiological data.

In typical office environments, ambient field levels may differ very little from domestic ambients. The committee therefore recommends use of the incremental ALARA guideline described above. However, the industrial workplace may involve intermittent or continuous exposure to fields orders of magnitude higher. In these situations, the committee also recommends an ALARA approach for 60 Hz fields, but with an awareness that neither major reductions in existing field levels, nor options to significantly reduce operating personnel exposures are immediately feasible on technical or economic grounds. As a long-term (ten-year) goal, an ALARA approach to mitigation in existing industrial environments would envisage a time-limited personnel exposure not exceeding one hour in any eight-hour workshift, and with time-averaged fields not to exceed 10 ∝T and/or 1 kV/m for any one hour in an eight-hour workshift. This guideline does not address magnetic transients associated with starting or stopping large inductive devices. Its development towards time-limited exposures is suggested by laboratory reports of ELF and RF exposures that modulate immune cell functions in a time-dependent manner.

The committee recommends further research into field mitigation, including the possibility of developing protective clothing capable of magnetic shielding, as a possible option in personnel protection in high-level industrial magnetic fields.

8.5.0 Exposure Guidelines Relating to Future Developments Affecting the ELF Electromagnetic Environment

There may be important societal options in considered planning for the future of electric power transmission, distribution and use. Planned development may avoid hazards and pitfalls of existing systems, and by offering guidance in new construction, may avoid much of the heavy economic impact inevitable in retrofitting and mitigating suspected health hazards associated with past and present technologies.

As safety guidelines for future planning, the committee recommends that: *1) New day care centers, schools and playgrounds should not be built where ambient 60 Hz magnetic fields exceed 0.2 ∝T; 2) New housing should not be built under existing high voltage transmission lines, or in such close proximity to these lines that measured ambient field levels would exceed 0.2 ∝T for periods longer than two hours daily; 3) New transmission and distribution lines should not be built in locations where they would produce fields exceeding 0.2 ∝T in existing housing; 4) In new office and industrial environments, design considerations should encompass problems of personnel exposure to high magnetic field levels, with the aim of reducing intermittent and ambient exposures to a 0.2 ∝T level, over the spectrum from near-zero to 3.0 kHz.*

8.5.1 Conclusion

In arriving at the proposed guidelines, the committee has considered available laboratory studies on bioeffects and epidemiological reports of health hazards from electric and magnetic field exposure. Lacking a basis for calculation of cumulative dose, these guidelines have been determined without drawing distinctions between acute and chronic exposure. They have not determined exposure levels from safety factors frequently used with other agents, nor has there been special consideration for sex, age or potentially sensitive populations, such as pregnant women, because current knowledge of mechanisms of field interactions does not allow identification of those likely to be affected. In medical diagnostic and therapeutic applications, these guidelines would exclude patients, but would apply to physicians, nurses and to all other health providers.

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UPDATES

BOOKS

Technical Primer on EMFs...A new book from CRC Press, *Power Frequency Magnetic Fields and Public Health,* explains how to estimate the strength and distribution of magnetic fields produced by the use of electric power. Coauthors William Horton and Saul Goldberg, both professors of electrical engineering at California Polytechnic State University in San Luis Obispo, write that they wanted the book to be accessible to "a nontechnical reader," but equally of interest to an engineer, scientist or architect. "The book focuses on characterizing the various kinds of field sources—transmission lines, transformers, ground currents, appliances, and so on—and allows readers to determine what their exposure might be," Horton told *Microwave News*. A number of two- and three-dimensional contour maps provide clear descriptions of different kinds of fields, from those in a typical residential living room to those around a pad-mounted transformer. The book leads the reader through the equations needed to calculate field strengths, with the most complicated technical material reserved for the appendixes. There is an extensive glossary of technical terms, and a section on how to apply prudent avoidance in one's daily life. Also on the Cal Poly faculty is Dr. David Hafemeister, author of the background paper for the American Physical Society's recent statement on EMFs (see *MWN,* M/J95). Hafemeister has recently spoken out against the concept of prudent avoidance (see p.10). Horton said that he and Hafemeister are friends and he downplayed any differences in their views: "His conclusion was that it would not be a good use of public funds to make big expenditures to reduce EMFs, and I would have to agree with that. I would just do the simple things, where you can reduce exposure without spending a lot of money." He added that, "I personally don't think there's much danger due to power frequency fields, but if I had a child I wouldn't put the crib next to the incoming power service. Who knows what the next study's going to show?" *Power Frequency Magnetic Fields and Public Health* costs $59.95. Order from: CRC Press, 2000 Corporate Blvd., NW, Boca Raton, FL 33431, (800) 272-7737 or (407) 994-0555, Fax: (800) 374-3401 or (407) 998-9114.

CALL FOR PAPERS

RF/MW Medical Applications... The October 1996 issue of *IEEE Transactions on Microwave Theory and Techniques* will deal with medical applications and biological effects of RF/MW radiation. Those interested in contributing papers on medical therapies, diagnostic techniques or safety issues should contact: Arye Rosen, David Sarnoff Research Center, 201 Washington Rd., CN 5300, Princeton, NJ 08543, or Andre Vander Vorst, Hyperfrequences, UCL, Bâtiment Maxwell, B-1348 Louvain-la-Neuve, Belgium. Manuscripts are due by this October.

CELLULAR PHONE INTERFERENCE

Astronomers' Concerns... New forms of mobile telecommunications technology could close the heavens to radio astronomers, according to the European Science Foundation (ESF) in Strasbourg, France. Concerned by plans for mobile phone sys-

tems using satellites in low earth orbit (for instance, Motorola's Iridium system), the ESF warned that, "To succeed, this potentially billion-dollar industry will need access to several frequency bands which are also crucial to the world's radio astronomers." The ESF said that cell phone interference with astronomy is already "a growing problem which the International Telecommunications Union (ITU) appears reluctant to recognize." Dr. James Cohen of the U.K.'s Jodrell Bank radio telescope explained the effects of interference: "It's like [being] a professional photographer who, despite being equipped with the latest in modern cameras, finds that just as he presses the shutter someone else shines a flashlight into his lens." Dr. Peter Napier of the U.S. National Radio Astronomy Observatory in Socorro, NM, said that the ESF's concerns are shared by U.S. astronomers. Napier praised some companies, including Motorola and the American Mobile Satellite Corp., for seeking the input of astronomers as they plan for satellite systems. This November, the ITU will decide which frequencies to allocate to satellite-linked phones.

CELLULAR PHONE TOWERS

When Is a Tree Not a Tree?... The telecommunications industry is branching out into aesthetics. With siting problems plaguing cellular phone companies throughout the country, the industry is looking for a way to camouflage its towers. Arcnet Inc. of Holmdel, NJ, may have the answer with its tree look-alike tower. Modeled after a white pine, the antenna can be 10 feet to 200 feet tall. The "limbs" of the pine tree vary from 2 feet to 14 feet and are made of polyvinyl chloride pipe coated with epoxy resin "bark." Not to worry if you want to erect an antenna tower in the tropics or the desert. Arcnet also is marketing royal palm and saguaro cactus look-alike towers.

COMET ASSAY

Lai-Singh Paper Published... The report by Drs. Henry Lai and Narendra Singh, which has attracted so much attention in the cellular phone community, is now in print (see *MWN,* N/D94). "Acute Low-Intensity Microwave Exposure Increases DNA Single-Strand Breaks in Rat Brain Cells" appears in *Bioelectromagnetics (16,* pp.207-210, 1995), which came out in early July. Lai and Singh, both of the University of Washington, Seattle, used the comet assay to measure DNA damage, a technique that Singh helped develop. In a recent review, Drs. Daryl Fairbairn and Kim O'Neill of Brigham Young University in Provo, UT, and Dr. Peggy Olive of the British Columbia Cancer Research Centre in Vancouver, Canada, conclude that, "The versatility of applications of the comet assay indicates its usefulness in addressing a wide range of questions in biology, medicine and toxicology." See "The Comet Assay: A Comprehensive Review," *Mutation Research, 339,* pp.37-59, February 1995.

MEETINGS

Hypersensitivity Conference... The proceedings of the *2nd*

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION
CHIEF, RADIATION BIOLOGY BRANCH

The Center for Devices and Radiological Health, Food and Drug Administration (FDA) is seeking a qualified individual to serve as Chief, Radiation Biology Branch, Division of Life Sciences, Office of Science and Technology. Responsibilities include direction and development of intra- and extramural FDA-related scientific programs in radiation biology; developing regulatory, educational, and other strategies concerning radiation-emitting products; representing FDA with national and international organizations; and establishing the technical basis for regulatory and policy matters.

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Research Opportunities

The California Public Health Foundation, fiscal manager for the California EMF Program, will soon issue Requests for Proposals (RFPs) for the following projects:

- Prospective Epidemiological Study of Spontaneous Abortion ($1,200,000);
- Power Grid and Land Use Policy Options ($550,000);
- Utility Workers Employees Policy Options ($170,000);
- Engineering Options Review ($97,000);
- Risk Assessment Guidelines ($130,000).

Later, the program will contract epidemiology consultants to write articles on selected topics of EMF epidemiology.
For further information or for a copy of these RFPs, contact: Dr. Vincent DelPizzo, EMF Program, 5900 Hollis St., Suite E, Emeryville, CA 94608, Tel: (510) 540-3657, Fax: (510) 540-2673.

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Copenhagen Conference on Electromagnetic Hypersensitivity, held in May 1995, are now available. Edited by Drs. Jyrki Katajainen of the Department of Computer Science at the University of Copenhagen, Denmark, and Bengt Knave of the Department of Neuromedicine at the National Institute of Occupational Health in Solna, Sweden, the 138-page book is comprised of 23 papers. The paperback volume, which costs 210 Danish Kr. (approximately $40), can be ordered by contacting: Danish Association for the Electromagnetically Hypersensitive, c/o Aase Thomassen, Lunden 1, Ålum, DK-8900 Randers, Denmark; (45) 86 46 61 14.

PEER REVIEW

Latest NIH Panel... Paul Strudler of NIH's Division of Research Grants in Bethesda, MD, convened a peer-review panel to examine EMF proposals, June 29-30. The members of the panel were: Drs. Deborah Cory-Slechta, University of Rochester, NY; Christopher Davis, University of Maryland, College Park; Amato Giaccia, Stanford University, Stanford, CA; David Grdina, Argonne National Laboratory, Argonne, IL; Sek-Wen Hui, Roswell Park Cancer Institute, Buffalo, NY; Howard Liber, Harvard School of Public Health, Boston; David McCormick, IIT Research Institute, Chicago; Steven Miller, SRI International, Menlo Park, CA; William Morgan, University of California, San Francisco; Keith Paulsen, Dartmouth College, Hanover, NH; Terry Pellmar, Armed Forces Radiobiology Research Institute, Bethesda, MD; Charles Polk, University of Rhode Island, Kingston; Joseph Roti Roti (chair), Washington University, St. Louis; Robert Ullrich, University of Texas, Galveston; and Peter Valberg, Gradient Corp., Cambridge, MA.

PEOPLE

Dr. **Richard Luben** of the University of California, Riverside, is the president-elect of the Bioelectromagnetics Society. He will take over from Dr. **Kjell Hansson Mild** of Sweden's National Institute of Occupational Health in Umeå, next year....**Frank Young** has taken a leave of absence from Enertech Consultants in Campbell, CA, where he is a senior vice president, to go to Jilin City in the People's Republic of China. He will be teaching electrical engineering at the invitation of the Northeast China Institute of Electric Power Engineering....The NCRP has reorganized its activities into nine scientific program areas. Dr. **Tom Tenforde** has been appointed vice president for non-ionizing radiation....**Michael Withey** is the new president of Trial Lawyers for Public Justice....Dr. **John Osepchuk** has retired from Raytheon Co. He has set up Full Spectrum Consulting, based in Concord, MA. In addition, he will continue to serve as the acting chairman of SCC28 on Non-Ionizing Radiation Hazards.

RESOURCES

Review Paper... Drs. Eugene Goodman, Ben Greenebaum and Michael Marron have published "Effects of Electromagnetic Fields on Molecules and Cells," in the *International Review of Cytology, 158,* pp.279-338, 1995.

CLASSIFIEDS

MICRO WAVE NEWS

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Both Electric and Magnetic Fields Seen as Critical to Cancer Risk

Ontario Hydro Worker Study Links Combined Exposures to Excess Leukemia

Workers exposed to high levels of magnetic *and* electric fields had leukemia rates that were up to 11 times greater than expected, according to researchers at the University of Toronto in Canada. This result indicates that electric field exposures may play a crucial role in the link between cancer and power frequency electromagnetic fields (EMFs). The leukemia risks found by the Toronto team are some of the highest reported in a major epidemiological study.

"Up until now, people have tended to pursue the notion that any cancer effects were likely to be from magnetic fields," said Dr. Anthony Miller,

See Commentary on Exposure Assessment, p.7

lead author of the Toronto paper, published in the July 15 issue of the *American Journal of Epidemiology (144,* pp.150-160, 1996). "However, this study suggests that electric fields are potentially critical to cancer risk."

Dr. David Agnew, a senior safety scientist at Ontario Hydro in Toronto and a member of Miller's team, agreed that the findings are "important." He predicted that they will prompt "future research to explore this further."

The Ontario Hydro results have put electric fields back in the limelight.

(continued on p.5)

FCC RF/MW Rules Favor NCRP Limits; Cell Phones To Be Tested for Safety

The Federal Communications Commission (FCC) has adopted final health and safety regulations for exposures to radiofrequency and microwave (RF/MW) radiation. The new rules are based in large part on those recommended by the National Council on Radiation Protection and Measurements (NCRP) in 1986, although the FCC adopted some provisions from the 1992 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) guidelines.

"We believe that the exposure criteria we are adopting will protect workers and the general public from potentially harmful RF emissions due to FCC-regulated transmitters," stated the FCC in its August 1 *Report and Order.* In favoring the NCRP limits, the FCC sided with the Environmental Protection Agency and against the communications and electronics industries, which had mounted a massive lobbying campaign in favor of the ANSI/IEEE standard (see *MWN,* M/J94 and M/A96).

The FCC will now require that all new cellular and personal communi-

(continued on p.13)

EMF NEWS

« Power Line Talk »

Are power line EMFs as harmless as moonlight? Last June's PBS television program ***Frontline*** (see *MWN,* J/A95) made this comparison, and this argument is becoming common among those seeking to downplay the EMF issue. The *Frontline* narration, which was written by **Jon Palfreman**, who also produced the show, stated that, "Physicists have calculated a person standing under a power line at night would get some 10,000 times more electromagnetic energy from moonlight than from the power line." The figure recently resurfaced in an interview for an ABC-TV special on scientific controversies hosted by **John Stossel** and scheduled to air this fall. **Marc Dorian**, the ABC program's producer, did not know the origin of the moonlight argument, but said it was a standard point in the EMF debate. When *Microwave News* asked Dr. **Robert Adair** of the Yale University Department of Physics in New Haven, CT, one of the physicists in the *Frontline* piece, about it, he replied that it was new to him. Later, after doing the math, he called back and said, "The calculation is in the ballpark." Dr. **Charles Polk** of the University of Rhode Island in Kingston, a coeditor of CRC Press' *Handbook of Biological Effects of Electromagnetic Fields,* agreed that the calculation may be accurate, but he was nevertheless harshly critical: "It is a propaganda argument and it's totally irrelevant—it has nothing to do with the possibility or impossibility of biological effects." Palfreman's assistant credited the statement to Dr. **Peter Valberg**, a utility consultant with the Gradient Corp. in Cambridge, MA. Valberg said in an interview that some of the points that led him to this calculation came from a 1994 report he wrote for **EPRI** on possible EMF mechanisms of interaction (see *MWN,* J/F96). When Stossel posed the moonlight question on June 28 to **Joan Tukey** of the **California Alliance for Utility Safety and Education** (CAUSE), a citizens group based in San Diego, she asked **Michael Silva** of Enertech Consultants in Campbell, CA, to join the discussion. Tukey told *Microwave News* that when Silva—who was also scheduled to appear on the show—approached the cameras, Stossel ordered them turned off. "I tried to explain to Stossel the problems with that argument," Silva said. Tukey, who had grown increasingly frustrated by the tone and direction of Stossel's questions, walked away from the interview. In a July 1 letter to ABC News Executive Producer Victor Neufeld, Tukey pointed out that, prior to the interview, readings of up to 85 mG were measured in a power line corridor in a residential neighborhood. Stossel himself is no stranger to controversy, having been called by consumer advocate **Ralph Nader** "the most dishonest journalist" he ever met. Stossel's 1994 ABC special, "Are We Scaring Ourselves to Death?" prominently featured Dr. **John Graham**, director of the Harvard Center for Risk Analysis in Boston, which established an EMF risk assessment program that is being funded by industry groups including EPRI (see *MWN,* J/A94). Stossel has also been referred to as "the darling of conservative and industry groups" by the *Washington Post* and has received as much as $22,000 per lecture. He claims to be giving proceeds from his speaking engagements to charity since an ABC policy took effect in 1994 barring correspondents from accepting money from corporations and trade associations. But while Stossel gave about $135,000 from 1994 lectures to charity, he pocketed some $25,000, according to the April 17, 1996, *Corporate Crime Reporter,* a Washington-based newsletter.

«« »»

"They treated me like a pig," **Father Shay Cullen** said of the Philippine police who arrested him on June 13 in Olongapo. The 53-year-old priest told the ***Philippine Daily Inquirer*** that he and a colleague, Lowell Maglaqui, were brutally beaten before being arrested without warrants for protesting the routing of high-voltage power lines near a home for destitute children (see *MWN,* M/J96). In a press release issued on July 3, Cullen said police forced their way onto the platform he had built atop a 40-foot pylon, where he had been staging his protest since April. The priest noted that the police then closed its curtains and began beating him up. He also claimed that his radio, cellular phone and camera were confiscated and not returned. Cullen's statement on the incident also alleged that an officer approached Alex Hermoso, a bystander who was taking photographs of the arrest, and ordered him at gunpoint to hand over his radio and camera. Police Chief Nicasio Radovan denied the charges, reported the *Daily Inquirer* on June 15, and claimed that his officers had patiently tried to convince the priest to climb down from the pylon for his own safety. Radovan said that he was following the orders of the town's mayor, Katherine Gordon, to remove the priest from the pylon. Cullen told *Microwave News* that these events show "the cost of protest in the Philippines." But he vowed that, "We will continue on with court actions and public awareness raising."

«« »»

The melatonin hypothesis got a big boost when ***Cancer Research*** featured Dr. **Richard Stevens** on the cover of its July 15th issue. Below a photograph of Stevens, the prestigious journal featured a flow diagram that outlines how light-at-night and/or EMFs from electric power could lead to low levels of melatonin, which in turn could lead to increased breast cancer risks. Dr. **Sidney Weinhouse**, the cover editor of *Cancer Research,* commented that the "direct evidence" for Stevens's hypothesis, first proposed in 1987 (see *MWN,* J/F87), "is sparse but provocative." Weinhouse, a member of the National Academy of Sciences since 1979 and formerly the editor of the jour-

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nal, added that the "body of evidence is sufficient to bind electric power over for trial, but not nearly adequate to render a verdict." The hypothesis' next big test will come next spring, when Stevens and Dr. Scott Davis of the Fred Hutchinson Cancer Research Center in Seattle announce the results of their major epidemiological study, which tests Stevens's theory (see *MWN,* N/D91). "I'm delighted," Stevens told us from his office at the Battelle Pacific Northwest Labs in Richland, WA. "*Cancer Research* is one of the most respected journals in the cancer research community and this is a real honor." He added that he is pleased with the recognition, not only for himself but also for the field of bioelectromagnetics: "This is a mainstream and highly visible recognition of the EMF research effort."

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The **DOE** and the **Fetzer Institute** are sponsoring a small by-invitation-only workshop on ***Self-Organized Biodynamics and Control by Chemical and Electromagnetic Stimuli,*** which will be held at the institute in Kalamazoo, MI, August 10-14. Those who do not attend will have a chance to cover some of the same ground in San Antonio on Sunday, November 17. The Texas meeting—***The Emerging Science of Nonlinear Dynamics and Self-Organized Systems: Can It Help Explain Reported EMF Bioeffects?***—is scheduled for the afternoon before the start of DOE's annual EMF research review. For more information on the DOE review, contact: Dr. William Wisecup, W/L Associates, 7519 Ridge Rd., Frederick, MD 21702, (301) 663-1915, Fax: (301) 371-8955. Special room rates at the St. Anthony Hotel in San Antonio are available for those who reserve by October 13.

«« »»

Dr. **Leonard Sagan**, who led EPRI's EMF program for many years before his retirement, has published ***Electric and Magnetic Fields: Invisible Risks?*** The 214-page paperback was issued in June by Gordon and Breach, which is based in Amsterdam, The Netherlands. In a foreword, Dr. **Donald Kennedy**, the former head of the FDA and the president emeritus of Stanford University, urges readers not to "accept at face value either the apocalyptic visions presented in the media, or the bland reassurances they receive from self-appointed experts." The book is available in the U.S. for $19.95 from: International Publishers Distributor, Attn: Marketing, c/o PO Box 200029, Riverfront Plaza Station, Newark, NJ 07102.

«« »»

The first damage award in an EMF personal injury case just got bigger. **John Altoonian** and his wife had won a jury verdict of $762,524 against **Atlantic Electric**, most of it for emotional distress (see *MWN,* M/J96). But in the official final judgment on June 25, New Jersey Superior Court Judge Charles Previti added interest charges of $174,873, as well as $8,870 that the utility had already agreed to pay for trespass, bringing the total amount to $946,267. The award is under appeal.

NAS-NRC EMF Report Watch

This time, the National Academy of Sciences - National Research Council (NAS-NRC) sounds quite certain. Its report on EMF health effects is now due out in early September—most likely the week of September 9.

"It's in post-review editing," said Dr. John Zimbrick, the director at NRC's Board on Radiation Effects Research in Washington. He noted that all the scientific reviews have been completed. The board will soon start working with the news office to schedule a press conference.

Cancer Plaintiffs' Lawyers Must Pay for Utility's Experts

The law firm representing plaintiffs in a major EMF–cancer suit has been ordered to pay all expert witness fees—past and future—for the defendants, which include Southern California Edison Co. (SCE). A higher court put the case on hold on June 20, so that it could consider an appeal of the unusual sanction.

The lawsuit, *Younkin v. SCE,* was brought by employees of an Orange County real estate firm who developed cancer while working in an office located over a set of SCE transformers (see *MWN,* J/A94, M/J95 and J/F96).

Superior Court Judge Dennis Choate imposed the penalty when an expert witness for the utility refused to testify after receiving a letter of complaint from the plaintiffs' lawyers. At a February 1 hearing, Choate emphasized that dissuading a witness "is a crime in this state," and angrily compared the case to another, in which a gang member had drawn his finger across his throat while staring at a witness in the courtroom. "This is a dumb move," said Choate, according to hearing transcripts. "Felony dumb move. Misdemeanor dumb move. This should be reported to the state bar....I don't know whether I am obligated to refer it to the district attorney."

