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Trying To Make Sense of It All

U.K. Parliamentary Panel Seeks Stricter RF Limits, More Research

The Select Committee on Science and Technology of the U.K. Parliament has recommended adoption of much stricter radiation limits. The committee concluded that there is no evidence of a health hazard from mobile phones or from towers but called for increased research on possible health effects.

In a report released by the House of Commons on September 22, the committee asked the National Radiological Protection Board (NRPB) to follow the exposure guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). To do so would entail an 80% reduction in current U.K. limits for the specific absorption rates (SARs) associated with mobile phones.

The U.K. SAR limit, 10 W/Kg, is the most lenient in the world. Even if brought into line with ICNIRP's 2 W/Kg standard, it would still be looser than the U.S. limit of 1.6 W/Kg. The U.K. radiofrequency and microwave (RF/MW) exposure standards are, in general, among the least stringent—and most complex—anywhere (see *MWN*, J/A89 and J/F94).

The NRPB maintains that its RF/MW exposure standards are already strict enough to protect human health, and that no change is needed. Dr. Michael Clark, an NRPB spokesperson, said that Parliament's call for tighter limits was based on "broadly political rather than scientific considerations."

The science and technology committee described the proposed adoption of the ICNIRP limits as "a precautionary measure," and stated that the scientific

(continued on p.10)

EMF Epidemiology Studies: Moving Towards a Clearer Picture

Studies of electromagnetic fields (EMFs) and cancer may seem to be a mess of conflicting evidence. Some residential studies link cancer to measured magnetic fields, some to wire codes, others to neither one. Some occupational studies report an increase in one type of cancer, some in another.

But two new analyses point to a more consistent picture.

Data from ten studies of EMFs and childhood leukemia indicate that the association with measured magnetic fields is "remarkably consistent across studies," according to Dr. Sander Greenland of the University of California, Los Angeles (see p.3).

And an EPRI analysis has found that, when examined together, several large occupational studies "suggest a small increase in risk of both brain cancer and leukemia." The analysis concluded that, "What previously seemed to be important differences in results across studies...may well have resulted from chance fluctuation" (see p.3).

« Power Line Talk »

In a recent keynote address on the biological effects of power line EMFs, Dr. **Russel Reiter** spoke eloquently about the state of the science, but, when pressed to offer policy judgments, he fell silent. Overall, the evidence for health impacts is “not compelling,” he said. “There are clearly no definitive answers.” Speaking at the General Assembly of the International Union of Radio Science (**URSI**) in Toronto in mid-August, Reiter pointed to the “inability to reproduce effects” as the central stumbling block. He cited an example from his own lab at the University of Texas Health Science Center in San Antonio: “We got more dramatic effects when we used ‘dirty fields,’ but when I got a new computer-controlled exposure system from EPRI, it was harder to see effects.” The problem may lie in the uncertainty over the most appropriate exposure metric, Reiter allowed. “The bottom line is that sometimes we don’t know what we are doing.” At the end of the talk, he was asked a series of questions often posed by a concerned public—for example, “Would you use an electric blanket?” Reiter declined to give his opinion. Dr. **Ross Adey** of the University of California, Riverside, followed by asking him to comment on the overlay of politics on the science, specifically as to the NIEHS Working Group’s designation of EMFs as possible human carcinogens (see *MWN*, J/A98). Again, no response. Then, Dr. **Yahya Rahmat-Samii** of the University of California, Los Angeles, posed a question that he said he is asked all the time: “Would you buy a house next to a power line?” Reiter responded that there are two distinct issues: possible health impacts and economic losses depending on public perceptions of the health risks. “In fact,” Reiter continued, “I got a call on this exact question just a few days ago.” What did Reiter tell his caller? “I don’t remember,” he said in a voice that could barely be heard.

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It’s payback time. That’s what the National Institutes of Health (**NIH**) told the **Lawrence Berkeley Laboratory** (LBL) in the wake of the government’s misconduct finding against Dr. **Robert Liburdy**, formerly with LBL (see *MWN*, J/A99). In an August 3 letter to the lab, the NIH’s **National Cancer Institute** (NCI) demanded repayment of an \$804,321 grant to Liburdy. Just five days earlier, NIH Director Dr. **Harold Varmus** had received a letter from Rep. **Tom Bliley** (R-VA), chair of a House committee that oversees the NIH, demanding to know whether the agency was “making any efforts to recover the taxpayers’ money for the NIH grants that supported the falsified studies.” Though Liburdy was not required to retract most of the data or any of the conclusions in the two published papers at issue, the NCI is seeking repayment of the entire research grant. The August 3 letter states that the government “considers the research...to be tainted, voiding any possible utility, as the fabricated and falsified data were central to the research.” Rep. Bliley’s letter cited press reports that Liburdy had received \$3.3 million in federal grants, but NIH’s Varmus wrote back that most of these grants funded research that was unrelated to the misconduct charge. LBL spokesperson Ron Kolb told *Microwave News* that the lab is appealing the repayment demand. Kolb said that

“EMF Health & Safety Digest” To Close Down

In yet another sign of the electric utility industry’s decreasing concern over the EMF issue, Robert Banks has announced that he will close down his consulting company and stop publishing the *EMF Health & Safety Digest* at the end of the year.

The newsletter is part of the EMF Information Project run by Robert S. Banks Associates Inc. in Minneapolis, with support from EPRI, the Edison Electric Institute (EEI) and the American Public Power Association, among others. Banks also organized EMF science seminars for EPRI, at first annually and then every other year. The seminar scheduled for last March was canceled on short notice (see *MWN*, M/A99).

The *Digest* is the last of the electric utilities’ newsletters on EMFs, which once included EEI’s *EMF News* and Central Maine Power’s *EMF Keetrack* and *Between the Lines* (see *MWN*, S/O97).

LBL has already returned the \$361,566 portion of the grant that had not been used. He argued that to require repayment of money already spent would unfairly penalize LBL. But even paying back the entire grant may not be enough to make Bliley happy: His letter suggests he may want to see Liburdy put in jail. “Did the **Office of Research Integrity** [ORI] make any attempt to refer this matter for criminal prosecution?” the congressman asked. Varmus answered that ORI has been advised by the **Office of Inspector General** (OIG) that “it is considering initiating an investigation into this matter,” after which the OIG could make “a referral to the Department of Justice for possible criminal or civil action.”

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A Colorado appeals court has reinstated a lawsuit that seeks damages for “trespass” on private property by power line EMFs. The three-judge panel held that a jury must consider **Mark and Erica Van Wyk**’s claim that “the noise and electromagnetic radiation emanating from the power line unreasonably interfere with their quiet use and enjoyment of their property.” Last year a New York court dismissed a trespass claim in an EMF case on the grounds that the fields “are incapable of being perceived by the senses and, thus, are not...a ‘physical’ invasion” (see *MWN*, J/F98). In the Van Wyk lawsuit against **Public Service Co. of Colorado**, the utility asserted that neither EMFs nor noise from the upgraded line constitute “the type of physical invasion that is required to sustain a claim for trespass.” But that argument was rejected by the Colorado Court of Appeals in Denver in its June 24 decision. The Van Wyks’ suit targets a power line that was upgraded from 115 kV to 230 kV in 1997. The appeals court ordered a trial on their claims that the upgraded line produces loud noises and that “the EMF created by the power line encroaches upon the property owners’ land.”

Utility Worker Studies Do Not Conflict, States EPRI Analysis

A joint analysis of three large studies of utility workers and EMFs has found that their results are much more consistent than originally thought. Dr. Leeka Kheifets of EPRI in Palo Alto, CA, found that, "Overall, the studies suggest a small increase in risk of both brain cancer and leukemia."

Kheifets and colleagues examined data from the largest and most reliable studies of electric utility workers, which some had seen as being at odds. For example, one reported an increase in the risk of leukemia, but not brain cancer, while another found the reverse. But Kheifets concluded that, "Apparent inconsistencies in the findings of these studies can be explained by statistical variation."

Dr. David Savitz of the University of North Carolina, Chapel Hill told *Microwave News* that the balance of evidence on occupational EMF exposure "points more neatly, now, to a small increase in both cancers associated with increasing estimated magnetic field exposure." Savitz led one of the three utility worker studies in the combined analysis (see *MWN*, J/F95).

The other two were Dr. Jack Sahl's study of workers at Southern California Edison (see *MWN*, M/A93 and J/A93) and the Canadian-French study of workers at Hydro Québec, Ontario Hydro and Electricité de France, led by Dr. Gilles Thériault (see *MWN*, M/A94). Sahl, Savitz and Thériault are all coauthors of the Kheifets paper, published in the August issue of *Occupational and Environmental Medicine* (56, pp.567-574).

"What previously seemed to be important differences in results across studies...may well have resulted from chance fluctuation," the researchers wrote. They concluded that, "All studies are compatible with a weak association between magnetic fields and both brain cancer and leukemia," and that this joint analysis "at least slightly strengthened the case for an association."

This is consistent with two meta-analyses of occupational studies led by Kheifets, one on brain cancer and one on leukemia (see *MWN*, J/F96 and N/D97). These studies, which were not confined to utility workers, found statistically significant increases in both diseases.

The pooled data from the utility worker studies point to a 12% increase in brain cancer risk, and a 9% increase in leukemia, per 10 μ T-years. (A μ T-year is a measure of cumulative exposure. A worker exposed to a 2 μ T field for a five-year period, or one exposed to a 0.5 μ T field for a twenty-year period, would each have 10 μ T-years—or 100 mG-years—of exposure.)

"I was struck by the overall consistency in the results," said Sahl, a consultant in Upland, CA. "When you sit down and take a more thoughtful look at them, we find that the studies are really quite similar." But Sahl was reluctant to draw any general conclusions about occupational EMF exposure, noting that, "Other work environments—smelting plants, for instance—are much more complex, in terms of types of EMF exposure and potential confounders."

Thériault emphasized that, "It's always quite difficult to compare different studies." But, he added, "I find it quite fascinating that when you look at the things that you *can* compare, they are

in fact quite compatible."

Kheifets did not respond to requests for comment. EPRI had called for some sort of joint analysis of the utility worker studies soon after the Savitz study was published (see *MWN*, J/F95).

"Consistent" Picture on EMFs and Childhood Leukemia

An analysis of research on EMFs and childhood leukemia has found that the link to measured magnetic fields is "remarkably consistent across studies," according to Dr. Sander Greenland of the University of California, Los Angeles.

Greenland told the annual meeting of the Society for Epidemiological Research (SER) this June in Baltimore that pooled data from ten studies showed no elevated risk of leukemia for children exposed to less than 2 mG—but above that amount, the risk ratio "rose steadily."

In a surprise to many, including himself, Greenland found much wider variation in the results of studies based on wire codes. "This was just the opposite of what I'd been led to expect," Greenland said in an interview. (Wire codes categorize power lines as low- or high-current, based on appearance and proximity.)

The pooled analysis found a higher risk of leukemia for children with higher exposures. Children exposed to 6 mG or more had an 80% greater risk, a statistically significant increase (95% confidence interval=1.1-2.9). But Greenland cautioned against taking one significant finding as definitive: "In all these studies, there's a relative handful of subjects with exposures of 5 mG and above." He stressed that, "This study doesn't establish an effect."

"I view the Greenland analysis as quite persuasive in documenting the inconsistency of wire code studies and the consistency of evidence pointing to magnetic fields," Dr. David Savitz, president-elect of the SER, told *Microwave News*. "There is tremendous imprecision in the interesting part of the dose-response curve, where exposures are highest," noted Savitz, who is at the University of North Carolina, Chapel Hill. "Nonetheless, I think this presents the most strongly positive integrated evidence on magnetic fields and cancer that I've seen."

