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INSIDE...

Mobile Phone–Brain Tumor Risk In the Limelight Again

Focus on Swedish and U.S. Epi Studies

Two studies have brought new attention to concerns about cellular phone use and brain cancer. Both provide some evidence that cellular phone users are more likely to develop brain cancer on the side of the head where they hold the phone.

Neither study, however, found any overall increase in brain tumor risk.

The two studies touched off a flurry of news stories about mobile phones and cancer in late May, and in the U.S. the subject got more prominent coverage than at any time since the 1993 controversy over the Reynard lawsuit (see *MWN*, J/F93). An article in the May 22 *Washington Post* was picked up by newspapers across the U.S.—the *Boston Globe*, the *Los Angeles Times* and others—while the new research was featured in virtually every major newspaper in Britain (see p.2). Television coverage included reports by the BBC and CNN, both on May 24, and stories are in the works at CBS News and ABC's news magazine, *20/20*.

"Increased risk was found for both left- and right-side brain tumors," writes Dr. Lennart Hardell of the Örebro Medical Center in Örebro, Sweden, in a paper that has been accepted for publication in the *International Journal of Oncology*. It will be the first published research on mobile phone users and cancer. "The results were based on low numbers, and must be interpreted with

(continued on p.6)

Canadian Childhood Leukemia Study: No Magnetic Field or Wire Code Link

A major epidemiological study has found no association between childhood leukemia and exposure to electromagnetic fields (EMFs). There also was no observed link between childhood leukemia and the presence of nearby high-current electrical wiring.

"These results provide little support for a relation between power frequency EMF exposure and risk of childhood leukemia," concluded a team of Canadian researchers led by Mary McBride in a paper that appeared in the May 1 issue of the *American Journal of Epidemiology (AJE, 149,* pp.831-842).

"Given the results of our study and those of the NCI, I think the balance of the weight of evidence has definitely shifted towards a conclusion that, if there is a risk, it is undetectable through epidemiological studies," McBride told *Microwave News*. She is with the Cancer Control Research Program at the British Columbia Cancer Agency in Vancouver, Canada.

In July 1997, a National Cancer Institute (NCI) study found "little evidence" that living near power lines is linked to childhood leukemia (see *MWN*,

(continued on p.10)

HIGHLIGHTS

« Wireless Notes »

On May 24, the **BBC** showed that it was not immune to the **U.K**. **media**'s love affair with the cell phone health controversy. The influential and respected TV news magazine ***Panorama*** devoted an unprecedented 40 minutes of airtime to the issue in a report titled "The Mobile Mystery." The program highlighted the latest epidemiological results from Sweden's Dr. **Lennart Hardell** and from the U.S.' **Joshua Muscat** (see p.1). To drum up interest, the BBC released some of their discoveries to the newspapers, which rushed them into print the day of the broadcast. MOBILE PHONE RESEARCH ADDS TO SAFETY FEARS warned the *Times.* The *Express* took a more conspiratorial tack: MOBILE PHONE COVER-UP. The same day, the BBC Web site ran its own promo for the show under the headline FEARS RAISED OVER MOBILE PHONES, but, later in the day, that headline had morphed into MOBILE PHONE CANCER STUDY "FLAWED." The change was prompted by a statement from the National Radiological Protection Board (**NRPB**), the government's official advisory group, which argued that the Swedish study "lacks statistical precision to draw conclusions on specific aspects of phone use and tumor location"—largely because it was based on a small number of cases. On the show itself, NRPB Director Dr. **John Stather**, when pressed by *Panorama*'s Paul Kenyon, endorsed the idea that manufacturers should tell consumers about potential radiation exposures. Muscat himself did not appear on the show, but Dr. **George Carlo** of **WTR**, which funded the study, detailed Muscat's results. Kenyon also cited the research by Drs. **Henry Lai** and **N.P. Singh** showing DNA breaks following RF/MW exposures. He asked **Motorola** spokesperson **Norman Sandler** about his now-infamous "War-Gaming" memo, written in anticipation of the release of the Lai-Singh DNA results (see *MWN*, J/F97). "We have never attempted to put a corporate spin on the science," Sandler said. At the end of the program, Carlo said: "The science that we have today clearly shows that this is not black and white, that we have moved now into a gray area. That suggests that there could be a problem that needs to be looked at very, very carefully." Kenyon then returned to **Peter Harrison** of **Nokia**, who opined that mobile phones do not present a health risk: "The scientific consensus is that there is no problem," Harrison said. When Carlo was asked whether he agreed, he replied, "At this stage, that is not a responsible position to take."

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A week later, on June 2, the **BBC** reported that the **Metropolitan Police** force in **London** was advised to limit the length of mobile phone calls to five minutes due to health concerns. Staff were told that, "There would be no harm in using an earpiece." Previously, on May 30, the ***Sunday Telegraph*** printed a copy of a purchase order from the **Ministry of Defense**'s research agency for 20 mobile phone shields from **Microshield Industries** in Enfield. The protective cases attenuate microwave exposures, according to company literature. Microshield said that at least 20 more had been sold to the defense agency.

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The next major **U.K.** event will occur on June 15, when **Phil Willis**, a Member of Parliament, sponsors a briefing on mobile phone towers. The meeting, which is being organized by **Northern Ireland Families Against Telecommunication Transmitter Siting** and the **Friends of the Earth Scotland**, will be held in the House of Commons. Among the scheduled speakers are: Drs. **Gerard Hyland** of the U.K.'s University of Warwick, **Michael Kundi** of Austria's University of Vienna and Dr. **Henry Lai** of the University of Washington, Seattle, as well as Libby Kelley of the **EMR Network** and representatives from the U.K.'s **NRPB**. Willis has been critical of the U.K. goverment's tower-siting policies (see *MWN*, J/F99).

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Motorola pays about $100,000 a year for antenna space on the **National Cathedral** in Washington, according to *Wired* magazine (February). Motorola's Sandler confirmed that the cathedral is a cell site, but did not confirm the dollar figure.

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The **CTIA** is planning to fund more research on wireless phone health effects. In an April 26 letter to Dr. **Elizabeth Jacobson** of the **FDA**, CTIA President **Thomas Wheeler** noted that the efforts of CTIA-funded **WTR** were "nearing completion," and affirmed "the industry's commitment to fund appropriate research following up on the work of WTR." Emphasizing that U.S. research must be coordinated with international efforts, such as the **WHO EMF project**, Wheeler asked for the FDA's guidance on how to proceed. A CTIA representative had attended a meeting with the FDA in March, at which WTR briefed federal agencies on its research results (including the **Muscat** study), and Wheeler expressed hope that the FDA and the CTIA could "continue the productive industry/agency relationship we have enjoyed over the past years." At press time, a CTIA spokesperson had no comment on the FDA's response, or on whether there would be a role for WTR in any future CTIA-funded research.

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Representatives from mobile phone companies outnumbered those from electric utilities by a two-to-one margin at the **WHO International EMF Project** Research Coordination Committee meeting, held in Geneva on December 8. Of the approximately 65 attendees, some 18 were from telecom companies, including **British Telecom, Cable & Wireless, Ericsson, France Telecom, Nokia** and **Optus**. **Motorola** was best represented, with four staffers at the one-day meeting. **Jo-Anne Basile** of the **CTIA** and Dr. **Gerd Friedrich** of **FGF** were also there. Interestingly, Americans were selected for all the key positions. At the suggestion of Dr. **Michael Repacholi**, the head of the WHO EMF project, Dr. **Christopher Portier** of the NIEHS was elected chair of the committee, with Dr. **Jon Klauenberg** of the U.S. Air Force as vice-chair. Two different working groups were set up: Dr. **Jack Sahl**, a consultant formerly with Southern California Edison, and Dr. **Leeka Kheifets** of EPRI were selected as chair and rapporteur, respectively, of the Static and EMF Fields Group, while Klauenberg and Dr. **Russell Owen** of the FDA were named as chair and rapporteur of the RF Fields Group. The next meeting of the committee is scheduled for November 26 (see p.18).

Canada Panel: Nonthermal Effects Exist and Need Study; Some Workplace Limits May Not Protect from Heating

An expert panel convened at the request of the Canadian government has concluded that radiofrequncy and microwave (RF/MW) radiation can have biological effects without causing heating. It also found that the country's current exposure standard may not always protect workers—even against thermal effects.

Last fall, the federal agency Health Canada asked the Royal Society of Canada (RSC) to examine RF/MW safety issues, with a focus on cellular phones (see *MWN*, S/O98). It also requested that the RSC evaluate Canada's RF/MW standard, known as Safety Code 6 (SC6), which Health Canada is now in the process of revising (see box at right).

"There are documented biological effects of RF fields even at low, nonthermal exposure levels, below SC6 limits," stated the RSC panel's report, which was released on May 17. It cited changes in the permeability of the blood-brain barrier, in calcium regulation and in the activity of the growth enzyme ODC.

Cellular phone users may experience some of these nonthermal effects, the RSC panel found. But it concluded that, for two reasons, SC6 should not be changed to take nonthermal bioeffects into account.

First, the panel argued, the nonthermal effects demonstrated to date have not been shown to harm human health. "There is no evidence *at this time* of a health risk," panel member Mary McBride told *Microwave News*. Second, the causes of nonthermal effects are poorly understood. "If you don't know the mechanisms for nonthermal RF effects, then you can't set a limit to avoid them," said panel member Dr. Frank Prato in an interview. "You don't know which parameters to protect from."

For thermal effects, the RSC panelists agreed that the limits presently in SC6 give good protection for whole-body exposure. Whole-body maximum SARs are 0.08 W/Kg for the general public and 0.4 W/Kg for workers.

For partial-body exposures, the panel found that SC6 may not always protect workers against heating, and called for strengthened limits for such exposures in the workplace.

SC6 currently allows workers' partial-body exposures to be as high as 8 W/Kg in the head, neck and trunk, and 20 W/Kg in the extremities—with no time limit. "For a worker, this exposure could be eight or more hours per day," said Prato. This "creates a situation where thermal effects could occur even within the limits of SC6," the panel noted, and "may in some cases lead to adverse health effects." Prato commented that, "We think this may be an issue for safety codes in other countries as well."

The report contrasted the lax time limits for workers with the strict time limits that apply when hospital patients are exposed to high RF/MW levels for diagnosis by MRI, or for anticancer therapy. For example, the report pointed out, in the U.S., patient head exposure can also reach as high as 8 W/Kg—but only for a maximum of five minutes.

In this context, the RSC panel expressed particular concern about exposure of the eye, especially given its limited ability to dissipate heat. "Because of the unique physiological characteristics of the eye," it wrote, "the panel recommends that a lower exposure limit be established." But the panel concluded that there are not enough data to set a precise limit for eye exposures, and therefore identifies research on ocular effects as a top priority. As an "interim measure," the report suggested, the general-public limit for head exposure, 1.6 W/Kg, should also be applied to eye exposure on the job.

It is unclear how widespread the effect of this interim proposal might be—whether, for example, it would apply to workers who use walkie-talkies on the job. "We thought that a real estate agent using a cell phone probably would not fall within SC6's definition of an RF worker," said panel chair Dr. Daniel

New Canada RF/MW Standard Will Not Set Strict Eye Limit

Health Canada will not include a strict limit on eye exposures from cellular phones and walkie-talkies in its revision of Safety Code 6 (SC6). The federal health agency has abandoned a proposed eye exposure limit of 0.2 W/Kg for the general public, which it had supported as recently as last fall (see *MWN*, S/O98).

