

The WiFi Blues

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Wireless broadband Internet access is all the rage. The noise is drowning out concerns for this technology's risks.

Philadelphia, the city of brotherly love is going to have it; many in San Francisco want it: Wireless broadband Internet access (*WiFi*).¹ It seems too good to be true. At relatively low cost, anyone can get on the Internet anywhere in a city. All the city needs to do is install a network of WiFi antennas.

An often-repeated argument in favor of citywide WiFi is that it will help close the digital divide: the poorer you are, the more limited your access to the Internet and its wealth of information resources. Cities like Philadelphia and San Francisco are actively trying to close the digital divide. One option is WiFi.

Yet in weighing the options, virtually nothing is heard about the potential health risks. Saturating an entire city with WiFi adds to the existing burden of radio frequency radiation (*RFR*). That burden, called *electrosmog*² by some, consists of long-term exposure to low-levels of nonionizing electromagnetic radiation in the radio frequency and microwave range from familiar sources like radio and TV broadcast signals, radar, and the ubiquitous cell phone.

Health Risks

Henry Lai, PhD has been researching the biological and health effects of RFR for 35 years. His research focuses on the effects of RFR in the range used by cell phones and other wireless technologies. His laboratory at the University of Washington in Seattle is the single remaining lab in the US that conducts such research. Ten years ago it was one of four.

There is no funding in the United States for research of the biological and health effects of RFR and EMF. No foundation, government agency, or corporation will lay down money to help clarify the science behind concerns about WiFi, cell phones, and other wireless devices. Dr. Lai keeps his lab going by doing cancer research, some of it concerning the use of electromagnetic radiation to treat cancer.

In Europe there are many well-funded projects in RFR research. Citizens are more organized. Public figures have championed the issue. And the European Union has a much greater public

¹ See the Wireless Philadelphia and San Francisco TechConnect websites: Wireless Philadelphia accessed October 5, 2006 at <http://www.wirelessphiladelphia.org>. and San Francisco TechConnect accessed October 5, 2006 at <http://www.sfgov.org/techconnect>.

² The term is more familiar in Europe than in the US because of the greater political attention paid to the issue by citizen groups and politicians who support them. Beginning in Sweden in the 1980s, citizens suffering from *electrohypersensitivity* have been vocal advocates for research into the health risks from nonionizing electromagnetic radiation and for the reduction of electrosmog. See Swedish Association for the Electrosensitive website: Swedish Association for the Electrosensitive accessed October 5, 2006 at http://www.feb.se/index_int.htm.

health orientation than the United States. These days we have to rely on the Europeans for the science of wireless technology health risks.³

It was not always so. For example, in the early 1990s the Cellular Telecommunications and Internet Association (CTIA) came up with \$25 million for research into the potential health effects of cell phones. The CTIA is the cell phone industry's trade organization. Their intention was to lay concerns about cell phones to rest. The Wireless Technology Research (WTR) program administered the funds and research program. When the \$25 million was spent, the WTR final report submitted in 2000 recommended further study. The CTIA cut a deal with the FDA to spend another \$1 million to review further research.⁴

The money is still there. The FDA has been waiting since 1999 when the deal with CTIA was cut to spend the money.

FDA plans to convene a meeting in the near future to evaluate all completed, ongoing and planned research looking at health effects associated with the use of wireless communication devices and identify knowledge gaps that may warrant additional research.⁵

Initially, the WTR found no cause for concern. But in 1995 Dr. Lai and his colleague NP Singh, PhD found that exposing the brain cells of rats to RFR at a level similar to cell phones produced breaks in strands of DNA. Their discovery was a turning point in the research and in the CTIA's enthusiasm for the project. Dr. Lai and Dr. Singh had uncovered a mechanism that explained how RFR exposure might cause health effects.⁶

Since 1990 Dr. Lai has maintained a database of research on the effects of RFR on humans, lab animals, and cell cultures. He has amassed over 300 studies published in peer reviewed scientific journals. To avoid bias, he excludes his own research from the database.

Of these studies, 56% show a biological or health effect⁷ from exposure to RFR. These effects include

- cancer,⁸

³ Slesin, Louis. *Emf Health News. Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes.

⁴ Carlo, George and Martin Schram. *Cell Phone: Invisible Hazards in the Wireless Age: An Insider's Alarming Discoveries About Cancer and Genetic Damage*. New York, NY: Carroll & Graf. 2001.