Greenland's analysis used data from 13 studies, ten of which measured magnetic field levels while six of the 13 used wire codes. "The results from studies using wire codes weren't really very consistent with each other," Greenland said. "They range from somewhere around nothing to something pretty positive."

The pooled analysis has been submitted for publication, said Greenland, who collaborated on the study with Drs. Asher Sheppard, Michael Kelsh and William Kaune.

Sheppard told *Microwave News*, "Our analysis turns topsy-turvy the idea that there is a 'wire code paradox'." Though not conclusive, Sheppard noted, measured-field results showed "a consistent pattern" of higher odds ratios for subjects with the highest exposures. A consultant based in Redlands, CA, Sheppard presented results of the analysis at the June meeting of the Bioelectromagnetics Society in Long Beach, CA.

Dr. Daniel Wartenberg said that these findings are similar to those of his 1998 meta-analysis of 15 childhood leukemia studies (see *MWN*, J/F99). "Results for the studies with calculated

and measured magnetic fields are more consistent than for those with wire codes,” said Wartenberg, of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ. “Wire codes might not be equally applicable in different regions.”

Another meta-analysis of childhood leukemia studies, funded by the European Community, is being conducted by Drs. Anders Ahlbom and Maria Feychting of the Karolinska Institute in Stockholm. Results are expected next year (see *MWN*, M/J99).

A recent childhood leukemia study by Dr. Lois Green of the University of Toronto in Canada pointed in the same direction as Greenland’s combined analysis, finding a link to measured EMFs but not to wire codes (see *MWN*, J/A99). Another Canadian study, by Dr. Mary McBride of the British Columbia Cancer Agency in Vancouver, did not find a link to either one (see *MWN*, M/J99). Greenland said that his analysis did not include the McBride or Green studies, but that their published data did

not suggest that either would have had a dramatic effect on his results. Data from Dr. Martha Linet’s study for the National Cancer Institute was included, and Greenland said that this “fit right in with all the rest” (see *MWN*, J/A97).

Greenland said that progress towards more conclusive answers will require studies that include more people with high exposures. He expressed hope that a study now under way in Japan might “break the logjam” (see *MWN*, M/J99). He noted that in some of the more densely populated Asian cities, “you have a lot more dwellings near high-tension lines.”

“It’s a rather frustrating situation, to have had about 12,000 subjects in all these studies and still not have gotten an unambiguous answer,” said Greenland. Still, he added, “Considering all the ambiguities and uncertainties that always come up in the course of an epidemiological study, it’s really rather remarkable how consistent the magnetic field studies are with one another.”

Löscher Again Finds EMFs Can Promote Breast Cancer

Germany’s Dr. Wolfgang Löscher continues to find experimental evidence that EMFs can promote breast cancer.

Löscher’s latest results were published in the August 1 issue of *Cancer Research* (59, pp.3,627-3,633), arguably the most prestigious cancer journal in the world. “The referees were very enthusiastic,” Löscher told *Microwave News*. He is at the School of Veterinary Medicine in Hannover. (See also *MWN*, J/A93, S/O94, J/F95 and J/A95.)

Paradoxically, the new results appeared at about the same time that the failed attempts to repeat his work were published by an American team in another high-quality journal, *Carcinogenesis* (20, pp.899-904, May, and 20, pp.1,615-1,620, August). (See also *MWN*, M/A98 and M/J98.)

Löscher’s new findings “are the strongest yet,” Dr. Larry Anderson told *Microwave News*. Anderson was in charge of three EMF-breast cancer studies at the Battelle Pacific Northwest Labs in Richland, WA, which did not find a promotional effect.

Löscher and Dr. Susanne Thun-Battersby, together with Löscher’s longtime collaborator, Dr. Meike Mevissen, now at the University of Bern in Switzerland, exposed 99 female rats to a 1 G, 50 Hz magnetic field for one week, before giving each rat a 10 mg dose of the chemical carcinogen DMBA. The magnetic field exposure then continued for 26 weeks, after which the animals were killed and examined for tumors. A second set of 99 DMBA-initiated rats served as controls. The German team did not know which animals were exposed to the EMFs.

The 50 Hz magnetic field enhanced the growth and development of the breast tumors. The largest difference came 13 weeks after DMBA administration, when the exposed rats had close to twice as many tumors as the controls. By the end of the experiment, the controls had closed some of the gap. Nevertheless, there were still more rats with breast tumors among those exposed to the magnetic fields—64.7% vs. 50.5%, a statistically significant difference. The tumors were histologically confirmed at the end of the experiment, which fact, Anderson noted, “speaks

to criticisms of earlier experiments.”

When asked by *Microwave News* about the divergence between his and the American results, Löscher replied, “Both studies are correct; the explanation must be in the genetic variations.” Indeed, Anderson does not claim that his experiments should carry greater weight than Löscher’s. “We believe our results and we have no reason to disbelieve Löscher’s results,” he said.

While Anderson would like to repeat his experiment, Löscher does not want to. “It makes no sense to do it again,” Löscher said.

In the *Cancer Research* paper, Löscher’s team explains the differences between its experiments and Battelle’s:

[A]lthough the studies were conducted in an attempt to replicate our previous MF [magnetic field] studies in the DMBA model, there were various differences from our experiments, including another diet, shorter exposure per day (e.g., 500 hours less exposure in 13 weeks), the use of different rooms for sham and MF exposure, differences in the exposure systems and the use of a subline of [Sprague-Dawley] rats with markedly higher susceptibility to DMBA than our rats. Because of this higher sensitivity to DMBA, two of the three DMBA protocols used in the United States study resulted in almost 100% tumor incidence in sham controls, which prevented obtaining any additional effect by MF exposure. Thus, because of these various differences, these experiments cannot be considered as replicate studies of our experiments.

Löscher reports a new and “interesting” finding in his new experiment: EMFs did not promote tumors equally across the six mammary complexes.

Scientists at the National Institute of Environmental Health Sciences (NIEHS), which sponsored the Battelle studies under the EMF RAPID program, have been dismissive of the work of Löscher’s team. Relations between them have become strained (see *MWN*, N/D98).

In its June report to Congress on the EMF RAPID program, the institute concluded that, based on the Battelle studies, there is “strong evidence” that EMFs do not promote breast cancer.

Neither NIEHS’ Dr. Gary Boorman nor Dr. Christopher Portier would comment on the new Löscher results. Boorman helped design the Battelle study, and Portier was the principal author of the NIEHS RAPID report to Congress.

Replication Attempt Finds No Support for Lai-Singh Work; Debate Continues Over DNA Damage from Microwaves

In a study that is almost complete, researchers in Dr. Joseph Roti Roti's lab at Washington University in St. Louis have found no evidence of DNA damage from microwave exposure. They are attempting an exact replication of work by Drs. Henry Lai and N.P. Singh that observed single- and double-strand DNA breaks in the brains of rats.

Dr. Isabelle Lagroye presented preliminary findings from the ongoing study at the annual meeting of the Bioelectromagnetics Society (BEMS) in Long Beach, CA, in June. In the study, live rats were exposed to pulsed 2450 MHz microwaves for two hours, and examined for DNA damage four hours later. With most of the work complete, no DNA damage has yet been detected.

Roti Roti's team had conducted several previous follow-up studies on the Lai-Singh work, none of which found any microwave effect (see *MWN*, J/F98, M/J98 and S/O98). These were criticized, however, for not being exact replications. Some observers, especially those in the wireless industry, believe that Roti Roti's current effort will be the final proof needed to put this highly contested matter to rest. But enough disagreements persist that a quick resolution seems unlikely.

Arguments over the contradictory findings have focused on how the two labs measured DNA damage. While both Roti Roti and Lai-Singh used a method known as the "comet assay" (named for the comet-like pattern made by DNA fragments), each lab chose a different version of the technique. Rather than using the procedure developed by Singh and used in the Lai-Singh experiments, Roti Roti decided to use a version developed by Dr. Peggy Olive of the British Columbia Cancer Research Centre in Vancouver.

Roti Roti's choice made things more complicated. The debate over microwave effects was soon entangled in a dispute as to whether Roti Roti was using Olive's technique correctly, after he reported an unprecedented level of sensitivity. Lai and Singh, as well as other researchers, were skeptical that such sensitivity was possible using Olive's procedure, which led them to question the validity of Roti Roti's results with microwaves at cellular phone frequencies.

"Damage from ionizing radiation cannot be detected below about 3-5 rads [3-5 cGy]," insisted Singh in an interview this September. "And that is with healthy lymphocytes." Cancer cells and other cells grown in culture will show higher background levels of DNA damage, Singh explained. "With fibroblasts, for example, you can only detect damage down to 15-25 rads."

In a 1997 paper in *Radiation Research*, Dr. Robert Malyapa and Roti Roti reported detection of significant DNA damage from as little as 0.6 rads, with both mouse fibroblasts and human brain cancer cells.

In the past, Olive has expressed doubt that it is possible to get sensitivity much below exposures of about 5 rads, even under the best conditions. She is said to have expressed skepticism to other researchers about the sensitivity claimed in the Malyapa-Roti Roti study. Olive did not respond to repeated requests for comment from *Microwave News*.

Malyapa also declined to comment, referring all questions to Roti Roti.

In an extensive interview, Roti Roti told *Microwave News* that results in his lab were not qualitatively different from those in Olive's. "She's gotten down to around 2.5 rads," he said, in work which she has not published. "So our sensitivity is not that much higher." But Roti Roti conceded that these numbers understate the difference, since the sensitivity reported in his lab was in work with fibroblasts and cancer cells.

Lagroye, of Dr. Bernard Veyret's group at the University of Bordeaux in France, has been working in Roti Roti's lab on the current Lai-Singh replication study. Using the Olive assay, she has observed DNA damage in mouse fibroblasts down to a 1 rad exposure. "Because of time constraints, I did not attempt to go below 1 [rad]," she told *Microwave News*.

Asked what is being done differently in Roti Roti's lab to produce a better sensitivity than Olive has achieved herself, Roti Roti and Lagroye pointed to a number of possible improvements: the computerized image analysis system used to measure the spread of the comet tail, the mathematical method for calculating DNA fragments, slight differences in the way the DNA is treated and the larger amount of data collected. "If each of these gave a 1.5- to 2-fold increase in sensitivity, we could expect a [net] 7.5- to 32-fold increase," said Lagroye.

Lai, however, is unconvinced. "You have to be very lucky to get such an improvement in every one of those steps," he said in an interview. "I cannot say that they cannot do it, but a lot of people are skeptical."

In fact, Singh's method is considered by most researchers to be more sensitive, and is more widely used. For example, a 1999 review article on the comet assay states that while the two versions are "similar in practice, the Singh method appears to be at least one or two orders of magnitude more sensitive."

Roti Roti questions this assessment. "That's the conventional wisdom," he said. "But the data we're getting so far suggest that they may be comparable."

Dr. Kim O'Neill of Brigham Young University (BYU) in Provo, UT, said that the Singh version of the assay is somewhat more sensitive. But, he added, it is "almost too sensitive—if you play the wrong music in the lab, you can have problems." O'Neill himself uses the Olive method.

Dr. James McNamee of the Canadian government's Radiation Protection Bureau (RPB) in Ottawa uses the Singh version. He agreed that with Singh's assay, it is more difficult to get reproducible results. "It's easy to run the assay with the Singh method, but it's tough to do it well," he said. "The problem is getting conditions standard enough from one experiment to another."

Roti Roti has explained his initial decision to use the Olive method in just these terms. "In terms of day-to-day response, the Olive method seems more robust, in that it's more reproducible," he said in September. "We thought we'd get results more quickly with the Olive method." But in retrospect, Roti Roti said, "I'm kind of agreeing with everybody's criticism that we should

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have used the Singh assay to begin with." The replication study now under way employs both the Singh and Olive methods.