The new standard will be released this summer; officials would not comment further on what it might contain. Last year, manufacturers expressed concern that most walkie-talkies would violate the proposed eye exposure rule, though they said that virtually all cellular phones would comply.

"The latest draft of SC6 says that lower exposures are desirable, but 0.2 W/Kg is not required," said Dr. Art Thansandote of Health Canada's Radiation Protection Bureau in Ottawa. In an interview with *Microwave News*, Thansandote cited the RSC's report, which concluded that more research is needed before definite conclusions can be drawn about RF/MW ocular effects.

Thansandote noted that Health Canada is currently carrying out such research in collaboration with the Eye Institute at the University of Ottawa. "It's a study with a corneal construct, a model of the human cornea made from a cell line of the human eye," he explained. Thansandote said that work on the exposure system is almost finished, and that preliminary results should be available in about a year.

The RSC report proposes limiting workplace exposures of the eye to 1.6 W/Kg as an interim measure, but Thansandote would not comment on whether this will be included in the new SC6.

When the revised version of SC6 is published this summer, it will take effect immediately, said Jeff Pender, a spokesperson for Health Canada. "At some point after that, we'll hold consultations with stakeholders like workers, Industry Canada and so on," Pender told *Microwave News*, and those meetings could lead to "some tinkering" with the new standard if it is warranted. The revision of SC6 began in 1993.

The new version of SC6 will be available on the Web at <www.hc-sc.gc.ca/ehp/ehd/catalogue/rpb.htm>.

Krewski. "It might be that only a small number of people would be affected. But our charge was not to survey individual occupational exposures—it was to look at the limits in SC6."

The report was silent on whether a separate eye exposure limit for the general public may be desirable. Health Canada had proposed limiting eye exposures to 0.2 W/Kg for the public, but has now dropped that idea (see box on p.3).

On DNA damage, the report concluded that "most genotoxicity studies conducted to date have been negative." However, it noted that the issue was "reopened" by the work of Drs. Henry Lai and N.P. Singh: "In carefully conducted experiments they report a dose-response for DNA breakage" at nonthermal levels of exposure (see *MWN*, N/D94). The issue is unresolved, the panel stated, since other labs have failed to reproduce these results, and it called for more research.

Similarly, the RSC panel cited Dr. Michael Repacholi's finding of a doubling of lymphoma among RF-exposed mice (see *MWN*, M/J97) as "very interesting," but not as a basis for any firm conclusions until it is replicated elsewhere.

Cellular phone base stations have been a focus of public concern (see p.15). But the RSC panel wrote that since mobile phone towers expose the public only to very low field strengths, "neither biological nor adverse health effects are likely to occur."

The report concluded with a wide-ranging proposal for research on RF/MW safety, calling for "targeted research funds [to] be made available for an extended period of five to ten years." But it is unclear whether such support will be forthcoming.

Jeff Pender, a spokesperson for Health Canada in Ottawa, said that the agency does not yet have a formal response to the RSC report, nor to its proposed research agenda.

A statement from the Canadian Wireless Telecommunications Association (CWTA), a service providers' group based in Ottawa, expressed general support for the RSC panel's call for more research. But CWTA President Roger Porier said in an interview that the group has no plans to help fund any research effort. "We would certainly look at any proposal," said Porier. "But we have always been reluctant to directly fund research, because doing so is often perceived as trying to influence it."

Porier pointed out that the wireless industry already pays the Canadian government $140 million Canadian dollars (about US$95 million) a year in fees for use of the broadcast spectrum. "If the government considers research in this area to be a priority," he commented, "even 10% of that money would make a fairly substantial contribution."

The members of the RSC Expert Panel on Radiofrequency Fields were: Dr. Craig Byus, University of California, Riverside, U.S.; Dr. Barry Glickman, University of Victoria, British Columbia; Dr. Daniel Krewski (chair), University of Ottawa, Ontario; Dr. Gregory Lotz, National Institute for Occupational Safety and Health, Cincinnati, U.S.; Dr. Rosemonde Mandeville, Biophage Inc., Montreal, Quebec; Mary McBride, University of British Columbia, Vancouver; Dr. Frank Prato, University of Western Ontario, London, Ontario; Dr. Donald Weaver, Queen's University, Kingston, Ontario.

The RSC report, *A Review of the Potential Health Risks of RF Fields from Wireless Telecommunication Devices*, is on the Web at <www.rsc.ca>. Copies may be bought for C$15.00 from: RSC, 225 Metcalfe St., Ottawa, ON K2P 1P9, Canada, (613) 991-6999, Fax: (613) 991-6996.

New Zealand Drops "Flat" RF/MW Limit; Australia in Limbo

Standard-setting bodies in Australia and in New Zealand have abandoned their frequency-independent 200 $\mu W/cm^2$ limit for public exposures to RF/MW radiation, which was in effect in both countries since 1990. Standards New Zealand has moved to replace the "flat" standard with a new standard based on ICNIRP's less stringent exposure guidelines, while Standards Australia has allowed the flat standard to lapse without reaching consensus on a replacement.

TE/7, a committee jointly formed by Standards Australia and Standards New Zealand, was responsible for developing new rules. When a push to adopt ICNIRP-based limits failed last year, TE/7 did reaffirm the flat standard, but only as an interim measure, through March 5, 1999 (see *MWN*, M/J98).

On March 4, members of TE/7 voted 20-9 in favor of the ICNIRP-based limits—short of the 80% support needed for adoption. But on April 22, New Zealand's TE/7 members separately voted 7-1 to adopt the ICNIRP limits following some revisions, and Standards New Zealand issued them as NZS 2772.1:1999. A similar proposal failed to pass in Australia.

This spring, the Australian Communications Authority (ACA) told Standards Australia that it would continue to use the old, flat standard as the basis for its regulations, despite the fact that TE/7 had allowed it to lapse. In February, the ACA had issued new regulations that made the flat standard legally binding in Australia.

Proponents of the ICNIRP-based standard include various government agencies and radiation labs of both countries, as well as their telecommunications industries. Those opposing the standard include national labor organizations, consumers' groups, Australia's Commonwealth Scientific Industrial Research Organization (CSIRO) and Australia's National Occupational Health and Safety Commission.

In 1998, opponents of an ICNIRP-based standard included Australia's two leading wireless carriers, Telstra and Optus, which were concerned about negative public reaction to higher limits. They have both since changed their position. "Telstra believes that the ICNIRP guidelines should form the scientific basis for a revised Australian RF standard," Telstra's Jack Rowley told *Microwave News* this May.

Speaking for the Australian Mobile Telecommunications Association (AMTA), Dr. Ken Joyner of Motorola said that, "The AMTA strongly supports international harmonization of technical standards in order to reduce costs and break down nontariff barriers to trade."

The TE/7 process has been marked by controversy. According to Stewart Fist, an Australian journalist who has followed the deliberations, there has been a "long and bitter fight."

In TE/7's March ballot, those opposing the proposed standard were required to submit detailed explanations of their votes, while those favoring the proposal were not. Fist called the one-sided requirement "an interesting new trend in making democratic decisions."

After the ICNIRP-based standard failed to win adoption in

March, Standards Australia and Standards New Zealand moved to split TE/7 into two national groups to enable New Zealand to adopt the ICNIRP limits, where they faced less opposition. Dr. Ivan Beale of the University of Auckland in New Zealand, who represented the public on TE/7, objected to this strategy as a possible breach of the standards groups' bylaws.

"I am fed up with this result after ten years of attending the meetings," Beale told *Microwave News.* Beale said that he has resigned from TE/7 and has asked Dr. Neil Cherry of Lincoln University in Canterbury, New Zealand, a longtime advocate of strict exposure limits, to take his place (see *MWN,* M/A97).

The opposition Democratic Party in Australia's Senate is preparing to call for an investigation of the standard-setting process, an aide to Senator Lyn Allison told *Microwave News.*

The flat standard's exposure limits for frequencies from 10 MHz to 300 GHz were 200 $\mu W/cm^2$ for the public and 1 mW/cm^2 for workers. The ICNIRP exposure limit for the public is 200 $\mu W/cm^2$ from 10 MHz to 400 MHz, and increases with frequency above 400 MHz to a maximum of 1 mW/cm^2 at 2 GHz. ICNIRP's occupational limits are higher than those for the public by a factor of five, and are similarly frequency-dependent.

TE/7 members in both countries who oppose the ICNIRP-based standard consider the ICNIRP exposure limits to be inadequate because they do not protect against possible nonthermal health effects. "While the potential risk to human health remains unknown, it is advisable to set exposure limits as far below levels known to cause adverse biological effects as is technically, economically and socially feasible," CSIRO's Dr. John Hunter told Standards Australia. "Increases in those compliance levels are unwarranted and imprudent."

These opponents are also dissatisfied with the standard's language endorsing precautionary measures. "What we now have in the current draft standard is a 'homeopathic' dose of prudent avoidance, which has been diluted to the extent that virtually nothing is left of the original intent," Australia's Don Maisch, a consultant based in Hobart, told Standards Australia.

Daniel Dwyer of Australia's Communications, Electrical Plumbing Union told *Microwave News* that he would have considered the ICNIRP limits if the precautionary language had been stronger. But, he said, the proposed standard "was basically an ultimatum to accept ICNIRP with a 'feel-good' precautionary approach."

The precautionary language is found in the standard's foreword, which states that, in view of ongoing RF research, "Generally, it is...sensible in achieving service or process requirements to minimize unnecessary or incidental RF exposure."

The flat standard was initially adopted in Australia in 1985 (see *MWN,* M/A86) and renewed in 1990, when it was also adopted in New Zealand (see *MWN,* J/F90). It originally included an endorsement of the "ALARA" principle—that exposures be kept "as low as reasonably achievable"—but TE/7 deleted that wording in 1998, substituting milder language calling for prudent avoidance.

The vote that allowed Standards New Zealand to adopt the ICNIRP limits was cast by Roger Matthews of the City of Auckland, who represents local government. Matthews voted against the proposal in March of this year, but in April he changed sides following revisions that he believes tighten the standard's compliance rules and allow local officials to adopt precautionary measures. Although he admits that he is "not happy with the ICNIRP high frequency numbers," Matthews told *Microwave News* that he stands by his decision: "We now have a standard that we can actually enforce in court if need be."

IEEE Adopts Some Changes in Standard for RF/MW Exposure

On April 16, the Institute of Electrical and Electronics Engineers (IEEE) published a revised version of its exposure standard for fields of 3 kHz to 300 GHz—a key standard for RF/MW radiation.

IEEE C95.1-1999 reflects changes proposed by the IEEE's Standards Coordinating Committee 28 (SCC-28) on Non-Ionizing Radiation Hazards last September, and approved by the IEEE Standards Board at the end of 1998.

"The full revision of the 1991 standard will take a few more years, but there were some changes that the committee felt should be included now," Ron Petersen, the secretary of SCC-28, told *Microwave News.* The changes affect limits on induced and grasping-contact currents, definitions of radiated power and spatial averaging and some measurement distances. The last major changes were adopted by the IEEE in 1991 (see *MWN,* N/D91), and the standard was reaffirmed in 1997 (see *MWN,* J/A97).