"It's a pretty strong sanction," commented SCE lawyer Joel Lamp, of O'Connor, Cohn, Dillon & Barr in San Francisco. "I've never seen it imposed before. The judge actually thought it was more serious than we did—he was very upset." Lamp said that this penalty was all the more striking because SCE had not requested it.

"It's just a disaster," said Annee Della Donna of the Santa Ana, CA, firm of Wylie Aitken. She contended that the ruling had created a conflict of interest that made it impossible to represent the plaintiffs fairly. Della Donna stated that her firm had already spent over $100,000 in costs—a figure that does not include any payment for the attorneys' time.

"Every decision concerning this action is now an ethical struggle between counsel's interest in reducing expert costs and their duty of undivided loyalty owed to the clients," Della Donna argued in court papers filed on March 28. If the sanctions ruling is not overturned, she told *Microwave News,* her firm will be required by state bar association rules to withdraw from the case. "Then the clients will be left to represent them-

Expert Witnesses and Fees in Office Cancer Suit

Listed below are selected expert witnesses in Johsz v. Koll, *an EMF–cancer lawsuit brought by a group of office workers against the Grubb & Ellis real estate firm, building owner Koll Co. and Southern California Edison Co. (see below). Witness lists have not yet been submitted in a related case,* Younkin v. SCE, *but attorneys for both sides say that they expect to retain the same experts on EMFs.*

For ***Plaintiffs:***		
John Bobis, PE	Engineering consultant, Rancho Cordova, CA	$1,100 first hour; $275 each additional hour
Dr. Wayne Lancaster	Economics consultant, Fullerton, CA	$360 first hour; $180 each additional hour
Dr. Abraham Liboff	Oakland University Physics Department, Rochester, MI	$2,000/day
Dr. Samuel Milham Jr.	Epidemiology consultant, Olympia, WA	$350/hour testimony; $100/hour standby
Gerard Moulin	Expert Technical Consultants, Thousand Oaks, CA	$275/hour
Dr. David Ozonoff	Boston University School of Public Health, MA	$3,200/day
For ***Defendants:***		
Dr. Hoda Anton-Culver	College of Medicine, University of California, Irvine	$150/hour
Dr. Patricia Buffler	University of California School of Public Health, Berkeley	$400/hour
Dr. Philip Cole	University of Alabama School of Public Health, Birmingham	$400/hour
Bill Eisinger, PE	Power Engineers Inc., Hailey, ID	$175/hour
Dr. Edward Gelmann	Lombardi Cancer Research Center, Washington, DC	$300/hour
Dr. Victor Levin	Anderson Cancer Research Center, University of Texas, Houston	$600/hour
Dr. Judith Luce	Oncology Services, San Francisco General Hospital, CA	$350/hour
Dr. Saul Allen Rosenberg	Oncology Division, Stanford University Medical Center, Stanford, CA	$400/hour
Dr. Jack Sahl	Southern California Edison, Rosemead, CA	(defendant's employee)
Michael Silva, PE	ENERTECH Consultants, Campbell, CA	$185/hour
Dr. Peter Valberg	Gradient Corp., Cambridge, MA	$180/hour

selves," she said, "and the case will go down in flames."

The expert witness involved is Dr. Hoda Anton-Culver, an epidemiologist at the University of California, Irvine, and the head of the Orange County Cancer Registry. She had been retained by SCE in *Younkin* and a related lawsuit, *Johsz v. Koll,* which grew out of the same cluster of cancer cases. The two actions involve different groups of workers but the same defendants—the Rosemead, CA-based utility, the real estate firm and the building owner. Both cases also involve the same attorneys on each side and substantially the same list of expert witnesses (see table above).

By coincidence, a plaintiff in *Johsz* named Mary Ann Stewart has a sister who is part of an unrelated breast cancer study being conducted by Anton-Culver. As part of that study, Anton-Culver asked Mary Ann Stewart to come to her office to be interviewed and provide a blood sample. Stewart did so on December 10.

When Della Donna learned what had happened, she accused Anton-Culver of improper conduct. "My feeling was that Dr. Anton-Culver had disqualified herself and would have to withdraw," she explained, noting that Anton-Culver had obtained "confidential medical information" without revealing that she was working for SCE. Della Donna said that the lawsuit was discussed during the office visit, and since Anton-Culver had read the plaintiffs' depositions, she "would have had to have her nose buried in the ground not to know that it was the same case."

Della Donna then wrote a letter to all defense attorneys demanding the return of the blood sample, insisting that Anton-Culver withdraw from the case and threatening legal action if she tried to take the stand. Della Donna also sent copies to Anton-Culver and her dean at UC Irvine. Soon afterwards, Anton-Culver informed SCE's attorneys that she would not testify.

SCE complained to Judge Choate about Della Donna's contact with its witness and asked that he dismiss the case. Choate rejected this request but ordered that a report which Anton-Culver had prepared for SCE be entered into evidence, even though she would not testify in support of it. He announced that he would tell the jury that her absence was the fault of the plaintiffs. And he ordered the plaintiffs' law firm to pay for all the defendants' expert witnesses as compensation for what he called "the kill shot inflicted upon witness Anton-Culver."

At the February hearing, Choate scolded Della Donna for taking action independent of the court: "Why didn't you...say, 'Judge, we have a problem here'?...Why don't you go through the route you are supposed to go through? Why do you have direct contact with the witness to the point where the witness has refused to testify?" The appeal of Choate's ruling will be heard by a three-judge panel on January 21, 1997.

Meanwhile, Della Donna filed a brief appealing the dismissal in the *Johsz* case on June 24. That case had been thrown out on December 8 of last year, in a dispute over admissible evidence and proof of causation (see *MWN,* M/J95 and J/F96).

In another major California EMF suit, the state's Supreme Court heard oral arguments on June 6 in the *Covalt* property-devaluation case (see *MWN,* N/D95). A decision is expected by the end of the summer. In May of 1995 an appeals court ruled that the state's public utilities commission had exclusive jurisdiction over all EMF issues, and that the *Covalt* case therefore did not belong in court.

New Support for Railway Exposure–Leukemia Link

Two new studies of Swedish railway workers provide further support for a link between EMF exposure and excess cancer risk. Building on Dr. Birgitta Floderus's 1993 study of railway workers, Dr. Lars Alfredsson's new research found a significantly higher rate of lymphocytic leukemia among these workers. Similarly, Dr. Ingrid Nordenson's study of railway employees detected a significantly higher incidence of chromosome breaks among the workers.

The study of engine drivers and conductors by a team from the Karolinska Institute in Stockholm led by Dr. Alfredsson showed that the incidence of chronic and acute lymphocytic leukemias was more than double that for the average Swedish male—a statistically significant finding. Published last May in *Cancer Causes and Control (7,* pp.377-381, 1996), the report described the data as uncertain, because of the small number of cases involved. There were ten cases of lymphocytic leukemia—eight chronic and two acute—observed in the railway workers from 1976 to 1990. Alfredsson said that it should be kept in mind that the 230 percent increase in lymphocytic leukemia among the workers corresponds to "about four extra cases...in a cohort of more than 9,000 engine drivers and conductors over a period of up to 14 years." He also pointed out that there was no increase in brain tumors observed in the cohort.

The study by Nordenson and her coauthors showed that engine drivers had a significant increase in chromosome breaks, which, the team argued, are associated with future cancer risk. It was conducted by the National Institute for Working Life (NIWL) in Umeå and presented at the Bioelectromagnetics Society annual meeting in June. The 18 drivers comprising the cohort were compared to a control group of seven dispatchers and 16 office workers.

The high and fluctuating EMF levels the drivers were exposed to occasionally reached into a range of 20 mG to 400 mG, with peak values at times exceeding 1300 mG. The mean value of occupational exposure for the control group was 2 mG.

While the study showed that the level of chromosomal aberrations overall was not significantly high, a significant number were found when only chromosome breaks were examined. In contrast to the 1.3% of drivers' cells with chromosomal breaks, the controls had only 0.3%.

Alfredsson's study agrees with the findings of Birgitta Floderus's epidemiological study of railway employees *(Cancer Causes and Control, 5,* pp.189-194, 1994), which showed cancer increases in workers exposed to EMFs. Alfredsson's study overlaps Floderus's, in that data from about 50% of the subjects, compiled between 1976 and 1990 and included in the new study, were initially used in the analysis of railway workers by Floderus, who is with the NIWL in Solna (see p.7 and *MWN,* S/O92, M/J94 and S/O95). Indeed, Alfredsson relates that both studies indicate that "this disease has persisted over time."

As early as 1985, the same team led by Nordenson was finding similar effects in substation workers (see *MWN,* J/F 85). This previous study showed that spark discharge pulses elicited chromosome breaks.

NIOSH Seeks Better Data for Railroad Worker Health Study

The National Institute for Occupational Safety and Health (NIOSH) will not embark on a study of railroad track workers because existing employee records are insufficiently detailed to gauge EMF exposures. The institute may, however, study railroad conductors—whose numbers are larger and whose exposure levels, NIOSH believes, may be higher.

In its *Electromagnetic Fields and Rail Maintenance Workers: Final Report of an Exposure Survey and Feasibility Investigation,* NIOSH found that employee records are not complete enough to estimate track workers' exposure levels. The feasibility study, which was released earlier this year, came in response to requests from Senator John Kerry (D-MA) and three congressmen—Frank Pallone Jr. (D-NJ), Robert Andrews (D-NJ) and Robert Borski (D-PA). In his March 6, 1993, letter to NIOSH, Pallone called the study "necessary," and stressed the "compelling need to further investigate this matter." His letter was prompted by a Pennsylvania railroad union's concerns over the health of its members.

Average exposures of rail maintenance workers are believed to be "slightly higher than the exposures of workers in other industries," according to NIOSH. These workers had higher exposures when a train was nearby. For example, average exposures rose from 12 mG to 80 mG as a train approached. Peak levels ranged from 34 mG to 185 mG when the train was passing the measurement location.

"We hope to take further measurements to learn if conductors have higher exposures than rail maintenance workers," said NIOSH's Dr. Thurman Wenzl in Cincinnati. "If so, rail passengers may also have elevated exposures on trains powered by overhead lines."

Dr. Birgitta Floderus has found that engine drivers had a threefold increased risk of chronic lymphocytic leukemia (see story on left), while Dr. Tore Tynes of the Cancer Registry of Norway in Oslo found no elevated leukemia risk among track workers.

Ontario Hydro Worker Study *(continued from p.1)*

They were the principal focus of attention in the 1970s and early 1980s, but in the mid-1980s researchers shifted their attention to magnetic fields. Earlier this year, a U.K. group suggested that electric fields could explain EMF–cancer risks through the concentration of radon by-products (see *MWN,* M/A96 and M/J96).

"There is no question after seeing Miller's study that I would be willing to put more effort into studying electric field exposures," Dr. David Savitz said in an interview from his office at the University of North Carolina, Chapel Hill. Savitz's 1995 report for the Electric Power Research Institute (EPRI) linked electric utility workers' EMF exposures to brain cancer (see *MWN,* J/F95).

Electric fields are now on EPRI's research agenda. "Further studies are needed to examine the relationship between occupational exposure to electric fields and leukemia," Dr. Leeka Kheifets, manager of EPRI's EMF research program in Palo Alto, CA, told *Microwave News.* "EPRI is exploring the availability of other survey measurement data to evaluate the relationship between magnetic fields and electric fields in occupa-

tional environments," she said.

One of the notable features of the Miller study is its detailed exposure assessment (see "Commentary," p.7). EMF exposures were estimated not only with job titles but also with where employees did their work.

Miller's team showed striking increases in leukemia risk for cumulative exposures to high electric and magnetic fields. Indeed, the adjusted risk ratio for all leukemia was 1.6 (nonsignificant) when the analysis was limited to magnetic field exposures only. But when electric fields were included as well, the risk ratio rose to 11.2, a significant result.

In the published paper, Miller's team concluded that the data point to "associations for all leukemia and its subtypes with increasing electric field exposure," especially when electric and magnetic fields were considered together.

Those exposed to the highest levels of both electric and magnetic fields were primarily power line maintenance workers and those who do jobs that put them close to electricity-generating equipment and high-voltage transformers.

The Ontario Hydro project is part of a three-utility study that also included Hydro-Québec and Electricité de France (EDF). While much of the magnetic field data for all three utilities was published in 1994 (see *MWN,* M/A94), the electric field analysis released in July is new. Although all three utilities recorded electric field data, the analysis for the other two utilities, as well as that for the three utilities combined, dealt only with magnetic fields.

The University of Toronto researchers asserted that their exposure estimates are more accurate than those used in past research or in the Hydro-Québec and EDF components of the three-utility study. In their paper, they wrote that, "There may have been greater opportunity for misclassification of exposure in the other two utilities than in Ontario Hydro."

Dr. Gilles Thériault of McGill University in Montreal, who led the Hydro-Québec study, confirmed that information on job location is critical. "I agree that exposure can vary more with location than with job title," he said. "We came across this in our study, too."

Over 30,000 present and former Ontario Hydro male employees were included in the study. Among these there were 50 cases of leukemia, 35 of brain cancer and 58 of malignant melanoma. Miller found elevated risks for both leukemia and skin cancer but not for brain tumors. With respect to brain cancer, he allowed that, "We may have failed to see a significant ...[statistical] association because of low power."

There was "a suggestion of a dose–response relation" for leukemia and melanoma, but the test for a trend did not produce a significant result, the Ontario team noted.

At the highest level of exposure to both magnetic and electric fields, the odds ratio jumped from 3.51 to 11.2 when the researchers included the interaction of the effects of the two types of fields. When asked which estimate was more indicative of the actual cancer risk, Miller replied, "The correct way to think about it is the 11.2, because what you're actually looking at is the combined effects."

Ontario Hydro is now investigating the reliability of the electric field exposure data. Ruth Greey, EMF issue manager at Ontario Hydro, told *Microwave News* that the next step will be to examine the relationship between the electric fields measured by the Positron monitor and the ambient electric field strengths in the workplace.

In addition, work is under way to see whether cumulative EMF exposures (that is, ∝T-years and V/m-years) are the best ways to gauge cancer risks. "We're looking at different metrics, including intermittent, peak and average exposures," Greey noted.

For his part, Miller would like to see the extent to which electric field exposures play a role in the residential environment. Two studies involving childhood leukemia, which are also using the Positron personal exposure meter, are due out next year. Miller is leading one of these and Dr. Richard Gallagher of the Cancer Control Agency of British Columbia is the principal investigator for the second study, which is being sponsored by BC Hydro.

"What worries me is that so much of the experimental cellular work that has been done has screened out electric fields," Miller said.

Canadian unions are expressing concern about the new findings—in contrast to American labor groups, which have generally been indifferent to EMF health risks. "It's alarming. This is cause for immediate employer and government action to protect workers," John Murphy of the Power Workers' Union told Ontario's *Windsor Star* (July 11) after the publication of the Miller study.

Savitz noted that the results of the Ontario Hydro study were released too late to be included in the NAS-NRC report due out in September (see p.3).

Transient Analysis Still on Hold

Work on the EMF transient data collected by the Canadian and French utilities is still at an impasse. "Pulsed [EMF] exposure has so far not been evaluated with [the] Ontario Hydro data," Dr. Anthony Miller and coworkers reported in their July 15 paper.

Ontario Hydro's Ruth Greey said that there is as yet no commitment to go forward with the transient analysis. "It's not scheduled now," she told *Microwave News*. She echoed others' concerns over what the Positron meter is actually measuring.

For his part, Miller wants to move forward. "Just give us the data and we'll analyze it," he said in an interview. He explained that whatever the sources of the transients may be, the data may reveal new information about EMF and/or RF health effects.

In November 1994, Dr. Gilles Thériault's group at McGill University reported an up-to-tenfold increased risk of lung cancer among Hydro-Québec and Electricité de France workers exposed to high-frequency transients (see *MWN,* N/D94). Thériault also reported a "very clear" exposure–response relationship.

In his paper, Miller noted a "suggestion of association"—a nonsignificant 80-90% increase—between lung cancer and high exposures to combined 60 Hz electric and magnetic fields.

As soon as the McGill paper was published, Hydro-Québec, which owns the data set, barred further study by Thériault (see *MWN,* N/D94). The stalemate continues. "I still believe that the pulsed magnetic fields are an important issue and that someone should follow it up," Thériault told *Microwave News* in July. "People may be suffering from something that could be brought under control."

Commentary

The Three Keys to EMF Epidemiological Studies: Exposure Assessment, Exposure Assessment, Exposure Assessment

The Ontario Hydro study (see p.1) puts a spotlight on the key issue for future epidemiological work: Are we measuring the relevant EMF exposures? Dr. Anthony Miller's results point to the importance of electric fields and show how sloppy exposure assessment can mask significant risks.

"When people say they've done a study that looked at magnetic fields and there's nothing there, I can't agree," Miller told *Microwave News*. "What our study says is, 'Well, you should have looked at electric fields, too.'" The Ontario Hydro study reveals that workers exposed to the highest levels of *combined* electric and magnetic fields had leukemia rates that were 11 times greater than expected.

"Miller's results support the notion that induced electric currents can affect human health, whatever their origins," commented Dr. Paul Héroux of McGill University, noting that both electric and magnetic fields can induce current flows in the human body.

Why have electric fields been ignored? Héroux offered an explanation: "These new results point to the troubling conclusion that the focus on magnetic fields may have resulted from political improvisation rather than thoughtful science." Héroux designed the Positron dosimeter used by Ontario Hydro, the only one that easily logs both electric and magnetic fields.

Miller also once again shows how job titles alone are at best vague measures of EMF exposures. "When you're assigning exposures retrospectively, you've got to be very careful not to rely only on job titles," he stressed. At least part of the solution lies in adding information on job location.

Miller makes this point elegantly in his paper with respect to high magnetic—but not electric—field exposures and leukemia risks. The odds ratio was 1.56 when he coupled job titles with job locations. In contrast, when only job titles were used, the risk fell to 0.97.

This is not the first time that researchers have documented how job titles can lead to erroneous results. For example, Dr. Birgitta Floderus of the National Institute for Working Life (NIWL) in Solna, Sweden, found that her study of EMF-exposed railway workers (see p.5) contradicted a similar report by Dr. Siv Törnqvist, also of the NIWL, completed the year before. While Floderus found excess cancers among railway workers, Törnqvist had not.

In 1994, the two researchers, working together, discovered that the types of work done by railway employees had changed between 1961 and 1979. In the early years, there were two engine drivers on each train. Later, there was only one. The displaced drivers either retired or were transferred to low-exposure jobs—but they retained their job title. On paper, they were still engine drivers.

Floderus and Törnqvist's joint assessment indicated higher chronic lymphocytic leukemia risks among drivers from 1961-69, but not from 1970-79. They concluded, "[T]his structural change of the industry...could dilute a potential effect."[1]

Later the same year, a team led by Dr. Patrick Breysse of Johns Hopkins University's public health school in Baltimore made a similar point regarding telephone linemen. Detailed measurements indicated that in the "lineworker" category, those with the "cable splicer" job title had distinctly higher EMF exposures, with average peaks of 99.2 mG, compared to 29.1 mG for "non-lineworkers." Central office technicians, categorized as linemen as well, also had elevated exposures, but other linemen had exposures similar to those in the non-lineworker job category.

Using job titles alone, Breysse's team had initially lumped workers with low- and high-exposure jobs together under the rubric of linemen. He found that the exposures of telephone lineworkers, thought to be higher than those of other workers, were often similar to those of non-lineworkers.

The Johns Hopkins group concluded further analyses should focus on cable splicers, and the use of vague job titles such as telephone lineworkers and non-lineworkers was "not appropriate."[2]

Importantly, the team had previously shown that it was the cable splicers and, to a lesser extent, the central office technicians who had elevated rates of leukemia.[3]

The elevated leukemia risk observed in the Ontario Hydro study may still be imprecise because of the difficulties associated with measuring electric fields—they are easily perturbed by body movements and by the location of the dosimeter. "Small electric field sensors worn on the body are not that reliable," said Michael Silva of Enertech Consultants in Campbell, CA. Ontario Hydro's Dr. David Agnew agreed: "As people move about, they move their arms and bend over. All these things influence the electric field measurement that you get on the monitor."

But Miller's study is still a wake-up call. The EMF–cancer risk may not necessarily be small for those who are exposed to relatively high electric and magnetic fields, which are still much lower than the exposures allowed by most health standards. If anything, the risks could be larger than the 11-fold increases reported by Miller.

In an interview, Dr. Gilles Thériault of McGill—who led the Hydro-Québec study—repeated one of the most basic lessons of epidemiology: "If there is an actual real association, then the more precise the estimate of exposure, the greater chance we have of seeing the real risk."

1. Birgitta Floderus, Siv Törnqvist and Carin Stenlund, "Incidence of Selected Cancers in Swedish Railway Workers, 1961-79," *Cancer Causes and Control, 5,* pp.189-194, March 1994. See *MWN,* M/J94.
2. Patrick Breysse et al., "60 Hertz Magnetic Field Exposure Assessment for an Investigation of Leukemia in Telephone Lineworkers," *American Journal of Industrial Medicine, 26,* pp.681-691, November 1994. See *MWN,* N/D94.
3. See *MWN,* N/D89 and J/A91.

Bioelectromagnetics Society Takes Stronger Stand on EMF Bioeffects After Members Criticize First Statement

The Bioelectromagnetics Society (BEMS) has issued a strongly worded statement in defense of research on EMF bioeffects. In a June 24 letter sent to all members of Congress, top BEMS officials point to public concern about links between EMFs and leukemia, breast cancer and Alzheimer's disease. They warn that "public statements by those...lacking in the requisite multidisciplinary expertise" might lead to cutbacks in research before these issues are resolved (see box at right).

Two months earlier, BEMS had staked out a much weaker public position in the controversy over EMF bioeffects and human health (see box at right). The society's board of directors adopted a statement on April 9 that was criticized by many members as too cautious. Criticisms were aired in public at BEMS' annual meeting June 9-14 in Victoria, Canada, as the board grappled with the research funding issue.

On the eve of the Victoria conference, Shirley Linde, chair of the National EMF Advisory Committee (NEMFAC), warned the BEMS board that funding for EMF bioeffects research was in serious danger. Linde attributed this to recent media coverage of the EMF issue, particularly the reporting on the statement by the American Physical Society (APS) and public television's *Frontline* show, both of which suggested that there are better ways to spend research money (see *MWN,* M/J95 and J/A95, respectively).

"I had members of Congress telling me that they had heard there are no biological effects, so why continue EMF research?" Linde told *Microwave News*. "I was getting statements from various funding sources that EMF scientists were either charlatans or prostitutes. Someone needed to provide a more balanced view." Linde is associated with a Los Angeles citizens group concerned about EMF risks.

The BEMS letter to Congress points out that EMFs can affect hormone levels, the immune system and the growth rate of cancer cells. It warns that if research is cut back while new communications and electronic technologies are being introduced, "international standards may be imposed before adequate scientific knowledge is available," adding that, "Failure to continue this research could ultimately result in extensive costs to the energy and communications industries, both in litigation and product development."