The use of the Singh method by Lagroye and Roti Roti has not convinced Lai and Singh. "I doubt very much whether they're doing the Singh method right," said Lai, "because of some discrepancies in the figures presented at BEMS."

Lai points to Roti Roti and Lagroye's data on the use of the enzyme proteinase K (PK), which is part of Singh's procedure but not Olive's. PK dissolves protein-DNA cross-links that can prevent the detection of DNA damage. At the BEMS meeting, Lagroye reported that when the Singh method was used without PK, DNA damage could not be detected after an exposure to 100 rads (1 Gy) of ionizing radiation. (With PK, she did observe DNA damage after a 100 rad exposure.)

"Something looks wrong with that graph," said Lai. "One hundred rads is not powerful enough to cause cross-linking, so there should be no difference with or without PK." Lai still thinks microwaves can increase DNA damage. "In our lab," he said, "we are still getting the same results."

What could account for the two labs' conflicting findings? Canada's McNamee and other researchers doubt that the choice of the Olive or the Singh technique is at the root of the matter. "I consider the differences between the assays themselves to be relatively minor," he said. "Both should be able to detect damage, if it's there." O'Neill, of BYU, agreed, saying, "They are both good methods. For microwave analysis, either one should give you a conclusive result."

"Roti Roti, Lai and Singh are all good investigators," McNamee told *Microwave News*. "If people are getting different results, it could be due to many factors."

"This issue has become very highly charged," commented McNamee. "What we need is for several different labs to get involved and do their own work, and over time it'll iron itself out."

McNamee's lab is starting its own *in vitro* study on the Lai-Singh findings. He hopes to start exposures in the next few months, and to have some results by mid-2000. "We'll be able to process a much larger number of samples at once than has been the norm," he said. His lab has written its own image-processing program because of questions about how commercial software may handle some parameters. "We want to be sure we aren't getting a computer-generated result," McNamee explained.

Dr. Luc Verschaeve of VITO in Mol, Belgium, is also planning further studies on effects of microwaves on DNA. Last year, at a workshop in Vienna (see *MWN*, N/D98), he presented an overview of data from his studies to date, with results that he described as "contradictory." For example, human lymphocytes exposed to the signal from a 954 MHz base station antenna showed an increase in genetic damage, as measured both by classical chromosome tests and by the comet assay (see also *MWN*, N/D96 and S/O97). No effect was seen, however, in studies with microwave exposure in the lab in TEM cells.

Roti Roti said it might be possible for his lab to work directly with Lai and Singh to find the reasons for their different results, but he emphasized that his own group is "looking at the twilight of our DNA damage funding" from Motorola. Lagroye's study had additional support from France Telecom.

Industry representatives are not calling for more research to

resolve the conflict between the Lai-Singh and Roti Roti labs. Rather, they have cited Roti Roti's results as reasons why the Lai-Singh work need not be cause for concern.

This June, for example, Motorola's Dr. Quirino Balzano told the British Parliament that the Lai-Singh experiments are "a very good example of an experimental procedure which has not been validated, and has not been able to be replicated."

Isabelle Lagroye et al., "Measurement of DNA Damage After Acute Exposure to 2450 MHz Microwaves in Rat Brain Cells by Two Alkaline Comet Methods," Abstract 1-1, *21st Annual Meeting of the Bioelectromagnetics Society*, Long Beach, CA, June 20-24, 1999.

Henry Lai and N.P. Singh, "Single- and Double-Strand DNA Breaks in Rat Brain Cells After Acute Exposure to Radiofrequency Electromagnetic Radiation," *International Journal of Radiation Biology*, 69, pp.513-521, 1996; and "Melatonin and a Spin-Trap Compound Block Radiofrequency Electromagnetic Radiation-Induced DNA Strand Breaks in Rat Brain Cells," *Bioelectromagnetics*, 18, pp.446-454, 1997.

Robert Malyapa et al., "Measurement of DNA Damage After Exposure to 2450 MHz Electromagnetic Radiation," *Radiation Research*, 148, pp.608-617, 1997; "Measurement of DNA Damage After Exposure to Electromagnetic Radiation in the Cellular Phone Communication Frequency Band (835.62 and 847.74 MHz)," *ibid.*, 148, pp.618-627, 1997; "Detection of DNA Damage by the Alkaline Comet Assay After Exposure to Low-Dose Gamma Radiation," *ibid.*, 149, pp.396-400, 1998; and "DNA Damage in Rat Brain Cells After *In Vivo* Exposure to 2450 MHz Electromagnetic Radiation and Various Methods of Euthanasia," *ibid.*, 149, pp.637-645, 1998.

E. Rojas, M.C. Lopez and M. Valverde, "Single Cell Gel Electrophoresis Assay: Methodology and Applications," *Journal of Chromatography B*, 722, pp.225-254, 1999.

Luc Verschaeve and Annemarie Maes, "Mobile Phone Cytogenetics," *Proceedings of International Workshop on Possible Biological and Health Effects of RF Electromagnetic Fields* (Michael Kundi et al., eds.), pp.221-230, Vienna, Austria, July 1999.

Australia Moves Towards New RF/MW Health Standard

The Australian government is moving to develop a new standard for public exposures to RF/MW radiation.

The new set of limits will be developed by an expert group under the aegis of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). The members of the group have yet to be chosen, according to Dr. Colin Roy, who heads ARPANSA's non-ionizing radiation division in Yallambie. The Australian Radiation Lab was combined with the Nuclear Safety Bureau in February to form ARPANSA.

The frequency-independent, or "flat," 200 $\mu\text{W}/\text{cm}^2$ standard that had been in place since 1985 lapsed earlier this year. At that time, Standards Australia, a private group, could not reach agreement on new, ICNIRP-based guidelines favored by many of its members.

The Australian Communications Authority (ACA) will continue to enforce the flat limit until the new government standard is ready, probably in late 2000 (see *MWN*, M/J99).

Meanwhile, the Australian Communications Industry Forum has agreed to develop a code of practice for mobile telephone base stations.

The government has come under fire for lack of public participation in the new initiative. Lyn McLean of the Electromagnetic Radiation Alliance of Australia in Sutherland told *Microwave News* that her group had expressed "strong misgivings" about the standard-setting process. The ACA stated that there had been "extensive consultation" with interested parties and that all had accepted the government's plan.

New Zealand Favors ICNIRP Limits, Curbs on Local Control

New Zealand is moving to adopt the RF/MW radiation guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) as a national standard and may discourage local authorities from setting stricter limits. New Zealand is one of the few countries where local governments can set their own limits.

In July, the Ministry of Health and the Ministry for the Environment released for public comment a draft “guidance” to local governments, which aims to “encourage a consistent approach” to regulating sources of RF/MW radiation. The document recommends the “strict application” of the ICNIRP limits.

In April, Standards New Zealand, a private group, adopted ICNIRP-based guidelines for RF/MW exposures to replace its frequency-independent 200 $\mu\text{W}/\text{cm}^2$ standard (see *MWN*, J/F90 and M/J99). The latest government proposal would advise local authorities to adopt the Standards New Zealand guidelines and forsake more restrictive rules, such as the city of Auckland’s current 50 $\mu\text{W}/\text{cm}^2$ limit (see *MWN*, N/D96).

“The concept of local control seems to have been lost,” said Dr. Ivan Beale of the University of Auckland, who was a public representative in the Standards New Zealand deliberations. Beale told *Microwave News* that the change in policy was driven by pressure from the telecommunications industry and by a recent ruling of the country’s Environment Court. The ruling held that a wireless carrier could not be required to reduce RF/MW emissions from a cellular antenna, since it already complied with ICNIRP limits and no RF/MW health hazards have been established at levels below those limits.

On the other hand, Roger Matthews, an Auckland planning official, does not believe that the proposed guidance would put an end to the city’s RF/MW standard. “There is and will continue to be discretion,” he told *Microwave News*. “To remove discretion, the government would have to legislate, and they are not about to do that.”

In drafting its new guidelines, Standards New Zealand grappled with how to address prudent avoidance measures to reduce public exposures. While endorsing “low- or no-cost interventions,” the proposed guidance recommends that any such measures be voluntary.

In the draft guidance, the health ministry argues that there is, at most, “residual scientific uncertainty” as to the safety of low-level RF/MW radiation. “Even if future research does eventually show that health effects exist, the risk from exposures to radiofrequency fields is likely to be very small or negligible.”

This conclusion departs from that of a 1996 independent literature review, which was commissioned by the health ministry (see *MWN*, N/D96). That analysis, by New Zealand researchers, found that, “[T]here is a high level of scientific uncertainty” about potential hazards of low-level radiofrequency radiation. They wrote that the evidence “may be construed as either ‘incomplete evidence of cause’ or ‘incomplete evidence of safety.’”

The proposed guidance does not address the Ministry of Education’s 1996 ban on new wireless antennas at public schools

(see *MWN*, S/O96).

The 109-page document, *Towards National Guidelines for Managing the Effect of Radiofrequency Transmitters*, is available on the Internet at: <www.mfe.govt.nz/about/publications/rma/draft_rf_guidelines.pdf>.

New Cordless Phones: Higher Power, More Exposure

Cordless phones, long thought to be a negligible source of microwave radiation exposure, are now approaching the peak power levels used in cellular phones. The Federal Communications Commission (FCC) has started requiring manufacturers of the new higher-power cordless models to show that they comply with federal exposure limits.

These new cordless models use a technology known as Digital Spread Spectrum, or DSS, and the peak power of some is as high as 400 mW. This compares with a peak power of about 500 mW to 1 W for 1800 MHz PCS mobile phones.

“We have requested specific absorption rate (SAR) data to demonstrate RF exposure compliance” for several cordless phones introduced in the last year and a half, said Kwok Chan of the FCC Office of Engineering and Technology laboratory in Columbia, MD. “We generally ask for data on SARs when phones operate at 100 mW or above—sometimes even less, depending on other performance data.”

Since DSS phones send a pulsed signal, their average power is lower. Still, Chan said, the more powerful DSS cordless phones have SARs “comparable to the low end of the range for PCS [cellular] phones.”

A cellular phone must communicate with antennas that can be miles away. In contrast, traditional cordless phones are designed for use within a few hundred feet of the base station in the owner’s home, and therefore need far less power. The peak power of traditional cordless models stays below 5 to 25 mW, and for many it is less than 1 mW. At such low power levels it would be impossible to exceed federal exposure limits.

The cordless picture changed last year, when DSS phones first appeared on the U.S. market. They operated with a peak power of 100-200 mW, Chan told *Microwave News*. “More recently,” Chan said, “mostly in the last five to six months, we’ve seen a few at even higher power levels—around 300-400 mW.” The peak power of cordless phones is not allowed to exceed 1 W.

DSS phones are “likely to be the standard type of digital cordless phone in a year or two,” according to the September *Consumer Reports*. Their extended range is a prominent theme in marketing campaigns, with some companies claiming that theirs can be used three-quarters of a mile away from home.

Chan noted that higher power is not the only source of DSS phones’ increased range. He explained that DSS phones use “digital coding techniques that can pull the signal out of a higher level of noise,” enabling the user to travel farther from the base station before the signal breaks up.

Similarly, Chan said, “Higher power does not necessarily mean that the SAR has to be higher,” noting that SARs are influenced

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by many aspects of a phone's design.

So far, less than a dozen cordless models have been required to submit SAR data to the FCC, said Chan. Consumers will see more different models in stores, since the same type of DSS phone may be sold under various brand names.