"The induced current limits were relaxed," said Petersen, who is with Lucent Technologies in Murray Hill, NJ. "But now they also have a ceiling, so they can't increase without bound anymore."

Induced currents no longer have to be measured if electric field strength is below certain values. In addition, for the 100 kHz to 100 MHz frequency band, the induced current limit was changed from a simple average over one second to the root-mean-square over any six-minute interval. "For frequencies above 100 kHz, where specific absorption rates are important, it needed to be changed," Petersen said. For these higher frequencies, the six-minute average is supplemented by a 500 mA ceiling on peak exposures. Similar changes were made to the limits on grasping-contact currents.

For hand-held mobile phones, the term "radiated power" is now explicitly defined as "the power radiated into free space in the absence of any nearby objects." (For cellular phones in the U.S., for instance, the FCC limits radiated power to a maximum of 0.6 W.) "When we polled the committee, we found we had ten different definitions among ourselves," Petersen explained. "Everything from antenna input power, to the power radiated by the antenna with the head present, without the head present and so on. I was really surprised—I always thought I knew what 'radiated power' was."

The standard formerly stated that measurements to check compliance must be made at a distance of at least 20 cm from an RF source. "The new standard says that for directly radiating devices you can take measurements no closer than 5 cm, and for objects that cause reflecting and scattering, no closer than 20 cm,"

said Petersen.

Dr. John Osepchuk, chair of SCC-28, said in an interview that the American National Standards Institute is likely to adopt the new IEEE standard sometime later this year.

"There are still some mistakes in it," Petersen remarked. "For instance, in the induced current limits for the general public, the averaging time should have been changed to 30 minutes, but it stayed 6 minutes and nobody caught it."

The changes were drawn up by SCC-28's Subcommittee IV, whose cochairs are Drs. C.K. Chou of Motorola in Plantation, FL, and John D'Andrea of the Naval Medical Research Institute at Brooks Air Force Base in San Antonio. Petersen is the secretary of both the subcommittee and the full SCC-28. Osepchuk, formerly of Raytheon, is now a consultant based in Concord, MA; SCC-28's vice-chair is Dr. Eleanor Adair of Brooks Air Force Base.

Two Studies Link Mobile Phone Use and Brain Cancer *(continued from p.1)*

caution." Hardell told *Microwave News.*

"I did a similar analysis, looking at where the tumor occurred," Joshua Muscat of the American Health Foundation in New York City said in an interview. "There was a correlation between the hand that holds the phone and tumor laterality—the side of the brain where the tumor occurs." But Muscat stressed that there were "inconsistencies" in the data from his study, and that his analysis was not yet complete.

Until more is known, Sweden's Hardell is recommending that mobile phone users practice "prudent avoidance" by taking steps to reduce their exposure (see p.7). "Use a hands-free earphone," he said. "I always do."

In normal use, the typical mobile phone antenna is positioned just behind the ear; the areas of the brain closest to that spot are the temporal and occipital lobes. Hardell found that cellular phone users were two-and-a-half times more likely to develop tumors in these lobes on the side of the head where the phone was normally held. This was true for both right- and left-side phone users. Hardell found no increased risk for the frontal or parietal lobes, which are farther from the phone's antenna.

Since cellular phone radiation does not penetrate very far into the head, Hardell explained, tumor location may well be a more sensitive indicator of a small increase in risk than the incidence of cancer in the brain as a whole. "Based on our experience, it is necessary to have anatomical tumor localization" to study this issue effectively, he said.

Muscat gave qualified support to this idea: "It could be that you have a very localized exposure, and anything beyond a small area is irrelevant."

On the other hand, Muscat said, it is far from clear that mobile phone radiation is the cause of any of the associations observed in his study. Though his analysis is still unfinished, Muscat said, he found that tumor location also appears to be linked with the side of the head to which a traditional wired phone is held. "The correlation is uneven," said Muscat, but it raises the possibility that the link may be to handedness rather than to the use of mobile phones *per se.*

In the Hardell study, the overall odds of brain cancer were about the same whether or not people had used a cellular phone. How can this finding be reconciled with an increased risk of a tumor near to where the phone is held? Hardell said that the results on tumor location might be due to chance. Alternatively, he said, there may be an increase in overall brain cancer risk, but one that is too small to be detected easily in a study with such a large margin of error. (None of the Swedish risks were statistically significant.)

The Swedish findings on tumor location were due almost entirely to data from people who had used analog NMT (Nordic Mobile Telephone) phones. "There are two ways you can discuss this," said Hardell. "It might be because the analog phones produce higher exposure"—three times higher than do digital GSM phones, according to Hardell. "Or it might be because we don't have enough people or long enough exposures for the digital phones." Hardell's paper states that "few subjects had used the [digital] GSM system, and [for them] the tumor induction period is still short since the digital system was introduced in the

The Hardell Study

The study by Dr. Lennart Hardell found that:

- The overall chance of developing brain cancer among mobile phone users, as compared to nonusers, was essentially the same (odds ratio = 0.98, with a confidence interval (CI) of 0.66-1.41).
- Cellular phone users who held the phone on the right side were 2.45 times more likely to develop a tumor in the temporal or occipital lobes on the right side of the brain (CI=0.78-7.76). For left-side phone users, such tumors were 2.40 times more likely to occur on the left side (CI=0.52-10.9).
- Mobile phone users showed no increase in the risk of acoustic neurinoma, a benign tumor of a nerve that leads from the brain to the inner ear.

Hardell's study was based on 209 cases, diagnosed in the areas around Uppsala (1994-96) and Stockholm (1995-96), and 425 controls.

The Muscat Study

The study by Joshua Muscat found that mobile phone users had:

- No overall increase in brain cancer.
- A higher risk of developing a tumor on the side of the cerebellum on which they held the phone. But such a risk was also found for users of traditional wired phones.
- A statistically significant two- to threefold increase in the risk of neuroepithelial tumors. There was no dose-response relationship, however: In fact, the highest risk was among people who spent less time on the phone.

Muscat's research was based on 466 brain cancer cases and 420 controls. Work on the study, which was funded by WTR, began in 1996.

Advice from Dr. Hardell

"Until this problem is solved, I think it's necessary to be somewhat cautious and reduce exposure," said Dr. Lennart Hardell, following the release of his findings on cellular phones and brain cancer.

In an interview with *Microwave News*, Hardell offered three pieces of advice for users of mobile phones:

• "Use a hands-free device." Using an earphone increases the distance between the phone's antenna and the user; Hardell said that doing so will reduce exposure by about 95%.

• Buy a low-radiation phone. "Ask about the specific absorption rate (SAR) when purchasing a mobile phone," said Hardell, "and buy one with as low an SAR value as possible."

• "Restrict use by children and young adults." Young people have been shown to be more sensitive to ionizing radiation and chemical carcinogens. We do not know whether cellular phones have any effect on growing bodies, noted Hardell, but he thinks it is best to err on the side of caution.

"I think these three points fit well under the idea of prudent avoidance," Hardell explained. "We have the technological ability to reduce exposure—so why not use it?"

Dr. Kjell Hansson Mild, a coauthor of Hardell's brain cancer study, gave qualified support to use of a hands-free device: "If I were to use a mobile phone regularly for an hour or more a day, I would definitely get an earpiece," he told *Microwave News.* "But I do not think that temporary use is of too much interest."

early 1990s."

Hardell's recently completed study included 209 people with brain cancer. His team is now working on a larger study, which will include 1,500 cases and an equal number of controls (see *MWN*, N/D97). "In our first study, the cases came from 1994 through 1996," he said. "The new one will have data from 1997 through 1999, and from two additional geographic areas in Sweden—which adds up to most of the country." Dr. Kjell Hansson Mild of the National Institute for Working Life in Umeå, a coauthor of the smaller Hardell study, said that they hope to present results from the new research at the annual meeting of the Bioelectromagnetics Society (BEMS) in 2000.

Muscat commented that, "Fifteen hundred cases will be a very large study," and will represent a major step forward in statistical power. "Even if you start dividing up the numbers by different lobes and so on," he explained, "that's big enough that if there's a real effect, you might expect to find it."

Also under way is a multicountry study by the International Agency for Research on Cancer, based in Lyon, France, for which Hardell is the main collaborator in Sweden (see *MWN*, J/F98 and S/O98). Results are expected in 2003 or 2004. A brain cancer study by the U.S. National Cancer Institute in Rockville, MD, which is examining a number of possible risk factors, will not be completed until next year, the institute's Dr. Peter Inskip told *Microwave News* (see *MWN*, J/F93 and N/D97). Another U.S. study, by Epidemiology Resources Inc. (ERI) in Newton Lower Falls, MA, has been on hold for a combination of financial and legal reasons (see *MWN*, M/J96 and N/D97).

A May 24 press release from Wireless Technology Research (WTR), an industry-funded group that is sponsoring both the Muscat and the ERI studies (see *MWN*, J/A96 and M/A99), stated that Muscat had found "a statistically significant risk of a rare tumor called a neurocytoma" among cellular phone users as a whole.

In fact, Muscat told *Microwave News*, the significant increase was not in neurocytomas but rather in neuroepithelial tumors—a broader class of which neurocytomas are one type. He said that cellular phone users had a two- to threefold greater risk of neuroepithelial tumors than did nonusers.

Muscat said he was "not inclined to emphasize" the increase in neuroepithelial tumors, for several reasons. "When you start chopping up the data and doing multiple comparisons," he explained, "you increase the odds of a chance finding." Also, he noted, neuroepithelial tumors are a rare form of brain cancer, and his study included an unusually large number: "The number is considerably out of the ordinary, which indicates that there's some ambiguity in the classification of these tumors."

As for the media focus on the fact of a statistically significant increase, Muscat commented that, "This is an isolated finding that's being taken out of context."

"I told WTR that these data were to be kept strictly confidential," Muscat said.

The May 22 *Washington Post* indicated that Muscat had found an association between cell phone use and tumor location for right-handed—but not left-handed—cellular phone users. Muscat told *Microwave News* that while this was an accurate description of his data, it is "not appropriate" to separate the two sides this way, in terms of statistical analysis.

Muscat hopes to submit his study for publication by the end of the summer. He is scheduled to present preliminary results in mid-June at a WTR symposium prior to this year's BEMS meeting in Long Beach, CA.

"Hopefully, when this study and Hardell's are both published," he said, "people will be able look at all the data and make some comparisons." If the results are inconsistent, he added, it would be important to look at differences in types of phone or patterns of use.

Danish Epi Study Under Way

An epidemiological study of cancer among cellular phone users is now under way in Denmark. It is based on annual use of mobile phones by 550,000 Danish cellular phone subscribers from 1982 through 1995.

"We are ready to begin risk calculations," Dr. Christoffer Johansen of the Danish Cancer Society (DCS) in Copenhagen told *Microwave News*. Partial funding for the study has been obtained from two of the main wireless phone companies in Denmark, TeleDanmark Mobil and Sonofon, as well as from the DCS.

While more funding must be secured before the study can be completed, Johansen is optimistic. He hopes to submit a paper for publication before the end of the summer. The study design is described in a paper in *Radiation Protection Dosimetry (83,* pp.155-157, 1999).