Both House and Senate appropriations committees later passed budgets that preserve most funding for EMF bioeffects research for fiscal year 1997, which begins on October 1, 1996.

The letter was signed by the newly installed president of BEMS, Dr. Richard Luben of the University of California, Riverside; his predecessor, Dr. Kjell Hansson Mild of the National Institute for Working Life in Umeå, Sweden; and the society's president-elect, Dr. Martin Blank of Columbia University in New York City. Luben succeeded Mild at the meeting in Victoria, and Blank will take over at next summer's conference.

Luben told *Microwave News* that the society is now working on a new public statement, which he hopes will be ready by the fall. "We were asked by the membership to make it more forceful," he explained. "The presidents' letter was a way of clarifying our position in the time between the previous and future statements."

The original statement was discussed by the BEMS board of directors for a few months before its adoption in April. It noted that concern about power line EMFs and cancer has been raised by epidemiological studies since 1979, and that "strong criticism" of these studies was "due primarily to [the] variability of results as well as the incomplete nature of laboratory data to support the specific cancer findings." It advocated further research to determine "whether adverse effects are (1) real and significant, (2) real but of minor importance or (3) nonexistent."

Even before the June meeting, some BEMS members were criticizing this statement as "extraordinarily weak" and "pretty bland." Board member Dr. Indira Nair of Carnegie Mellon University in Pittsburgh, who had worked on drafts that she considered weak, asked, "Why are we behaving like lawyers?"

In an outcry at BEMS' annual membership meeting on June 12, speakers described the board's statement as "very disappointing" and "less than inspiring" and insisted that it "should have been stronger." Several members argued that while there might be no consensus within BEMS on EMFs and cancer, it was important that the society challenge the idea that EMF bioeffects are either nonexistent or unimportant. Some called for "a strong rebuttal" to the APS statement. Mild closed the debate by saying that the board would discuss the issue when it met two days later. It then decided on the June 24 letter.

In an interview in May, Mild had noted that the society "includes respectable scientists with a wide variety of opinions" on EMF health risks. "The current body of evidence can reasonably be used to support...different tentative conclusions," he added, "depending upon one's assumptions and personal feelings on how to handle risk calculations in the absence of data." Board member Dr. Paul Gailey of Oak Ridge National Lab in Oak Ridge, TN, gave a similar assessment and said that the April statement had been "an effort to represent the diversity of views within BEMS."

Both Gailey and board member Janie Blanchard of Bechtel Corp. in San Francisco described the board's April statement as a response to the APS. But Dr. James Lin of the University of Illinois, Chicago, who helped to draft it, told *Microwave News,* "It was not intended to refute or confront any other statements, including the APS one." Luben offered that, "It was not necessarily a direct response to the APS statement, but that was part of the stimulus for it."

At the same time, Lin made a point of stating that, "Despite the recent arguments by some physicists that such effects are not possible and thus the health issue does not exist, the biological and epidemiological evidence continues to mount and the public concern does not decrease."

"It is necessary to clearly separate the official [APS] statement from all the other things that accompanied it," emphasized Mild, citing the background report written by Dr. David Hafemeister of California Polytechnic State University in San

Bioelectromagnetics Society: Two Statements

BEMS Board of Directors on EMF Issue

The following statement was unanimously adopted by the BEMS board of directors on April 9, 1996. The board is now working on a new statement (see opposite page).

The Bioelectromagnetics Society [BEMS] is a scientific society which was established in 1979 to promote the study of the interaction of electromagnetic energy with biological systems. The board of directors of [BEMS] is issuing this statement because we believe it is our responsibility to inform interested parties of the fundamental scientific issues that form the basis for public concern about possible health risks from exposure to electric and magnetic fields.

The health questions associated with exposure of individuals to extremely low frequency (ELF) electric and magnetic fields have been driven largely by cancer epidemiological studies. The first such study was reported in 1979 and a number of studies have appeared since with variable results. Strong criticism of these epidemiological studies has been due primarily to this variability of results as well as the incomplete nature of laboratory data to support the specific cancer findings. Additional difficulties in the evaluation of the epidemiological data are that the apparent increases in cancer are relatively low, and that there is at present no proven mechanistic explanation to support the epidemiological findings. The answers to these exposure and health questions can only be clarified through a well-coordinated and funded research program.

Both public concern and the potential cost of engineering mitigation are considerable. A large portion of the population of industrialized nations is exposed and thus potentially at risk. However, it is yet to be determined whether there is cause for concern or what the appropriate mitigation, if any, should be. Whether adverse effects are (1) real and significant, (2) real but of minor importance or (3) nonexistent must be determined by current and future research to allay public fears and to provide to industry a basis for appropriate response or action.

There have been many occasions in the history of science when distinguished scholars have argued that an observed phenomenon must be invalid on the basis of current understanding. A great deal is yet to be discovered about the interaction of EMFs with biological systems. These discoveries will only come through careful, competent investigation. It is imperative that good science be sponsored and conducted to answer these important health questions. These questions will continue to be important in public debate and continuation of good scientific research will significantly help to clarify these issues.

BEMS Presidents on EMF Bioeffects Research

The following letter was sent to all members of the U.S. Congress on June 24, 1996.

Public concern continues to grow about possible connections between exposure to electric and magnetic fields and such diseases as childhood leukemia, breast cancer and Alzheimer's disease. At the same time, daily exposure of the public to electric and magnetic fields is increasing rapidly due to new electronic and communications technology, more use of electric power and new medical applications of electric and magnetic fields. As leaders of the largest international scientific society studying biological effects of electric and magnetic fields, we are concerned about a potential decline in research in this area, due in part to public statements by those who we believe are lacking in the requisite multidisciplinary expertise.

The biological processes involved in human diseases are complex and multifaceted. Moreover, electric and magnetic fields, unlike many other environmental agents, are not characterized by a single quantity but involve many different factors. Proper approaches to such complex scientific questions can be achieved only by a multidisciplinary collaboration of biologists, physicians, engineers and biophysicists. A wealth of published, peer-reviewed scientific evidence indicates that exposure to different combinations of electric and magnetic fields consistently affects biological systems in the living body as well as in laboratories, including:

- Altering the function of nerve cells.
- Changing the density and healing rate of bone.
- Disturbing the balance of important hormones.
- Changing the growth rate and drug sensitivity of cancer cells.
- Modifying the immune system's ability to fight disease.
- Altering the heart rate.

There is a potential for benefits from these fields, as well as the possibility of adverse public health consequences. Understanding their biological effects may allow us to increase the benefits as well as mitigate the possible hazards. But these processes cannot be well understood without further research.

Major strides have been made in the past 20 years of research in this area. The program has only recently expanded to a critical mass of interdisciplinary and multi-laboratory effort that, in our opinion, must be continued. In this still emerging area of scientific research, controversy about reported results is a natural and healthy part of the scientific process. Such controversy should not be the basis for discarding programs of research before the important questions are answered conclusively.

We believe it is essential that research in this area be continued. Without U.S. government funding, the remaining available sources of funds are too limited, too focused by discipline and may in some cases carry questions of bias. The governments of other industrialized countries such as Sweden, Japan, Germany and Norway are presently spending significant amounts of money to further research in this area. But without U.S. leadership, the task of determining the potential health risks and benefits involved in the distribution and use of electric and magnetic energy will be difficult to complete.

We are also concerned that international standards may be imposed before adequate scientific knowledge is available. Failure to continue this research could ultimately result in extensive costs to the energy and communications industries, both in litigation and product development. Public concern can be reduced only when the issues and questions are resolved by careful research.

We ask that you take these views into account when making decisions regarding the future of research into the effects of electric and magnetic fields. The undersigned will be happy to confer with you in detail or provide any further information you may need in order to make an informed decision.

Sincerely yours,

Kjell Hansson Mild, PhD
President 1995-1996

Richard Luben, PhD
President 1996-1997

Martin Blank, PhD
President-Elect 1997-1998

Luis Obispo, the Internet news bulletin put out by APS information director Dr. Robert Park, who works in the Washington office of the APS, and other comments by individual APS members. Hafemeister's report was released along with the APS statement but was not endorsed by the APS Council (see *MWN,* M/J95), while the opinions in Park's bulletin are explicitly his own and not those of the APS (see also *MWN,* S/O 95).

"It is those [other] statements that sometimes make or imply the accusation that all of the positive low-field results in bioelectromagnetics are violations of physical law, artifacts or pseudoscience," Mild explained. "Most of the people making these statements have never done work in bioelectromagnetics, nor even in biophysics."

Linde voiced the same opinion, noting that funding officials "were coupling the statements of Hafemeister, Park and the APS Council as if they were the same thing." She said that while "the APS statement itself didn't say that much, the Hafemeister report was full of innuendos, half-truths and distortions."

Unlike the APS statement, which received widespread coverage, both BEMS statements have so far been completely ignored by the press.

« *Cellular Phone Notes* »

On June 5, the **CTIA** announced that it had approved a $6.7 million budget for its research organization, **WTR**, in its current fiscal year (which began on June 1). The press release stressed that this amount would keep the CTIA on schedule with its five-year, $25 million commitment for health research. But it will apparently take more than a press release to settle the CTIA/WTR financial dispute (see *MWN,* M/J96). WTR spokesperson **Michael Volpe** said in an interview that WTR has received only $2.4 million of this money, which "did not go much beyond enabling us to pay off our back debts." According to Volpe, WTR has spent $1.7 million on pacemaker research and $600,000 on litigation, a total of $2.3 million, "which the CTIA has stated will not have to come out of our research budget." CTIA President **Thomas Wheeler** confirmed that only $2.4 million was paid in June. The rest will be provided "on a quarterly schedule jointly agreed to by the CTIA and WTR," he wrote in response to questions from *Microwave News*. "It's perfectly true that WTR has legal bills and expenses on the pacemaker work," said CTIA spokesperson **Tim Ayers**. "But they haven't billed us for that yet." When the bill is received, he added, "That'll be paid right away." Volpe would not comment further, noting only that, "The money determines the amount of work that WTR does."

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A **WTR** meeting on electromagnetic interference (**EMI**) from cellular phones to **cardiac pacemakers** has been postponed from July 16 to September 30. A WTR statement attributed the postponement to a need for "greater input from federal regulatory agencies and the pacemaker and cellular phone industries." WTR's Michael Volpe explained that researchers at the FDA, the Mayo Clinic in Rochester, MN, and the Mt. Sinai Medical Center in Miami Beach, FL, had "asked for more time so that they could complete some of their studies." WTR plans to issue a final report on its pacemaker research at the symposium (see *MWN,* M/J96). The meeting will take place in Washington. Contact: Mary Supley at (202) 833-2800, or look up WTR's Web site at <http://www. WTRLLC.com>.

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Interference with pacemakers will also be discussed on September 11 at a forum sponsored by the University of Oklahoma's **Center for the Study of Wireless Electromagnetic Compatibility** (EMC), which was established in 1994 by a number of telecom companies (*MWN,* J/A94). The session will address not only pacemakers but also medical devices in hospital settings and hearing aids. The meeting will be held in Washington, and the featured luncheon speaker will be **CTIA** President **Thomas Wheeler**. The next day the center will host a workshop at the offices of the CTIA on how to develop hospital EMI policies. The center has just issued Part I of a report titled *EMI Management in the Hospital Environment*. "The issue was brought to public attention by cell phone use," said Dr. **Ravi Ravindran**, the center's director, "but less than 5% of all medical equipment failures are due to cellular phones." Walkie-talkies used by emergency personnel, security guards, police and firefighters are a bigger problem because they use higher power levels, Ravindran said in an interview. "Electrostatic discharge is a bigger problem, too," he added. "Some hospitals are reacting by banning the use of cell phones and thinking the problem has been solved—when it has not. It takes a lot of work to develop more specific policies." The recommendations in Part I include: restricting the use of wireless devices in critical-care areas with a high concentration of medical instruments; establishing areas where wireless phones and walkie-talkies *can* be used; installing microcells within the hospital to make possible more widespread use of low-power wireless devices; and encouraging hospital staff to report all incidents of EMI to the FDA at (800) FDA-1088. Part II of the report, due out in the fall, will focus on how to develop a hospital EMI policy. The center will also provide computer software that can help make these decisions. To request the report, send a fax to (405) 325-2556, or e-mail to <shawkins@mailhost.ecn.uoknor.edu>. For more information on the Washington sessions, call Ravindran at (405) 325-2429.

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Another group has joined the fray over cellular tower siting regulations. The **Helicopter Association International** (HAI) wants legislation to give the Federal Aviation Administration and local zoning boards "uncompromised authority" in cellular tower siting cases. The industry group, based in Alexandria, VA, contends that the telecom act will facilitate the spread of cellular towers, posing a serious risk to helicopter safety. "What

Bulletin from BEMS

Motorola Keeps a Low Profile on Adey Animal Study Showing Tumor-Inhibiting Effect of Cellular Phone Radiation

Dr. Ross Adey's paper was arguably the most important presentation at the annual meeting of the Bioelectromagnetics Society (BEMS), held in Victoria, Canada, June 9-14. A press release was prepared, edited and reedited. A room was reserved for a press conference, which was canceled at the last minute.

It soon became apparent that Motorola in fact wanted to *avoid* publicity for this, its own major study, which showed that at least one type of cellular phone radiation does not promote brain cancer in lab animals.

With all the scare stories in the media about cellular phones and brain tumors, some were surprised that Motorola was not shouting the news from every hilltop.

Yes, Motorola was pleased with Adey's results, but there was a rub. The five-year animal study suggested that 836 MHz radiation, designed to mimic signals from a digital cellular phone, could in fact inhibit brain tumor development in rats (see *MWN,* M/J96). That is, there might be some kind of protective effect at work. And if so, the long-awaited paradigm shift could be at hand: Low-level RF/MW radiation could no longer be treated as biologically neutral.

A desire to downplay the results was apparent when Adey showed his slides. He said that rats given a cancer-inducing drug and exposed to the digital cellular phone signals had only four brain tumors, as compared to nine such tumors among the rats that were only given the cancer drug. The difference was suggestive but not statistically significant.

But the data in Adey's abstract, published before the meeting and distributed to attendees on registration, showed four additional tumors among the unexposed rats. When these are included in the statistical analysis, the difference between the two groups becomes 4 to 13—which *is* significant.

In his talk, Adey explained that the four other tumors were in the rats' spinal cords. And he stressed that "one can legitimately include spinal cords" in the comparison between the two groups of rats—as he had done in the abstract. After all, all the tumors arose from the same cell type (glial), and dosimetric analysis by Dr. Niels Kuster of the ETH in Zurich, Switzerland, had shown that the rats' spinal cords were exposed to the cellular phone radiation.

The apparent protective effect was also observed when no cancer drug was administered. In this case, too, Adey saw fewer tumors among radiation-exposed rats compared to controls.

Adey avoided the phrase "protective effect," explaining that the Food and Drug Administration (FDA) had warned that it would fall into "the snake oil category." The FDA had suggested "tumor-inhibiting" as preferable, Adey said.

But even this made the Motorola lawyers nervous. (One of them was at the BEMS meeting to keep a watchful eye on the presentation.) There were even rumors that the lawyers did not want Adey to mention the possibility that the radiation could have enhanced DNA repair. But if so, Adey did not play along. He speculated on various mechanisms that could explain the decrease in brain tumors.

In the end, however, Motorola's efforts at spin control won the day. The company issued no press release, and Adey's VA hospital in Loma Linda, CA, had only a three-paragraph statement. Only one small newspaper, *The Press Enterprise* in Riverside, CA, ran a story on the results—probably because Dr. Craig Byus, one of Adey's collaborators, is at the University of California, Riverside. And, other than a story in the trade newspaper *RCR* and a short item on CNN's financial network (and an article in the last issue of *Microwave News),* there was no further coverage of the results.

The significance of the Motorola study was not lost on those at the BEMS meeting. As Dr. Abraham Liboff of Oakland University in Rochester, MI, told the audience after Adey's presentation, such low-level effects fly in the face of the conventional wisdom that only thermal effects are relevant to public health. "This makes me absolutely sure that there could be a coupling between fields and tumor development," he said.

we're trying to prevent is the proliferation, without proper oversight, of dangerous obstacles to low-level flight....We can minimize this new and ominous threat to aviation and public safety if we can get the Congress to act quickly and responsibly," HAI President Frank Jensen Jr. said in a statement.

«« »»

Add another medical device to the list of items cellular phone users should be wary of: **aneurysm clips**, which are implanted in the brain to reinforce blood vessels. In a paper presented at the June Bioelectromagnetics Society meeting in Victoria, Canada, a group led by Dr. **Niels Kuster** of the **Swiss Federal Institute of Technology** (ETH) in Zurich reported that metallic implants can enhance the absorption of RF energy by a factor of four, when averaged over one gram of tissue. But, they warned, over smaller volumes, the energy absorbed can be enhanced by "a factor of several hundred." They cautioned that metallic eyeglasses and jewelry can, in certain cases, also cause significant enhancements. An aneurysm clip is probably the most common type of metallic implant in the head. **Janine Morris** of **FDA's Center for Devices and Radiological Health** in Rockville, MD, estimated that 15,000-18,000 clips are put in place each year in the U.S. She said that it is hard to say how many Americans have aneurysm clips because of the lack of long-term records and the fact that some people have had more than one clip implanted. "Until the health implications of strong, locally concentrated fields inside the human body are known, I would advise those with such implants against extensive use of mobile phones," Kuster told *Microwave News.*

New Cell Phone–Brain Cancer Epidemiology Study by WTR

Wireless Technology Research (WTR), the cellular telephone industry's research organization, announced on June 28 that it would fund a $419,000 case–control study of cell phone use and brain cancer risk. Results from the study, which will be conducted by the American Health Foundation (AHF) in New York City, are expected in about two years.

"We should be able to answer the question of whether short-term use of cellular telephones is related to the incidence of brain tumors," said AHF's Joshua Muscat, the project's director. Five hundred brain cancer patients and 500 controls will be interviewed at participating hospitals. The research design was developed in an AHF pilot study, funded by a $75,000 grant from the National Cancer Institute (NCI).

Last May initial results were released from an ongoing WTR-sponsored epidemiological study, a survey of 256,000 cellular phone customers being conducted by Drs. Kenneth Rothman and Nancy Dreyer and others at Epidemiology Resources Inc. (ERI) in Newton Lower Falls, MA (see *MWN,* M/J96). The ERI team found no increase in overall mortality from short-term use of hand-held cellular phones. The ERI and AHF studies have different designs and are each intended to shed light on the issue from a different angle. "Theirs is a population-based cohort study, while ours is a hospital-based case study," Muscat noted, "so the two should complement each other nicely."

Work on the ERI study was suspended in the spring due to an interruption in funding and privacy issues raised by the passage of the new telecom law. Dreyer, president of ERI, said that ERI is still waiting for its WTR money to be restored.

"We are trying to prioritize and balance WTR's research funding needs based on the amount of money we have received and which has been promised by the CTIA," said WTR spokesperson Michael Volpe. He said ERI should get more money once funding issues with the Cellular Telecommunications Industry Association (CTIA) and privacy questions are resolved.

Volpe stressed that sufficient funds are definitely available for the AHF study. "I checked with the lawyers and the bank before I sent out the press release," he told *Microwave News.* "This was ready to go for a couple of months—we were just waiting for an infusion of money into our escrow account."

Last year, an NCI research team pointed out that "the introduction and widespread use of cellular telephones are very recent phenomena," and that this limits what can now be learned from epidemiological research on cellular phones and brain cancer risk (see *MWN,* M/A96 and M/J96; also S/O95). Volpe argued that, "WTR would be remiss in its public health responsibility if it didn't study this issue." He explained that, "Since we don't know what kinds of cancer mechanisms might be involved here, it makes good scientific sense to look at brain cancer, no matter what the latency period."

"The etiology of brain tumors remains largely unknown," said Muscat, "and we know little about the possible health effects of EMFs. So we don't know enough to conclude that it's too early for epidemiological studies." He added that potential long-term effects will need to be studied in the future.

Norwegians Study Possible RF/MW Link to Birth Defects

Norway's defense department has begun a study of a potential link between RF/MW radiation and birth defects among children of 30,000 naval officers over the last 30 years. Onboard radio transmitters, radar and electronic equipment are all under investigation, navy Captain Stig Morten Karlsen in Oslo told *Microwave News.*

The study was spurred by a chance discovery in which two officers from the motor torpedo vessel *Kvikk* met at a clinic in Bergen and found that they each had a child with clubfoot, according to the Swedish newspaper *Svenska Dagbladet* (July 4). The two men brought this to the attention of the Norwegian navy, which then ordered an investigation. Soon, three more officers from the *Kvikk* were found to have children born with clubfoot. To date, 82 cases of birth defects, including clubfoot, heart and central nervous system defects, brain dysfunction and hydrocephalus, have been identified among children of navy personnel.

"We are working from the hypothesis that electromagnetic radiation is responsible," Jan Helge Halleråker, a naval captain and chief medical officer, told *Svenska Dagbladet.* Interestingly, the study has received very little attention in the Norwegian press.

When the cluster was reported at a recent NATO meeting in Brussels, Belgium, a decision was made to use radio transmitters at half-power on all ships, *Svenska Dagbladet* reported. After the investigation began, the Norwegian navy took RF/MW radiation measurements on the ships and marked potential "danger" areas for the crews to avoid, Karlsen said.

The data analysis is under way but is not expected to be completed until 1998. The research is being coordinated with a larger RF/MW study, which includes other NATO countries.

In spite of the discovery of the *Kvikk* cluster, Karlsen remains cautious about linking it to RF/MW radiation: "So far, no one in Norway or anywhere else in the world can say that this has anything to do with birth defects."

The incident is similar to one reported 25 years ago in the United States. In 1971, Dr. Peter Peacock, then chairman of the Department of Public Health and Epidemiology at the University of Alabama, Tuscaloosa, identified 17 cases of clubfoot among helicopter pilots' children born between July 1969 and November 1970 at the Lyster Army Hospital in Fort Rucker, AL.

In a report for the Environmental Protection Agency, Peacock noted that one of Fort Rucker's "unique characteristics" is the prevalence of radar—46 installations within 30 miles of the base. He theorized that helicopter pilots would have relatively high RF/MW exposures, because they fly at low altitudes, where radar radiation is greatest, for long periods of time. In addition to clubfoot, Peacock turned up defects in the infants' hearts, genitals and circulatory and respiratory systems.

Peacock repeatedly sought to follow up this work, but each time he was denied access to military records and documents by the Army Medical R&D Command. "The Army closed down on us—they refused to give us access to their records," Peacock said in an interview in July. Peacock, now retired, speculated,

"My guess is that the Army was afraid of the possibility of someone suing them if a link was found." His travails were reported in detail in Paul Brodeur's 1977 book, *The Zapping of America.*

Some are optimistic that the Norwegian study will not meet the same fate as Peacock's effort. "Norway is a small and 'open' country, where these kinds of facts are hard to cover up," according to Leif Södergren of the Association for the Electrically- and VDT-Injured in Göteborg, Sweden.