Though most DSS phones are labeled as "900 MHz," they actually broadcast in a range between 902 and 928 MHz. This is part of the ISM band, which was first established for industrial, scientific and medical uses. DSS phones shift frequencies in the course of a call, using a "spread spectrum" technique similar to that used in CDMA cellular phones.

The technology originally used in cordless phones operates at 49 MHz and has a maximum range of about 400 feet. Also known as a "25-channel" phone, these analog models are still being made and operate at the lowest power. "Some of these have an output power in microwatts, not milliwatts," said Chan.

900 MHz cordless phones were introduced later, both analog and fixed-frequency digital models, with an effective range as high as 1,400 feet. These often use more peak power, but are still under 25 mW. For any of these models, said the FCC's Chan, "the power is so low that I hardly pay attention."

Higher-power cordless phones are also being marketed in Britain, where questions about their safety have become a focus of media attention and public concern.

Most often cited are cordless phones made to the Digital European Cordless Telephone (DECT) standard, which operate at 1900 MHz with a peak power of 250 mW. Unlike DSS cordless models or many cellular phones, DECT phones do not reduce their power to the lowest level needed to maintain a call, said the

Nokia Applies for Patent for Low-Exposure Phone Antenna

Nokia, the world's leading mobile phone manufacturer, has developed an antenna that directs "most of the radiation away from the caller," according to Britain's *New Scientist* (September 4).

The company, with headquarters in Finland, has applied for a U.K. patent for its new antenna. Nokia's Peter Harrison, based in Camberley, Surrey, told *Microwave News* that the patent has yet to be formally granted. He noted that a phone with this antenna will have a larger bandwidth than others.

Details are available on the U.K. Patent Office's Web site, <www.patent.gov.uk>, under publication number GB2330951. Japan's Mitsubishi and Hitachi have patented designs for reducing wireless phone RF/MW exposure (see *MWN*, N/D96).

U.K.'s Alasdair Philips, a consultant on RF/MW safety issues based in Ely, Cambridge.

After several stories on possible health effects of DECT phones appeared in the U.K. media this summer, including coverage in the *Sunday Times* (July 4) and on BBC 4 radio (July 12), Britain's National Radiological Protection Board (NRPB) in Chilton issued a statement in response. "Exposure to radio signals from cordless phones is many times below the guidelines and therefore their use is not considered hazardous to health," the NRPB concluded.

Desperately Seeking SARs

All over Europe—as well as in the U.S.—there is a growing interest in which mobile phones cause the lowest radiation exposures.

British and Swedish legislators want consumers to have SAR data so that they can make up their own minds about possible radiation risks. On September 22, a U.K. parliamentary committee advised industry and government officials to find ways to assist "consumer choice" (see p.1).

About ten days earlier, Eva Flyborg, a member of the Swedish parliament, introduced a motion calling for manufacturers of mobile phones to make SAR numbers public. "If they refuse, we should seriously consider a legislative approach," Flyborg told *Microwave News*.

Flyborg explained that she favors disclosure of radiation levels because, "We simply know too little today about the health risks" and because "children and teenagers are using phones more and more." There is an "immediate need" to clarify whether safety standards protect the public, she said.

In Switzerland, the consumer magazine *K-Tip* published the SARs for 25 different phones in its September 22 issue. Five were tested both with the antenna up and with it down. SARs ranged from 0.10 W/Kg for the Motorola StarTac 130 (0.38 W/Kg with the antenna retracted) to 1.59 W/Kg for the Bosch GSM 908. (These SARs are averaged over 1 g of tissue, as required in the U.S.—in Europe, they are averaged over 10 g.) The 900

MHz Philips Genie had the highest measured SAR: 2.67 W/Kg with the antenna down (1.26 W/Kg with the antenna up).

In an accompanying editorial, Hans R az wrote that the SAR safety standard is "worthless" because, "It was established without knowledge of the long-term risks of radiation, and set so that any manufacturer can meet it without difficulty."

News of the *K-Tip* survey was released in the U.K. by the *Independent on Sunday* on October 3. Sweden's Clas Tegenfeld, an EMF researcher in Lingham, has put the *K-Tip* list, together with other published SAR data, on his "Better Electromagnetic Environment" Web site; see <www.bemi.se>.

Meanwhile, *20/20*, an ABC television news magazine, will present its own measurement results to the American public in mid-October. Sources told *Microwave News* that *20/20* will disclose that some cellular phones did not meet the FCC's 1.6 W/Kg limit in certain testing positions.

ABC News hired the Institute for Mobile and Satellite Radio Technology in Kamp-Lintfort, near D usseldorf, Germany—the same firm used by *K-Tip*—to do the SAR measurements. A *20/20* producer explained that none of the four American testing labs contacted by ABC was willing to measure SARs if the names of the manufacturers of the phones were to be revealed.

The first set of SAR measurements was disclosed by the Swiss media—the television show *Kassensturz* did so in 1997 (see *MWN*, N/D97).

Chinese RF/MW Exposure Standard Is the Strictest

In China, the Health Ministry's limit for public exposures to 30-300 MHz radiation is the most stringent in the world. Public concern about RF/MW radiation is strong, according to Motorola's Dr. C.K. Chou, who visited China in May (see box at right).

"The whole country is concerned about RF health effects," Chou told *Microwave News*. He said that according to an internal government document, 16% of China's cellular telephone base stations cannot be operated due to public objections.

But Dr. Huai Chiang of Zhejiang University Medical College in Hangzhou, a leading authority, said in an interview that she knew of no such report.

Nevertheless, there appears to be no doubt that there is widespread interest in possible health effects. Chinese scientists "are eager for information," said Ron Petersen of Lucent Technologies, who also went to Beijing in May.

Petersen told *Microwave News* that China is "far behind" the Western countries in the field of dosimetry. "In terms of measurements, they are about where we were 15 years ago," he said. Petersen pointed out that when measurements are taken too close to a cell phone antenna, there will be areas where the standard is exceeded—and this may be what is generating public concern.

Chiang described Chinese RF/MW standards during a recent visit to the U.S. She attended the Bioelectromagnetics Society annual meeting in Long Beach, CA, in June, where she presented a paper and briefed SCC-28, the IEEE standards committee. She later discussed the standards with *Microwave News*.

China's Health Ministry and Environmental Protection Agen-

Repacholi Mission to China

Dr. Michael Repacholi is expanding his International EMF Project to involve China. In May, Repacholi visited Beijing for talks that touched on the proposed worldwide harmonization of exposure standards for EMFs and for RF/MW radiation. Among those accompanying him were representatives of both wireless technology manufacturers and the U.S. Air Force.

The Chinese "have agreed to participate fully," Repacholi told *Microwave News* from his office at the World Health Organization in Geneva. He said that in November, Chinese scientists will travel to Erice, Italy, where Repacholi will be hosting a workshop on biological and health effects of pulsed RF/MW radiation, as well as meetings on coordination of international research and on standards harmonization (see *MWN*, M/J99).

Along with the world's largest population and a booming wireless telephone market, China has RF/MW exposure limits that are among the most stringent in the world (see story at left and table below).

Joining Repacholi in Beijing were Germany's Dr. Jürgen Bernhardt, chair of the International Commission on Non-Ionizing Radiation Protection, Dr. C.K. Chou of Motorola in Plantation, FL, Dr. Michael Murphy of Brooks Air Force Base in San Antonio, Ron Petersen of Lucent Technologies in Murray Hill, NJ, and Prof. Veli Santomaa of the Nokia Research Center in Helsinki, Finland.

This list was assembled by *Microwave News*; Repacholi did not respond to a request for a list of those accompanying him.

China's Two Sets of RF/MW Exposure Limits

Frequency	Health Ministry			EPA	
	Public 1st Class*	Public 2nd Class†	Occupational	Public§	Occupational§
100 kHz-3 MHz	10 V/m	25 V/m	50 V/m (5 A/m)	40 V/m 0.1 A/m	87 V/m 0.25 A/m
>3-30 MHz	10 V/m	25 V/m	25 V/m	$67/\sqrt{f}$ V/m $0.17/\sqrt{f}$ A/m	$150/\sqrt{f}$ V/m $0.40/\sqrt{f}$ A/m
>30-300 MHz	5 V/m	12 V/m	$50 \mu\text{W}/\text{cm}^2 \ddagger$	$40 \mu\text{W}/\text{cm}^2$	$200 \mu\text{W}/\text{cm}^2$
>300 MHz-3 GHz	$10 \mu\text{W}/\text{cm}^2$	$40 \mu\text{W}/\text{cm}^2$	$50 \mu\text{W}/\text{cm}^2 \parallel$	$40 \mu\text{W}/\text{cm}^2$	$200 \mu\text{W}/\text{cm}^2$
>3-15 GHz	$10 \mu\text{W}/\text{cm}^2$	$40 \mu\text{W}/\text{cm}^2$	$50 \mu\text{W}/\text{cm}^2 \parallel$	$f/75 \mu\text{W}/\text{cm}^2$	$f/15 \mu\text{W}/\text{cm}^2$
>15-30 GHz	$10 \mu\text{W}/\text{cm}^2$	$40 \mu\text{W}/\text{cm}^2$	$50 \mu\text{W}/\text{cm}^2 \parallel$	$200 \mu\text{W}/\text{cm}^2$	$1,000 \mu\text{W}/\text{cm}^2$
>30-300 GHz	$10 \mu\text{W}/\text{cm}^2$	$40 \mu\text{W}/\text{cm}^2$	$50 \mu\text{W}/\text{cm}^2 \parallel$	—§§	—§§

* For permanent exposure and for all people.

† For temporary exposure only—not allowed in homes, hospitals or schools.

‡ For exposures of 8 hours/day; the limit is doubled for 4 hours/day or less.

For pulsed waves, the limits are $25 \mu\text{W}/\text{cm}^2$ for 8 hours/day and $50 \mu\text{W}/\text{cm}^2$ for 4 hours/day.

¶ For continuous wave/rotating pulsed wave radiation; must not exceed $400 \mu\text{W}/\text{cm}^2$ for a working day.

Must not exceed $25 \mu\text{W}/\text{cm}^2$ or $200 \mu\text{W}/\text{cm}^2$ for a working day for stationary pulsed wave radiation.

§f=frequency in MHz.

§§ No limit has been set.

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cy (EPA) each has its own public and occupational exposure guidelines (see table on p.9). Chiang said that she expects the two standards to be “harmonized in a few years.”

The Health Ministry limits exposures to 5 V/m—the equivalent of 6.6 $\mu\text{W}/\text{cm}^2$ —between 30 and 300 MHz for long-term exposures of the general public, especially groups thought to be sensitive, such as children and hospital patients.

The 6.6 $\mu\text{W}/\text{cm}^2$ limit is even stricter than Russia’s 10 $\mu\text{W}/\text{cm}^2$ standard, although a recent revision of the Russian standard dictates a special lower limit for pregnant women and children under 18.

From 300 MHz to 300 GHz, the Chinese Health Ministry specifies 10 $\mu\text{W}/\text{cm}^2$ and 40 $\mu\text{W}/\text{cm}^2$ for continuous and temporary exposures, respectively. For workers, the standard is also frequency-independent, from 30 MHz up to 300 GHz, with a limit of 50 $\mu\text{W}/\text{cm}^2$.

The Health Ministry limits are based on effects observed in

medical examinations and epidemiological studies and are stricter than those of the EPA. Tighter standards are specified for pulsed radiation, because, according to Chiang, pulsed radiation is “more effective in producing a biological effect” for the same power density.

The EPA limits are derived from specific absorption rates (SARs). They are based on maximum whole-body SARs of 0.02 W/Kg and 0.1 W/Kg for the general public and workers, respectively. The ICNIRP and ANSI/IEEE limits are also based on SARs, but at levels that are four times higher: 0.08 W/Kg and 0.4 W/Kg, respectively.