NAS–NRC Panel Criticizes RAPID Program; Sees No Need for New EMF Health Research Effort

There is no need to fund an EMF health effects research program, according to a National Academy of Sciences-National Research Council (NAS–NRC) committee that reviewed studies conducted under the EMF Research and Public Information Dissemination (RAPID) program. An NAS–NRC report released in May discounted reported EMF bioeffects on the grounds that they have not been replicated.

All replications attempted in the RAPID program had either negative or equivocal results, the committee concluded. It called this lack of confirmation "an important contribution," which has "reduced the credibility of many of the claims of biologic effects of power frequency magnetic fields."

The report also discounted RAPID studies that reported new EMF bioeffects, arguing that unreplicated findings "have little value in answering the basic question of whether there are biologic effects of low-level power frequency magnetic fields." In RAPID's *in vitro* studies, it contended, "the few reported effects were small and their connection to disease processes are speculative at best and irrelevant at worst."

(Dr. Robert Liburdy's work showing that EMFs can block the anticancer action of melatonin, which has been successfully repeated three times since 1992 (see *MWN*, J/A98), is acknowledged in a footnote, with the comment that none of the replications of Liburdy's work have yet been published.)

The RAPID research program, established by Congress in 1992, was intended "to determine whether or not exposure to electric and magnetic fields...affects human health." Congress directed the NAS to "evaluate the research activities under the program," while the National Institute of Environmental Health Sciences (NIEHS) was directed to give Congress an overall report on the program. The latter report is expected to be released in June.

Since the health effects observed in epidemiological studies "range from none to weak," the NAS–NRC panel argued, they cannot be accepted without "evidence that supports the biologic plausibility of such an association."

It acknowledged, however, that:

> People evaluating epidemiologic findings in this field can arrive at different conclusions, depending on their starting viewpoints. Those concerned about protecting public health might lean towards acceptance of a possible association between magnetic fields and cancer risk, whereas others might reject such an association based on the lack of a plausible mechanism and the inability to identify possible confounders.

The NAS–NRC committee was critical of the NIEHS Working Group on EMF health effects, which decided last June that power frequency EMFs should be regarded as a "possible human carcinogen"—based mainly on the epidemiological evidence. According to the NAS–NRC panel, the Working Group's statement "conveys to the public a conclusion that our committee believes is not supported by the underlying research."

The committee conceded that the Working Group's reading of the evidence was "not greatly dissimilar" from that of the NAS-NRC's own committee on EMF health effects in 1997, though it was "differently worded." But the report argued that the NAS–NRC's 1997 formulation—that there was "no conclusive and consistent evidence" for EMF health risks—"more accurately convey[s] the health implications of the underlying research to the public." It blamed the discrepancy mainly on the Working Group's use of the criteria developed by the International Agency for Research on Cancer, which the NAS–NRC panel considered inappropriate for EMFs.

The one member of the NAS–NRC panel who also served on the Working Group, Dr. Walter Rogers, was the only member of the Working Group to vote that the evidence actually showed that EMFs "lack" carcinogenic properties (see *MWN*, J/A98).

The NAS–NRC committee stated that it was "difficult to judge the quality, completeness or significance of the biologic studies funded by the EMF RAPID program" because many of

NAS–NRC Recommendations on EMF Health Research

These are the recommendations of the NAS–NRC committee reviewing research conducted under the RAPID program:

1) The committee recommends that no further special research program focused on possible health effects of power frequency magnetic fields be funded. Basic research on the effects of power frequency magnetic fields on cells and animals should continue but investigators should compete for funding through traditional research funding mechanisms.

2) If, however, Congress determines that another time-limited, focused research program on the health effects of power frequency magnetic fields is warranted, the committee recommends that emphasis be placed on replications of studies that have yielded scientifically promising claims of effects and that have been reported in peer-reviewed journals. Such a program would benefit from the use of a contract-funding mechanism with a requirement for complete reports and/or peer-reviewed publications at program's end.

3) The engineering studies were initiated without the guidance of a clearly established biologic effect. The committee recommends that no further engineering studies be funded unless a biologic effect that can be used to plan the engineering studies has been determined.

4) Much of the information from the EMF RAPID biology program has not been published in peer-reviewed journals. NIEHS should collect all future peer-reviewed information resulting from the EMF RAPID biology projects and publish a summary report of such information periodically on the NIEHS Web site.

5) The communication effort initiated by EMF RAPID is reasonable....There are two limitations to the effort. First, it is largely passive, responding to inquiries and providing information, rather than being active. Second, much of the information produced is in a scientific format not readily understandable by the public. The committee recommends that further material...be written for the general public in a clear fashion....

the results had not yet been published. "Some papers reported to be submitted or in preparation have not appeared," it noted, "raising concerns about the reproducibility or quality of their data." Project summaries provided to the committee were said to be "of uneven quality," with most not giving complete results.

Some observers were surprised that the NAS–NRC issued its report when the NIEHS had yet to submit its own report to Congress. "I am absolutely stunned," Dr. Michael Marron of the Office of Naval Research in Washington told *Microwave News*. "I had been told that the academy could not possibly issue its report so quickly." Marron heads the federal interagency group on EMF health effects research, which is to release its own report on the RAPID program later this year.

"Every report by the academy—including this one—goes through a formal review process," said Dr. Rick Jostes of the NRC, study director for the report. Far from being premature, he said, the release of the report did not occur until months after a December 31, 1998, deadline.

The NAS–NRC report had few positive comments about the RAPID engineering studies. "Many of the engineering studies were of little use," the committee stated. It complained that:

> The projects were commissioned without any convincing evidence of specific linkages between low-level magnetic field exposure and human health effects. As a result...they anticipate all possible field parameters of potential relevance, without good reason to focus on any specific one.

Of the 11 engineering studies conducted under RAPID, "only two are regarded as noteworthy," according to the panel: the Enertech 1,000-person exposure study and an Illinois Institute of Technology study of field-reduction technologies. Overall, the panel felt that the engineering studies were of "questionable" value.

One significant conclusion from the engineering studies, according to the panel, was that most people's EMF exposures at home or at work are "remarkably similar." The panel stated that most people are exposed to 1-2 mG, and "very few" to more than 4 mG. (See also p.19.)

The members of the NAS–NRC panel were: Drs. John Ahearne (chair), Duke University, Durham, NC; Edwin Carstensen, emeritus, University of Rochester, NY; Raymond Erikson, Harvard University, Cambridge, MA; Maurice Fox, emeritus, MIT, Cambridge, MA; James Hoburg, Carnegie Mellon University, Pittsburgh; Walter Rogers, University of Texas Health Sciences Center, San Antonio; Jan Stolwijk, Yale University, New Haven, CT; and Thomas Tenforde, Battelle Pacific Northwest Laboratories, Richland, WA.

The NAS–NRC panel expressed its thanks to several people, "chosen for their diverse perspectives," who reviewed and commented on a draft of the report. The reviewers were: Drs. Robert Adair, Yale University; Leeka Kheifets, EPRI, Palo Alto, CA; Ross MacDonald, emeritus, University of North Carolina, Chapel Hill; John Moulder, Medical College of Wisconsin, Milwaukee; Richard Saunders, NRPB, U.K.; Herman Schwan, emeritus, University of Pennsylvania, Philadelphia; and Charles Stevens, Salk Institute, La Jolla, CA.

The panel's report, *Research on Power Frequency Fields Completed Under the Energy Policy Act of 1992*, is available on the Internet, and a hard copy can be purchased, at <books.nap.edu/catalog/9587.html>. It can also be ordered for $26.75, plus shipping, from: (800) 624-6242.

EMFs Protect Chick Embryos Against Cardiac Stress

Weak power frequency EMFs can help chick embryos survive severe cardiac stress, according to Drs. Theodore Litovitz and Andrea DiCarlo of the Catholic University of America in Washington. They attribute the protective effect to the increased production of heat shock proteins in response to EMF exposure.

"There's nothing subtle about the experiment," Litovitz explained. "At the end, the embryos are either alive or dead."

The starting point for the studies was Dr. Reba Goodman's research showing that low-level EMFs can activate gene expression of heat shock proteins in human HL60 cells. Despite their name, heat shock proteins are formed not only in response to heat, but also as a defense against a variety of other stresses. They are known to minimize the damage to cardiac tissue caused by oxygen deprivation and reoxygenation, both of which can be lethal. Litovitz and DiCarlo believe that magnetic fields can prepare chick embryos for such stress.

Litovitz and DiCarlo exposed chick embryos for 20 minutes to 60 Hz EMFs ranging from 40 mG to 100 mG. One hour after the EMF treatment, the exposed eggs and the unexposed controls were placed in sealed containers and deprived of oxygen until at least 60% of the controls' hearts had stopped beating. At this point, the containers were opened, allowing oxygen levels to return to normal.

Writing in the February 16 issue of *Circulation (99*, pp.813-816, 1999), Litovitz and DiCarlo reported that 68.7% of 506 exposed embryos had a heartbeat 30 minutes after reoxygenation, compared to 39.6% of the controls—a highly significant difference ($p<0.0001$).

These new chick embryo results "confirm our cellular studies and extend them to an animal model," Goodman, who is at Columbia University in New York City, said in an interview. "In each case, there are changes in transcription and translation caused by relatively weak magnetic fields."

Interestingly, Litovitz and DiCarlo found that a minor change in the strain of hens was a key variable. In a paper recently published in *Bioelectrochemistry and Bioenergetics (48*, pp.209-215, 1999), they document different results with embryos from two flocks of the same breed of hens.

While embryos from the first flock showed a response after a 20-minute, 80 mG exposure, those from the second flock did not. Litovitz and DiCarlo failed to see a protective effect in these embryos until they extended the exposure to at least 60 minutes.

Litovitz and DiCarlo believe that such genetic variations may explain the inconsistent biological responses seen in EMF experiments. In the "henhouse project," for example, one of six participating labs could not reproduce an experiment by Spain's Dr. Jocelyn Leal in which very weak pulsed magnetic fields impaired the development of chick embryos. That lab used eggs from a different breed of hens (see *MWN*, Mr83 and M/A88).

"In other areas of biology, genetic factors are well known to affect experimental results," DiCarlo told *Microwave News*. But, she added, "When researchers can't replicate an EMF biological effect, people tend to assume that the effect doesn't exist."

J/A97). A number of prior studies had shown such an association, leading a panel at the National Academy of Sciences (NAS) to conclude that children living near high-current power lines did appear to have higher-than-expected rates of leukemia. The NAS panel doubted, however, that EMF exposure was to blame (see *MWN*, N/D96).

"This study is good enough to add evidence against there being a substantial association," Dr. David Savitz, chair of the Department of Epidemiology at the University of North Carolina School of Public Health in Chapel Hill, said in an interview. In the 1980s, Savitz reported increased cancer among children living near high-current power lines (see *MWN*, N/D86).

McBride's study was based on 399 children in five Canadian provinces, who were diagnosed with leukemia at up to 14 years of age between 1990 and 1995. In addition, McBride's team selected 399 matched controls. EMF exposures were estimated with personal measurements over a 48-hour period and with 24-hour EMF measurements in each child's bedroom, both taken with a Positron meter. In addition, the researchers noted local power line characteristics and magnetic field measurements at the perimeter and the front door of both the mother's residence in the year prior to the child's birth and the child's residence from birth to the date of diagnosis, all using an EMDEX-C magnetic field meter. Power line characteristics were classified according to both the wire-coding scheme first devised by Dr. Nancy Wertheimer and Ed Leeper for their landmark 1979 study and the modified scheme developed by Savitz and Dr. William Kaune.