FCC Adopts RF/MW Rules *(continued from p.1)*

cations services (PCS) hand-held telephones be tested to assure that users are not exposed to a specific absorption rate (SAR) over 1.6 W/Kg. Compliance may be shown with laboratory measurements or by computer modeling. The FCC followed the recommendation of the Food and Drug Administration and rejected an exclusion clause for low-power devices—allowed under the ANSI/IEEE standard.

"We are not routinely going to require SAR data for phones already on the market," Dr. Robert Cleveland, who led the FCC's effort to write the new rules, told *Microwave News.* "However, if we have reason to believe that any of these phones are not in compliance, we may ask for more information from the manufacturers."

In other major provisions of the new RF/MW rules, the FCC:

• Denied requests to extend federal preemption of state and local RF/MW health regulations for personal wireless services to all communications facilities—for instance, radio and television towers. Preemption of state and local RF/MW rules for cellular and PCS towers was mandated by the Telecommunications Act of 1996 (see *MWN,* M/J95 and M/A96).

• Acted "out of an abundance of caution" to require routine evaluation of cellular and PCS antennas if they are mounted lower than 10 meters above the ground and have a total power output over 1 kW.

• Generally endorsed the distinction between "occupational" and "general population" exposures used by the NCRP instead of the "controlled"/"uncontrolled" dichotomy cited by ANSI/IEEE.

• Set limits of 1 mW/cm^2 for public exposures and 5 mW/cm^2 for occupational exposures above 1500 MHz (which are up to ten times more stringent than those recommended by ANSI/IEEE) for continuous exposures.

• Rejected special consideration of modulation effects as "premature."

Although all four sitting members of the FCC approved the new rules, Commissioners Rachelle Chong and James Quello issued a separate statement, noting that their decision "does not in any way diminish our support for the ANSI standard-making process or the latest 1992 ANSI standard."

The new FCC RF/MW rules, which take effect on August 6, were issued as *Microwave News* went to press. Further coverage will appear in our next issue. All 108 pages of the FCC rules are available on the Internet in the Office of Engineering and Technology section of the FCC's World Wide Web site at <http://www.fcc.gov>.

Cell Phone RF Tests Required—But Who and How To Do Them?

All cellular phone manufacturers must now certify that their products comply with the FCC's new RF/MW rules (see p.1). What the commission does not specify, however, is how to demonstrate compliance.

The two main methods of RF exposure assessment—both allowed by the FCC—are computer modeling and direct measurement. "The results of numerical techniques differ sometimes from experimental results," noted Ron Petersen of Lucent Technologies in Murray Hill, NJ. Until this spring, the Cellular Telecommunications Industry Association (CTIA) was funding a research program designed to resolve these discrepancies. But after the CTIA cut off funding for this work, its research group, WTR, canceled all related contracts (see *MWN,* M/J96).

Two days before the FCC decision was announced, the CTIA took the position that it is not important which technique is used. CTIA President Thomas Wheeler refused to be interviewed, but gave this written response to questions from *Microwave News:* "There are multiple exposure-measurement techniques which have been developed. The important fact is that all phones must meet the [new] standards."

Another unresolved question about certification is who will do it. CTIA spokesperson Tim Ayers had predicted that if the FCC allowed manufacturers to do it themselves—as it now has—then the CTIA would not conduct industry-wide RF testing. "If self-certification is an option, then it's probably not worth it for us to get into it," Ayers said, adding, "We'll only do the testing ourselves if there's a market for it."

This represents a shift for the CTIA, which had told the FDA in 1994 that it planned to add RF exposure testing to its existing equipment certification program. In 1995, the CTIA asked Aprel Labs of Nepean, Canada, to get ready to perform these tests—but on January 26, 1996, the CTIA abruptly put the project on hold.

"It was a 'go' one day and a 'no go' the next," Aprel President Kathy MacLean told *Microwave News.* MacLean said that she had sent her staff to a training course at Motorola to learn how to use the robot measurement system developed by Dr. Niels Kuster of the ETH in Zurich, Switzerland. MacLean contended that reliance on mathematical calculations is "not acceptable when it comes to handsets."

An observer, who asked not to be identified, offered this explanation of the CTIA's changing plans: "The CTIA viewed RF certification as a revenue source. But it underestimated how strongly manufacturers felt about handling this themselves."

Petersen said that Lucent is now planning to fund research by Dr. Kenneth Foster that was halted when WTR cut off his funds in April (see p.10, p.15 and *MWN,* M/J96). WTR will not be involved, and, Foster told *Microwave News,* that he prefers it this way. Petersen maintained that Lucent is still interested in helping WTR to raise industry money for dosimetry research. "But we haven't got a commitment from other manufacturers yet, and we feel we have to get this work moving."

WHO Launches $3 Million Project on EMF and RF/MW Health Effects

The World Health Organization (WHO) has embarked on a five-year, $3.3 million project to examine the status, and plan the future, of EMF health effects research. The decision was announced shortly after a May 30-31 preparatory meeting at WHO headquarters in Geneva, Switzerland, which was attended by representatives from 23 countries, including Mary Beth Jacobs of the U.S. Food and Drug Administration (FDA).

The study, which will cover research on both extremely low frequency (0-300 Hz) and radiofrequency and microwave (300 Hz-300 GHz) radiation, will be led by Dr. Michael Repacholi, on leave from the Royal Adelaide Hospital in Adelaide, Australia.

"For the first time, we will have an international focus to clarify the science of EMFs," Repacholi told *Microwave News*. The project will involve a number of steps—for example, meeting to gain an overview of the science, identify gaps in knowledge, prioritize needs, produce generic research protocols and encourage support for future studies, Repacholi said.

The WHO has scheduled a seminar, titled *Biological Effects on Nonthermal Pulsed and Amplitude-Modulated RF Electromagnetic Fields and Related Health Risks,* for November 20-22 in Munich, Germany. Speakers will include Drs. Martin Blank, Kenneth Foster, Konstantin Hossman, Kenneth Rothman and Thomas Tenforde.

Financial support for the project has been pledged by Australia, Ireland, Sweden and the U.K., with Austria and Germany funding specific activities. Repacholi noted that the U.S. has yet to give money, but he is still optimistic that the FDA and the FCC will contribute. France has not decided whether it will support the project.

For more information, contact: Repacholi, Office of Global and Integrated Environmental Health, WHO, 1211 Geneva 27, Switzerland, (41+22) 791-3427, Fax: (41+22) 791-4123, E-mail:<repacholim@who.ch>. The WHO can now be reached on the World Wide Web at: <http://www.who.ch>, but Repacholi is planning a separate home page for the EMF project.

FROM THE FIELD

Clippings from All Over

"Alexander Graham Bell didn't have to go before a zoning board and describe a telephone pole or put on the kind of show we're being forced to.... It's an incredible impediment—an incredibly unnecessary impediment."

—Priscilla Triolo, attorney for Bell Atlantic–Nynex, on community opposition to a proposed cellular phone tower in Wyckoff, NJ, quoted by John Keller in "Bad Reception: With Cellular Towers Sprouting All Over, Towns Begin To Rebel," *Wall Street Journal,* p.1, July 2, 1996

Yesterday I saw a man standing bareheaded in the midday sunshine while using a mobile phone and smoking a cigarette. Would anyone care to estimate his life expectancy?

—Tom Baldwin, in a letter, "Risk Assessment," to *The Times* (U.K.), July 2, 1996

The question about radiotelephones' impact on human health remains unanswered. Practically all groups insist on continuing experiments to determine the causative connection between use of radiotelephones and changes in human health. We think that the research will cost less than curing "fried" brain and compensating thousands of people.

—Aleksey Savin, "Could a Cellular Phone Be a Cause of Brain Cancer?" *Izvestia* (Moscow, Russia), p.9, June 19, 1996

[I]f Iridium goes ahead as planned, it will be piracy in the radio spectrum, it will make a mockery of the [International Telecommunication Union] and its radio regulations, and it will be a disaster for radio astronomy.

—John Ponsonby, Onsala Space Observatory, Onsala, Sweden, in a letter, "Motorola Versus Radio Astronomy," to *Nature* (U.K.), p.550, June 13, 1996 (see p.15)

Until clarifying results are obtained, governments must make a decision as to which, if any, regulations or policies are warranted. Formal risk assessments, as some call for, are difficult to interpret in light of the imprecise and sometimes contradictory study results. In my view, in light of the positive data, limited action is called for. Whether the underlying risk factor for the observed childhood leukemias is magnetic field exposures or not, the evidence shows that these cancers are indeed correlated with high wire codings and thus possibly with the presence of magnetic fields. Therefore, where we can reduce exposures at low cost and low inconvenience, we may substantially reduce future disease. Even if the association proves spurious, this strategy of limited, low-cost action will not have had a large impact on society.

—Dr. Daniel Wartenberg, Environmental and Occupational Health Sciences Institute in Piscataway, NJ, "EMFs: Cutting Through the Controversy," *Public Health Reports,* p.216, May/June 1996. Wartenberg is a member of the NAS-NRC EMF committee.

...EMF personal injury litigation is likely to continue for many years to come. An esteemed scientist once explained that public health issues do not die a sudden death, but rather die from years of neglect. We cannot and should not expect one study or several studies to put an end to either the EMF health debate or EMF litigation. Nor is the "neglect stage" anywhere in sight. We should instead expect a protracted battle over EMFs. The science of EMFs is a critical weapon for both sides in most, if not all, aspects of this battle.

—Mark Warnquist, Russell Yates and Chad Neuens, lawyers at LeBoeuf, Lamb, Greene & MacRae in Denver, CO, "The Role of Science in EMF Litigation," *IEEE Engineering in Medicine and Biology,* p.69, July/August 1996

Don't count on melatonin to make you live longer, improve your sex life, cure cancer or lower your cholesterol. There is little scientific basis for sensational claims for melatonin's health benefits reported recently in the popular press. These claims are based on anecdotal reports ("I tried it and it worked"), animal research—some of it flawed—and pure speculation.

—From "Melatonin—1996: Frequently Asked Questions," a brochure published by the *Society for Light Treatment and Biological Rhythms,* based in Wheat Ridge, CO, July 15, 1996

Letter to the Editor

WTR v. NYPLP

June 27, 1996

To the Editor:

The well-publicized problems with Wireless Technology Research Inc. (WTR)—which is leading an industry-sponsored research program on health effects of cellular phones—raise the question as to whether there might be another model for such an effort. Indeed there is: the New York State Power Lines Project (NYPLP).

This five-year program was established in February 1980 with $5 million in research funds from the settlement of a lawsuit against a proposed 765 kV power line. It funded 16 research projects, including two major epidemiology studies (the studies by Dr. Richard Stevens and by Dr. David Savitz), a long-term animal study, a human study, primate studies, a variety of *in vitro* studies and important studies on dosimetry. A series of lengthy final reports was published in 1987. In addition, I counted nearly two dozen papers in peer-reviewed journals citing funding from this source. By and large, the quality of these studies was very high.

How could the project accomplish so much with fewer resources than those promised to WTR (even taking inflation into account)? It had much less infrastructure. The project was administered by Dr. David Carpenter, a talented scientist-administrator, with the help of an advisory committee of eight scientists. No doubt, New York state provided considerable in-kind administrative support. In contrast, WTR has a large infrastructure to support. Carpenter also had a guaranteed source of funds, which WTR apparently lacks.

But there are also differences in scientific philosophy as well. Carpenter came from a background of research science (he was briefly my boss at the Armed Forces Radiobiology Institute, and before that he was at the National Institutes of Health). Dr. George Carlo, the head of WTR, came from a background in regulatory science. Regulatory science differs from research science in the strict bureaucratic controls it imposes on research (such as the insistence on Good Laboratory Practices), which naturally drive up costs and reduce flexibility. The NYPLP enforced scientific quality by carefully selecting projects to fund, scheduling occasional site visits and providing engineering support to investigators.

The ultimate success of WTR can only be judged according to its goals—what information it is supposed to produce, at what level of reliability and for whose use. But in terms of the amount of high-quality research it supports on an issue that the public views as important, the NYPLP will certainly come out ahead by a large margin. The public, I suspect, would judge the NYPLP to be far more effective, and I suspect that the industry sponsors of WTR would also.

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Dr. Foster's research contract with WTR was abruptly canceled in April (see p.13 and MWN, *M/J96). For more on the NYPLP, see* MWN, *F81, Ap82, J/A87, N/D88 and M/A90.*

UPDATES

BREAST CANCER

Battelle Visits Löscher's Lab... In late July, Dr. Larry Anderson of the Battelle Pacific Northwest Labs in Richland, WA, began a set of six-month studies to examine the combined effects of magnetic fields and the carcinogen DMBA on the incidence of breast cancer in rats. Animals were treated with a single 10 mg dose of DMBA and are being continuously exposed to fields of 50 Hz at 1 G, or 60 Hz at either 1 or 10 G. In a set of three-month studies, which Anderson plans to start in August, the animals will be exposed under the same conditions but will be given four 5 mg doses of DMBA. The three-month study at 50 Hz will be an exact replication of the work of Dr. Wolfgang Löscher and colleagues at the School of Veterinary Medicine in Hannover, Germany, who found that EMFs can promote the action of DMBA, increasing the risk of breast cancer in rats (see *MWN,* J/A93, J/F95, M/A95, J/A95 and M/A 96). In preparation for these experiments, Anderson's colleagues, Drs. James Morris and Richard Stevens, visited Löscher's lab to ensure that the conditions at Battelle would be as similar as possible to those in Germany. Stevens told *Microwave News* that his intent had been to record the strain of rats, the DMBA doses and the magnetic field exposures. He noted that he was impressed by what he had seen in Hannover. "Löscher has done these experiments very carefully and very well," Stevens said. Meanwhile, Löscher and Dr. Meike Mevissen are completing the data analysis of a replication of their 1 G, 50 Hz study with funds from the U.S. Department of Energy. In an article published in the May 1996 issue of *Carcinogenesis (17,* pp. 903-910), Löscher and Mevissen concluded that rats exposed to 500 mG had a higher incidence of breast cancer than did rats exposed to 100 mG, but a lower incidence than those exposed to 1 G, providing evidence for a dose–response relationship.

CELLULAR PHONE INTERFERENCE

Astronomers Wrangle with Iridium... Motorola's Iridium satellites are based on a flawed design that will cause unacceptable interference with neighboring parts of the radio spectrum, according to a letter in the June 13 issue of *Nature*. Dr. John Ponsonby of the Onsala Space Observatory in Onsala, Sweden, warns that the resulting interference with radio astronomy will violate the rules of the International Telecommunication Union (ITU), which allocates frequency use on a global basis. Ponsonby explains that the problem stems from Iridium's use of high-efficiency power amplifiers together with composite signals, which combine several transmissions destined for different subscribers. He states that, "This inevitably leads to 'intermodulation distortion'—spurious frequency components

are generated both inside and outside the band occupied by the intended signals." Ponsonby concedes that an output filter on each amplifier could remove the "out-of-band" signals. But he notes that since each Iridium satellite uses many individual amplifiers, this would probably add too much weight to be practical. How much out-of-band interference will there be? Since it depends on the level of phone traffic, Ponsonby calls it "hard to estimate," but contends, "Typically, it might be 1,000 times above the level acceptable [for radio astronomy], and it therefore would amount to total jamming of the band." On April 18, *Nature* reported that Europe's Committee on Radio Astronomy Frequencies (CRAF) had asked Motorola to limit the number of Iridium users on the system at times of peak traffic in order to minimize this type of interference. "But such a solution is clearly not compatible with a commercial aim of maximizing revenue," wrote correspondent Alison Abbott. In a 1994 agreement with the U.S. National Radio Astronomy Observatory (NRAO), Motorola promised at least four hours of zero interference per day—during times of least phone use. "We have coordinated with radio astronomy sites in the U.S. and have every intention of coordinating with radio astronomers worldwide," John Windolph, Iridium's director of marketing and corporate communications, said in a telephone interview from the company's headquarters in Washington. He explained that Iridium will pay for a beacon at each radio astronomy site: "When the subscriber's phone detects the beacon, it ratchets up to a higher part of the spectrum so it won't interfere." How will this change Iridium's downlink—the satellite-to-earth transmissions that are the focus of Ponsonby's critique? "If you take the handset out of the equation, you don't have a problem," Windolph asserted. "The satellite transmission alone doesn't cause the interference. It's the interaction between satellite and handset transmissions, which are in the same bandwidth, that causes a potential problem." However, NRAO spokesperson Dave Finley, in Socorro, NM, maintained that, "It is expected that intermodulation products of the Iridium downlink will appear within the radio astronomy band during times of high satellite usage." Finley told *Microwave News* that the NRAO will be "working with Motorola on tests to measure the interfering emission levels" when the Iridium system enters its test phase. (See p.14 and *MWN,* J/A95.)

ELECTRIC BLANKETS

Mothers' Use Not Linked to Childhood Cancer...A recent study of exposures to electric blankets and water bed heaters *in utero* and after birth suggests that they do not promote brain tumors in children. A team led by Dr. Susan Preston-Martin of UCLA's medical school investigated 540 children under the age of 19 living on the West Coast of the United States who were diagnosed with cancer between 1984 and 1991. The report, published in the *American Journal of Epidemiology (AJE, 143,* pp.1116-1122, June 1, 1996), indicates that the risk of brain cancer did not depend on the trimester of the pregnancy in which the exposure occurred. Similarly, there was no rise in the rate of brain cancer among children directly exposed to water bed heaters or electric blankets—compared to the 801 children in the control group. These results stand in contrast to the findings of the first study of this kind: Six years ago, Dr. David Savitz of the University of North Carolina, Chapel Hill, reported *(AJE, 131,* pp.763-773, May 1990) that children exposed *in utero* to electric blanket EMFs had a two-and-a-half times greater than expected risk of developing brain tumors (see *MWN,* M/J90). "Their study provides credible evidence against an association," Savitz told *Microwave News,* "just as ours provided some evidence in support."

MEDICAL DEVICES

OrthoLogic Under Scrutiny... On May 31, the FDA issued OrthoLogic Corp. a "warning letter" threatening regulatory ac-

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• A former radar repairman wins a $200,000 out-of-court settlement from General Electric Co. and Western Electric Co. after he charged that his deafness, bleeding eyes and systemic hemorrhaging were due to 14 years of RF/MW radiation exposure from a Nike Hercules radar.

• A NIOSH RF/MW criteria document is delayed by the Reagan administration's proposal to move the institute from Washington to Atlanta.

Years 10 Ago

• Shipbuilders at the Bath Iron Works in Portland, ME, report facial burns, headaches, irritated eyes, nausea and exhaustion after spending a rainy March morning working near a U.S. Navy ship with its radar accidentally turned on.

• The EPA proposes four options for public RF/MW exposures: maximum SARs of 0.04, 0.08 or 0.4 W/Kg, or setting no limit at all.

• Human tumor cells exposed to power-frequency EMFs proliferate more easily and are more immune to attack, according to Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX.

Years 5 Ago

• An animal study by Drs. Jack McLean and Maria Stuchly of Health and Welfare Canada in Ottawa and a cell-culture study by Dr. Chris Cain of the VA Hospital in Loma Linda, CA, independently show that ELF magnetic fields can act in concert with the carcinogen TPA to promote cancer development.

• The U.S. Congress, the General Accounting Office and the FDA investigate scores of fatalities that occurred after apnea monitors—devices that detect respiratory failure—did not respond due to EMI.

• Telephone line workers have higher mortality rates from leukemia than other telephone company employees, according to Dr. Genevieve Matanoski and colleagues at Johns Hopkins University in Baltimore.

tion if the company did not retract "misleading" information about its Model 1000 Bone Growth Stimulator, which uses magnetic fields to increase the synthesis of growth factor IGF-II. In the letter, Lillian Gill, director of the Office of Compliance at FDA's Center for Devices and Radiological Health in Rockville, MD, questioned the company's claims that the device has a 78% success rate with an average treatment time of 4.1 months and that it was approved by the FDA for areas other than the arms and legs. Dr. Allan Weinstein, CEO of OrthoLogic, did not make the letter public, telling the *Wall Street Journal* that he did not believe it would have a "material adverse effect" on the company. Nevertheless, he later admitted to the *Journal* that while the letter was still under wraps, he sold 50,000 shares of OrthoLogic, claiming to have done so in the interest of "portfolio diversification." When the warning letter was leaked to the press in mid-June, the price of OrthoLogic shares tumbled—falling from $23.75 to $14.88 over a two-day period (all prices are adjusted to reflect a two-for-one stock split in late June). The shares, which had risen from $2.50 to $26.75 in the last year (see *MWN,* M/J96), leveled off at about $8-$9 at the end of July. Meanwhile, Weinstein has been replaced as president and chief operating officer by George Oram Jr.—who was previously with OrthoLogic's competitor, EBI Medical Systems Inc. in Parsippany, NJ. Weinstein remains with the company as chairman and CEO. OrthoLogic now faces lawsuits from disgruntled shareholders who charge that Weinstein and other company officials sold their shares to avoid losses totaling over $2 million.

MEETINGS

Coghill Congresses... The *1st World Magnetotherapy Congress,* which was held at the headquarters of the Royal Society of Medicine in London, U.K., May 7-8, attracted 60 delegates from 12 countries. The event, which included 16 papers on the use of magnetic fields to aid the body's healing processes, was sponsored by Coghill Research Labs in Gwent, U.K. Dr. Martin Blank of Columbia University's medical school in New York City, the president-elect of BEMS, chaired the meeting. He praised Roger Coghill for having "brought together a lot of new and not-so-new ideas." Coghill is already planning his next conference: the *1st World Congress on Bioelectromagnetics in Nature,* to be held in London, May 8-9, 1997. For more information, or to order the proceedings of the Magnetotherapy Congress ($60.00), contact: Coghill Research Labs, Lower Race, Gwent, Wales NP4 5UH, U.K., (44+1495) 763-389, Fax: (44+1495) 769-882, E-mail: <100771.1170@compuserve.com>.

Bioeffects Symposia... As the *25th General Assembly of the International Union of Radio Science* (URSI), to be held in Lille, France, draws near, presentations from a 1993 symposium in Fukuoka, Japan, which was held after the 24th assembly in Kyoto, have been published. The 243-page volume, titled *Biological Effects of Magnetic and Electromagnetic Fields,* was edited by Dr. Shoogo Ueno of the University of Tokyo and is comprised of 16 papers. Several Japanese authors are featured, including Drs. Ueno and Masakazu Iwasaka on "Magnetic Nerve Stimulation and Effects of Magnetic Fields on Biolog-

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ical, Physical and Chemical Processes" and Drs. Masamichi Kato and Tsukasa Shigemitsu on "Effects of Exposure to a 50 Hz Magnetic Field on Melatonin in Rats." To order a copy, contact Plenum Publishing Corp. at (800) 221-9369, or send $79.50 to Plenum, 233 Spring St., New York, NY 10013.