According to Chiang, the EPA uses its limits in licensing and monitoring TV and radio transmitters and other RF/MW sources.

There are currently no EPA standards for millimeter-wave radiation (30-300 GHz), because such sources are absent in the general environment. Chiang also pointed out that there are no epidemiological studies for exposures at these frequencies.

U.K. Parliament to NRPB: Lower Limits and More Research (continued from p.1)

justification for the NRPB’s current rules has gone “largely unchallenged.”

Nonetheless, Alasdair Philips, a consultant based in Ely, Cambridge, called the Parliament’s recommendation to adopt the ICNIRP standard “a slap on the wrist” for the NRPB. He pointed out that earlier this year the NRPB had reaffirmed its commitment to its own standards and declined to bring them into line with those of ICNIRP (see *Documents of the NRPB*, 10, No.2, p.2, 1999).

At present, the U.K. government has only a small RF/MW health effects research program. At a parliamentary hearing on June 9, Tessa Jowell, the minister for public health, revealed that her total budget for mobile phone health research is about £60,000 (approximately \$100,000) a year.

“We recommend that a higher priority [be] given to a research program into the health impacts of mobile phones” in view of the current state of scientific uncertainty, stated the committee (see p.11 for a complete summary of the committee’s findings).

The chair of the parliamentary committee, who is also named Dr. Michael Clark, was widely quoted in the British press as saying that £60,000 could only pay for “one man and a dog.” He called for enough money to fund a team of some 50 researchers.

The committee specifically pointed to a “need to confirm or deny” that microwaves can cause DNA breaks (see p.5).

In addition, the committee advised that the public be told the SAR of each mobile phone model “to assist consumer choice” (see p.8 and p.11). In his submission to Parliament, Dr. Alan Preece of the University of Bristol had specifically recommended that SAR figures “should be in the public domain so that concerned individuals can make a choice.”

By early October, the NRPB had not yet responded to Parliament. The NRPB’s Clark told *Microwave News* that a formal answer was still under consideration. But he added that any change in exposure limits is unlikely before a report is issued by an expert panel that the government has charged with investigating mobile phone health risks.

The expert panel has gotten off to a slow start. Jowell requested advice in early April after the release of a study by Preece which showed that cell phone radiation can speed up brain function (see *MWN*, M/A99). In addition, wireless health risks have been a hot topic in the British press over the last year (see *MWN*, J/A98 and N/D98).

While Sir William Stewart, a former science adviser to the prime minister, was named the chair of the ten-member expert group in June (see *MWN*, J/A99), the other members of the panel were announced by the NRPB only on August 24. The group is composed primarily of academic researchers (see p.11). Two exceptions are John Fellows, a student at Edinburgh University, and Dr. Michael Repacholi of the World Health Organization’s (WHO) EMF Project in Geneva, the only non-British member. The NRPB’s Clark told *Microwave News* that the members were selected by Stewart.

The composition of the panel was the subject of an extended exchange at the June 9 hearing before the Committee on Science and Technology. “I intend [the expert group] to have a strong representation of the consumer and public interest,” Jowell said, adding that she did not want anyone from industry on the panel.

In his testimony, Dr. Roger Clarke, the director of the NRPB, countered that neither consumer nor industry representatives would be on the panel, but that they would be “invited to submit evidence and perhaps appear in front of the group.”

The new report from Parliament recommends that there be “at least two lay members” on the expert group and that the “rationale for their appointment must be made clear.” A number of observers have wondered why Fellows was selected, given that he has no prior knowledge of RF/MW issues. The committee also noted that it had no objection to industry representatives with “useful, relevant expertise” being on the panel.

When asked who would decide which issues would be investigated by the expert group, NRPB Director Clarke told the committee that he would do so himself, in conjunction with Sir Richard Doll, the chair of the NRPB Advisory Group on Non-

Ionizing Radiations.

The NRPB has announced that Minister Jowell approved the following scope of the inquiry for the panel: "To consider present concerns about possible health effects from the use of mobile phones, base stations and transmitters, to conduct a rigorous assessment of existing research and to give advice based on the present state of knowledge. To make recommendations on further work that should be carried out to improve the basis for sound advice."

In September, the expert panel published a "Call for Evidence" in a number of national newspapers, including the *Times* and the *Daily Mail*, as well as in the *New Scientist*, seeking written evidence on mobile phone health risks. The deadline for submissions is October 15.

In addition to Stewart, the members of the expert panel are: Dr. Colin Blakemore, University of Oxford; Dr. Laurie Challis, University of Nottingham; Dr. David Coggon, MRC Environmental Epidemiology Group, Southampton; Sir David Cox, University of Oxford; John Fellows, past president, Edinburgh University Students' Association; Dr. Michael Repacholi, WHO International EMF Project, Geneva, Switzerland; Dr. Michael Rugg, Institute of Cognitive Neuroscience, London; Dr. Anthony Swerdlow, University of London; and Thelekat Varma, Walton Center for Neurology and Neurosurgery, Liverpool. Dr. Alan Baddeley of the University of Bristol, Dr. Hilary Walker of the U.K. Department of Health and Graham Worsely of the U.K. Department of Trade and Industry are panel observers. The NRPB's Drs. John Stather and Nigel Cridland are serving as the panel's secretary and assistant secretary, respectively.

Summary of U.K. Parliament Select Committee on Science and Technology's Recommendations and Conclusions

General Conclusion

Validated scientific evidence supports the conclusion that neither mobile phones nor their associated base stations, if they comply with current maximum exposure guidelines, as they appear to do, present a health hazard. Uncertainties, however, remain. Some scientific results, albeit unreplicated, and anecdotal evidence underline the need for further research (§41*).

Specific Conclusions

(a) We recommend that the Government adopt the ICNIRP recommended guideline limits for microwave exposure as a precautionary measure. We further recommend that these guidelines be introduced quickly but with a grace period to allow network operators to achieve full compliance (§22).

(b) We reject the main criticisms of the NRPB. Whilst the NRPB's guidelines for maximum microwave exposures are significantly higher than those found in some other countries, their scientific justification is largely unchallenged. Other bodies, including ICNIRP, a European Expert Group and the WHO, agree with the NRPB's assessment that there is no scientific basis for exposure limits to avoid potential harm from athermal effects of microwaves (§28).

(c) We recommend that the NRPB regularly review the scientific evidence for athermal effects (§29).

(d) The establishment of the Expert Group on Mobile Phones is a highly appropriate response from Government but we view it as a temporary measure. In the long term, Government and the NRPB must ensure that the Advisory Group on Non-Ionizing Radiations has sufficient resources to discharge its duties effectively and in a timely manner. We regard this as a responsible recognition by Government that constant vigilance is required in a rapidly changing field (§31).

(e) We recommend that, while they should not be in the majority on the proposed Expert Group, if industrial representatives have useful, relevant expertise, they should be included (§32).

(f) We recommend that there should be at least two lay members of the Expert Group, as recommended in our previous report (§33).

(g) Greater clarity in the role of lay members on advisory bodies and working groups is required. We recommend that their role be clearly set out, in advance of appointment, in terms of bringing alternative perspectives to bear and holding up scientific assumptions to proper scrutiny. To perform effectively lay members may need some specialist knowledge. The rationale for their appointment must be made clear (§34).

(h) We agree that there is a "need to confirm or deny the work on microwave-induced DNA fragmentation." We note with approval that industry is cooperating with the WHO and the EU's fifth framework program to determine priorities for a collaborative research program to examine athermal effects of non-ionizing radiation and endorse the need for this (§35).

(i) We agree with the Royal Society of Canada that the evidence for neurological problems reportedly caused by mobile phones, including symptoms such as headache, nausea, tiredness, sleep problems and memory loss, is unclear, but there is sufficient anecdotal evidence and uncertainty to justify further research (§36).

(j) We believe that the level of publicly funded research into the effects of microwave emissions falls short of an adequate program into an area where public health implications should be regularly reviewed. We recommend that the Government ensure that a higher priority is given to a research program into the health impacts of mobile phones. The public health aspects of new technologies should be incorporated into the Foresight Program (§37).

(k) It is essential that there is an independent and appropriately funded research program which is seen to be objective and which is seen not to be directed by commercial interests, even if industry makes a contribution to the funding (§39).

(l) We recommend that the industry and the NRPB explore ways in which the design of mobile phones might limit personal exposure to radiation as a means of assisting consumer choice (§40).

*Refers to paragraphs in the Select Committee's report, *Mobile Phones and Health* (House of Commons No.489), available from the Parliamentary Bookshop, 12 Bridge St., London SW1A 2JX, U.K., (44 +171) 219-3890. The full text of the report is available on the Web at: <www.parliament.the-stationery-office.co.uk/pa/cm199899/cmselect/cmsctech/489>.

FROM THE FIELD

Motorola Memos: Small Changes in Manufacturing or Test Procedures Can Mean Big Changes in SARs

Below are excerpts from three memos from Motorola, recently obtained by Microwave News. They open a window onto how a mobile phone maker tests its new models for compliance with exposure limits.

The two phones described in the memos were at first found to exceed the 1.6 W/Kg specific absorption rate (SAR) limit of the ANSI/IEEE safety standard. (SARs in the original memos are given in mW/g; we have changed these to W/Kg.)

As detailed below, different manufacturing conditions and settings can have dramatic effects on the phones' SAR values. One memo notes a "wide variation" in SARs for three different phones of the exact same model. And something as seemingly minor as the paint used to coat the phone can change the SAR.

Changes in testing configurations could also cause the SAR to change. Whether the antenna is up or down, whether the test is done with or without a simulated hand—according to one memo, these factors could alter the result by up to a factor of four.

In the U.S., the FCC did not require compliance with the 1.6 W/Kg limit until August 1996 (see MWN, J/A96). But it began to consider what limits should be imposed on mobile phones in March 1993, when the commission proposed adopting the 1992 ANSI/IEEE standards (see MWN, M/A93).

These memos show how Motorola—along with other companies—was preparing for the new rules. It is not clear, however, when Motorola began to require that its phones comply with the FCC SAR standard.

The Microtac Lite has been one of Motorola's most popular phones. According to the Motorola Cellular Information Center, it was first put on the market "around the first quarter of 1994." The following two excerpts, from memos written in November 1993 and February 1994, detail the difficulties that faced Motorola in trying to get the phone to comply with the 1.6 W/Kg limit. Motorola's Libertyville Cellular Electromagnetics Laboratory is in Illinois.

Date: November 10, 1993

Subject: SAR Measurements of Microtac Lites

Summary

The Libertyville Cellular Electromagnetics Laboratory has performed a set of detailed measurements of the maximum potential exposure of the user of a U.S. Microtac Lite cellular phone. The measurements show that the peak SAR in the phantom user of the Microtac Lite cellular phone is above the 1.6 W/Kg limit of the ANSI C95.1-1991 [*sic*] Safety Standard for exposure of humans to Radio Frequency Electromagnetic Energy (EME) in the uncontrolled environment. The Microtac Lite maximum SAR level is in the range of 1.6 W/Kg to 2.2 W/Kg depending on the unit measured and the phones' actual transmitter power output. The maximum SAR level has been measured in the temporal area of the phantom user with the phone's antenna in the retracted position....The presence of a human hand is not simulated in the test setup....

Measured Results

The intent is to measure the actual SAR generated by the Microtac Lite phones as the user would have received the product from the factory. Thus, all measurements were made on the phones "as is," namely no changes to the phones either mechanically or in terms of transmitter power output were made....Variation from unit to unit in actual transmitter output power is partially responsible for the wide variation in measured SAR. In order to give an indication of what the SAR would have been had the phones all had the same transmitter output power,

the measured SAR numbers are normalized to a transmitter power of 600 mW. The results are indicated below.