For measured magnetic fields and for high-current wire codes, there were no elevated leukemia risks. For all leukemia and for acute lymphatic leukemia (ALL) alone, the adjusted odds ratios (OR) for personal magnetic field exposures were 0.95 and 0.93, respectively.

"There were no clear associations with predicted magnetic field exposure two years before the diagnosis/reference date or over the subject's lifetime or with personal electric field exposure," McBride wrote in the *AJE*.

The study was the first to ask children to wear an EMF dosimeter for two days. "By looking at personal exposures, we addressed some of the limitations of previous studies," McBride said. She also highlighted the short time between the identification of cases and the measurements.

Key Error in AJE *Paper and Abstract*

One of the few elevated risks reported in the McBride paper turns out to have been an error. In the abstract, published in the *AJE*, the McBride team highlighted an OR of 1.72 for ALL among those children who lived in houses with very high-current wiring configurations two years prior to diagnosis compared to those who lived next to underground wiring. This OR was actually 0.84 (see table, p.11). The error was due to a mistabulation of several columns of numbers, according to McBride.

Most of the children were exposed to EMFs of less than 2 mG (0.2 μT) based on a time-weighted average: Of the 293 children for whom 48-hour personal exposure data were available, 54 were exposed to 2 mG or more. The adjusted OR for these exposures was 1.12, with a confidence interval (CI) of 0.69-1.80, relative to exposures of less than 2 mG. McBride did not calculate risks for those exposed to more than 3 mG.

Only eight children and six controls were exposed to 5 mG or more. This group had an unadjusted elevated risk of 1.48 with a CI of 0.49-4.42—but after adjustment for the age at which each mother gave birth, maternal education, household income and the child's ethnicity and number of residences, the OR went down to 0.89 (CI: 0.24-3.36).

"The study tells you that kids are not highly exposed. This is reassuring," Dr. Richard Gallagher, a coauthor and the chief cancer epidemiologist at the BC agency, told *Microwave News*.

Gallagher, who was the initial principal investigator on the McBride study, noted that little could yet be said about the cancer risk for exposures over 5 mG: "No study to date has had the statistical power to examine the high-exposure group," he said. "My feeling is that we have not yet demonstrated that there is a risk at high exposures, but we cannot rule it out."

In an interview from her home in Boulder, CO, Dr. Nancy Wertheimer also stressed the importance of looking at the children who are most-highly exposed. "The McBride study has unusual and potentially serious exposure assessment problems, particularly for the highest exposure groups," she said.

Japan Set To Begin Childhood Cancer Epi Study

The Japanese government has approved funds for a three-year epidemiological study of power line EMFs and childhood cancer. The effort will be the first of its kind in Japan.

The Environment Agency's National Institute for Environmental Studies (NIES) in Ibaraki will lead the study, with the institute's Dr. Michinori Kabuto as the principal investigator. Kabuto has been assessing the feasibility of such a large-scale study for over a year (see *MWN*, M/J98).

The institute aims to go beyond measuring power frequency exposures. "The study will evaluate the relationship between children's cancers...and EMF exposures that previous studies have neglected to examine, such as high-level exposures, harmonics and transients," according to the NIES.

Dr. Anders Ahlbom of the Karolinska Institute in Stockholm, Sweden, who is advising the NIES on the study, told *Microwave News* that the study's importance will be enhanced by its large number of highly exposed subjects.

The study will include as many as 1,000 children with leukemia and 500 with brain cancer, with each case matched to three controls, the *Mainichi Shinbun*, a leading newspaper, reported on April 20. The institute has not yet released details of the project's expected cost.

Researchers at the NIES and at Tokushima University will be responsible for the EMF exposure assessment, as well as for the evaluation of other possible risk factors, including air pollution, radon and medical radiation exposures.

The study will be part of a national research effort on the potential health effects of non-ionizing radiation that was launched last year in response to growing public concerns (see *MWN*, M/J98).

The NIES said that it plans to exchange information with the World Health Organization's International EMF Project in Geneva as the study proceeds.

The one remaining elevated risk found by McBride was that for children living near high voltage power lines. The adjusted ORs for those whose homes were within 50 meters of a transmission line of at least 50 kV were 1.31 and 1.65 for all types of leukemia and for ALL, respectively. For children living within 100 meters, the ORs were 1.81 for all leukemias and 1.99 for ALL. These results were not statistically significant and had large CIs—due to the small number of cases. There were seven cases and four controls within 50 meters and 14 cases and seven controls within 100 meters of power lines of at least 50 kV.

McBride pointed out that the cancer risk was higher at distances greater than 50 meters from a power line. But one of her coauthors, Dr. Gilles Thériault, was not swayed by this apparent inconsistency. "When you have so few cases, you expect variation," he told *Microwave News.* "You cannot put much weight on this lack of dose-response." Thériault is the chair of the Department of Epidemiology, Biostatistics and Occupational Health at McGill University's medical school in Montreal.

"A review of the literature shows that those living in houses that were next to high voltage transmission lines have a fairly constant risk," Thériault said. "We keep observing this anomaly."

One of the most important studies to show a link between living near transmission lines and cancer among children is the Swedish, Feychting-Ahlbom study (see *MWN,* S/O92). But Gallagher commented that he prefers his and the NCI's strategy of investigating the myriad possible causes of cancer. "We want to know what is causing childhood leukemia, while the European studies are only looking at EMFs."

In addition to measuring electric and magnetic fields, the Positron dosimeter also captures high frequency transients (see *MWN,* M/A94 and N/D94). The McBride paper did not detail any results based on transient exposures. "We have taken an initial look at the transient data and we plan to publish them," she said. "But there does not seem to be much exposure."

Initial funding for the study came from the Canadian government, through the federal agency Health Canada. Later, the Canadian Electricity Association (CEA) paid for half of the study's total cost, and half of the CEA share was paid by the U.S.' EPRI. "We sent a report to our sponsors a year ago," McBride said.

Two additional papers have been prepared. The first, which addresses exposure variability in the personal measurements, will appear in the June 1999 issue of the *Scandinavian Journal of Work, Environment & Health.* The lead author is Dr. Jan Deadman of McGill University. The second, which is in review at the same journal, looks at the use of statistical modeling to predict lifetime exposures. The lead author of this paper is Dr. Ben Armstrong of the London School of Hygiene and Tropical Medicine in the U.K.

Multinational Meta-Analysis on Childhood Leukemia Due Next Year

The McBride childhood leukemia data are included in a meta-analysis being carried out by Drs. Anders Ahlbom and Maria Feychting of the Karolinska Institute in Stockholm in collaboration with an international group of researchers.

The meta-analysis combines epidemiological studies from nine countries—Canada, Denmark, Finland, Germany, New Zealand, Norway, Sweden, the U.K. and the U.S.—Ahlbom told *Microwave News.* He said that it should be completed by January 31, 2000.

The National Cancer Institute study headed by Dr. Martha Linet is the single U.S. study to be part of the multinational meta-analysis, which is being funded under a contract from the European Community (see *MWN,* J/F96).

In a separate meta-analysis of 15 EMF–childhood leukemia studies, published at the end of 1998, Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, found "relatively strong and consistent support for a somewhat weak elevated risk" (see *MWN,* J/F99).

At the request of *Microwave News,* Wartenberg added the McBride data and recomputed the risks. He found only small changes. The odds ratio for wire code risks went down approximately 10%, he said, while there was no change in the risk associated with spot measurements. For calculated fields, the odds ratio decreased but the association became statistically significant because of the larger number of cases.

"Unless we get an additional study with either extremely different results or an extremely large sample size, we are unlikely to see a substantial change in the average effect," Wartenberg said.

Revised Table 6 in McBride AJE Paper

The revised data presented below were provided to *Microwave News* by Mary McBride. The errors in Table 6 of the published paper *(AJE,* p.839) were first pointed out by Dr. Nancy Wertheimer. McBride will be publishing a correction in the *AJE.*

Wire configuration code of residence two years before diagnosis/reference	Cases	Controls	Odds Ratio	95% Confidence Interval	Adjusted Odds Ratio*	95% Confidence Interval
Underground	59	44	1.00			
Very low current	57	69	0.61	(0.35-1.08)	0.59	(0.31-1.09)
Ordinary low current	60	60	0.75	(0.42-1.34)	0.72	(0.38-1.35)
Ordinary high current	74	83	0.66	(0.38-1.17)	0.69	(0.37-1.28)
Very high current	24	22	0.84	(0.40-1.75)	0.70	(0.31-1.56)

*Adjusted for maternal age at birth of subject, maternal education, household income, ethnicity and number of residences of subject since birth.

Letters to the Editor

Carlo Defends WTR's Record

May 15, 1999

To the Editor:

Enough is enough!

Your pattern of libelous and uninformed commentary, "reporting" and editorializing on the activities of Wireless Technology Research (WTR) over the past six years has reached a new level of absurdity with your most recent attack (see *MWN*, M/A99). While I personally have refrained from dignifying your ad hominem attacks on me with any response, I am compelled to set the record straight as you have now attempted to impugn the reputations of my colleagues Drs. Don McRee and Graham Hook, Joshua Muscat, the American Health Foundation and Integrated Laboratory Systems (ILS).

First, the letter you published from Drs. Lai and Singh in your latest issue is a mesh of innuendo, half-truths and outright lies about WTR, Drs. McRee and Hook, and ILS. That you should publish such a long letter without first allowing those who are mentioned in it a chance to respond takes the letter out of the realm of "letter to the editor" and into the realm of reporting. Further, the reporting over the years in your own newsletter substantiates that you knew or should have known of the inaccuracies before you published it. What is your motive?

Second, your position that I would "dangle" positive results in front of your reporter to induce "a major story" to help secure follow-up funding for WTR is preposterous on its face and self-aggrandizing on your part. In your May/June 1997 issue, you reported that the WTR program would end in the middle of 1999 and that I had been asked by the industry and agreed to stay on until that time. You knew in 1997 that my tenure at WTR would be up this year and that the future of WTR was in the hands of the industry, not mine. Nothing has changed, so why report otherwise?

Third, your implication that the evidence of "genetic damage has been around for a long time, and WTR never seemed too worried before" betrays the fact that no one anywhere in the world has been able to substantiate the peculiar findings of Lai and Singh regarding genetic damage from RF, although many scientists have tried, including Lai and Singh themselves. That your bias in reporting shows through is no surprise, but your pattern of frivolously playing with the emotions and concerns of millions of consumers who use cellular phones borders [on the] criminal.

Fourth, your attempt to create a controversy regarding the interpretation of the Muscat study to support your thesis that WTR is "crying wolf" is ridiculous. When the peer-review process is completed and the study is made public, those data will speak for themselves. Joshua Muscat and I are not in disagreement about the findings, as will be abundantly clear.