Workshop on Interaction Mechanisms...COST 244 on Biomedical Effects of EMFs—part of the European Cooperation in the Field of Scientific and Technical Research—is organizing a workshop on *Delineation of Differences in the Mode of Energy Coupling and Mechanisms of Interaction at ELF and RF,* to be held in Zagreb, Croatia, October 5-6. Also on the agenda is a roundtable discussion comparing various measurement standards. The official language of the workshop will be English, and there will be no registration fee. For more information, contact: Dr. Dina Simunic, Faculty of Electrical Engineering and Computing, University of Zagreb, Unska 3, HR-10000 Zagreb, Croatia, (385+1) 6129-789, Fax: (385+1) 6129-606, E-mail: <dina.simunic@fer.hr>; or look up <http://pubwww.srce.hr/cost244/zgwork> on the World Wide Web.

Lawyers Unplugged... The Environmental Law Center at Vermont Law School is holding a conference, *Unplugged: Health and Policy Implications of the Wireless Revolution,* at the Killington Ski Resort, November 15-16. Among those speaking will be Dr. Stanislaw Szmigielski and attorney Anthony Roisman. For more information, contact: Clare Kelsey, Public Interest Law Cooperative, PO Box 1, Strafford, VT 05072, (802) 765-4409, Fax: (802) 765-4509, E-mail: <cckelsey@sover.net>.

PEOPLE

After turning 65, writer **Paul Brodeur** has retired from *The New Yorker.* His three books on EMFs, *The Zapping of America* (1977), *Currents of Death* (1989) and *The Great Power Line Cover-Up* (1993), were all excerpted in the pages of the magazine prior to their publication. A novelist before he began to write about EMFs, Brodeur was on the staff of *The New Yorker* for 38 years. He is now finishing a memoir, which is slated for publication next year....Dr. **Martin Blank** of Columbia University's medical school in New York City is the new president-elect of the Bioelectromagnetics Society. Blank won a three-way election, beating out Dr. **Q. Balzano** of Motorola and Dr. **John Osepchuk**, who recently retired from Raytheon Co. Blank takes over from Dr. **Richard Luben**, the current president, next June....**Thomas Maney**, a former chairman of the board of directors of the EMR Alliance, died on June 5 of a heart attack at the age of 72. Maney, who lived in Fort Walton Beach, FL, was vice president of the Florida Undergrounders Inc. Most recently, he was the author of "Benefits of Urban Underground Power Delivery," which appeared in the spring 1996 issue of *IEEE Technology and Society Magazine*....**Gary Taubes**, a contributor to *Science* and *Discover* magazines, is making news, rather than just writing about it. Taubes has long been a skeptic and critic of EMF health effects, most notably in "Fields of Fear," which appeared in the November 1994 issue of *The Atlantic*. But the spotlight now shining on him has nothing to do with EMFs—rather the controversy cen-

ters on a profile of Dr. **Stanley Prusiner** written by Taubes a decade ago. Prusiner, a neurologist, has spearheaded the prion hypothesis—that there exist infectious proteins. When first proposed, the theory was regarded as heresy, but it is now mainstream science. Some still maintain that the prion hypothesis is the "cold fusion" of infectious diseases, according to a detailed special report in the July 12 issue of *Science*. But Prusiner, the world's leading prion scientist, refused to be interviewed by *Science*. The reason, according to several of his colleagues, is that Prusiner has never gotten over a decade-old profile by Taubes, in *Discover,* "The Name of the Game Is Fame, But Is It Science?" *Science* correspondent Rosie Mestel explained that, "Taubes reported in his story that Prusiner's forceful personality and a flair for public relations, rather than the scientific merit of his work, was behind the growing prominence of the hypothesis." Prusiner won the Lasker Award two years ago and is said to be on the short list for a Nobel Prize.

POLICE RADAR

Another Lawsuit Voluntarily Dismissed... On May 29, a federal court in South Carolina agreed to the dismissal of a lawsuit against Kustom Signals Inc., a manufacturer of police radar equipment—a dismissal requested by the plaintiffs. The suit had been brought on behalf of the wife and child of Danny Farr, who had worked for the South Carolina Highway Patrol and died of testicular cancer in May 1995. Attorney John Kassel of Suggs & Kelly in Columbia, SC, asked that the suit be dismissed without prejudice, meaning that it could be refiled at a later date. Judge Joseph Anderson granted the request, but with certain conditions. Before Farr's family could refile such a suit in the future, they would have to pay Kustom for its court costs to date, plus an additional $2,000 for what the judge called "a partial attorney's fee." Kustom attorney Mark Oium, of O'Connor, Cohn, Dillon & Barr in San Francisco, said that he knows of no personal injury lawsuits now pending against Kustom or any other police radar makers. "I think the bloom is off the radar litigation rose," he commented in a telephone interview. "There doesn't seem to be a lot of enthusiasm out there for filing these lawsuits." Kassel did not return phone calls requesting comment. In January he told *Microwave News* that "these are tough cases," noting that there is a lack of research on the health effects of radar.

STANDARDS

Hearing Aid EMI...IEEE committee C63.19 is preparing two standards addressing compatibility between hearing aids and wireless technology. One of these, *Method of Measurement for Hearing Aid Compatibility with Wireless Communications,* is a protocol for making measurements, while the other, *Limits for Hearing Aid Compatibility with Wireless Communications,* is a set of guidelines to prevent interference. The committee had an organizational meeting in late June in Minneapolis and will convene again in August in Santa Clara, CA, according to one of its cochairs, Dr. Stephen Berger of Siemens Rolm Communications in Austin, TX. Berger told *Microwave News* that he expects the standards to be finished by fall 1998.

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MICRO WAVE NEWS

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NCI Dismisses Leukemia Risk for Children Living Near Power Lines

Measured Magnetic Fields Stir Debate

A major study by the National Cancer Institute (NCI) has found "little evidence" that living near high-current power lines is associated with childhood leukemia.

"The results of our study differ from three earlier studies," said the lead investigator, Dr. Martha Linet of the NCI's radiation epidemiology branch. Linet explained that her team found no evidence of a significantly increased risk of acute lymphoblastic leukemia (ALL) among children who lived in homes near high-current electrical wiring.

More Coverage of the NCI Study on pp.10-14
Germans and Swedes Find Links • Dose-Response Flap • Wertheimer-Leeper vs. Kaune on Wire Codes

For measured magnetic fields, the NCI team found "a slightly elevated, but not statistically significant, risk" for ALL among those children exposed to 2 mG or more, as compared to those in homes with magnetic fields below 0.65 mG. Linet also said that there was "no evidence" of a dose-response relationship—that is, an increase in the risk of leukemia with increasing exposures to electromagnetic fields (EMFs).

Newspapers across the country and television networks featured prominent coverage of the NCI study, which appeared in the July 3 *New England Journal of Medicine (337,* pp.1-7). In an accompanying editorial, the *Journal* called for an end to power line health research.

The NCI's characterization of the results for measured fields has provoked

(continued on p.10)

Views on the News: The NCI Study

NCI Comes to a Cautious Conclusion —Or Is It Reckless?

CANCER STUDY FINDS NO LINK TO POWER LINES read the headline in the *Los Angeles Times*. The NCI study has "debunked" the link between EMFs and childhood cancer, according to a news story in the *Montreal Gazette,* while the *Hartford Courant* reported that the study has "discounted" the connection. *Science* magazine suggested, "It could be the obituary" for the EMF issue.

Yet the NCI's own data show an increased leukemia risk at EMF levels found in about 5% of U.S. homes. On the job, workers are often exposed to levels many times higher. Is the NCI willing to tell these people that they are safe?

(continued on p.19)

HIGHLIGHTS

At the World Congress

The Talk of Bologna: Wireless Comes Home

Bologna was the star attraction. A beautiful, cosmopolitan setting where the people take their food seriously and the cafés stay open into the early morning hours. A good time was had by all —except for those fleeced by pickpockets.

When our minds wandered—a not infrequent event in the warm June sun—we were soon reminded of why we were there. Cellular phones were everywhere. From the moment we walked off the plane in Milan, we were surrounded by them. It looked like Motorola heaven. That seemed appropriate when we were reminded that Bologna is the birthplace of Guglielmo Marconi, the father of wireless communications.

Motorola also dominated the science presented at the conference.* And with good reason: The company has the largest cellular phone health research program in the world—a situation that will continue now that the European Commission's $20 million initiative has been delayed until at least 1999, and as long as the U.S. Cellular Telecommunications Industry Association's (CTIA) $25 million program remains in its perpetual holding pattern.

Is there anything to worry about? It all depends on whom you ask. In an invited lecture, Dr. Konstantin Hossmann of the Max Planck Institute in Cologne, Germany, a Motorola contractor, expressed skepticism about any health risks. "My guess is that nonbiological health hazards are more important than biological effects," he said, citing the dangers of car accidents and EMI to pacemakers. Hossmann reserved his harshest criticism for those who use "handys" near him: They are, he said, "a pain in the neck."

Others are less dismissive. Poland's Dr. Stanislaw Szmigielski of the Military Institute of Hygiene and Epidemiology in Warsaw presented the latest findings of his long-term study showing that servicemen exposed to RF/MW radiation (mostly pulsed) have higher rates of cancer. Szmigielski said that he is now seeing indications of a dose-response relationship.

Dr. George Carlo of CTIA's Wireless Technology Research in Washington was impressed. "If it were our data, it would clearly tell me that we should look closer," he told us.

Perhaps the most remarkable results were presented by Dr. Sianette Kwee of Denmark's University of Aarhus. She reported seeing changes in cell proliferation following exposures to GSM radiation at SARs of 0.021 mW/Kg. These exposures seemed so startlingly low that we sought her out during one of the coffee breaks and asked whether she had made a typo and had really exposed the cells to 0.021 W/Kg (already a low level). There was no mistake, she answered. We resigned ourselves to waiting for a replication study—if one is ever funded.

Wondering how long the Australian GSM–mouse lymphoma study would stay in replication limbo, we went to see Motorola's Dr. Q. Balzano. "It will be repeated," he declared, "whether by Motorola or by someone else. It cannot be left as an open question."

Dr. Michael Repacholi was in Bologna, albeit briefly, to give a paper on the Australian study's results, which show a doubling of lymphoma among the GSM radiation-exposed mice. The presentation was almost a nonevent, however, after the international media blitz that followed the publication of his paper in May.

The amount of radiation to which Repacholi's mice were actually exposed, though, was a hot topic. "It's hard to tell if this is a thermal effect. The SARs are very difficult to pin down," Balzano said. Dr. Niels Kuster of the ETH in Zurich, Switzerland, also a Motorola-funded researcher, had less difficulty. "It is very unlikely that the mice had a thermal response," he said.

Nevertheless, Kuster was not impressed with Repacholi's experimental setup, pointing to the "large, uncontrolled standing waves" in the room where the mice were exposed. He said there was a simple solution: Move the cages from the wall to the floor and put absorbent material on the walls.

Also still awaiting replication is the now well-known Lai-Singh experiment. Three years after word first began to spread that Drs. Henry Lai and N.P. Singh of the University of Washington, Seattle, had observed more DNA breaks in the brains of rats exposed to RF/MW radiation, their work remains unsettled. Dr. Joseph Roti Roti of Washington University in St. Louis, hired by Motorola to repeat the study, has been doing the experiment differently and has been getting different results. In Bologna, Motorola's Dr. Mays Swicord announced that Roti Roti would now embark on an *exact* replication.

And then there are the concerns over RF/MW–induced leakage through the blood-brain barrier (BBB). This is possibly the most talked about and most contentious effect in the literature. Dr. Leif Salford of Sweden's Lund University has been saying at scientific meetings for most of the 1990s that he sees such leakage. Anyone who has been tracking the RF/MW debate must have a sense of *déjà, déjà vu*.

Over the last 20 years, Drs. Ernest Albert, Allan Frey, Daryl Hawkins, Henry Kues, David Lange, Kenneth Oscar, Frank Prato and others in North America alone have all documented BBB leakage—and yet the effect is still considered an anomaly.

In Bologna, Salford once again reported that he sees leakage at very low levels (0.4 mW/Kg)—levels similar to those used by Kwee! "It's a dramatic effect. What it means, I can't say," Salford concluded. But, he said, it may be "more significant for Alzheimer's disease than for brain tumors."

Dr. Terry Kenny, a consultant to the cellular phone industry based in Southampton, U.K., balked, asking for electron microscope images of the breaks in the BBB. Salford had no such pictures, but he did not waver: "It's very difficult to believe that we have an artifact after so many years of work," he replied.

We left Bologna wondering when a single biological effect of RF/MW radiation will be replicated and resolved. With the current funding situation, that time seems as elusive as ever. Where, we asked ourselves, are the pickpockets when we really need them.

* *2nd World Congress for Electricity and Magnetism in Biology and Medicine,* Bologna, Italy, June 8-13, 1997.

« Wireless Notes »

Opposition to tower siting from wireless industry employees is not common. One reason why may be found in the case of **Ann Shirreffs**: When she tried to keep a **PCS** tower from her children's school, she lost her job as a cellular phone sales rep. On June 1, the Cleveland *Plain Dealer* reported that Shirreffs was asking parents of children at the school in suburban Pepper Pike to petition the school board against an **AT&T Wireless** tower. Early that same Sunday morning, her boss called and they "mutually agreed" that she should look for another job, Shirreffs told *Microwave News*. Two weeks later, Pepper Pike Mayor Bruce Akers announced that the school board had voted down the AT&T tower—in large part due to the petition, which had been signed by 950 parents. "I have truly risked my job and my career," Shirreffs said. "I wouldn't have done it if I didn't have doubts about the safety of this technology." She sees no inconsistency between selling hand-held phones and opposing the tower. "The difference is very clear. The person who buys a phone has choices—when and how to use it," Shirreffs said. "The minute we place a cell tower on school property, we eliminate choices for the students." The lack of long-term RF/MW exposure studies prompted her decision to oppose the tower at the school, which runs from pre-K through high school. Still, the decision has been unpopular in some quarters because AT&T would have paid $100,000 up-front and $1,000 per month after five years. One of those in favor of the tower was school board member David Noble, who was absent for the deciding vote, according to the June 26 *Chagrin Valley Times* (OH). "You cost us money for certain towers that are not a health hazard," the paper quoted him as telling residents. "They've given up thousands of dollars a month," Kathleen Riehle, a spokesperson for AT&T in Cincinnati, said in an interview. "I think that's kind of sad." AT&T is proceeding with a plan to locate the tower at a nearby electrical substation, according to Riehle. Shirreffs, meanwhile, has put her job hunt on hold while she helps nearby communities keep towers away from their schools.

«« »»

Would anyone at the **Harvard School of Public Health** sign a petition on public health without reading it? **Beverly Freeman**, the school's director of public affairs, says that more than 40 of the faculty, staff and students did exactly that. They endorsed an effort to keep Sprint Corp. from activating its **PCS** system in Boston. The petition, which was also signed by some faculty members from the **Boston University School of Public Health** and **MIT**, was circulated by **Susan Clarke**, an environmental health advocate based in Concord, MA. The *Boston Globe* (June 16) ran an article in which Harvard's Dr. Joel Schwartz, one of the signers, said: "There are a lot of studies that suggest there's

Cellular Phones Pronounced Safe in Helsinki —But Some Key Data Not Yet Available

On May 22, Finnish scientists briefed the press in Helsinki on new research that found NO HEALTH HAZARDS FROM MOBILE PHONES—as the State Technical Research Center (VTT) declared in its press release. The Reuter news service picked up the story, reporting that a Finnish study had concluded that "mobile phones pose no health threat to phone users."

At that time, the only information available was in Finnish. Specifics emerged two weeks later when an English-language synopsis of the research, dated June 6, was given out at the *World Congress* in Bologna, Italy (see p. 2). Some key data were missing, however: The group studying cancer-promotion effects of cellular phone radiation in mice had no cancer results yet.

Finnish researchers have also been investigating how much radiation cellular phones deposit in the brain, and whether such radiation can affect human electroencephalograms (EEGs). The studies began in 1994 as part of the European Cooperation in the Field of Scientific and Technical Research program on biomedical effects of EMFs (COST 244). A substantial part of the program funding came from Finnish cellular phone manufacturers (Nokia and Benefon) and telecommunications firms (Telecom Finland and HPY).

Dr. Jukka Juutilainen of the University of Kuopio exposed mice to 902 MHz radiation—50 mice each to analog and to pulsed signals—after the mice were initiated with ionizing radiation. A mortality analysis found no difference between the RF–exposed mice and the controls. In an interview, Juutilainen said that a final report, which will include the results of a histopathological analysis, should be finished early next year.

Dr. Maila Hietanen of the Institute of Occupational Health in Helsinki directed the EEG study. She exposed 19 volunteers to signals lasting 20 minutes each from analog and from digital (GSM) phones. Data analysis showed no effect on "human brain activity." When *Microwave News* asked whether either 20-minute exposure was sufficient to reach this conclusion, Hietanen replied, "If there were some real changes, we would have seen them."

At the Center for Radiation and Nuclear Safety, also in Helsinki, Dr. Kari Jokela and colleagues are developing techniques to estimate specific absorption rates (SARs) in mice and in simulated human heads. Jokela presented some mouse data in his report; however, he does not yet have any "useful data on actual SAR measurements" for human phantoms, he told *Microwave News*.

The Helsinki press conference came only three weeks after results of the Repacholi mouse study were published. The timing, Juutilainen said, was "just a coincidence."

an increased cancer risk." Schwartz, who in 1991 won a MacArthur "genius" award, declined to talk to *Microwave News,* instead referring us to Freeman. "What they thought they were signing was a petition to encourage research on the subject," Freeman said in an interview. She maintained that Clarke did not disclose to the signers that her intent was to present the petition to the Massachusetts Department of Public Health (DPH) in an effort to stop Sprint's PCS system. Nevertheless, the petition begins:

> We the undersigned physicians and scientists call upon public health officials to intervene to halt the initiation of communication transmissions employing ground level, horizontally transmitted, pulsed microwaves in Boston. This form of transmission is scheduled to begin in June 1997 by the Sprint Corporation for PCS.

Freeman said she was disappointed that the *Globe* had covered the story, explaining that it implied that the opinions of the signers represented the official position of the school. "It's really not a story at all," she said. "It was the work of a woman who really sort of used Harvard." Clarke herself said that her motive was to protect people from involuntary exposure. "The industry is in effect precluding any right to know regarding the health effects of digital microwaves," she said. In July, Clarke presented the petition to the DPH as well as to the EPA and the federal Agency for Toxic Substances and Disease Registry.

Cell Phone EMI with Pacemakers Confirmed, Seen as Manageable

With the publication of an industry-sponsored study in the *New England Journal of Medicine,* there appears to be a consensus that cellular phones can interfere with implanted cardiac pacemakers, but that the problem is manageable.

Dr. David Hayes and colleagues report in the *Journal*'s May 22 issue *(336,* pp.1473-1479, 1997) that cellular phones can cause "clinically significant" electromagnetic interference (EMI) with pacemakers. Such interference occurred in only 6.6% of their tests, however, and never when the phone was next to the ear. The study defined clinically significant EMI as that which can cause dizziness, fainting, shortness of breath and irregularities in heart function.

There is "no significant public health issue" concerning wireless phones and pacemakers, Hayes told *Microwave News* from his office at the Mayo Clinic in Rochester, MN. He noted that a pacemaker user can minimize the risk of interference by carrying and using a cellular phone away from his or her chest, and that those "who want to be safest," including people dependent on their pacemakers, can use analog or PCS phones.

Filters are an important part of the solution to the pacemaker EMI problem. Hayes found that interference occurred in only 0.4% of the tests on pacemakers with feed-through filters, but in 28.9% of the tests on pacemakers lacking such filters. Dr. Roger Carrillo of Mt. Sinai Medical Center in Miami Beach, FL, first reported that pacemakers with filters were much less susceptible to EMI (see *MWN,* M/J96).

In Hayes's view, there is no need for further study of pacemaker EMI unless a new phone technology is introduced. But he believes that more research is needed on the possible vulnerability of implanted defibrillators to cellular phone interference (see *MWN,* M/J97). The Mayo Clinic and the New England Medical Center in Boston are seeking funding to study this question.

The newly published study involved 5,533 tests with 980 subjects at the Mayo Clinic, the New England Medical Center and the University of Oklahoma Health Sciences Center, Oklahoma City. It was funded by Wireless Technology Research (WTR); preliminary results were released in May 1996 (see *MWN,* M/J96). Previous research in the U.S. and Europe had shown that pacemakers can be affected by cellular phone radiation (see *MWN,* J/A94 and M/J95).

Hayes's recommendations were echoed in an accompanying editorial in the *New England Journal* (pp.1518-1519). Drs. Marc Roelke, an electrophysiologist, and Alan Bernstein, an electrical engineer, both of Beth Israel Medical Center in Newark, NJ, advised that, "Patients should be counseled to keep cellular telephones away from the pacemaker pulse generator when carrying, dialing or talking into the telephones." This recommendation is similar to that issued in September 1996 by WTR, and endorsed by the U.S. Food and Drug Administration and the Cellular Telecommunications Industry Association (see *MWN,* N/D96).

Hayes and his team confirmed previous findings that analog phones are less likely to cause interference than digital models. The incidence of EMI was 2.5% with analog phones, as compared to 23.7% with digital units. But the incidence of EMI varied

IEEE Reaffirms Its RF/MW Exposure Standard

The Institute of Electrical and Electronics Engineers (IEEE) has reaffirmed its guidelines for human exposure to radiofrequency and microwave (RF/MW) radiation. The standard, officially known as ANSI/IEEE C95.1-1992, is now under review by the American National Standards Institute (ANSI).

The IEEE's Standards Board voted in April to reaffirm C95.1-1992, concluding a yearlong review and comment process, Dr. John Osepchuk told *Microwave News.* Osepchuk is chair of the IEEE's Standards Coordinating Committee (SCC) 28, which developed C95.1-1992 and other standards on non-ionizing radiation. ANSI requires participating organizations to revise or reaffirm standards every five years.

SCC28 has already begun a substantive revision of the standard, however. "Extensive work" is under way, said Osepchuk, a consultant based in Concord, MA, who was formerly with Raytheon Co. "We expect the revision will be finished and on the street well before the end of the [next] five-year cycle" that runs through 2002. Prior to that, Osepchuk added, SCC28 may issue a supplement that will make minor changes in the standard.

The IEEE completed its last major revision of the RF/MW standard, which covers 3 kHz-300 GHz, in 1991; the revision was adopted by ANSI in 1992 (see *MWN,* N/D 91 and N/D92).

with different digital signals. The highest incidence of interference, 52.6%, was observed with TDMA–11, which is not in commercial use. PCS–1900 phones had the least—1.2%. The incidence of EMI for NADC units was 21.3%, the highest among the phones tested that are currently on the U.S. market.

Australian Insurance Company Opposes Wireless Antennas

A leading insurance company in Australia, Mercantile Mutual, has sided with residents and local elected officials in their efforts to block mobile phone antennas in Sydney.

Vodaphone—one of three cellular service providers in Australia—sought to put antennas on a Mercantile office building located in a residential area near a school.

On June 30, when Vodaphone workers arrived at the site to begin installing the antennas, Mercantile officials refused them entrance into the building. Later that day, the officials backed down when police told them that Vodaphone had a legal right to install the antennas.