Phone serial number	measured SAR	600 mW normalized SAR
no s/n, call it PM-1	2.21 W/Kg	2.10 W/Kg
D89DC2EE	2.00 W/Kg	1.83 W/Kg
no s/n, call it PM-2	1.89 W/Kg	1.81 W/Kg

As late as February of 1994, the Microtac Lite still exceeded the 1.6 W/Kg limit.

Date: February 10, 1994

Subject: Microtac Lite housing paint

...Here are the results of standard SAR tests that I have done on a Microtac Lite:

unmodified radio: SAR=2.23 W/Kg

same radio with front housing replaced by housing with no

conductive paint: SAR=2.69 W/Kg

I have done other tests that involve using copper tape instead of conductive paint as well as numerous others involving extra conductive paint, conductive paint in different locations on the front housing, and even completely covering the housing with conductive paint or copper tape. All of these tests have only increased SAR by amounts ranging from a couple of percent to over 50%.

The following memo shows the large difference in SAR that can result from testing with or without a simulated hand, or with the antenna up or down. NMT stands for the Nordic Mobile Telephone system, which is used in the Scandinavian countries. Most European regulations allow an SAR of up to 2 W/Kg.

Draft

Date: January 18, 1994

Subject: SAR Measurements of NMT Eagle

The Libertyville Cellular Electromagnetic Laboratory has performed a set of detailed measurements of the maximum potential exposure to the user of an NMT Eagle cellular phone....

Measured Results

The intent is to measure the actual SAR generated by the NMT Eagle phone as the user would have received the product from the factory. Thus all measurements were made on the phone "as is," namely no changes to the phones either mechanically or in terms of transmitter power output were made....

Antenna position	without simulated hand	with simulated hand
retracted	2.02 W/Kg	1.25 W/Kg
extended	0.66 W/Kg	0.47 W/Kg

In order to give an indication of what the SAR would have been had the phone had a transmitter power of 1 W (NMT spec), the measured SAR number is modified in dB by the difference between actual measured power and 1 W. This results in an SAR of 2.79 W/Kg with the antenna in the retracted position and 0.91 W/Kg with the antenna in the extended position, both without the simulated hand....

Conclusion

The U.S. NMT Eagle phone has a measured SAR of as much as 2.02 W/Kg in the highest cubic cm. This is 1.0 dB [about 20%] higher than the 1.6 W/Kg limit....

Hot New Papers

Eugene Johnson, Sylvester Chima and David Muirhead, "A Cerebral Primitive Neuroectodermal Tumor in a Squirrel Monkey," *Journal of Medical Primatology*, 28, pp.91-96, April 1999.

"A male squirrel monkey (>20 years) was euthanized after a 5-day history of intermittent ataxia and general depression. No hematological or clinical biochemical abnormalities were found. The monkey had been used in a physiological study that involved exposing the animal weekly for 90 minutes to 2450 MHz radiofrequency radiation over a 3-year period....[T]he squirrel monkey in this case was the only one of a group of monkeys to develop a brain tumor [a malignant tumor of the right cerebral cortex] after long-term microwave radiation....It is...not unlikely that the long-term exposure of this animal to microwaves may have been associated with the presented pathology....[T]he cerebral primitive neuroectodermal tumor presented in this case is only the second described in a nonhuman primate....The aggressive and malignant nature of the tumor was clearly shown...."

Ronald King, "Shielding by a House from the Electric Field of a Power Line," *Radio Science*, 34, pp.773-779, July-August 1999.

"The claim that 'a typical house shields about 90% of electric fields from outside' is examined when the house is located near a high-voltage, 50 to 60 Hz transmission line. Calculated electric fields near such a line are used. In order to provide an accurate analysis, the usual house shape is approximated first by a hemisphere, then by a cylinder and finally by a box-like shape on the conducting earth....It is concluded that the superposition of incident and scattered fields from pipes and wires in the walls yields widely varying fields at different points, but that the average exposure of persons living inside the house is not greatly reduced below exposure to the unmodified field of the power line."

Michael Burkhardt and Niels Kuster, "Review of Exposure Assessment for Handheld Mobile Communications Devices and Antenna Studies for Optimized Performance," W. Ross Stone ed., *The Review of Radio Science 1996-1999*, pp.873-918 (New York: Oxford University Press, 1999).

"Antennas for mobile communications equipment must not only be inexpensive to produce, small and light; they must also provide high radiation efficiency, in order to conserve battery energy and to ensure communications under bad radiation conditions. In addition, the antennas must withstand the mechanical and environmental demands of daily usage (bending, dropping, etc.). Classical simple whip and helical antennas mounted on the top of handsets are therefore still the dominant antenna types for current cellular phones. However, their omnidirectional free-space pattern with cylindrical symmetry is degraded when operated in close proximity to the user's body, due to absorption and reflections at the head. In general, the smaller the antenna and the closer to the head it is operated, the more directional its radiation pattern becomes, and the greater the amount of energy lost through absorption by the user. Since the resulting far-field pattern is similar to that of directional radiators, more sophisticated antennas with minimum energy loss in the user's head could substantially increase radiation performance. An additional motivation for improved antennas is that the user's exposure could become a factor for a consumer's choice."

Margaret Wrensch, Michael Yost et al., "Adult Glioma in Relation to Residential Power Frequency Electromagnetic Field Exposures in the San Francisco Bay Area," *Epidemiology*, 10, pp.523-527, September 1999.

"In a population-based study, we examined residential power frequency electromagnetic field exposures for 492 adults newly diagnosed with histologically confirmed glioma between August 1, 1991, and April 30, 1994....Residential exposure assessment consisted of spot measures with EMDEX meters and wire codes based on characterization and loca-

Digital Cell Phone Signals: Protection Against Brain Tumors

Ross Adey et al., "Spontaneous and Nitrosourea-Induced Primary Tumors of the Central Nervous System in Fischer 344 Rats Chronically Exposed to 836 MHz Modulated Microwaves," *Radiation Research*, 152, pp.293-302, September 1999.

"We have tested an 836.55 MHz field with North American Digital Cellular (NADC) modulation in a two-year animal bioassay that included fetal exposure. In offspring of pregnant Fischer 344 rats, we tested both spontaneous tumorigenicity and the incidence of induced central nervous system (CNS) tumors after a single dose of the carcinogen ethylnitrosourea (ENU) *in utero*, followed by intermittent [2 hours/day] digital phone field exposure for 24 months....SAR levels simulated localized peak brain exposures of a cell phone user. Of the original 236 rats, 182 (77%) survived to the termination of the whole experiment and were sacrificed at age 709-712 days. The 54 rats (23%) that died during the study ('preterm rats') formed a separate group for some statistical analyses. There was no evidence of tumorigenic effects in the CNS from exposure to the TDMA field. However, some evidence of tumor-inhibiting effects of TDMA exposure was apparent. Overall, the TDMA field-exposed animals exhibited trends toward a reduced incidence of spontaneous CNS tumors ($p < 0.16$, two-tailed) and ENU-induced CNS tumors ($p < 0.16$, two-tailed). In preterm rats, where primary neural tumors were determined to be the cause of death, fields decreased the incidence of ENU-induced tumors ($p < 0.03$, two-tailed)....

TDMA field exposure appeared to decrease the incidence of spontaneous primary CNS tumors and those induced by the transplacental administration of the carcinogen ENU, but at incidence levels that were not statistically significant for the full experimental group. This inhibitory effect was more evident (statistically significant) in the preterm animals....

While our animal tumor protocol aimed to determine whether TDMA field exposure resulted in an increase in a number of indices of tumorigenicity, the potential inhibitory effect of TDMA field exposure should not be dismissed out of hand because of marginal statistical significance in a study with few tumors overall. We suggest that additional experiments be performed to establish with certainty whether or not the TDMA-mediated inhibitory effect bears a causal relationship to the field exposure....[T]here is considerable evidence in the literature to support the suggestion that low frequency modulated radiofrequency fields are capable of interacting with biological systems when applied at athermal levels, involving interactions with key messenger and growth-regulating enzyme systems. These reported athermal sensitivities would be consistent with an action of TDMA fields in tumorigenesis in conditions of low tumor incidence, and they suggest important options for further research with athermal exposures...."

(See *MWN*, M/J96 and J/A96.)

FROM THE FIELD

tion of nearby power lines....Using the Kaune-Savitz wire code classification, the relative risk for longest-held residences coded as "high" compared with "low" was 0.9 (95% confidence interval (CI)=0.7-1.3), while relative risk and 95% CIs for front door spot measures of 1.01-2.0 mG, 2.01-3.0 mG and higher than 3.0 mG compared with ≤ 1.0 mG were 1.0 (0.7-1.4), 0.6 (0.3-1.1) and 1.7 (0.8-3.6)....Because of potential exposure misclassification and the unknown pertinent exposure period, these data cannot provide strong support against, but clearly do not support, an association between adult glioma and residential power frequency electromagnetic field exposures."

Qishan Yu, Om Gandhi, Magnus Aronsson and Ding Wu, "An Automated SAR Measurement System for Compliance Testing of Personal Wireless Devices," *IEEE Transactions on Electromagnetic Compatibility*, 41, pp.234-245, August 1999.

"An automated specific absorption rate (SAR) measurement system has been developed for compliance testing of personal wireless devices. Unlike other systems, this system uses a model with a lossy ear-shaped protrusion, and the accuracy of this experimental setup has been checked by comparing the peak 1 g SARs for ten cellular telephones, five each at 835 and 1900 MHz, with the results obtained using a 15-tissue anatomically based model with the finite-difference time-domain (FDTD) numerical electromagnetic technique....The head and neck part of the

model with an ear-shaped protrusion of 3 mm thickness is made of a lossy outer shell of 5-7 mm thickness of epoxy laced with KCl solution. The phantom is filled with appropriate frequency-specific fluids with measured electrical properties (dielectric constant and conductivity) that are close to the average for gray and white matters of the brain at the center frequencies of interest (835 and 1900 MHz)....Peak 1 g SARs for ten telephones using different antennas are within ± 1 dB of those obtained using the FDTD numerical method....The measured and calculated SARs for the ten telephones, which have quite different operational modes [TDMA or CDMA] and antenna structures (helical, monopole or helix-monopole), vary from 0.13 to 5.41 W/Kg. Even though widely different peak 1 g SARs are obtained because of the variety of antennas and handsets, agreement between the calculated and the measured data is good and generally within $\pm 20\%$ (± 1 dB)...."

Dalsu Baris, Martha Linet et al., "Residential Exposure to Magnetic Fields: An Empirical Examination of Alternative Measurement Strategies," *Occupational and Environmental Medicine*, 56, pp.562-566, August 1999.

"Our results suggest the need for caution when imputing missing magnetic field data to reconstruct historical exposures....Our results argue against attempting to estimate lifetime exposure to magnetic fields with imputed values derived from current residences to fill in gaps caused by unmeasured residences lived in previously."

New Books: Short Reviews

Mark Powell, *Science at EPA: Information in the Regulatory Process*. 433 pp., \$49.95, Washington: Resources for the Future (RFF), 1999.

Powell presents eight detailed case studies that explore the role of science in regulatory decision-making—unfortunately, for our readers, neither EMFs nor RF/MW radiation have made the cut. Of special interest, nevertheless, is the discussion of the roles played by uncertainty and consensus-building in the formulation of public policy. Much of what Powell has written will not sit well with readers at the Environmental Protection Agency (EPA). Indeed, the agency's senior research and development official called this analysis "flawed" and "naive" (see *Science*, August 27, p.1,351). Powell calls for a doubling of EPA's research budget. RFF is an economics-oriented think tank based in Washington.