Fifth, your assertion that the credibility of WTR rests with funding disclosures to you is outright arrogance. Since its inception, WTR has been subjected to the most rigorous of annual audit procedures, mandated by the industry, implemented by top accounting firms and reported to the industry by an independent audit committee. Furthermore, in your newsletter you have published WTR research expenditure information every year since 1995, and in significant detail. You have repeatedly refused to come to WTR and review our material and learn about our program. Your "reporting" with respect to WTR is therefore uninformed and just plain wrong.

Overall, your treatment of the very important public issue of the potential health impact of wireless technology amounts to theater masquerading as journalism. You have attempted to propagate this controversy in the same manner you have propagated the controversy regarding power lines—all presumably to sell newsletters and to promote yourself as a television news personality.

You have continuously overlooked the important contributions of both WTR and the wireless industry. You have derogated the wireless industry, who, in an unprecedented manner for business, has voluntarily and publicly assumed the responsibility for health impacts from their products and services. The mechanism they chose, including surveillance and research through WTR, was developed in concert with the Food and Drug Administration, the government's Interagency Working Group on RF and the reasoned recommendations of a congressionally mandated report by the General Accounting Office. This is a model that should be emulated.

The process has worked, the necessary science continues to unfold and the public continues to be protected. That should be your bottom line.

George Carlo, PhD, MS, JD
Chair, Wireless Technology Research
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Carlo Accuses Lai and Singh of Libel

In a May 14 letter to Dr. Richard McCormick, the president of the University of Washington, Seattle, WTR's Carlo called the Lai-Singh letter to *Microwave News* "libelous." Carlo charged that the two university researchers engaged in "a pattern of slanderous conduct" over the past several years.

In his four-page letter, Carlo disputed the factual accuracy of Lai and Singh's account of their dealings with WTR, and requested a meeting with McCormick "to discuss this very serious problem" in order "to resolve this outside of the courts." Carlo has circulated this letter widely to the press.

An assistant to McCormick told *Microwave News* in early June that a "formal review" is under way and that no meeting has yet been scheduled.

Chou Issues Clarification

May 27, 1999

To the Editor:

I would like to clarify the statements made in the Lai and Singh letter concerning my involvement with the WTR-sponsored DNA study (see *MWN*, M/A99).

1) Before I left the City of Hope, which was after my three-year WTR contract expired on April 16, 1998, I made all necessary arrangements to ensure that our obligation in exposing animals was fulfilled. I made two trips to the City of Hope during May and June of 1998 to check on the progress of the extended contract. There was no problem with our part of the contract.

2) A WTR representative was our quality assurance [QA] monitor, according to good laboratory practices. Following the contract, the exposure results including the codes were submitted to WTR. John McDougall, who exposed the rats, was the only one from the City of Hope who knew the codes. After he signed the data sheets, they were turned over to the WTR QA monitor. My departure did not alter the submission process.

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NAS–NRC Panel Members on Press Release on 1996 EMF Report: "We Had No Input"

One of the most controversial aspects of the release of the National Academy of Sciences-National Research Council's (NAS–NRC) report, Possible Health Effects of Exposure to Residential Electric and Magnetic Fields, *on October 31, 1996, was the academy's press release. At the time, a number of the members of the NAS–NRC panel complained that the press release did not properly reflect the substance of the report (see* MWN, *N/D96). A few weeks later, seven members of the 16-member panel made their views known directly to Dr. Bruce Alberts, the president of the academy (see* MWN, *J/F97). The full text of their letter, which was recently obtained by* Microwave News, *is reprinted below.*

January 2, 1997

Dear Dr. Alberts:

As members of the NAS–NRC Committee on the Possible Biological Effects of Electromagnetic Radiation, we write to express our concern over the press efforts associated with our report and to recommend a strategy to lessen the chance of a similar occurrence with other reports.

Our report addressed a fairly controversial issue of concern to scientists and the public. In our view, the press releases (both hard copy and video) tended to emphasize one aspect of the committee's conclusions rather than providing a more balanced presentation, and the news reports reflected this. Even the headline on the video release misrepresented the results: "New Report Finds No Evidence of Health Hazard from Residential Electromagnetic Fields." Certainly we found evidence; the debate was on the reliability and consistency of these data. The specific wording contained in the report, which we all stand by, was arrived at after careful review, consideration and negotiation. We believe that people not involved in the committee process were not sufficiently sensitive to the careful crafting of the report and the importance of nuance and specific wordings arrived at by the committee. In-depth reporters who compared the report to the press release noted the disparity and, in some cases, questioned the credibility and objectivity of the NAS–NRC on this issue. It has put us as committee members in an awkward position of being asked to explain the contradictions.

Given the concern over the possible misinterpretation of our study, at least three committee members asked to be involved in the review of all public release materials well in advance of the release, in addition to the committee chair and cochair. Two were not involved and one involved only days before the release, and major concerns were not addressed. The result was that nearly half of the 16-member committee was dissatisfied with the final release materials, over which we had no input. Is there some action the NAS–NRC can take to give the public a more balanced understanding of the report? We look to you for suggestions.

In addition, we have one recommendation. For developing press release or public informational documents related to the release of future reports, we urge you to involve any and all interested committee members in the review process at the same time as the committee chairs and cochairs. While this does increase the complexity of the logistics, it will result in better and more accurate press materials.

As the NAS–NRC continues to take on cutting edge, controversial issues, abiding by the fragile consensus carefully crafted by committee members is increasingly important.

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"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• The EPA delays the release of its proposed RF/MW radiation exposure guidelines, citing an "internal debate." The agency's assistant administrator indicates that the guidance may be abandoned.

• After exposing rats to 2.45 GHz radiation, Drs. Don McRee and H.G. Davis of the NIEHS find that local SARs in the brain can be two-to-three times higher than whole-body SARs.

• Dr. Mays Swicord of the FDA and Dr. Christopher Davis and Glen Edwards of the University of Maryland report that microwave radiation can cause "direct excitation of the DNA molecule" at 8-12 GHz.

Years 10 Ago

• Antoinette Yannon settles with RCA Corp. for $250,000 to conclude a 13-year wrongful death suit. She charged that 15 years of microwave exposure from RCA's relay equipment at the New York Telephone Co. gave her husband, Samuel Yannon, the neurological disease that killed him.

• BC Hydro offers to buy the homes of those living along a right-of-way on which it has built a new 230 kV power line. The Canadian utility says that it will put any property it buys back on the market.

• Paul Brodeur publishes a three-part series in *The New Yorker* addressing health, scientific and political issues related to EMFs from power lines, radar and VDTs.

Years 5 Ago

• Utility companies win three EMF lawsuits in a row, prompting a Georgia Power Co. lawyer to comment that, "The plaintiffs' bar should look long and hard before bringing another one of these cases."

• The U.S. military nears completion of a transmitter in Alaska that will use powerful RF radiation to modify the ionosphere for possible military applications. The project is known as HAARP, or the High Frequency Active Auroral Research Program.

• Digital mobile phone radiation affects the duration of, and the brain waves associated with, REM sleep, German scientists Drs. Klaus Mann and Joachim Röschke discover.

Hot New Papers

Christoffer Johansen, Nils Koch-Henriksen, Søren Rasmussen and Jørgen Olsen, "Multiple Sclerosis Among Utility Workers," ***Neurology, 52,*** **pp.1,279-1,282, April 12, 1999.**

"Although MS is a relatively common, chronic neurologic disease in young and middle-aged adults, its causes remain largely unknown; nevertheless, the evidence from epidemiologic studies seems consistent with an environmental influence occurring on a background of genetic susceptibility. Our results do not support the hypothesis that EMFs are one of the environmental agents that play a significant role in the etiology of MS."

Jan Walleczek, Esther Shiu and George Hahn, "Increase in Radiation-Induced *HPRT* Gene Mutation Frequency After Nonthermal Exposure to Non-Ionizing 60 Hz Electromagnetic Fields," ***Radiation Research, 151,*** **pp.489-497, April 1999.**

"Our findings should not be linked to the health concerns raised by recent epidemiological surveys, since the flux densities we applied were higher by three orders of magnitude than those ($B_{rms} \approx 0.3$-$0.4\ \mu T$ [3-4 mG]) that were found to be associated with small increases in cancer rates. On the other hand, while the flux densities tested here are well above residential exposure levels, they are near or within the recommended safety limits for occupational exposures to magnetic fields. In summary, our results are the first to suggest that moderate levels of at least one type of non-ionizing field, oscillating 60 Hz magnetic fields of about 1 mT [10 G], may enhance mutagenesis in a mammalian cell system. Future studies should investigate whether such magnetic fields can act as an enhancer of *HPRT* gene mutations in conjunction with DNA-damaging agents other than ionizing radiation, such as environmental chemical genotoxins."

S. Velizarov, P. Raskmark and S. Kwee, "The Effects of Radiofrequency Fields on Cell Proliferation Are Nonthermal," ***Bioelectrochemistry and Bioenergetics, 48,*** **pp.177-180, February 1999.**

"Since the changes in cell proliferation due to [GSM] MW radiation [at an SAR of 2.1 mW/Kg] are of the same order of magnitude at both temperatures [35°C and 39°C], there must be another mechanism that initiates the cell cycle reactions. The induction of stress to the cells could be related to an increased release of stress proteins, e.g., heat shock proteins (hsp), which need not be induced by heat only....Others applying RF/MW radiation at much higher power levels and prolonged exposure times did not find a change in hsp level after exposure. However, in these studies very long exposure times were used, in some cases up to one week. EMF exposure causes only transient effects and long exposure times (hours, days) could result in a kind of adaptation, so that small changes may not be detected." (See also p.9.)

B. Nelson, D. Snyder and P. Shaw, "Developmental Toxicity Interactions of Salicylic Acid and Radiofrequency Radiation or 2-Methoxyethanol in Rats," ***Reproductive Toxicology, 13,*** **pp.137-145, March/April 1999.**

"Combined exposure to RF radiation (10 MHz) and the industrial solvent 2-methoxyethanol (2ME) produces enhanced teratogenicity in rats. [See *MWN*, N/D91.] The purpose of the present research was to determine if the synergistic effects noted for RF radiation and 2ME are generalizable to other chemicals. Since salicylic acid (SA) is widely used as an analgesic and is teratogenic in animals, SA was selected to address generalizability. Based on the literature and our pilot studies, 0, 250 or 350 mg/Kg SA were administered by gavage on gestation Day 9 or 13 to rats. Concurrently, rats given SA on Day 9 were exposed to RF radiation sufficient to maintain colonic temperature at 41°C for 60

Two Assessments: Little Evidence for RF/MW Radiation-Cancer Link

J.E. Moulder, L.S. Erdreich, R.S. Malyapa, J. Merritt, W.F. Pickard and Vijayalaxmi, "Cell Phones and Cancer: What Is the Evidence for a Connection? (A Review)," ***Radiation Research, 151,*** **pp.513-531, May 1999.**

"A biophysical evaluation indicates that it is implausible to expect that cell phone RF radiation would have biological activity at the subthermal power levels characteristic of the current generation of cell phones. The published epidemiological studies of RF radiation do not suggest a causal association, but the studies are few and all suffer from deficiencies in exposure assessment. Cellular studies have largely been limited to genotoxicity testing. Although a few of these studies have suggested the possibility of genotoxicity, the weight of evidence is that RF radiation is not genotoxic. Assessment of the epigenetic potential of RF radiation in cell culture has been minimal, and the results are equivocal at best. The studies of long-term exposure of animals present no compelling evidence that long-term exposure has a negative impact on overall health and show no convincing evidence that RF radiation is genotoxic in animals. However, some of the studies of long-term exposure suggest the possibility that RF radiation may have epigenetic activity, particularly at high exposure levels. A weight-of-evidence evaluation indicates that the evidence for a causal association between exposure to RF radiation and cancer is weak. However, relevant data in some areas are sparse. In particular, the epidemiological evidence is limited, and there is little immediate prospect for improvement, since highly exposed populations are relatively small and assessment of exposure remains a serious problem. The studies of long-term exposure of animals are also relatively weak.... It is often stated that the risks from exposure to RF radiation, even if real, are too low to be of significance to public health. However, if the cancer risks suggested by some of the studies were real, then RF radiation could conceivably be a significant environmental cause of cancer."