"We objected because of community concerns including the school nearby," David Sinclair, a spokesperson for Mercantile, told *Microwave News*. "We're sympathetic to those concerns and worry that there might be health effects."

Vodaphone acted quickly, because under telecom siting rules which took effect on July 1, antenna siting requires approval from local governing bodies.

In an April letter from Mercantile to Vodaphone, quoted in *The Australian* (July 4), the company warned about the potential financial backlash it could face. "The risk to health...may expose us as owners of the property to liability for injury to persons who are or who are alleged to have been exposed to emissions from the base station," the letter stated. "The amount of such claims is impossible to calculate."

Vodaphone—a mostly U.K.–owned telecom company—did not respond to requests for comment.

Potential health effects from wireless technology remain a hot issue in Australia. On July 2, for instance, residents of a town south of Sydney claimed victory in their campaign to keep Vodaphone from building a tower near two schools and a children's center. And the July 21 *Herald Sun* reported that 500 protesters marched through a Sydney suburb calling for the removal of towers. The mob carried a burning effigy of Australian Senator Richard Alston, an outspoken skeptic of health risks from mobile phones and towers (see *MWN,* M/A97).

Australian Mobile Telecom Association on the Repacholi GSM–Mouse Lymphoma Study

The following "talking points" were prepared by the Australian Mobile Telecommunications Association in Canberra to guide responses to questions from the press and the public about the recent Australian mouse study by Dr. Michael Repacholi and colleagues. The study showed that transgenic mice exposed to weak GSM radiation had twice the rate of lymphoma as controls (see MWN, *M/J97).*

Q1: What does this say about the safety of mobile phones?
A1: In a word, nothing. That's not our position, but the position of the scientists who did this study. Their clear position is that it can't be directly related to human health. And that means it definitely can't be related to the safety of mobile phones.

Q2: But weren't these animals exposed to mobile phone signals?
A2: The animals were exposed to a type of radio signal common to some digital phone systems. However, the conditions and levels of exposure were quite different from the use of those phones.

Q3: How so?
A3: In short, the animals were in cages at a certain distance from an antenna operating at higher power than mobile phones. They were exposed in a way and at levels unlike those of mobile phones. In fact, in humans, whole-body exposures of this kind would be in excess of recognized safety standards.

Q4: You seem to be dismissing this study as completely irrelevant?
A4: Not at all. As the researchers have said, it raises some interesting questions. Those questions involve the use of a certain genetically engineered mouse in research of this kind. That warrants further independent, focused investigation. But as the researchers say, their findings cannot and should not be interpreted as bearing on human health or the safety of cellular phones.

Q5: You say this raises "interesting questions." What do you mean?
A5: Well, there seems to be general agreement that issues about the kind of mouse used, the exposure conditions and other factors need further investigation to more fully assess the significance of this study.

Q6: But in the meantime, that's not a cause for concern by cellular phone users?
A6: Not at all. The researchers themselves have said their findings cannot be directly related to human health. In fact, they stated that *no* single study can yield qualified judgments about human health risks. The scientific community understands that, government and international health authorities understand that, and the public should understand that.

Q7: What's going to be done to follow up on this research?
A7: That remains to be seen, but the Australian government is in the process of developing priorities for its own research program in this area and I suspect this latest study may be a subject for consideration in those deliberations.

Q8: What do you say to those who contend there has been far too little research to conclude the safety of cellular phones?
A8: I say they're wrong. The safety of cellular phones is supported by a broad and expanding body of scientific knowledge. Anyone claiming evidence of risk in this latest study ignores the fact that it was done with a highly experimental model and produced results contrary to other animal studies. Research continues and more will be done. We anticipate it will provide further support for the safety of cellular phones.

EMF NEWS

« Power Line Talk »

A dispute has arisen over the future of the **California EMF Program**. Dr. **Raymond Neutra**, the program's chief, wants to extend it through December 31, 2000. **San Diego Gas & Electric Co.** (SDG&E), however, disagrees, arguing that the five-year program should end two years earlier. In a June 9 petition, SDG&E attorney **Steven Nelson** stated that the need for an extension results from "unwarranted program delays"—specifically, in the naming of a research director. Nelson also criticized the program's "emphasis upon 'nonscience' and perception issues unrelated to public health," as well as its methodologies, which "could cause the program results to be rejected by mainstream scientific and public health communities." Neutra responded on July 3 that the budget had to be planned before a director could be picked and research could begin. Neutra maintained that the program did not start until February 1995 and therefore was running on time (see *MWN,* N/D93 and N/D94). SDG&E's schedule is "patently unrealistic," Neutra stated, stressing that a number of research projects will not be finished until early 1999. Some members of the Stakeholders Advisory Committee—a group that advises the program—also oppose SDG&E's proposal. **Ellen Stern Harris**, executive director of the **Fund for the Environment** in Beverly Hills, charges that the program's "alleged science has been largely corrupted by conflicts of interest." She said that too many of the researchers work for utilities. "My only hope for this program lies in dealing with public policy issues," she said. Some in the electric utility industry are also siding with Neutra. "I tend to agree more with Raymond," said Dr. **Jack Sahl** of **Southern California Edison** in Rosemead. "There's no reason to short-circuit the process at this time." On July 22, SDG&E amended its petition, citing the recent *New England Journal of Medicine* editorial calling for an end to EMF research (see p.1). The final word will come from the state's Public Utilities Commission.

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On May 8, New York state's highest court refused to hear an appeal of **Howard and Eve Reiss**'s lawsuit against Consolidated Edison Co., which was dismissed by a lower court on December 5 of last year (see *MWN,* J/F97). The Reisses charged that a Con Ed power line next to their property caused them to lose money on the sale of their home in Pleasantville, NY. One of their attorneys, **Michael Rikon** of Goldstein, Goldstein & Rikon in New York City, told *Microwave News* that they have asked the high court to reconsider. "It's not a long shot," said Rikon, "but it's not a certain thing at all. They have stated that we don't have the right to an automatic appeal—so we're telling them why we think it's important anyway." Rikon said he did not expect a response until late August.

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The **Southwest Research Institute** (SwRI) in San Antonio has pulled the plug on its biosciences program. "It was strictly an economic decision," Craig Witherow, SwRI's communications director, told *Microwave News,* explaining that the program had "a cost structure that just was not working well." The program had included an EMF research effort best known for studies of the effects of 60 Hz EMFs on melatonin levels and behavior in baboons. The research was conducted for a Japanese client, the utility-funded Central Research Institute of the Electric Power Industry. Dr. **Walter Rogers**, who directed the EMF studies, is leaving SwRI to work in San Antonio as a consultant on neurotoxicology and bioelectromagnetics. An expert on animal behavior who has worked at the institute since 1974, Rogers is also a member of the NAS–NRC panel reviewing the performance of the RAPID program (see *MWN,* N/D95 and M/J97).

NAS–NRC Reviews, Criticizes Navy Studies of Project ELF

A National Academy of Sciences-National Research Council (NAS–NRC) committee has found that there is "no evidence of statistically significant, widespread, adverse effects of EMFs" from a U.S. Navy submarine communications system in northern Wisconsin and Michigan, known as "Project ELF." But the committee's report is sharply critical of the Navy's 14-year ecological monitoring program, urging a reanalysis of the data from many studies and calling other studies "unsalvageable."

Few of the studies could have picked up small effects, according to the report—defining "small effects" as those comparable to natural factors, such as drought. "Calling it a small effect doesn't mean that it's insignificant," committee chair Dr. Duncan Patten, professor emeritus at Arizona State University in Tempe, told *Microwave News.* "An accumulation of small effects can become a big effect."

The report concludes that, "The few small possible effects that were found were often too readily dismissed" by researchers. It warns that "concerns arose about the scientific credibility" of such interpretations.

Dr. Asher Sheppard, a consultant who worked on the monitoring program for Research & Development Laboratories in Culver City, CA, told *Microwave News,* "I was surprised at the strength of the critical tone in the NRC report." Sheppard, who is based in Redlands, CA, expressed concern that "some of the program's accomplishments might have gotten lost with ten years of hindsight."

"The NRC's report supports the general findings of the Navy's ecological programs," said Commander John Tull, public affairs officer with the Navy's Space & Naval Warfare Systems Command in San Diego. Tull could not say when the Navy would respond to the report's recommendations. He emphasized that there had been no evidence of harm "to the surrounding ecosystem."

But John LaForge, codirector of the peace group Nukewatch, in Luck, WI, pointed to the possible small effects discussed in the report, such as apparent increases in moss growth and chlorophyll production in river algae. "This increased cell growth is frightening," he said, "considering that other studies have connected cancers, especially childhood leukemia, to exposure to EMFs."

NAS–NRC Report Challenges Project ELF Tree Study: Growth Effect "Disappears"—Or Maybe Not

One Project ELF study linked EMFs to an increase in tree growth. The NAS–NRC report attacks this conclusion—but a key committee member says that the issue is still open.

The tree growth study, by Dr. David Reed and colleagues at the School of Forestry and Wood Products at Michigan Technological University (MTU) in Houghton, sparked news stories in both *Science* and *New Scientist* two years ago. The NAS–NRC report questions its validity with some very blunt language:

> The committee's analysis of the primary data indicates misuse of the data. When the analysis is corrected, the growth effect disappears.

Committee chair Dr. Duncan Patten referred questions on this point to Dr. Robert Olsen. "Bob Olsen was the one who really looked at that," said Patten. "He talked to the researchers, and brought it back to the committee."

But, in an interview, Olsen was more equivocal. "There may or may not be an effect," said Olsen, of the School of Electrical Engineering and Computer Science at Washington State University in Pullman. "I have no position about whether there is or not."

"We feel that we pointed out an empirical relationship that, statistically speaking, is pretty strong," Reed told *Microwave News*. "And we stand by that."

At issue is the relevant measure of exposure. Reed's team concluded that EMFs between 1 and 7 mG appeared to increase the growth of aspen, red maple and red pine trees (see *MWN*, J/F95). These figures were based on spot measurements taken by IITRI while the antenna was on.

Olsen insisted that spot measurements are inappropriate, and that a time-weighted average should have been used instead. "In 1988, the spot measurements were between 5 and 2.6 mG—but the antenna was only on for a total of 162 hours," he said. "To use those values is like taking a spot measurement of the temperature in New York City in July, and saying it represents the whole year."

Reed responded that his team looked at "many different ways of calculating exposure: for example, hours of operation, time of exposure, number of on/off cycles." The paper's analysis, he said, was based on the measure "where we found the strongest relationship. That's not to say this was the only relationship we found, but it was the strongest."

Ironically, the NAS–NRC report itself provides an argument in favor of spot measurements. The section discussing the tree growth study in detail notes that:

> In fact, the trees almost always were exposed to a magnetic field either higher or lower than the average....Thus, average strength is not likely to correspond to an actual exposure level.

Olsen said that he did not draft this section of the NAS–NRC report, and that it reflects "the whole debate over how to measure exposure. People have argued for years about what is the right metric. Clearly, it's an open question."

"There's no one right way to measure EMF exposure," said Reed. "We're all arguing out of ignorance, because none of us knows what might be the physiology in the plants that would lead to this response." He added that while the NAS–NRC panel had asked to review his exposure data, "no one ever asked to see the data on tree response." Olsen acknowledged this, saying, "We didn't go through the analysis at that level."

Olsen strongly objected that one passage in Reed's paper inaccurately defines the exposure metric as "average exposure to magnetic flux density during that particular growing season." He told *Microwave News*, "If you say you're using a time-weighted average, you should follow through and do it. But there are no time-weighted averages for any growing season in the range of fields for which the effect was claimed. That's why we say the effect disappears."

Reed said the reference to an "average" does not mean an average over time. Instead, he stated, it refers to a calculation over distance, to assess the field strengths in between IITRI's measurement points.

Olsen asserted that Reed's growth effect was seen only during one season; Reed said the effect was seen in three seasons, though most strongly in only one. Olsen also argued that the MTU paper is not clear about why certain spot measurements were chosen; Reed responded that they used the prevalent exposure during the growing season.

Olsen praised many features of Reed's study, noting that it is the only one that tried to use IITRI's data on measured field levels. And unlike many other teams, Olsen pointed out, the MTU group published its work in the peer-reviewed literature.

For his part, Reed admitted limitations in his group's exposure assessment, and added that the study "certainly doesn't prove anything by itself." But, he insisted, "Our data is consistent with a growth effect."

In other words, the debate over the Michigan tree growth study is not over yet.

Project ELF uses a total of 84 miles of antennas located in public forests. Transmitting extremely-low-frequency signals between 72 and 80 Hz, the antennas can send instructions to deeply submerged nuclear submarines. Environmentalists and antiwar activists have protested against the project since the 1970s.

The 11 studies in the Navy's ecological monitoring program began between 1982 and 1984 and were completed by 1996. In 1994, the Navy asked the NAS–NRC to evaluate the program's activities and findings, and work began the following year (see *MWN*, J/A95). The NAS–NRC had conducted a review of EMF bioeffects for Project ELF in 1977, when it was known as Project Seafarer. Dr. Woodrow Hastings of Harvard University in Cam-

bridge, MA, who served on both panels, explained that, "The 1977 report said if the Navy built this facility, they should create a monitoring program to see if there were any effects. So that's the origin of the current report."

The NAS–NRC report faults most of the studies for not making use of exposure data provided by the Chicago-based IIT Research Institute (IITRI). For example, studies of short-term phenomena such as local navigation by birds did not examine whether the antenna at the test site was actually turned on at the time of observation. Thus, "the negative results might reflect the lack of exposure rather than the lack of an [EMF] effect." The tree-growth study, which claimed a positive result, did use exposure data—but is strongly criticized for mishandling them (see p.7).

The committee also points to the low statistical power and poor matches of test and control sites in several studies. The frequent use of "only one study site for each level of exposure," it states, could allow other variables to mask any EMF effects.

Despite the number and severity of such problems, the NAS–NRC panel does not call for doing any of the field studies over again. Since there was "no evidence [of]...obvious adverse ecological effects," the committee writes, it is "highly unlikely" that repeating any of the studies would lead to significantly different findings. Where results suggested possible small EMF effects, the committee recommends pursuing these findings with controlled laboratory experiments.

The report does recommend the reanalysis of much of the data, but notes that this will not be easy because the raw data from several studies can be deciphered only by the original investigators. IITRI was responsible for overall management of the monitoring program, and is severely criticized in the report for poor archiving of the data. The NAS–NRC panel recommends that the reanalyses be directed by "an organization that is independent of the Department of Defense and IITRI." IITRI is praised for the quality of its exposure data, but is reproached for not providing more technical assistance to ensure that these data were used.

This year, both of Wisconsin's senators and six of its nine representatives introduced legislation to cut off Project ELF's funding. This proposal passed the Senate in 1995, only to be reversed in a House-Senate conference committee (see *MWN,* M/J95).

Local opponents of Project ELF are planning a 50-mile march from Ashland, WI, to the Wisconsin transmitter. Nukewatch's LaForge said that the protest is timed to coincide with the anniversaries of the bombings of Hiroshima (August 6) and Nagasaki (August 9).

The NAS–NRC report is available for $39.00 plus $4.00 shipping from: National Academy Press, 2101 Constitution Ave., NW, Box 285, Washington, DC 20055, (800) 624-6242 or (202) 334-3313, Web site: <www.nap.edu>.

EMF Claims Could Endanger Entire Insurance Industry, Warns Swiss Firm in Report on "Electrosmog"

"The EMF problem is more dangerous and more threatening for the insurance industry than has generally been supposed." So warns a major Swiss insurance firm in a recent report, which argues that EMF cases might "confront...the insurance industry with claims on a scale which could threaten its very existence."

"EMF research has already found out too much to be able to ignore the conceivable health risks, yet has not found out enough to gauge them," notes the Zurich-based Swiss Reinsurance Co. (Swiss Re), which provides coverage to insurance companies to offset their risks. "On the basis of present knowledge alone," the report states, "it must be expected that plaintiffs will win suits dealing with [the EMF] issue." It warns of potential verdicts of tens of billions of dollars—not necessarily because of new research findings, but simply as a result of shifting public attitudes about acceptable risks.

The Swiss Re report does not propose specific responses to either the public health dilemma or the threat to the insurance industry. But it argues that solutions will not be found in the courtroom or the laboratory. Instead, it calls for a focus on "the sociopolitical controversy on how to deal with risks."

"The feedback I've heard from others in the industry is that they think this report is pretty good," Janina Clark, editor of the trade magazine *Reinsurance* in London, told *Microwave News. Reinsurance* hosted a roundtable discussion on July 11 with representatives of the different groups in the British EMF debate—activists, trial lawyers, scientists, utility experts and insurance executives. Both British and German insurance companies have recently expressed concern about the EMF issue (see *MWN,* M/J 95 and N/D96).

Swiss Re's EMF report is titled *Electrosmog—A Phantom Risk,* but despite the title it does not take a dismissive view of the EMF issue. Are EMFs harmful to human health? "The only reliable answer," according to Swiss Re, "is 'perhaps.'" While the company seems skeptical that any large-scale danger will be uncovered, it argues that the scientific questions cannot be resolved for years to come: "We are dealing with complex relationships which cannot even be identified, let alone understood, using the research methods presently available."

Some physicists have argued that low-level EMFs simply do not have enough energy to be harmful to human health, but Swiss Re rejects this argument. Life is based on complex systems of signals and responses, the report notes, and "an organism can convert weak signals into powerful biological responses." Swiss Re highlights the distinction between these "signal effects" and simple "energy effects."

As long as the EMF issue "remains a subject of controversy and is not decided, there can be no calculatory basis for providing insurance protection," Swiss Re explains. In fact, it calls the risk "incalculably great." According to the company, the problem is not that EMFs might "gradually [be] proved to be deleterious to health," as happened with asbestos. Instead, it points to "the risk of sociopolitical change," defining this as the risk that

"scientific findings might be assessed differently in a subjective sense due to changing social values."

"The sociopolitical risk...must be classified as extraordinarily high," argues Swiss Re, "because the legal instrument of liability is increasingly being used or even misused as a means of coping with the problems of life."

The report points to growing public suspicion of science, technology and industry, and notes that, "A cause, in the sense of legal liability, is whatever society defines it to be." Thus, "if society wishes to consider weak EMFs a cause of illness," it will do so, and liability will follow.

Swiss Re stresses that EMFs are just one of many agents in modern life that may be, but have not been proven to be, harmful to our health. Technology changes fast, but science is slow to provide clear answers about safety. "This lack of clarity prompts people to resort to the courts," Swiss Re notes. But it insists that the concept of legal liability is ill suited for considering technologies that *might* give someone a disease.

What is at stake, according to the report, is broader than the EMF issue: "There is a socio-legal problem: How should society deal with technologies which cannot be used with absolute safety and which therefore may represent a hazard?" New technologies often bring with them potential risks that cannot be clearly assessed or measured. So, Swiss Re contends, if society wants to employ these technologies, "we must...focus on how much *uncertainty* we are prepared to accept."

Swiss Re suggests that, "The solution to the EMF problem could thus consist in a binding agreement on who is to be responsible for damages when the cause is not clearly known or can only be conjectured."

Defining how this might be done is not easy. At the London *Reinsurance* forum, according to Clark, "The discussion didn't produce any answers. We had a wide-ranging discussion about what the problems were—the scientific and sociopolitical issues, and the underlying questions for reinsurers." It is that kind of discussion, Swiss Re hopes, that will eventually generate some solutions. "We are ready and willing to enter into this dialogue," states executive board member Dr. Bruno Porro in his foreword.

Electrosmog—A Phantom Risk can be read on Swiss Re's Web site: <www.swissre.com/com/reinsurance/earlierpublic.html>. Requests for copies can be made to: Swiss Re, Public Relations, Postfach, CH-8022 Zurich, Switzerland, Fax: (41+1) 285-2023. The report is available in English, French, Spanish and the original German.

Glazer, Jordan Lawsuits Both Withdrawn Voluntarily

Two major EMF personal injury lawsuits have been withdrawn by the plaintiffs. On May 20, Nancy Jordan withdrew her suit against two Georgia utilities, and ten days later Leonard Glazer's case against Florida Power and Light (FPL) was dismissed at his request.

"Leonard's leukemia had moved into an accelerated state," explained Glazer's attorney, Howard Talenfeld of Colodny, Fass & Talenfeld in Ft. Lauderdale. "And FPL was threatening him and his family with a cost judgment decision for $280,000. He did not want to take the risk that he'd be leaving his family with that problem—despite the fact that we felt we'd prevail in the state Supreme Court."

Last year Glazer's suit was dismissed by a lower court, a ruling that was appealed. But in the meantime, FPL took advantage of Florida's "loser pays" rules for civil suits and secured an order requiring Glazer to pay for some of its expert witness fees and other expenses (see *MWN,* S/O96).

"They withdrew their appeal to the Florida Supreme Court, and we withdrew our motion for costs," FPL's attorney, Alvin Davis of Steel, Hector & Davis in Miami, said in an interview. "We're very pleased that it's finally resolved."

"It was a very difficult decision," Talenfeld told *Microwave News,* "because we believe that this case would've made a difference." But Talenfeld does not expect the EMF controversy to fade from the courtroom: "This is a battle that'll be going on for many years to come. Look at the tobacco companies—they've denied for 30 years that their product causes cancer."

Glazer's wife, Elsa, died of chronic myelogenous leukemia (CML) in 1988. In 1992, Leonard Glazer was also diagnosed with CML; he filed the lawsuit in January 1994. Several power lines ran across the Glazers' property, where they had lived since 1969 (see *MWN,* J/F94, M/J94 and S/O95). But most of the EMFs in their home were due to ground currents flowing through the household plumbing system. In May 1996, FPL convinced a circuit court judge that ground currents were not their responsibility, and he dismissed the case (see *MWN,* M/J96; also J/F97). Glazer then appealed to the state Supreme Court. At the time he decided to end his suit, the Supreme Court had not yet indicated whether it would hear the case.

Deteriorating health was also cited in Nancy Jordan's decision to withdraw her suit against Georgia Power Co. and Oglethorpe Power Co. "Mrs. Jordan has developed much more serious cancer," attorney Bruce DeBoskey of Silver & DeBoskey in Denver told *Microwave News.* "Sadly, we felt she didn't have the emotional or physical strength to go through another trial."

DeBoskey noted that the cancer now threatening Jordan's life was not at issue in the lawsuit. "It's breast cancer, and it preceded her EMF exposure," he said. "It was in remission but unfortunately it came back. Only her subsequent development of non-Hodgkin's lymphoma was related to the EMFs."

"The suit was withdrawn at Jordan's request, and there was no settlement," said David Mould, spokesperson for Georgia Power in Atlanta. "I don't think we will have any comment beyond that."

Jordan developed lymphoma in 1989 and filed suit in 1991. In 1994, a jury returned a verdict in favor of the utilities—although jurors' comments indicated they would have gone the other way had the case involved childhood, rather than adult, leukemia (see *MWN,* S/O91, S/O93 and M/J94). A Georgia appeals court threw out the jury's decision and ordered a new trial, on the grounds that the lower court judge had allowed improper testimony (see *MWN,* J/F96 and N/D96). But Jordan withdrew her lawsuit on May 20 before the new trial had begun.

some strong opposing views. "It's baffling how any epidemiologist could look at the data in the NCI paper and say it is dead negative," argued Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA.