⁵ FDA. Cell Phone Facts: Consumer Information on Wireless Phones accessed July 3, 2006 at <http://www.fda.gov/cdrh/wireless/braincancer040606.html>.

⁶ The original Lai and Singh research was published in 1995 (Lai, Henry and Narendra Pal Singh. Acute Low-Intensity Microwave Exposure Increases DNA Single-Strand Breaks in Rat Brain Cells. *Bioelectromagnetics*. 1995. 16: 95-104.). The next year they published a paper showing even more alarming effects on DNA: double DNA strand breaks (Lai, Henry and Narendra Pal Singh. DNA Single- and Double-Strand DNA Breaks in Rat Brain Cells after Acute Exposure to Low-Level Radiofrequency Electromagnetic Radiation. *Int J Radiat Biol*. 1996. 69: 513-21.). Subsequent research has confirmed these findings and found that the breaks can persist in cell cultures through multiple mitotic cycles Gandhi, G. Genetic Damage in Mobile Phone Users: Some Preliminary Finding. *Ind J Hum Genet*. 2005. 11(2): 99-104.

⁷ The phrase "biological or health effect" is common in this literature. Some research is focused specifically on illness while other research simply looks at effects on the organism which might have a downstream health effect.

- genetic effects such as damage to DNA,⁹
- cellular and molecular effects such as a reduction in enzymes critical to the central nervous system,¹⁰
- changes in electrophysiology such as reduced activity between nerve cells,¹¹ and
- physiological and behavioral changes such as impairment of peripheral vision.¹²

Biased Research?

An interesting thing happens when the studies from Dr. Lai's database are placed in two stacks: one of studies funded by the wireless industry (30% of the studies), the other stack of independently funded studies (70%). Of the studies that show a biological or health effect from wireless RFR, 14% are industry funded while 86% are independently funded. Of studies showing no effect, 49% are industry funded while 51% are independently funded.

To make the point another way, of industry funded studies, only 27% found an RFR effect. Independently funded studies found an RFR effect 68% of the time. This discrepancy is consistent among the effects listed. Of studies that found an effect on cancer, 11% were industry funded, 47% were independently funded. Cellular and molecular effects: 19% industry, 69% independent. Electrophysiology effects: 33% industry, 77% independent. Physiological and behavioral effects: 57% industry, 83% independent.

If Dr. Lai's research were included in the tally, the percent of studies showing an effect from RFR would be even greater. But when Dr. Lai is asked about these statistics, he often says that 50% of the studies show an effect. And then he points out that 50% is a significant number, significant enough to justify a precautionary approach that minimizes exposures.

The differences between the industry funded stack of studies and the independently funded stack suggest bias. Bias enters research through the way a study is designed, the methods used in the study, how data is collected, and how results are interpreted. It might be that some independently funded researchers are biased because they are consumed by a burning passion to eliminate RFR exposures or, even more sinister, destroy the wireless industry. They might have consciously or unconsciously designed their studies, chosen methods, collected data, and interpreted the results to show health effects from RFR. However, the rewards for doing so are not great. Many researchers who advise precaution regarding RFR have been ostracized or their research funding has been

⁸ For example Hardell, Lennart, Michael Carlbert and Kjell Hansson Mild. Pooled Analysis of Two Case-Control Studies on Use of Cellular and Cordless Telephones and the Risk of Malignant Brain Tumours Diagnosed in 1997-2003. *Int J Oncol.* 2006. 28(2): 502-18.

⁹ For example Diem, E, et al. Non-Thermal DNA Breakage by Mobile-Phone Radiation (1800mhz) in Human Fibroblasts and in Transformed Gfsh-R17 Rat Granulosa Cells in Vitro. *Mutat Res.* 2005. 583: 178-83. and Gandhi, G. Genetic Damage in Mobile Phone Users: Some Preliminary Finding. *Ind J Hum Genet.* 2005. 11(2): 99-104.

¹⁰ For example Barteri, M, A Pala and S Rotella. Structural and Kinetic Effects of Mobile Phone Microwaves on Acetylcholinesterase Activity. *Biophys Chem.* 2005. 113(3): 245-53.

¹¹ For example Xu, S, et al. Chronic Exposure to Gsm 1800-Mhz Microwaves Reduces Excitatory Synaptic Activity in Cultured Hippocampal Neurons. *Neurosci Lett.* 2006. 398(3): 253-7.