Mark Elwood, "A Critical Review of Epidemiologic Studies of Radiofrequency Exposure and Human Cancers," ***Environmental Health Perspectives, 107, Supplement 1,*** **pp.155-168, February 1999.**

"The studies individually are weak and, as a consequence, the results cannot be easily interpreted in terms of cause and effect. The major impression from these studies is their inconsistency. There is no type of cancer that has been consistently associated with RF exposures. The epidemiologic evidence falls short of the strength and consistency of evidence that is required to come to a reasonable conclusion that RF emissions are a likely cause of one or more types of human cancer. The evidence is weak in regard to its inconsistency, the weak design of the studies, the lack of detail on actual exposures and the limitations of the studies in their ability to deal with other likely factors, and in some studies there may be biases in the data used. Whereas the current epidemiological evidence justifies further research to clarify the situation, there is no consistent evidence of any substantial effect on human cancer causation."

min (or sham). Those given SA on Day 13 were also given 0 or 100 mg/Kg 2ME (gavage). Dams were sacrificed on gestation Day 20, and the fetuses were examined for external malformations. The data provide no evidence of synergistic interactions between RF radiation and salicylic acid (resorptions and malformations)." (See also B. Nelson et al., "Effect of Environmental Temperature on the Interactive Developmental Toxicity of Radiofrequency Radiation and 2-Methoxyethanol in Rats," *International Archives of Occupational and Environmental Health, 71,* pp.413-423, 1998.)

G. Boorman, L. Anderson et al., "Effect of 26-Week Magnetic Field Exposures in a DMBA Initiation-Promotion Mammary Gland Model in Sprague-Dawley Rats," *Carcinogenesis, 20,* pp.899-904, May 1999.

"The present study does not support the hypothesis that magnetic field exposure enhances breast cancer growth in the DMBA rat breast cancer model. In fact, there were fewer rats with tumors in the 1 G, 60 Hz exposure group compared with DMBA controls. When all carcinomas were considered, the total number of carcinomas induced was lower in all magnetic field exposure groups and this was significant for the 1 G, 50 Hz and 60 Hz exposure groups....While this data is not sufficient to establish a definitive protective effect, it does suggest that we are not missing a subtle promoting effect of magnetic fields....These data are, in part, inconsistent with studies suggesting that magnetic field exposure may promote chemically induced breast cancer in rats....The positive effects reported by Löscher and colleagues were often an earlier onset of tumors or an increase in tumor size. There are also differences between the studies of Löscher and colleagues and the present study...." (See also *MWN,* M/A98 and M/J98.)

Bu-Tian Ji et al., "Occupation and Pancreatic Cancer Risk in Shanghai, China," *American Journal of Industrial Medicine, 35,* pp.76-81, January 1999.

"The most consistent finding in our study was the positive association between employment as an electrician and pancreatic cancer. Over a sevenfold overall risk was observed and the [odds ratio] rose to 9.3 for subjects with more than 35 years of employment among men. In addition, intensity and probability of EMF exposure, as estimated by a [job exposure matrix], were associated with risk. However, no such consistent excesses were found among women because of the small number of female cases who were electrical and electronics workers or exposed to high levels of EMFs. Electrical or electronics worker was the most frequent job category among those with high intensity of EMF exposure (24 of 28 exposed men and 14 of 15 exposed women had at least one job related to electrical or electronics work). A possible explanation for the increased risk among electricians may be related to EMF exposures, although other exposures related to electrical machinery manufacturing are possible, such as solvents, solder fumes and cutting oils."

Artnarong Thansandote, Gregory Gajda and David Lecuyer, "Radiofrequency Radiation in Five Vancouver Schools: Exposure Standards Not Exceeded," *Canadian Medical Association Journal, 160,* pp.1,311-1,312, May 4, 1999 (the paper is also available on the Internet at:<www.cma.ca/cmaj/vol-160/issue-9/1311.htm>).

"Although the purpose of the survey was to determine the actual levels of RF radiation in the analog (first-generation cellular phone) and personal communications services (PCS, the new generation of digital cellular phone) cellular base-station frequency bands, measurements also covered AM, FM and TV broadcast frequencies where possible....The measureed power densities did not exceed the safety code limits. In light of the current scientific understanding of the risks of RF radiation exposures, we conclude that the levels measured during our study posed no health risk to the students, school staff or the general public in or around the five Vancouver schools involved."

Clippings from All Over

"What we don't want to do two, three, four years from now is to say, 'God—this was the tip of the iceberg, and we didn't see it!'"

—Dr. George Carlo, chair, Wireless Technology Research, Washington, on the need for continued research into possible health effects of mobile phone radiation, quoted by John Schwartz (who notes that Carlo uses a cell phone with a plug-in earpiece, allowing him to talk without holding the phone to his head) in "Study: Cell Phone Use May Have Cancer Link," *Washington Post,* p.E2, May 22, 1999

What is remarkable is how little public anxiety has been generated by almost a year of health scares about [mobile telephones]. Despite being told that they might give us cancer or cause memory loss, we have just gone out and bought them in record numbers....

—Matt Ridley, in a column, "Mobile Phones Dangerous. Ah, Well...," *Daily Telegraph* (U.K.), April 12, 1999

"Concerns have been raised that the precautionary principle may be too simplistic to guide decision makers facing complex choices involving technologies with uncertain risks, benefits and costs to current and future generations."

—Dr. John Graham, Harvard Center for Risk Analysis, Boston, in a May 1999 press release announcing the center's workshop, *The Precautionary Principle: Refine It or Replace It?,* held June 3-4 in Washington (the featured speaker in a session on EMFs was Dr. Ralph Keeney of Pros and Cons Consulting in San Francisco and the discussants were Drs. Leeka Kheifets of EPRI in Palo Alto, CA, and Timothy McDaniels of the University of British Columbia in Vancouver, Canada)

One of the prominent features of the recent *Annual Meeting of the Society of Toxicology* in New Orleans was the debate on a hypothetical motion to have the results of mechanistic toxicity studies supersede ambiguous epidemiological data in chemical risk assessments for humans....The motion implies that one should choose either weak epidemiology data or mechanistic information. However, both mechanistic data and epidemiological findings are often suggestive, but not conclusive, when taken alone. With this in mind, it seems imprudent to discard one set of inconclusive data for another set of inconclusive data. Instead, scientists and policy makers should attempt to integrate all of the available data into health risk assessments.

—Dr. George Lucier, director, Environmental Toxicology Program, National Institute of Environmental Health Sciences (NIEHS), Research Triangle Park, NC, in an editorial, "Why Not Use It All?," *Environmental Health Perspectives* (published by the NIEHS), p.A232, May 1999 (the editorial is also available on the Internet at: <http://ehpnet1.niehs.nih.gov/docs/1999/107-5/editorial.html>)

"My seven-year-old will start school in the fall, and he's already worried that he'll be the only kid in first grade without a phone."

—Olli Martikainen, Helsinki University of Technology, Finland, quoted by T.R. Reid in "Letter from Finland: A Cell Phone in Every Pocket," *Washington Post,* p.C3, May 26, 1999

"I wouldn't let a child sleep up under an old electric blanket or put a motorized alarm clock beside their bed. My feeling is there is no risk here, but there are these little nagging things."

—Dr. Richard Gallagher, British Columbia Cancer Agency, Vancouver, Canada, quoted by Margaret Munro in "Home, Dangerous Home," *National Post* (Canada), p.A17, April 27, 1999 (see p.1)

Sir, "Mobile Phones 'Quicken the Brain'," *(Times* headline, April 8, 1999). At last I know how my student son manages to do nothing much but still gets results.

—Christopher Balkwill, Abingdon, Oxfordshire, U.K., in a letter to the editor, the *Times* (U.K.), April 13, 1999 (see *MWN,* M/A99)

UPDATES

EXPOSURE ASSESSMENT

EMFs in Transportation...A new survey of EMFs encountered in various transportation systems includes assessments of both gasoline- and electric-powered cars, trucks and buses, passenger aircraft, ferryboats and self-powered electric commuter trains. Sponsored by the U.S. Department of Transportation (DOT) and the RAPID research program, the study was conducted by Electric Research, a consulting firm based in State College, PA. Interestingly, it concludes that electric cars have field levels "similar to their conventional internal combustion counterparts," based on prototype electric vehicles with technology similar to that of those now coming into mass production. For both gasoline- and electric-powered cars and light trucks, the fields were predominantly below 60 Hz, and "magnetized steel belts in radial tires appeared to be the common dominant source." (See also a letter by Dr. Samuel Milham on EMF exposure from steel-belted radials, *MWN*, M/A98.) Fields above 60 Hz were stronger in some electric cars than in their gasoline-powered kin, but were still "only a minor part of the total field environment" within the car and were largely localized around travelers' ankles. Passenger jets were the only form of transportation that showed substantial fields above 300 Hz, due to the fact that the AC power used onboard aircraft operates at 400 Hz. By far the highest magnetic fields (and the only significant electric fields) were found in the self-powered commuter train, the only type of transit that produced high readings at 60 Hz. In all systems, fields varied widely with both time and location within a vehicle. Electric Research previously assessed EMFs for DOT in subway systems, passenger trains and an experimental maglev train (see *MWN*, J/A93). Its new study, *Survey and Assessment of EMF Public Exposure in the Transportation Environment* (Report No.PB99-130908) can be ordered for $51.00 (or $23.00 for microfiche) from: National Technical Information Service, Springfield, VA 22161, (703) 605-6000, Fax: (703) 605-6900, Web: <www.ntis.gov>.

MEETINGS

URSI Preview... Four different sessions will address mobile phone health risks at the International Union of Radio Science's (URSI) general assembly in Toronto, Canada, the week of August 16. On the 17th, speakers from three continents will be featured at "Hazard Assessment for Wireless Communication," chaired by Italy's Dr. Paolo Bernardi and France's Dr. Bernard Veyret. On the 18th, Drs. Ross Adey of the U.S., E. Bonek of Austria and Niels Kuster of Switzerland will present a session titled "Health Effects of Mobile Telephones." On the 19th, Drs. Om Gandhi and Yahya Rahmat-Samii, both of the U.S., will chair "Computation of EMFs in the Human Body." And on the 20th, the U.S.'s Dr. C.K. Chou and Japan's Dr. Masao Taki will host "Exposure Assessment for Cellular and Personal Telecommunications." The emphasis on wireless communications health research follows a resolution adopted by URSI's Commission K on Electromagnetics in Biology and Medicine at the Kyoto, Japan, meeting in 1993 to promote a "broad-based research program" (see *MWN*, N/D93). URSI general assemblies are held every three years. Other noteworthy sessions include two on the bioeffects of EMFs and one on biomedical applications. In ad-

dition, on August 20, there will be a session on EMI with medical devices. The URSI meeting will be held at the University of Toronto. For more information, contact the URSI management office at (613) 993-7271, by E-mail at <ursi99@ nrc.ca> or on the Internet at <www.nrc.ca/confserv/ursi99/welcome.html>.