The principal investigators on the three previous childhood EMF–cancer studies in the U.S. also disagree, to various degrees, with the NCI's interpretation of the measured field findings. "The NCI study should not be viewed as a negative study," said Dr. Nancy Wertheimer, "since it reports a significant positive result exactly where one might expect to see such a positive finding—at the high end of the measurement data they collected with such care." In 1979, Wertheimer and Ed Leeper first reported that children living near high-current electrical wiring (classified by a system of wire codes) had higher cancer rates.

Linet and coworkers report a nonsignificant 24%-53% increase in leukemia among those children exposed to 2 mG or higher. For exposures of 3 mG or above, the risk rises to 72% and is statistically significant.

"The NCI study is suggestively positive for measured fields," said Dr. David Savitz of the University of North Carolina, Chapel Hill, who replicated the Wertheimer-Leeper study in 1986 (see *MWN,* N/D86). He added that, "If 3 mG were the cutoff point, this study could be seen as a positive study."

On the other hand, Dr. Dimitrios Trichopoulos of the Harvard School of Public Health in Boston told *Microwave News* that, "The [3 mG] result in itself would have been significant, but it is an isolated finding because all previous studies have been dead negative with respect to measured magnetic fields." Trichopoulos added that, "This very important study goes as far as possible in epidemiology to indicate that there is no link between childhood leukemia and magnetic fields."

In a 1993 reanalysis of the 1986 Savitz data, Savitz and Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, found that by shifting the cutoff point from 2 mG to 3 mG, the relative risk of ALL jumped from 1.6 to 5.3 and achieved statistical significance, albeit with only a very small number of cases. They concluded that, "Future studies should seek subject populations with a greater proportion of subjects" with exposures above 3 mG.

Indeed, the NCI had 45 cases and 28 controls with exposures of 3 mG or higher. Savitz had only 3 cases above 3 mG. In a letter to the *New England Journal,* Wartenberg notes that the NCI's numbers over 3 mG "are statistically robust and rarely considered small in epidemiology."

"There was not a lot of power to look over 3 mG," commented Dr. Robert Hoover, the director of the NCI's epidemiology and biostatistics program, "If the *a priori* hypothesis had been over 3 mG, you would have done a different study."

The NCI's view that there is no dose-response data for measured fields has also been challenged (see p.11). "The data are indicative of a trend," Dr. Anders Ahlbom of the Karolinska Institute in Stockholm, Sweden, told *Microwave News.* In 1992, Ahlbom and Dr. Maria Feychting, also of the Karolinska Institute, reported an association between calculated historical magnetic fields and childhood leukemia; they also found a dose-response relationship (see p.12 and *MWN,* S/O92).

"This study conclusively shows no wire code risk," said Linet, referring to the system first devised by Wertheimer and Leeper to categorize homes according to their proximity to different types of power lines.

"I see this as a negative study for wire codes and as an ambiguous study for measurements," said Dr. Stephanie London of the National Institute of Environmental Health Sciences (NIEHS) in Research Triangle Park, NC. In 1991, London and Dr. John

A Different Story in Germany: Measured EMFs Linked to Leukemia in Kids

Just prior to the release of the NCI study, German researchers announced new evidence linking EMFs and childhood leukemia.

At the June *World Congress* (see p.2), Dr. Joachim Schüz presented an analysis of 176 cases and 414 controls in Berlin and Lower Saxony, conducted along with Dr. Jörg Michaelis and other colleagues at the Institute of Medical Statistics and Documentation at the University of Mainz.

Schüz reported that children with a median 24-hour exposure above 2 mG were more than twice as likely to develop leukemia as children with lower exposures. Children under four years old with such exposures had a sevenfold increased risk. Children with high nighttime exposures were almost four times more likely than others to get the disease.

In June 1996, Michaelis presented results from Lower Saxony at the Bioelectromagnetics Society conference in Victoria, Canada. At the time, he emphasized the data's limitations and the lack of statistical significance of the initial findings. Asked about the different tone of this year's presentation, Schüz told *Microwave News,* "We changed our minds." He explained that with the addition of data from Berlin, the picture became clearer.

Increased risks for younger children and for those with high nighttime exposures showed up in both the Berlin and Lower Saxony data. In the combined analysis, these odds ratios become more significant. The researchers suggest that these measurements "may reflect the actual exposure best." They note that "very young children are more likely to be at home full-time," and that overnight bedroom measurements would closely track the exposure of a sleeping child.

The Lower Saxony data were recently published in *Cancer Causes and Control (8,* pp.167-174, 1997), while the combined analysis will appear in *Epidemiology* in November.

"Spot measurements were *not* related to childhood cancer," Schüz said in an interview, contrasting them with the 24-hour and overnight averages. Wire codes were not used, he explained, since they do not apply to the German power system. Almost all measurements were taken within five years of diagnosis.

Schüz cautioned that the reported associations were based on small numbers and often emerged from *post hoc* analyses. Very few subjects had high-EMF exposures, and a nationwide study with greater statistical power is under way.

The combined data "lend some support" to the link between EMFs and childhood leukemia, Schüz and his colleagues conclude. But they estimate that only 2%-4% of German childhood leukemia cases might be attributable to EMFs.

One Tail or Two?
A Tale of Statistical Significance and Dose-Response

The NCI team says that it found "no evidence" of a dose-response relationship between magnetic field exposures and childhood leukemia. Others are not so sure.

Dr. Richard Stevens, an epidemiologist at Battelle in Richland, WA, contends that if the NCI had applied a more appropriate statistical test, a significant dose-response relationship would have become apparent. In a letter submitted to the *New England Journal of Medicine* in early July, he concludes that the use of a single-tail, instead of a two-tail, trend test would "substantively change" the message of the NCI paper.

Stevens is not alone. "A one-tail test would be appropriate," Dr. Raymond Neutra of the California EMF Program said in an interview. Dr. Robert Tarone, who led the statistical analysis of the NCI data, is holding his ground. "It is absolutely conventional to do a two-tail test," he told *Microwave News*.

All this may appear to be esoteric, but the interpretation of the NCI study hangs in the balance. Dose-response is widely seen as a necessary condition for an association to be judged as reliable. For example, Dr. Charles Stevens of the Salk Institute in La Jolla, CA, told the *New York Times* (July 3), "If you can't find a dose-response, you can't believe it."

At issue are the assumptions that go into the selection of the statistical tests that show whether an association or, in this case, a trend is deemed to be reliable or due to chance. Many outcomes of a study are possible, with some more probable than others. By convention, if a result is estimated to occur less than 5% of the time by chance alone, it is called statistically significant.

The tails refer to the two ends of a standard bell curve—the least likely of all the various possible outcomes of a given study. If it is assumed that magnetic fields are not related to leukemia, then one tail is consistent with promotion of cancer, and the other tail with protection against cancer.

Using a two-tail test, the NCI found that the observed dose-re-sponse relationship between measured magnetic fields and childhood leukemia would occur only 9% of the time by chance—a little short of the standard 5% criterion.

Richard Stevens argues that the NCI study was designed to test only the hypothesis that magnetic fields increase the risk of childhood leukemia. It did not ask whether magnetic fields can increase *or* decrease childhood leukemia. If only a deleterious effect is to be considered, then a one-tail, rather than a two-tail, test is appropriate.

"The authors' *a priori* hypothesis was that risk would increase with increasing exposure," wrote Richard Stevens. And when he applied a one-tail test, he found that the dose-response relationship reached statistical significance, occurring only 4.5% of the time by chance.

Tarone countered that if he were looking into the effects of tobacco smoke, then he might favor a one-tail test because there is no doubt about the negative effects of smoking. But for EMFs, he added, "there is no controversy": A two-tail test is the only way to go.

"I would have probably used a two-tail test," said Dr. Eugene Sobel, a biostatistician at the University of Southern California in Los Angeles, who worked on the London-Peters EMF–childhood leukemia study. But, he allowed, "You can make an argument that EMFs from power lines can't possibly be beneficial and therefore favor a one-tail test."

Dr. Stephanie London, now at the NIEHS, commented that, "It is a very strong convention to use a two-tail test, but there is some justification for the use of a one-tail test."

Dr. Christopher Portier, the chief of the NIEHS' Laboratory of Computational Biology and Risk Analysis, acknowledged that a one-tail test "would likely" increase the chance that the observed dose-response relationship would occur less than 5% of the time. But Portier declined to take sides, saying that, "This is a judgment call left to the original authors, whose names must appear on their work."

Peters of the University of Southern California in Los Angeles also found an association between wire codes and childhood leukemia—the third study in the U.S. to produce such a finding (see *MWN,* M/A91 and S/O91).

The wire code result surprised many observers, especially because a report by a National Academy of Sciences-National Research Council (NAS–NRC) committee concluded last year that, "The link between wire code rating and childhood leukemia is statistically significant (unlikely to have arisen from chance) and is robust" (see *MWN,* N/D96).

"I was amazed when I first saw there was no association with wire codes," said Dr. William Kaune, a consultant based in Richland, WA, who led the NCI's exposure assessment effort.

But Wertheimer and Leeper suggest that the NCI team failed to verify the applicability of their wire code before using it for homes in nine different states. "Inadequate tailoring of the W/L code to the various NCI locales is a likely explanation of the discordant results for wire codes and measurements," they state (see p.12; also p.14 for Kaune's response).

In addition, Dr. Raymond Neutra, the head of the California EMF Program, argued that, "The power of the NCI study is insufficient to settle the wire code issue because it cannot rule out a 50% increase in cancer risk, the value estimated by the NAS–NRC report."

Nevertheless, Dr. Robert Tarone, the chief of the NCI's statistical research and applications section and one of Linet's co-authors, said that, "The main result [of our study] is that of the wire code because the wire codes have been driving this controversy for a long time." Tarone added that, "We cannot say that there is nothing going on at higher exposure levels. I don't know if that will ever be resolved."

The strengths of the NCI study include the large number of cases and controls (629 and 619, respectively) and the relatively short time between a child's leukemia diagnosis and the measurement of residential magnetic fields. In most cases, the fields were measured within 24 months of diagnosis.

Dr. Clark Heath of the American Cancer Society in Atlanta called the study "extraordinarily well done." He told the *Los*

Angeles Times (July 3) that it makes "a strong statement about the lack of association" between power lines and leukemia in children.

For his part, Neutra draws a parallel between the short interval from diagnosis to measurement and the use of calculated historical fields by Ahlbom and Feychting. In a letter submitted to the *New England Journal of Medicine,* Neutra notes that, "Linet's real qualitative advance was to measure within two years of diagnosis. Perhaps this is why she came almost as close as the Swedes at showing a direct EMF measurement effect."

At least two meta-analyses of EMF–childhood cancer studies are planned. On July 14, the NIEHS sought proposals for a meta-analysis that includes the NCI data. "The idea is to have the most up-to-date analysis possible" for the epidemiological review planned for the final report on the EMF research program known as RAPID, said the NIEHS' Dr. Christopher Portier.

Neutra has also asked Wartenberg, who did the meta-analysis for the NAS–NRC study, to repeat it for the California EMF Program with the NCI results included. "My preliminary analysis shows that the odds ratio for an association between wire codes and leukemia goes down but is still statistically significant, while the odds ratio for measured fields increases but is still not statistically significant. In short, including the data from this additional study does not change the qualitative conclusions from the meta-analysis done for the NAS–NRC report," Wartenberg told *Microwave News.*

A committee on epidemiology of the International Commission on Non-Ionizing Radiation Protection, chaired by Ahlbom, is preparing an evaluation of the NCI paper.

The *New England Journal* editorial, by Deputy Editor Dr. Edward Campion, called for an end to EMF studies. "It is time to stop wasting our research resources. We should redirect them to research that will be able to discover the true biologic causes of [childhood leukemia]."

Linet would not endorse this view. She and the NCI's Hoover are waiting for the two other major EMF–childhood leukemia studies, under way in the U.K. and Canada, before reaching a final verdict. If these were negative, said Hoover, "it would personally convince me it was time to stop."

Dr. Lawrence Fischer of Michigan State University in East Lansing, chair of the NCI's advisory committee, agrees with Campion. "This study tips the scale," he said, "Exposure to magnetic fields is not a major, and probably not even a minor, cause of cancer." He added that it would be "more productive" to pursue other avenues of research.

Some are worried that the NCI paper and the editorial might make it difficult to finish ongoing studies. "There is no question that the coverage of this study will have a chilling effect on further research," said the NIEHS' London, who is currently at work on an epidemiological study of EMFs and breast cancer.

EMF Exposure at Both Home and Work Raises Leukemia Risk

Epidemiological studies of adult EMF exposure and cancer face a serious problem: Adults divide their time between home and work, and may have high exposures in the place not under study. This can lead to classifying people as "unexposed" who may, in fact, be exposed—thus diluting the apparent risk.

A new Swedish study examines this problem and finds that adults with high EMF exposures in both home and workplace had the greatest risk of leukemia—a risk between three and four times as high as those with low exposures in both locations.

In the July issue of *Epidemiology (8,* pp.384-389, 1997), Dr. Maria Feychting, Dr. Birgitta Floderus and Ulla Forssén, all of the Karolinska Institute in Stockholm, Sweden, report that adults with residential exposures over 2 mG faced a leukemia risk 30% higher than those with low residential exposures. The one-quarter of adults with the highest workplace exposures faced a risk 70% higher than the one-quarter with the lowest exposures on the job. People with high exposures both at home *and* at work faced the highest risk of all: They were 3.7 times more likely to develop leukemia than people who were unexposed in both places, a statistically significant finding.

The researchers did not find an excess risk of brain tumors, which several other occupational studies have linked to EMFs. Their study combined data from Feychting's large-scale residential study (see *MWN,* S/O92) and exposure assessment from Floderus's major workplace study (see p.16).

An Exchange on the Use of Wire Codes in the NCI Study

Microwave News *asked Dr. Nancy Wertheimer and Ed Leeper to comment on the wire code results in the NCI study and then offered Dr. William Kaune, a coauthor of the NCI study who led the team's exposure assessment effort, an opportunity to respond. Here are their comments.*

Wertheimer and Leeper

The Wertheimer-Leeper (W/L) wire code was designed to estimate magnetic field exposures in Denver during the 1950s and 1960s, and one should not expect it to work well for other locales and times—as we pointed out in a memo[1] circulated in 1986, as well as in a 1991 article[2] and in numerous verbal communications before and since then. This caveat certainly applies to the National Cancer Institute's (NCI) goal of discerning any modest but real risk that may have existed for the 816 children whose 1980s-1990s homes were wire-coded in dozens of different areas in nine states.

In devising the W/L code, we made hundreds of measurements at or near homes and power lines that were representative of our study locale—thus designing our code to discern homes with unusually high fields *in old Denver.* (In our published measurement tables, we always used the percent over 0.3 ∝T [3 mG] to illustrate the degree to which a wire code or power line indicated "high" fields.)

The W/L code does have features that will result in a *rough* association with measured fields anywhere in the U.S. We cannot say how "rough" that association is in the NCI study (since data on that subject are not being released at this critical time). However, the NCI's own pilot work, used to determine their exposure assessment protocol,[3] re-

ports that measurement variability within wire code categories was "sufficiently large that the code could not be considered to be an effective predictor of children's contemporaneous...exposures." (Furthermore, even if wire codes and measurements *are,* broadly speaking, "well correlated," they can yield entirely different estimates of cancer risk when the risk level occurs in the high tail of the distribution.[4])

In old Denver, most homes had good conductive current-return paths in the plumbing, open rather than spun secondaries, wires running in the backyard and wye-connected primaries that had three phases where, and only where, large current loads would be expected. Each of these details carries implications about the type, intensity and variability of magnetic field exposures in nearby homes. In other regions and times with different wiring and plumbing practices, constructing new coding systems taking account of some of these factors has generally produced both a stronger association with measured fields and clearer evidence of a cancer risk.[2,5,6,7]

To produce valid coding for all the NCI locales, site-specific variations like these would have to be taken into account. This problem was discussed at a 1989 meeting convened by the Electric Power Research Institute (EPRI) to help NCI researchers and others determine how best to assess exposures for their studies. At that time, the general consensus was that constructing "tailored" wire codes for all areas would be prohibitively time-consuming.

Instead, the "gold standard" favored for assessing exposures was the time-weighted average field measured by a dosimeter worn by the child being assessed. That standard was used in the pilot study that guided how the NCI *measurement* data were to be gathered and used.[3] Thus, the measurement data—which gave positive results in the NCI report—were the data presumed *a priori* to be most trustworthy; and the W/L wire code—which gave negative results—was recognized *a priori* to be flawed for use in this geographically wide-ranging study.

But if we understand that one may expect the W/L code to perform poorly in a mixed bag of other locales, we must ask why the W/L code *did* seem to be a fair indicator of magnetic field levels—and leukemia risk—in the Los Angeles leukemia study.[8] The answer probably lies mainly in the fact that the *wye vs. delta* variable, a major factor that should have been included in any wire code properly tailored to the Los Angeles area (where both types of primary are used), just happened to be associated with our W/L code in Los Angeles. (The relatively high-field wye-connected primaries were seen about twice as often at homes with high W/L codes as at homes with low codes.[9]) To a considerable degree, the significant overall trend associating increased cancer risk with W/L wire codes appears to be due to this fortuitous association.[10]

Fortunately, the Los Angeles researchers constructed their own area-specific field predictor, results of which have been published thus far only in their 1991 and 1995 EPRI reports.[6,7] That improved field predictor did not produce a stronger risk trend over the *entire range* of predicted fields, but it did yield a significant (twofold) risk estimate for the *highest* field estimates analyzed, while the W/L code did not. This finding provides more reliable evidence of a leukemia risk associated with high magnetic fields in Los Angeles than can the somewhat confusing association with the Denver-based W/L codes.

Interestingly, the Feychting-Ahlbom study[11] also provides good evidence that the better a surrogate predicts high magnetic fields, the better it predicts cancer risk. Their surrogate, which calculated historical magnetic field levels, did an excellent job of predicting high fields at single-family houses, but a mediocre job of predicting them at apartment houses. Using that surrogate, they found clear evidence of cancer risk at the former, but none at the latter.

Thus, inadequate tailoring of the W/L code to the various NCI locales is a likely explanation of the discordant results for wire codes and measurements in that study, though it is not the only one: Other possible explanations may become evident when data are provided on how the modest number of high-field ($\geq 0.3\ \propto T$) homes retained in the wire-

What They Are Saying

"Overall, I believe this study demonstrates that exposure to electromagnetic fields does not increase a child's risk of leukemia."

—Dr. Leslie Robison, University of Minnesota and a coauthor of the NCI study, quoted by Steve Sternberg in "Power Lines Not a Cancer Risk for Kids," *USA Today,* July 3-6, 1997

"Parents would be well advised to take the National Cancer Institute's evaluations with a grain of salt and take steps to insure that their children are not exposed to high levels of EMF[s]. This latest study clearly shows that it is hazardous for children to live in homes near power lines giving off strong electromagnetic fields. Don't allow government officials, or anyone else, to make test animals of your children."

—Paul Brodeur, quoted in a press statement issued by the EMR Alliance in New York City, July 2, 1997

This study adds important information but does not resolve the issue of whether residential magnetic field exposures or wire codes are associated with childhood ALL.

—Electric Power Research Institute, Palo Alto, CA, comments on the NCI study, July 1997

"As we approach the new millennium, pieces of the puzzle are being put together so that people alarmed by EMF scares are getting the sound science they need to assuage their concerns."

—David Swanson, senior vice president of energy and environmental activities, Edison Electric Institute (EEI) in Washington, DC, quoted in an EEI press release, July 2, 1997

Any statement claiming the demise of the EMF and cancer issue should be based on an analysis of all the available data and not one study, particularly one in which the reported data are apparently not reflected in the conclusions.

—Dr. Kjell Hansson Mild, National Institute for Working Life, Umeå, Sweden; Cindy Sage, Sage Associates, Santa Barbara, CA; and Dr. Bary Wilson, Battelle Pacific Northwest Labs, Richland, WA, in a press release from the *1st World Conference on Breast Cancer* (Canada), July 15, 1997

This study will be announced as "negative" and calling for [an] end to funded EMF research. This is NOT correct!!! It actually acknowledges, in no less than four places, a statistically significant increase in acute lymphoblastic leukemia (ALL) in children exposed to power line magnetic fields in excess of 3 mG, finding almost twice (1.72 times) the number of expected cases.

—Powerwatch Network, Sutton, U.K., press release, July 2, 1997

"The best, strongest study so far," and one that may hasten the day when an incontestable accumulation of negative results means that "at some point, we're going to have to say there's no risk."

—Dr. Jerry Williams, Johns Hopkins Oncology Center in Baltimore, quoted by Curt Suplee in "No Greater Cancer Risk Is Found in Children Living Near Power Lines," *Washington Post,* July 3, 1997

EMF: THEY SAY IT'S NOT OVER TILL IT'S OVER—WELL, IT'S OVER

—Headline from *What's New by Dr. Robert Park,* Internet newsletter, American Physical Society, July 3, 1997

coded sample were distributed over the wire code categories; and how both measurements and wire codes were distributed over different locales and demographic groups.

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8. S. London et al., "Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia," *American Journal of Epidemiology (AJE), 134,* pp.923-937, 1991.
9. See Table II-6 in reference 6.
10. See Table III-5 in reference 6.
11. M. Feychting and A. Ahlbom, *Magnetic Fields and Cancer in People Residing Near Swedish High-Voltage Power Lines,* Stockholm, Sweden: Karolinska Institute, Institute of Environmental Medicine, 1992. See also M. Feychting and A. Ahlbom, "Magnetic Fields and Cancer in Children Residing near Swedish High-Voltage Power Lines," *AJE, 138,* pp.467-481, 1993.

Kaune Replies

The exposure assessment protocol for the NCI's study of childhood leukemia and exposure to residential magnetic fields was developed in 1989 and 1990. At that time, the main guides for this development were the 1979 W/L[1] and the 1988 Savitz[2] studies. One question that came up early in the design process was whether to include wire coding using the W/L system.[1,3] At that time, it seemed to us almost unthinkable to undertake a new study of childhood leukemia and magnetic-field exposure in the U.S. without including wire coding, because the strongest findings of previous studies[1,2] were associations between childhood leukemia and this very measure of exposure.

By 1989, Wertheimer and Leeper had already argued in several venues that it was inappropriate simply to apply their wire coding system to other areas of the U.S. without "tuning" it for local wiring and plumbing practices. Since the geographical area covered by the NCI study was served by more than 200 electric utility companies, we concluded that it was not feasible to carry out this prescription. However, by 1989, we knew that the W/L wire coding system was being used in Los Angeles without modification.[4] (This study subsequently reported a significant association between childhood leukemia and wire codes, in an area with wiring practices substantially *different* from those used in Denver.) We thus decided to include unmodified W/L coding in a pilot study that we performed in 1990 to provide data to guide the design of the final exposure assessment protocol for the NCI study. This study, conducted in the greater metropolitan Washington, DC, area, provided evidence of an association between contemporaneously measured magnetic fields and wire codes.[5] When this result was combined with other observations of associations between wire codes and measured magnetic fields in Denver[6] and Seattle,[7] it appeared to us that the unmodified W/L wire coding system might be a rather geographically robust surrogate for residential magnetic fields. Based on these results, we decided to include wire codes in the exposure assessment protocol used in the full NCI study.