Alwyn Scott with Mads Peter Sørensen and Peter Leth Christiansen, *Nonlinear Science: Emergence and Dynamics of Coherent Structures*. 474 pp., \$39.95, New York: Oxford University Press, 1999.

This is not a book for the mathematically squeamish. But there are still items for those of us who cannot make our way through pages of differential equations, n-by-n matrices and multiple integrals. The two chapters that bracket the technical stuff are more relevant to a general audience. The opening overview, "The Birth of a Paradigm" runs from John Scott Russell's first description of a solitary wave in 1834 to the coining of the term "soliton" in the 1960s and on to the most recent applications of nonlinear science. In his final chapter, "Looking Ahead," Scott presents the reader with this sage advice: "Perhaps the most important message to carry away from the experiences of nonlinear science over the past

three decades is this. *Don't be overly impressed by theorists.* Always think things through for yourself. Be wary of procrustean tendencies to stretch or truncate the facts of nature until they fit within the confines of some narrow doctrine. As the theorists lovingly unfold their formulations, maintain a jaundiced eye."

Tim Rifat, *Remote Viewing: The History and Science of Psychic Warfare and Spying*. 442 pp., £17.99, London: Century, 1999.

Rifat recounts government efforts to develop psychological warfare and spying techniques during the Cold War, first in the Soviet Union and later in the U.S. While primarily interested in the development of paranormal psychological skills such as remote viewing, Rifat also looks at attempts in both countries, beginning in the 1960s, to use modulated microwaves for mind control. His command of facts is, to be kind, shaky. For instance, Dr. Robert Becker is not a "Los Angeles physicist," and to say that Dr. Ross Adey "repeated [Dr. Carl] Blackman's experiments" gets things exactly backwards. And then there is his reliance on "experts" such as Eldon Byrd and Andrija Puharich. The bulk of the book is a bunch of appendices, one of which is devoted to a reproduction of a 1976 U.S. Defense Intelligence Agency report on RF/MW bioeffects research in "Eurasian Communist Countries." Rifat argues that the document "shows that the dangers [of mobile phones] were known over 20 years ago." This document was declassified in 1976, at the request of Barton Reppert, then of the Associated Press. There is nothing new here. Paul Brodeur discussed the report in 1979, in *The Zapping of America* (Norton). *Remote Viewing* is currently available only in the U.K.

Across the Spectrum

“We do not believe cell phones can pose any health risks to humans.”

—Dr. Russell Owen, FDA’s Center for Devices and Radiological Health, Rockville, MD, quoted by Patricia Wen, “Mixed Signals” *Boston Globe*, p.C4, October 4, 1999 (see p.19)

“The ear can take a lot of abuse.”

—Kwok Chan, FCC laboratory, Columbia, MD, quoted by Jeffrey Silva in “Scientific Community Debates Validity of RF Absorption Tests,” *RCR*, p.2, September 20, 1999

“[N]ot one single study of RF and cancer could be said to be strongly persuasive as to causality. There is no basis at this time that RF can cause cancer. My position is -40 on the spectrum chart of -40 to +40.”

—Dr. Philip Cole, professor of epidemiology, University of Alabama, Birmingham, speaking in support of a DTV tower proposed for the Lookout Mountain antenna farm near Denver, quoted in “Summary of 12 Hours of ‘Super Tower’ Hearings,” *City and Mountain Views* (Golden, CO), p.17, August-September 1999 (see *MWN*, J/A98, M/A99 and J/A99)

“Adults have no idea this subculture is springing up.”

—Industry “insider,” quoted by John Harlow in “Mobiles Trap Children in Spiral of Debt,” on the U.K. “tele-tot” mobile phone market, four million and growing, *Sunday Times* (U.K.), p.13, September 19, 1999

“The airlines are misleading the traveling public. There is no real connection between cell phone frequencies and the frequencies of the navigation.”

—John Sheehan, chair of the 1996 RTCA Inc. inquiry on EMI to avionics, quoted by Jon Auerbach in “Connecting Flights: Cell Phone Use Aloft May Not Be the Danger that Airlines Claim,” *Wall Street Journal*, p.A1, October 5, 1999 (see p.19 and *MWN*, S/O96)

“There are still some who believe there is a correlation between ELF EMFs and adverse health effects and are continuing to push for more research. We should also be concerned about the epidemiological bias of the World Health Organization study, as well as recommendations in

the EMF RAPID report to Congress urging the National Institute for Occupational Safety and Health and the Occupational Safety and Health Administration to review exposure guidelines and ensure they provide adequate worker protection.”

—Doug Bannerman, consultant to the National Electrical Manufacturers Association (NEMA), Rosslyn, VA, quoted in “EMF Research Shifting Focus to Higher Frequencies,” *Electroindustry* (published by NEMA), p.8, August 15, 1999

“Somebody ought to pay attention to the siting of these things, so we don’t have a bad feeling about this 15 years from now.”

—Dr. Tom McGill, Fletcher Jones professor of applied physics, California Institute of Technology, Pasadena, CA, on Pacific Bell Wireless’s plan to install antennas at a school, quoted by Kevin Uhrich in “Sorry, Wrong Number,” *Los Angeles Times*, September 16, 1999

“Are we next going to have advertisements on the wall of the church or a sign saying, ‘This crypt sponsored by McDonald’s?’”

—Peter Burt, Daventry District Council, Northamptonshire (U.K.), quoted by Helen Johnstone in “Vicar Under Fire for Phone Mast in Church Spire,” *Times* (U.K.), August 23, 1999 (see also *MWN*, M/J99)

“The more towers, the more dead birds.”

—Dr. Bill Evans, Cornell Laboratory of Ornithology, Ithaca, NY, in “Communications Towers Killing Birds,” a press release on *Avian Mortality at Communications Towers*, held in Ithaca on August 15, Cornell University News Service, September 22, 1999

“To our knowledge, after extensive research, there has never been an incident where a use of a wireless phone created a spark that caused a fire or explosion.”

—Jeffrey Nelson, spokesperson, Cellular Telecommunications Industry Association (CTIA), Washington, quoted by Bernadette Tansey and Michael Cabanatuan in “Cell Phone Fire Hoax Spurs Warnings from Fuel Industry,” *San Francisco Chronicle*, p.A17, August 28, 1999 (see p.18 and *MWN*, J/A99)

“MICROWAVE NEWS” FLASHBACK

Years 15 Ago

- Dr. Carl Blackman reports that the frequency windows within which ELF magnetic fields alter calcium efflux in brain tissue shift with the strength of the Earth’s magnetic field.
- Maryland officials are concerned that a U.S. Navy electromagnetic pulse (EMP) simulator proposed for Chesapeake Bay might cause interference at the nearby Calvert Cliffs nuclear power plant.
- For the first time, work in occupations with high EMF exposures is linked to increased brain cancer risk, by Dr. Ruey Lin.

Years 10 Ago

- Lawsuits alleging cancer due to RF radiation exposures—from an AM radio antenna in Washington state and from an FM transmitter in Kentucky—are settled out of court. The terms are not revealed.
- Motorola’s Dr. Q. Balzano says that the IEEE standards committee will “look like yo-yos” if the exposure limit for frequencies above

3 GHz is doubled from 5 mW/cm² back up to 10 mW/cm².

- In a victory for the New York Power Authority, a judge rejects the claim of 58 landowners along the 345 kV Marcy-South power line that “cancerphobia” caused their properties to lose value.

Years 5 Ago

- “Basic information in all areas” is needed to determine whether wireless phone radiation is safe, says the CTIA’s scientific adviser, Dr. George Carlo, contradicting CTIA President Thomas Wheeler’s earlier claim that the phones had been proved safe.
- The NIEHS issues the first round of grants under the EMF RAPID program. The 21 awards, which run for up to four years and total \$15.5 million, are for cellular and animal research.
- Dr. Om Gandhi advises the FCC that his 1993 estimates of SARs from wireless phones are too low, by factors of as much as two and a half. After correcting errors in both calculated and measured estimates, Gandhi says, the two methods are again in agreement.

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AVIONICS EMI

Cute But Dangerous?...They might not look like much of a threat. But Furbys—wide-eyed, furry dolls that respond to speech and seem to gradually “learn” human language—have been banned from the National Security Agency in Fort Meade, MD, due to concern that they might also “learn” government secrets. The *Wall Street Journal* (September 24) reports that the high-tech toys now may not be used on most U.S. airlines. “Airlines, concerned about interference with navigational equipment, have started insisting [that] the toy can only be carried on board if the batteries are removed,” the *Journal* states. Some foreign carriers have adopted a similar rule: Furbys are so common on airline flights in Japan that it is common for the captain to make “a special Furby announcement” before a plane takes off. Japanese airlines say that the rule will be enforced strictly. “We’re sympathetic to children who may be without their Furby’s company for a long trip,” said a Japan Airlines representative, “but this is a safety issue.” The manufacturer, the Tiger Electronics division of Hasbro Inc., insists that the computerized dolls do not pose a risk. “There is no conclusive evidence that Furbys interfere with electronic equipment,” a company spokesperson said.

CONGRESS & RF SITING AND RESEARCH

Leahy Seeks More Local Control, Research...The U.S. Congress is again considering weakening the 1996 Telecommunications Act’s federal preemption of local control over tower siting. And this time, it is also pushing for federally funded research on the safety of RF/MW radiation. In August, Sen. Patrick Leahy (D-VT) introduced S.1538, which, if enacted, would authorize local officials to demand written evidence of compliance with the FCC’s RF/MW exposure limits and allow them to require the use of “alternative telecommunication or broadcast technologies” if a proposed installation is “inconsistent” with local rules. For those disputes that end up in court, the bill requires wireless carriers to show that they are in compliance with the telecom act. S.1538 allocates \$10 million in fiscal year 2000 for research into RF/MW health effects, to be directed by the Department of Health and Human Services (HHS), and requires the HHS to report to Congress on the present state of RF/MW safety research by January 2001. On August 5, Leahy told the Senate that the lack of a federal research effort “should no longer be overlooked” and that the EMF RAPID program “could serve as an excellent model” for such an effort. S.1538 follows two similar initiatives by Leahy, both thwarted by Sen. John McCain (R-AZ), who, as chair of the Senate Commerce Committee, wields much power over telecom laws (see *MWN*, N/D97 and S/O98). “McCain is usually not sympathetic to the direction we’re moving in,” an aide to Leahy told *Microwave News*. S.1538’s backers have a strategy to avoid this obstacle: They will try to attach their bill as a “rider” to a popular piece of legislation, according to Leahy’s aide. The new measure’s sponsors also include Sens. Russ Feingold (D-WI), Kay Bailey Hutchison (R-TX), James Jeffords (R-VT) and Daniel Moynihan (D-NY). In the House, Rep. Bernie Sanders (Ind-VT) introduced H.R.2834 and H.R.2835 in September. The two bills are effectively the same as the Senate proposal, with research funding addressed in the latter measure.