PEOPLE

Dr. **James Lin** of the University of Illinois, Chicago, has been elected to the National Council on Radiation Protection and Measurements (NCRP), which is based in Bethesda, MD. Among those reelected were: **Ronald Petersen** of Lucent Technologies/ Bell Labs in Murray Hill, NJ, Dr. **Paul Slovic** of Decision Research in Eugene, OR, and Dr. **Marvin Ziskin** of the Temple University School of Medicine in Philadelphia....Dr. **Ron Cameron** has taken over from Dr. **Colin Roy** as editor of the *Journal of the Australasian Radiation Protection Society*....**Tim Ayers** has left the CTIA, where he was vice president for communications, to become the president of North Light Public Affairs, an offshoot of North Light Communications in College Park, MD. Among the parent group's clients are the American Institute of Physics and the Chemical Manufacturers Association.

VISIBLE LIGHT

Myopia and Light-at-Night... Children who had slept in a room with a night-light before the age of two were more likely to become nearsighted, according to a study by researchers at the University of Pennsylvania Medical School in Philadelphia. Those who slept in a fully lighted room were even more likely to become myopic. " The absence of a daily period of darkness during early childhood" appears to increase the risk of nearsightedness, Dr. Graham Quinn and colleagues reported in the May 13 issue of *Nature (399,* pp.113-114, 1999). The study, based on 479 children aged 2-16, found no link to the level of nighttime light after the age of two. Only 10% of children who had slept in darkness before they were two were later found to be myopic. For children who had slept with a night-light, the figure jumped to 34%. Among those who had slept with a room light on before the age of two, a majority—55%—are nearsighted today. The data show a strong dose-response relationship. The risk of nearsightedness increased with increasing light, in a trend that is extremely significant (P<0.00001). The University of Pennsylvania team cautioned that these findings do not prove a causal connection: For example, it is not known whether parents' lighting preferences might have been related to known risk factors for nearsightedness, such as socioeconomic status or their parents being nearsighted themselves. But the researchers pointed out that a link between light-at-night and nearsightedness is biologically plausible. Myopia "commonly arises from excessive postnatal eye growth," they explained, and the length of daily exposure to light has been shown to affect eye growth in chicks. Myopia in humans usually does not occur before the age of two, but it has been shown that in various animal species "early neonatal visual experience markedly affects refractive development." Although the case is not closed, Quinn and colleagues wrote, for the time being "it seems prudent that infants and young children sleep at night without artificial lighting in the bedroom."

More 1999 Conferences

August 13-16: **6th Annual Michaelson Research Conference,** Cloudcroft, NM. Immediately preceding the meeting, August 11-12, the U.S. Air Force will sponsor a **Workshop on Infrared and Millimeter Waves.** For more information, contact: Dr. Eleanor Adair, AFRL/HEDR, 8308 Hawks Rd., Brooks AFB, TX 78235, (210) 536-4698, Fax: (210) 536-3977, E-mail: <eleanor.adair@aloer.brooks.af.mil>.

September 16-17: **Mobile Telephones and Health: An Update on the Latest Research,** Radisson SAS Scandinavia Hotel, Göteborg, Sweden. Contact: Les Wilson, Microshield Industries, 59 Southbury Rd., Enfield EN1 1PJ, U.K., (44+181) 363-3333, Fax: (44+181) 372-3232, E-mail: <microshld@aol.com>, Web: <www.microshield.co.uk>.

October 4-6: **Effects of Electromagnetic Fields on the Living Environment,** Munich, Germany. A seminar hosted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the World Health Organization (WHO) and the German Federal Office of Radiation Protection. For more information, contact: R. Matthes, Institut für Strahlenhygiene, Bundesamt für Strahlenschutz, Ingolstädter Landstrasse 1, D-85764 Oberschleißheim, Germany, (49+89) 31603 288, Fax: (49+89) 31603 289, E-mail: <rmatthes@bfs.de>, Web: <www.icnirp.de> or <www.who.int/emf/>.

November 21-24: **Biological Effects, Health Consequences and Standards for Pulsed Radiofrequency Fields,** Erice, Sicily, Italy. A seminar sponsored by ICNIRP and the WHO. On November 26, there will be a **WHO EMF Research Coordination Meeting** and on November 27 a **WHO EMF Standards Harmonization Meeting.** For more information, see October 4-6 above or contact: Dr. Michael Repacholi, WHO, 1211 Geneva 27, Switzerland, (41+22) 791-3427, Fax: (41+22) 791-4123, E-mail: <repacholim@who.int>.

Keeping Current: Follow-Up on the News

◆ The IEEE's Committee on Man and Radiation (COMAR) has drafted a "Technical Information Statement" on *Possible Health Hazards from Exposure to Power Frequency Electric and Magnetic Fields.* The text and the list of contributors are available at <www.eece.ksu.edu/~rdmiller/COMAR60HZ.html>.

◆ For those who will not be attending the annual meeting of the Bioelectromagnetics Society in Long Beach, CA, June 20-24, the abstracts are up on the Web at <www.bioelectromagnetics.org>. Paper No.15-6 is especially noteworthy.

◆ The May 21 *Wall Street Journal* reports that the FAA is now advising airlines to allow their passengers to use mobile phones "anytime the aircraft is stationary and is going to remain stationary." However, FAA rules still leave the decision on whether to permit cell phone use to the discretion of the captain (see *MWN*, S/O96).

◆ In an editorial in its May 26 issue, the *Irish Times* called for a national research effort on mobile phone safety. "It is not appropriate that this work fall to scientists and institutions working abroad," the paper declared, noting that there are some one million wireless phone users in Ireland. While suggesting that the Irish government "could take a more proactive role" in getting answers to the public, the *Times* called on telecom companies to fund the research.

◆ After issuing mobile phones equipped with earpieces to employees of his company, the Virgin Group (see *MWN*, N/D98), the U.K.'s Richard Branson has decided to sell phones that will include this exposure-reducing device as a standard feature, the U.K.'s *Times* reported on June 7. The phones, which Virgin will market in a joint venture with the U.K. wireless carrier One 2 One, are expected to go on sale before Christmas.

As We Go to Press

The National Institute of Environmental Health Sciences (NIEHS) has announced that it will release its long-awaited report to Congress on the RAPID EMF health research program on June 15 (see p.8).

The full text of the report will be available on the NIEHS Web site: <www.niehs.nih.gov/emfrapid/home.htm>.

Microwave News will present detailed coverage of the report in its July/August issue.

VIEWS ON THE NEWS

What About EMF Health Risks Above 5 mG?

We hate to spoil the party being organized by the National Academy of Sciences (NAS) and the electric utility industry, but we are not quite ready to toss EMF cancer risks onto the junk science heap.

We do agree with Canada's Dr. Richard Gallagher that his and Mary McBride's study is good news (see p.1). Most children are not exposed to EMFs of over 5 mG, and below 5 mG, the leukemia risk is small, if there is any risk at all at these low levels.

But we also agree with Gallagher that these childhood EMF studies really don't tell us much about what may be going on above 5 mG. As Dr. Gilles Thériault, who collaborated with Gallagher and McBride, told us: "We keep seeing smoke, but have not yet been able to spot the fire." He was referring to those exposed for long periods of time to higher field levels.

The new NAS report on the RAPID program states that only "very few" people are exposed to more than 4 mG (see p.8). In percentage terms, the number is relatively small, but the absolute number is large: One million Americans are routinely exposed to average fields of more than 10 mG and over 5 million to fields of more than 5 mG (see *MWN*, M/J98). This statistic comes from an Enertech survey, one of only two RAPID engineering reports that the NAS panel singled out as noteworthy.

The focus on childhood leukemia was propelled by mothers around the country who demanded answers to power line health questions. Workers, however, who may be exposed to higher levels, have never organized in the same way about their own risks.

This is surprising because meta-analyses by EPRI, the industry's own research arm, indicate a significant increase in both leukemia and brain cancer among workers (see *MWN*, J/F96 and N/D97). The 1996 NAS study that many interpret as dismissing EMF cancer risks conceded that the workplace studies "have increased rather than diminished the likelihood of an association between occupational exposure to [EMFs] and cancer."

And cancer is not the only potential problem. Despite repeated requests, the NIEHS RAPID program never sponsored any studies into Alzheimer's disease and other neurological effects. Those concerns have been left hanging.

No one should forget that the ICNIRP magnetic field limits, touted by industry and the WHO EMF Project as the model standard to be adopted worldwide, allow children to be exposed continuously to 1,000 mG and workers to 5,000 mG. We wonder how many of those who endorse the standard would allow themselves to be exposed to such levels day after day.

It is welcome news that the McBride study does not show a leukemia risk, but that does not mean we should ignore the millions exposed to higher levels both at home and at work.

Mobile Phone Radiation Levels Should Be Made Public

The latest study by Sweden's Dr. Lennart Hardell suggests a possible link between mobile phone use and brain cancer. He cautions against jumping to conclusions, however, and is the first to say that more research is needed.

In the meantime, Hardell has some advice for cellular phone users: Do what you can to reduce your exposure (see p.7). "Ask about the specific absorption rate (SAR) when purchasing a mobile phone," says Hardell, "and buy one with as low an SAR value as possible."

But that is easier said than done. When consumers ask how much radiation they will get from a phone, they cannot get an answer.

Mobile phone manufacturers will not disclose SAR values for the phones they sell. When BBC's *Panorama* pressed a Nokia representative to reveal the numbers (see p.2), he bobbed and weaved around the question—and ultimately refused.

So far, only one company has broken ranks. In 1997, the small German company Hagenuk began an ad campaign featuring the slogan "Low Radiation Is Better" (see *MWN*, S/O97). Hagenuk had reason to brag: In tests by Dr. Niels Kuster of ETH in Zurich, the Hagenuk phone scored the lowest out of 16 mobile phones tested—with an SAR one-fifth as large as the highest-exposure model. It was also one of the least expensive (see *MWN*, N/D97).

But Hagenuk met with unified hostility and pressure from other companies. "I feel threatened by representatives of the industry," said a Hagenuk official in Sweden. And today, the Hagenuk low-radiation phone seems to have sunk from sight.

The industry's standard position is that consumers have no reason to know each phone's SAR, because every phone meets legally required safety standards. That misses the point: The current debate is precisely about whether those standards are adequate. People who are curious about how much radiation their phones emit ought to be able to find out.

Consumers can now choose their favorite color or style of mobile phone—but for a choice that might affect their health, they can't get the information they need.

Hundreds of millions of wireless phones have been sold, and the industry has made billions of dollars in profit. Yet the public is not given the results of tests that the government requires before any phone is allowed on the market.

Intelligent people disagree about whether there is any reason to be concerned about mobile phone health effects. That is precisely why the industry should make SAR numbers public—and let consumers decide for themselves.

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