Data published after 1990 provided additional evidence for our hypothesis that W/L wire codes were associated with contemporaneously measured magnetic fields over a broad geographical area. In the Los Angeles study mentioned earlier, an association was found between wire codes and measured fields.[4] Zaffanella[8] examined a sample of 991 homes that spanned the entire U.S. and observed a clear relation between measured residential magnetic fields and wire codes. And, Bracken[9] studied 396 residences occupied by employees of 39 U.S. electric utility companies and also observed an association between wire codes and measured magnetic fields. Indeed, I can think of no study in the U.S. that has examined wire codes and magnetic fields and has *failed* to find an association between them.

My colleagues and I have also examined the NCI data to ascertain the relation between magnetic fields and wire codes. A paper reporting these results is currently undergoing journal review. All I can say at this time is that we observe a relation between wire codes and contemporaneously measured magnetic fields similar to those observed in other studies. Even so, it is possible that wire codes were a less effective surrogate for contemporaneously measured (and historical) magnetic fields in the area covered by the NCI study than in Denver, so perhaps we should have observed an association between childhood ALL and residential wire codes somewhat reduced in strength compared to that observed in Denver. However, in actual fact, the NCI study[10] found *no relation whatsoever* between childhood ALL and residential wire codes.

These observations lead me to seriously doubt that the wholly negative wire code results of the NCI study can be explained by the failure of wire codes to be a surrogate for residential magnetic field exposure in the geographical area of the study.

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5. W.Kaune et al., "Development of a Protocol for Assessing Time-Weighted-Average Exposures of Young Children to Power-Frequency Magnetic Fields," *Bioelectromagnetics, 15,* pp.33-51, 1994.
6. F. Barnes et al., "Use of Wiring Configuration and Wiring Codes for Estimating Externally Generated Electric and Magnetic Fields," *Bioelectromagnetics, 10,* pp.13-21, 1989.
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9. T. Bracken et al., *The EMDEX Project: Residential Study, Vol.1: Summary,* EPRI, Report No.TR-104325-V1, 1994.
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FROM THE FIELD

Letter to the Editor

July 16, 1997

To the Editor:

Despite the suggestion in *Microwave News* (M/J97), there has been no industry cover-up in the publication of the results of the study by Repacholi et al., "Lymphomas in E∝-*Pim1* Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields," first published in *Radiation Research (147,* pp.631-640, May 1997).

Indeed at the time of publication, the researchers ensured that they were available to comment on the results of the research, and to put it into its proper context. It is regrettable that a few observers have questioned the integrity of some of Australia's leading researchers and cancer specialists by alleging that they would engage in a cover-up on behalf of industry.

Telstra was not given access to the results until the paper had been peer-reviewed and accepted for publication. And in keeping with the wishes of the researchers, Telstra kept the results confidential until the journal was published.

The Royal Adelaide Hospital chose to publicize the research findings with a video conference held in Adelaide, not Sydney. The hospital arranged the video conference, including the invitation list. Telstra did not fund or stage the video conference and it did not have transcripts. A simple phone call to Telstra or the Royal Adelaide Hospital would have made these facts clear to *Microwave News*. Telstra issued only a media release and provided a copy to *Microwave News*.

To ensure the independence of the research findings, Telstra referred all inquiries from members of the public and media to the Oversight Committee, which carried out the research.

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On hearing of the video press conference in Adelaide, we faxed Kerrina Lawrence in Telstra's communications office, asking if a transcript was available, and if so, how we could obtain a copy. Lawrence had responded to our earlier request for a copy of the Telstra press release on the Repacholi mouse study. But, this time, we never heard back from her.

Clippings from All Over

[A] disquieting trend. Call it the "whoops factor," a phenomenon that starts with shoddy research or the misinterpretation of solid research, moves on quickly to public outcry, segues swiftly into the enactment of new laws or regulations and often ends with news organizations and some public policy mavens sounding like the late Gilda Radner's character Emily Litella as they sheepishly chirp, "Never mind!" The public has been buffeted by reports suggesting a campaign to torch black churches, a surge in juvenile crime, rampant child abuse in day-care centers, a rape crisis on college campuses and the continued poisoning of the country by cancer-causing chemicals like alar, saccharin or cyclamates or by electromagnetic forces emanating from high-voltage power lines.

—Steven Holmes, "It's Awful! It's Terrible! It's...Never Mind," ***New York Times,*** **Week in Review, p.3, July 6, 1997 (see p.1)**

"When in doubt, obfuscate."

—Ron Nessen, former press secretary for President Gerald Ford and, more recently, vice president for communications and public affairs at the CTIA, quoted by Al Kamen in "Some Submit to Washington—And Win," ***Washington Post,*** **p.A17, June 30, 1997**

[T]he Air Force's Armstrong Laboratory at Brooks Air Force Base in Texas is heavily engaged in [RF antipersonnel weapons] research. According to budget documents, the lab intends to spend more than $110 million over the next six years "to exploit less-than-lethal biological effects of electromagnetic radiation for Air Force security, peacekeeping, and war-fighting operations."

—Douglas Pasternak, "Wonder Weapons: The Pentagon's Quest for Nonlethal Arms Is Amazing. But Is It Smart?" ***U.S. News & World Report,*** **p.45, July 7, 1997**

In my view it is totally irresponsible to position a cellular antenna near a site where young children spend significant periods of time. While I am not saying that the association between these exposures and childhood cancer is proven beyond any shadow of doubt, I do see the evidence to be suggestive. When children's health is concerned, I strongly feel that our society must be cautious...

—Dr. David Carpenter, dean of the School of Public Health at the State University of New York, Albany, in a letter to the Planning Commission and City Council of San Rafael, CA, June 13, 1997

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• Dr. Samuel Milham Jr. finds a link between occupational exposure to EMFs and elevated leukemia rates among workers in Washington state—the first time such an association is reported.

• A plan to extend a highway under the Omega radio navigational antenna on Oahu, HI, leads to public concerns over shock hazard and interference with pacemakers.

• Attendees of the BEMS conference express concern that severe cuts in spending on EMF research could imperil their research and lead to the dissolution of the society.

Years 10 Ago

• The New York State Power Lines Project issues its final report, estimating that 10%-15% of childhood cancers could be linked to EMFs.

• Researchers at the Swedish University of Agricultural Sciences in Uppsala find that exposure to VDT-type radiation increases the incidence of miscarriages and resorptions in pregnant mice.

• Scientists in Sweden and the U.K. challenge the finding that aqueous solutions of DNA can absorb 1-10 GHz microwaves.

Years 5 Ago

• Dr. Keith Florig of Resources for the Future in Washington estimates that concerns over EMFs are costing over $1 billion per year.

• Dr. Dana Loomis of the University of North Carolina, Chapel Hill, notes a doubling of male breast cancer rates among electrical workers under 65, but he also sees a decrease in the rates among older workers.

• At the *1st World Congress for EMFs in Biology and Medicine,* the Army and the Air Force spar over the adequacy of the ANSI/IEEE RF/MW exposure standard.

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UPDATES

DIGITAL TELEVISION

Sutro Tower EIR... Digital television (DTV) broadcasting is just a year away, and Sutro Tower will be the site of the new antennas in San Francisco. The effect on the area around the 977-foot tower, which now has transmitters for ten TV stations and four FM radio stations, is the subject of a draft environmental impact report (EIR) prepared by Sutro Tower Inc. and the city's public health and planning departments. According to an appendix on bioeffects, the DTV signal will operate at frequencies of 494-758 MHz, with a pilot tone at 12.9 kHz. The "signals are distinct from all signal types used in health-related research," write the appendix's authors, consultants Dr. Peter Polson of Cupertino, CA, and Louis Heynick of Palo Alto, CA. Drs. Asher Sheppard, a consultant based in Redlands, CA, and C.K. Chou of the City of Hope National Medical Center in Duarte, CA, also contributed to the bioeffects review. A second appendix, by San Francisco-based consulting engineers Hammett & Edison Inc. (H&E), states that each of the ten DTV stations that will be broadcasting from the site will have an average effective radiated power (ERP) of 500 kW. While Polson and Heynick estimate that the overall ERP from DTV will be about one-eighth of that from current TV transmitters, the two TV formats will broadcast simultaneously for at least nine years, leading to an anticipated 12% increase in ambient power densities. H&E calculates that the maximum RF power density will be 14.3% of the FCC standard, at a distance about 300 feet from the tower. The nearest residence is 250 feet from the base and 800 feet from the closest antenna. The draft was discussed at a public hearing on July 24. Comments will be accepted until August 11.

ELECTROMAGNETIC INTERFERENCE

Baby Broadcasts to Air Traffic Control... It seemed like a nice thing to do for the mother-in-law. The father of a Baltimore infant tinkered with a baby monitor to increase the power of its transmitter, so that the child's grandmother could listen in from her own home some distance away. But grandma was not the only one who could hear the baby's gurgles and cries. Pilots landing at the Baltimore-Washington International Airport picked up the signals, too, which interfered with communications with air traffic control. The incident was described in a Knight-Ridder dispatch published in the July 3 *Seattle Times*. The article noted that the FAA is encountering more and more such incidents, as the number and variety of wireless communications devices continue to grow.

EPIDEMIOLOGY

Testicular Cancer on the Job... Men with higher occupational EMF exposures were more likely to develop testicular cancer than were those in jobs with lower exposures, according to a new Swedish study. "The results for testicular cancer gave some support to the hypothesis of a hormonal link between [EMFs] and cancer," write Drs. Carin Stenlund and Birgitta Floderus, both of the Karolinska Institute in Stockholm. The 25% of men with the highest exposures were compared with the 25% with the lowest exposures: Their risk of testicular cancer was about

one-third greater. The 10% of men with the very highest exposures had an even greater risk, more than twice that of the 25% with the lowest exposures. Testicular cancer is most common among men under 40, and the study found that EMF exposure elevated that risk. In this age group, the 25% and the 10% with the highest exposures were twice and four times as likely, respectively, to get the disease as were those with the lowest exposures. Stenlund and Floderus conclude that their results are "in accordance with an exposure-response relationship," and that this trend is statistically significant. Exposure assessment was based on an earlier landmark occupational study, by a team led by Floderus (see *MWN,* S/O92 and S/O93). Very few studies have examined EMFs and testicular cancer. Stenlund and Floderus cite only two, neither of which found evidence for an association. Their paper, which appears in *Cancer Causes and Control (8,* pp.184-191, 1997), also analyzes male breast cancer risks, which a number of other epidemiological studies have linked to occupational EMFs. (See, for example, *MWN,* N/D93 and M/J 94.) Stenlund and Floderus's data do not support a male breast cancer connection. They note that "the possibility of an association cannot be rejected due to the limited numbers and limitations regarding the exposure assessment." (For coverage of testicular cancer and police radar, see *MWN,* J/A93.)

MEDICAL DEVICES

EBI Loses $150 Million Suit... In June, EBI Medical Systems Inc., a leader in EMF bone-growth stimulators, lost a $150 million judgment to Orthofix International in a breach-of-contract lawsuit. Orthofix, which is based in Curaçao, had had an arrangement with EBI to distribute its own device in the U.S. The unit—called an external fixator—is used to treat fractures without the application of EMFs. Orthofix claimed that while their agreement was in force, EBI was stockpiling—instead of selling—Orthofix products and at the same time was developing a competing device. A jury at the U.S. District Court in Camden, NJ, awarded Orthofix nearly $49 million in compensatory damages plus more than $100 million in punitive damages. EBI, based in Parsippany, NJ, filed counterclaims, which apparently did not impress the court. While the jury decided in favor of EBI on some of these, it awarded EBI a total of $2.00. "We are astounded by the jury's decision," said Dane Miller, president of Biomet Inc., EBI's parent company. Biomet plans to appeal the decision.

Single-Coil OrthoLogic Unit Approved... OrthoLogic Corp.—EBI's primary competitor in the EMF bone-growth stimulator market—has received U.S. FDA approval for a variation on its model 1000 unit. The new device uses the same technology but relies on one coil, instead of two, to generate the fields. "The purpose of the single-coil device is to be able to treat harder-to-reach areas like the hips and hands," Dr. James Koeneman, the company's vice president for engineering, told *Microwave News.* Last year, OrthoLogic had to retract marketing claims for the original model 1000 that the FDA called "misleading" (see *MWN,* J/A96 and S/O96). Dr. Allan Weinstein, OrthoLogic's chairman, has not yet named a replacement for George Oram, who this spring stepped down as president of the Phoenix-based company (see *MWN,* M/J97).

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Wall Street Journal, April 28, 1995

MWN

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Sydney Morning Herald (Australia), December 10, 1996

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MEETINGS

Beneficial Effects of Magnetic Fields... The Lawson Research Institute (LRI) in London, Ontario, Canada, will host a symposium November 14-16 on *Magnetic Fields: Recent Advances in Diagnosis and Therapy,* to be held at the LRI and at the London Convention Center. Saturday, November 15, is devoted to *The Therapeutic Uses of Magnetic Fields*. "The session is for those who believe that ELF magnetic field effects at levels on the order of 1 G can have effects and who are interested in how they can be used for beneficial purposes," the LRI's Dr. Frank Prato, one of the organizers of Saturday's session, told *Microwave News.* The other two days will feature talks on magnetic resonance imaging and spectroscopy and on near-infrared spectroscopy, both the technologies and their applications. The LRI is affiliated with St. Joseph's Health Center and the University of Western Ontario. For more information, contact: Liana Heaney, LRI, Rm. H410, St. Joseph's Health Center, 268 Grosvenor St., London, ONT N6A 4V2, Canada, (519) 646-6100 ext.4530, Fax: (519) 646-6110, E-mail: <lianah@stj.stjosephs.london.on.ca>, Web site: <www.stjosephs.london.on.ca/LRI/bemw>.

PEOPLE

Lawrence Weinstock is the new acting director of the EPA's Office of Radiation and Indoor Air (ORIA) in Washington. Weinstock previously headed the office's Radiation Protection Division. **Ramona Trovato**, the former head of ORIA, is now the director of the newly created Office of Children's Health Protection at the EPA....The Bioelectromagnetics Society has elected Dr. **Betty Sisken** of the University of Kentucky, Lexington, as its next president. She will succeed Dr. **Martin Blank** of Columbia University in New York City next June....Dr. **Ben Greenebaum** of the University of Wisconsin-Parkside in Kenosha is on sabbatical for the 1997-1998 academic year. He is spending it working with Dr. **Michael Repacholi** on the World Health Organization's EMF Project in Geneva, Switzerland. Greenebaum will continue as editor of *Bioelectromagnetics*....After 33 years in the post, **Roger Ney** has stepped down as director of the National Council on Radiation Protection and Measurements (NCRP). Ney will continue his work for the International Commission on Radiation Units and Measurements, and he might also act as a consultant to the NCRP. **William Beckner**, Ney's deputy, is serving as the council's acting director....The CSIRO, Australia's large research organization, has closed its ultrasonics lab. Dr. **Stan Barnett** has moved to the CSIRO's Division of Telecommunications and Industrial Physics. He said that, while continuing to work on ultrasound, his "main emphasis" will be on RF health effects....On June 30, 1998, Dr. **Patricia Buffler** will step down as dean of the School of Public Health at the University of California, Berkeley. After a one-year leave, she will return as a professor of epidemiology....**Bob Hemstock**, the central figure in **Paul Brodeur**'s article "Calamity on Meadow Street," has died. Brodeur's report of a cancer cluster in Guilford, CT, originally appeared in the July 9, 1990, *New Yorker* and was later reprinted in his book, *The Great Power Line Cover-Up*....**Bill Croker**, Georgia Power's EMF and occupational health specialist, died suddenly in April of a heart attack.

In a word, no. Dr. Robert Tarone of the NCI conceded that, "We cannot say that there is nothing going on at higher exposure levels." Yet the NCI is not discouraging anyone from sounding the "all clear."

The NCI's results actually show that children exposed to more than 3 mG face a 72% increase in leukemia risk. Many other epidemiologists believe that this study provides evidence for an EMF effect. But you'd never know this from the NCI's press release.

How did the NCI arrive at a conclusion that seems at odds with its own data? First, there is the question of statistical significance. The researchers found a higher risk above 2 mG and indications of a dose-response relationship. But these results were not statistically significant, meaning that they could have happened by chance more than 5% of the time.

This is an important point—but no one should forget that the definition of "statistical significance" is a rule of thumb, not a law of nature. A finding with a significance level of 4% could still turn out to be due to chance. And one with a significance level of 10% could still reflect a real association.

Epidemiologists are arguing about whether the NCI team used the right kind of test to look for a dose-response relationship (see p.11). Regardless of who is right, the numbers tell us basically the same thing: There is some evidence of a dose-response relationship, but it is not conclusive.

The data that show a higher risk above 3 mG *are* statistically significant—but the NCI researchers discount this finding for another reason. The *a priori* hypothesis they had decided to test was that a child's leukemia risk would increase with exposures above 2 mG.

The use of *a priori* hypotheses has been adopted by epidemiologists for important reasons. It is a way for researchers to keep themselves honest since, if enough different comparisons are done, some false-positive findings will emerge due to chance. But it was never meant to be dogma.

The Chasm Between 2-3 mG and 1,000 mG

The selection of 2 mG rather than 3 as the cutoff point was somewhat arbitrary. Current international standards allow exposures up to 1,000 mG for children and 5,000 mG for workers. In this context, the difference between 2 and 3 mG almost seems a nonissue.

Had 3 mG been chosen instead, the headlines would have told a completely different story. As a *post hoc* finding, it is only limited evidence of a higher risk—but why is the NCI holding it up as evidence that there is no danger at all?

Epidemiologists have recently come under fire for acting as accomplices of an alarmist media in needlessly stirring public fears. But if epidemiologists need to take some responsibility for the headlines prompted by their studies, this has to cut both ways. When a study that suggests some risk leads to news reports that there is no danger, science is not well served. In this case, being too conservative in the interpretation of data is not an act of caution—rather, it leads to a reckless indifference to public health.

Millions of people live in the 5% of U.S. homes with EMFs above 3 mG. Add in the power company employees, telephone workers, sewing machine operators and others who routinely experience even higher exposures, and it is clear that a huge number of people are potentially at risk.

The NCI's Dr. Martha Linet has acknowledged that her conclusions are at odds with those of three previous studies. It is worth noting that none of the investigators in those studies feels that the NCI study is the last word. In fact, all three—Drs. Stephanie London, David Savitz and Nancy Wertheimer—feel that the NCI's results are either ambiguous or show a cancer link. And, in fact, the risks uncovered by the NCI are consistent with the range found in earlier investigations, and the weight of the evidence still favors an association between EMFs and leukemia in children.

But the *New England Journal of Medicine* is in a hurry to toss all these studies aside. Dr. Edward Campion's editorial asserts that "the better epidemiologic studies, including that by Linet," support the conclusion of no risk. These "better studies" are not identified, and what makes them better is not defined—unless it is the fact that Campion agrees with their conclusion.

The *Journal* does not stop there. It goes on to declare that "it is time to stop wasting our research resources" on EMF health research. In an interview, Campion said he saw no distinction between studies of residential EMFs and on-the-job exposures.

Never mind the higher risk ratios found in occupational cancer studies. Never mind the links to Alzheimer's disease, Lou Gehrig's disease, brain tumors and breast cancer. The *Journal* views any interest in the health effects of non-ionizing radiation as essentially without scientific foundation, blaming "activists and the media" for concerns about "microwave appliances, radar, VDTs, and even cellular telephones."

It is this kind of overreaching that betrays an ideological agenda. But sweeping statements will not make the EMF issue go away. Too many facts already litter the scientific landscape, and their number continues to grow. In this issue alone, we report on three new epidemiological studies pointing to health risks posed by EMFs, including a German study that contradicts the NCI's conclusions.

The issue of EMFs and human health is an unsolved puzzle. All the pieces do not fit together neatly, and that, of course, is frustrating. But the correct response to a frustrating puzzle is not to dump all the pieces on the floor, as Campion does.

The media have little tolerance for uncertainty. But good science requires dealing with uncertainty every day—having your curiosity spurred on by what you do not know, while avoiding a rush to judgment. It is unfortunate when national scientific and medical institutions, like the *New England Journal* and the NCI, show as little tolerance for uncertainty as the television news.

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NIEHS Panel Finds EMFs Are "Possible" Human Carcinogens

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

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

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

More on the EMF–Cancer Decision Inside

• Overall conclusion of the working group, p.5
• How big are the health risks? p.5
• Panel members, their affiliations and how they voted, p.6
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The evaluation of the EMF literature—as well as the specific votes—followed procedures developed by the International Agency for Research on Cancer (IARC), based in Lyon, France. Dr. Lorenzo Tomatis, the former director

(continued on p.4)

Views on the News: the EMF–Cancer Decision

NIEHS Spins the News, Downplays the Health Risks

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

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

The sound bite worked like a charm. It was the only direct quote offered by the NIEHS and every reporter assigned to the story dutifully reprinted it. A Divided NIH Panel Agrees Power Lines May Pose Small Cancer Risk, ran the *Boston Globe* headline (June 25).

(continued on p.19)

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

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

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

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

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

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

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

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

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

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

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

Epi Study Gets Fast Track for NIEHS EMF Working Group

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

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

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

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

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

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

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

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

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

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

Fourth Lab Finds 12 mG Field Blocks Anticancer Effect

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

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

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

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

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

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

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

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

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

Liburdy's experiments and their subsequent replications have attracted a great deal of interest because of past failures to repeat observed magnetic field effects in other labs—for instance, EMF-induced changes in gene expression (see *MWN,* M/J95). Three English researchers recently wrote of the "overriding need to demonstrate a single, unequivocal [extremely low frequency] EMF-induced response that will be consistently reproducible in independent laboratories" (see A. Lacy-Hulbert, p.11).

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

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

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

French Link Workplace EMFs to Immune and Nervous System Ills

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

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

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

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

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

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

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

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

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

More Evidence on Lou Gehrig's Disease Among Utility Workers

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

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

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

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

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

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

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

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

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

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

Special Report: EMFs Found To Be Possible Carcinogens *(continued from p.1)*

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

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

Exposure Guidelines Would Be Premature

The Minneapolis meeting closed with a debate as to whether the decision to categorize EMFs as possible carcinogens might be used as the basis for exposure guidelines. Panel member Dr. Paul Gailey drafted a statement that, after some editing, was endorsed by the working group and inserted into the closing paragraphs of the report. It read:

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

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

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

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

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

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

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

How Big Are the Health Risks?

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

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

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

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

Working Group's Overall Conclusion

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

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

Decision on EMF–Cancer Link Was Expected

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

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

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

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

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

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