EXPOSURE METRICS

Workshop Proceedings...In September 1998, the U.K.'s National Radiological Protection Board (NRPB) hosted a workshop on *Exposure Metrics and Dosimetry for EMF Epidemiology*. Attendance was by invitation only, and was limited to 49 participants from academia, government and industry. The meeting was closed to the press, but the proceedings are now available. On power frequencies, particularly noteworthy papers include: the U.K.'s Dr. Philip Chadwick on an assessment of industrial environments; Sweden's Dr. Birgitta Floderus on combining residential and occupational exposures and the resulting relative risks (see *MWN*, J/A97); and the U.S.'s Dr. Michael Yost on magnetic field exposure metrics beyond time-weighted averages, using trolley workers as a case study. The RF/MW section is essentially limited to papers on cellular phones and towers, with very little on studies of broadcast or radar radiation. Of interest here are: the U.S.'s Dr. Q. Balzano on the critical variables for estimating the radiation exposure of cell phone users; Drs. Elisabeth Cardis and M. Kilkenny of the International Agency for Research on Cancer (IARC) in France on the multicenter cell phone-cancer study (see *MWN*, J/F98 and S/O98); and Drs. G.F. Pedersen and J.B. Andersen of Denmark on the differences between the ELF and RF signals from CDMA and TDMA handsets. The workshop, which was organized by the NRPB together with ICNIRP and the WHO, was sponsored by the GSM Association, the Mobile Manufacturers Forum and the U.K.'s National Grid Co. Representatives from the funding organizations, together with three staffers from the U.S.'s EPRI, made up close to a quarter of those invited to attend. The proceedings are available for £53.00 in the U.K. and US\$100.70 elsewhere from: Nuclear Technology Publishing, PO Box 7, Ashford, Kent TN23 1YW, U.K., (44+1233) 641683, Fax: (44+1233) 610021, E-mail: <sales@ntp.org.uk>, Web: <www.ntp.org.uk>. They were published as Vol.83, Nos.1-2, 1999 of *Radiation Protection Dosimetry*, which was provided to all subscribers of this journal.

PEOPLE

France's Dr. **Bernard Veyret** has been elected vice-chair of URSI Commission K on electromagnetics in biology and medicine. He will take over as chair from Japan's Professor **Shoogo Ueno** in 2002 at the next URSI General Assembly, to be held in Maastricht, the Netherlands. At this August's assembly in Toronto, Ueno took over from Dr. **James Lin** of the U.S. Meanwhile, Motorola's Dr. **Q. Balzano** has been elected vice-chair of URSI Commission A on electromagnetic metrology....Dr. **Edward Elson**, who long worked on microwave health effects at the Walter Reed Institute of Research in Washington, retired on August 31....**Shaheera Bieber** has succeeded **Ruth Greedy** as EMF issue manager at Ontario Hydro Services Co. in Toronto, which runs the transmission and distribution division that was part of Ontario Hydro. Greedy is currently on a two-year assignment with the Canadian Electrical Association in Ottawa....Dr. **David Rall**, the former director of the NIEHS, died on September 28 from injuries sustained in a car accident. He was 73. In a 1988 speech, Rall said: "The big challenge for environmental health sciences in the 21st century is likely to be exploring the effects of microwaves and other EMFs on living things."

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Conferences & Courses

November 6-7: **COST 244bis Workshop on Emerging Technologies**, University of Southampton, U.K. Contact: Dr. Terry Kenny, Multiple Access Communications, Chilworth Research Center, Southampton SO16 7NS, U.K. (44+23) 8076-7808, Fax: (44+ 23) 8076-0602, E-mail: <cost244@macltd.com>, Web: <www.radio.fer.hr/cost244>.

November 8-9: **1999 Tower Summit and Show**, Paris Hotel and Casino Resort, Las Vegas, NV. Contact: Shorecliff Communications Inc., 27127 Calle Arroyo, Suite 1909, San Juan Capistrano, CA 92675, (800) 608-9641 or (949) 443-3735, Fax: (949) 443-9206, Web: <www.scievents.com>.

November 9-10: **Mobile Phones—Is There a Health Risk?** London, U.K. Contact: Simon Moss, IBC, (44+171) 453-5495, Fax: (44+171) 636-1976, E-mail: <cust.serv@ibcuk.co.uk>, Web: <www.ibctelecoms.com/health99>.

November 11-12: **Electromagnetic Compatibility Compliance for Medical Devices**, Park Hyatt Hotel, Philadelphia, PA. Contact: Barnett International Conference Group, 1400 N. Providence Rd., Suite 2000, Media, PA 19063, (800) 856-2556 or (610) 565-2622, Fax: (610) 565-4842, E-mail: <customer.service@parexel.com>, Web: <www.barnettinternational.com>.

December 12-13: **COST 244bis Workshop on Quality Assurance in EMF Epidemiology**, National Institute for Working Life, Solna, Sweden. Contact: Dr. Birgitta Floderus, Karolinska Institute, PO Box 210, S-17177 Stockholm, Sweden, (46+8) 728-7286, Fax: (46+8) 31 39 61, E-mail: <birgitta.floderus@imm.ki.se>, Web: <www.radio.fer.hr/cost244>.

January 10-13, 2000: **RF Safety: Science, Compliance and Communications**, Marriott Riverwalk Hotel, San Antonio, TX. Contact: Michelle Gutberlet, Electromagnetic Energy Association, 1255 23rd St., NW, Suite 200, Washington, DC 20037, (202) 452-1070, Fax: (202) 833-3636, E-mail: <eea@elecenergy.com>, Web: <www.elecenergy.com>.

In our last issue, we mistakenly listed the November 19-21 4th European Bioelectromagnetics Association Congress in Zagreb, Croatia. In fact, it was held in 1998. We apologize for the error.

Keeping Current: Follow-Up on the News

◆ On July 12, the Council of Ministers of the European Union formally adopted its recommendation on public exposures to non-ionizing radiation (see *MWN*, J/A99). The text was published in the July 30 *Official Journal of the European Communities*, which is available on the Web at: <europa.eu.int/eur-lex>.

◆ In a September 21 letter, Thomas Wheeler, president of the CTIA, urged the IEEE subcommittee on mobile phone compliance testing to complete its work on revised guidelines with “all deliberate speed” (see *MWN*, J/F99).

◆ NIOSH’s *Manual for Measuring Occupational Electric and Magnetic Field Exposures*, which was released earlier this year, is now available in “pdf” format on NIOSH’s Web site: <www.cdc.gov/niosh/98-154pd.html> (see *MWN*, N/D98).

◆ A special issue of *IEEE Transactions on Microwave Theory and Techniques*, on medical applications and biological effects of RF/MW radiation, is slated for November 2000. Submissions should be sent by November 15, 1999, to: Dr. Arye Rosen, Sarnoff Corp., 201 Washington Rd., Princeton, NJ 08543.

◆ Just when we thought that the mobile phone–gas station ignition hazard had been put to rest (see p.15 and *MWN*, J/A99), the EPA issued a “cellular phone alert.” On August 13, EPA’s Howard

Wilson told his managers that it would be “prudent” not to use cell phones “near areas where flammable and/or combustible liquids and chemicals are stored.” And the *Calgary Sun* reported on September 28 that the Technical Standards and Safety Authority of Ontario, Canada, has issued its own warning about using cell phones when pumping gas.

◆ Magnetic Shield Corp. in Bensenville, IL, has introduced a gaussmeter rental program. The devices can be used for 30 days for \$79, with a \$100 deposit. For more information, see the company’s Web site: <www.magnetic-shield.com>.

As We Go to Press

A meeting organized by the CTIA, FDA and WHO to define future research needs on mobile phone safety was cancelled at the last minute. Originally scheduled for October 12-13 in Rockville, MD, the meeting had not been rescheduled at press time.

All costs were to be paid by the CTIA. Government sources suggested that FDA officials were concerned that the agency might be seen as too close to industry.

VIEWS ON THE NEWS

Trying To Make Sense of the News

Six years ago, the wireless industry declared that mobile phones were safe, while the FDA warned that no one really knew.

Now they seem to have traded places. This month, the head of the industry research group Wireless Technology Research (WTR) warned that the consumer is not being protected, while the FDA said that the phones pose no risk at all.

"We do not believe cell phones can pose any health risks to humans," stated the FDA's Dr. Russell Owen (see p.15). Owen claims to have been misquoted: In a widely circulated e-mail, Owen wrote that, "Neither the content nor the context accurately reflects what I said." But reporter Patricia Wen told *Microwave News*, "That is a verbatim quote." Owen stated this opinion several times in different ways, she said.

WTR head Dr. George Carlo disagrees with Owen. "My recommendation is that it's much better for children to use a pager than a cell phone," Carlo told the *Boston Globe*. "The science is in a gray area," he explained. Carlo modeled a "hands-free" headset for a *Globe* photographer and urged adults to keep mobile phone antennas at least two inches from the skull.

Carlo's recommendations make sense—but not because of anything we have learned from WTR's shell game of a research program. The prudent avoidance measures cited by Carlo make sense precisely because of how much we do *not* know about cellular phone safety, at a time when there are over 250 million cellular customers worldwide.

If the FDA, WTR or anyone else had mounted a serious health research effort over the last six years, we would have a wealth of data to digest. Instead, we are left chewing on sound bites.

* * *

Epidemiological evidence on EMFs and leukemia now paints a clearer, more consistent picture than ever before. Data from ten studies taken together show a significant risk for children exposed to 6 mG or more (see p.3). And officials of EPRI, the electric utility industry group, have concluded that the main studies of workers in the industry suggest an increase in the risk of both leukemia and brain cancer (see p.3).

You might think that the EMF issue would now be taken more seriously. Instead, we get an end to the government's research program, cutbacks at EPRI and newspaper editorials that declare, "People sincerely concerned about possible health dangers from EMFs...should be relieved to learn that [the threat] was a fake" (*Providence Journal*, August 13).

* * *

"It's not a problem" to use cellular phones on a commercial airplane in midflight, aviation consultant John Sheehan told the *Wall Street Journal* (see p.15). The *Journal* suggested that the airlines' real motive for restricting their use is to force passengers to use the high-priced "air-phones" built into the seat backs.

But here's what Sheehan told *Microwave News* three years ago: "Although interference from personal electronic devices is extremely rare, the very fact that it can *possibly* occur should give the FAA and airlines pause about their unrestrained use." Sheehan chaired a committee of the aviation standards group RTCA that prepared a report on this issue (see *MWN*, S/O96).

The *Journal* dismissed evidence of interference from wireless phones as "anecdotal," arguing that attempts to recreate such interference have failed. But Sheehan's committee pointed out that, "The likelihood [of reproducing interference] is low since it has been impossible to duplicate the original conditions with the same device, aircraft, location, RF environment and the airborne system's settings." The *Journal* quoted from the report, but somehow left this part out.

If a mobile phone, laptop or video game did play a role in a plane crash, would we know it? When we asked Sheehan, he answered, "To tell you the truth...it would be very difficult to tell." He added, "I guess it's public knowledge that after Secretary [of Commerce Ron] Brown's crash, a special team of investigators was dispatched to look at that very thing—especially to see if somebody might have been using a cellular telephone."

An airline pilot posted this response to the *Journal* on the junkscience.com Web site: "When executing an instrument approach to 50 feet with 600 feet of visibility while traveling at 145 knots, precision is vital. Do not expect me as your pilot to be sympathetic with your impatience to call your broker via cell phone or to play Nintendo."

* * *

Last year, Britain's NRPB hosted a meeting on dosimetry (see p.17 and *MWN*, M/J98). We wanted to attend—but the NRPB told us the invitation-only meeting was "limited to leading experts in the fields of epidemiology, EMF exposure metrics and dosimetry...and mobile telephony."

One who did get an invitation was CTIA Vice President for External and Industry Relations Jo-Anne Basile. Until three years ago, Basile was a CTIA lobbyist on Capitol Hill; before that she was a congressional staffer. Whenever we have spoken with Basile, she has always been well-informed, friendly and intelligent. But she is no more of a "leading expert" than we are.

Clearly, *Microwave News* and others were kept out because the press and the public were not welcome at this industry-funded meeting. The NRPB seems to view public scrutiny as an annoyance. This habit of working behind closed doors is part of the reason that Britain has a mobile phone exposure standard at least five times higher than that of any other country in the world.

But, as we report on page 1, the U.K.'s exposure standard may be about to change. The NRPB complains that this is based on what it calls "political considerations." We have another name for it: public accountability.

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