¹² For example Langer, P, et al. Hands-Free Mobile Phone Conversation Impairs the Peripheral Visual System to an Extent Comparable to an Alcohol Level of 4-5 G 100 Ml. *Hum Psychopharmacol.* 2005. 20(1): 65-6.

slashed. Careers have been stalled and in some cases terminated — hardly circumstances that would encourage jumping on that particular bandwagon.¹³

The rewards for producing industry-friendly results are obvious: funding, professional recognition, a clear career path, and employment opportunities in industry. This is not to say that these researchers are dishonest. It is to say that rewards are more likely as a consequence of producing the “right” answers. In other words, researchers typically aren’t corrupted into conducting biased research. More often they’re already biased and the rewards flow to them as a consequence.¹⁴

Within each group, whether industry or independently funded, results don’t always agree — some studies show an effect while others do not regardless of who did the funding. That difference suggests another kind of problem: scientists don’t know enough yet to conduct decisive experiments that can produce something like a professional consensus regarding the biological and health effects of wireless RFR. Many of the scientists who work in this field and who believe that there’s ample reason for concern will say that the science is not yet conclusive.¹⁵ This drives some activists crazy. Yet it is a true statement about the state of the science.

We should not be surprised that this lack of conclusive science has led the wireless industry to claim that cell phones and other wireless technologies are safe. The FDA is with them, stating that

[t]he available scientific evidence does not show that any health problems are associated with using wireless phones. There is no proof, however, that wireless phones are absolutely safe.¹⁶

¹³ A telling example is described in the November 2005 edition of *Microwave News*. Slesin, Louis. When Enough Is Never Enough: A Reproducible Emf Effect at 12 Mg. *Microwave News*. 2005. 25(2): 1-2. Beginning in 1992, seven separate research projects have demonstrated an effect on breast cancer cell metabolism from extremely low electromagnetic radiation, intensities much lower than current standards and well below intensities that are supposed to have any effect. The effect disrupts cell signaling. Each report was ignored. The original researcher was, as Louis Slesin describes it, “drummed out of the EMF profession.” The others have had funding cut and endured other harassments. An even more chilling example is described in Gunni Nordström’s *The Invisible Disease* Nordström, Gunni. *The Invisible Disease: The Dangers Fo Environmental Illnesses Caused by Electromagnetic Fields and Chemical Emissions*. New York: O Books. 2004. She describes how the once promising career of Olle Johansson, MD, a leading dermatological researcher at the Karolinska Institute in Stockholm, Sweden, has been damaged. With over 400 peer reviewed publications and major discoveries in dermatology, Dr. Johansson has been refused promotion to full professorship, denied research funding, and denied research facilities for his continued interest in RFR health effects and for his advocacy for electrosensitives.

¹⁴ The notorious example of how pharmaceutical companies shape medical research and medical practice is described by two insiders: Marcia Angell, MD, a former editor at the *New England Journal of Medicine* and John Abramson, MD, a professor at the Harvard School of Medicine Angell, Marcia. *The Truth About the Drug Companies: How They Deceive Us and What to Do About It*. New York: Random House. 2004. and Abramson, John. *Overdosed America: The Broken Promise of American Medicine*. New York: Harper. 2005.

¹⁵ Dr. Lai’s 2005 review article is a good example. It describes the many issues in the field that remain unresolved. Lai, Henry. Biological Effects of Radiofrequency Electromagnetic Fields. In *Encyclopedia of Biomaterials and Biomedical Engineering*. G.L. Bowlin and G. Wnek: Taylor & Francis Books. 2005.

¹⁶ FDA. Cell Phone Facts: Do Wireless Phones Pose a Health Hazard? accessed July 3, 2006 at <http://www.fda.gov/cellphones/qa.html#22>.

This carefully constructed statement is intended to reassure us. Yet Dr. Lai's database puts the lie to the first sentence: it's simply false. The framework set up for us is that a technology should be adopted unless there's conclusive evidence that it does harm. Not all regulatory agencies think this way.

The UK's equivalent to the FDA, the Health Protection Agency (HPA), has declared a voluntary moratorium of marketing cell phones to children as a precautionary measure.¹⁷ The moratorium has so far been observed by the UK cell phone industry. The HPA opens its discussion of the health risks from cell phones by saying that

There is a large body of scientific evidence relating to exposure to radio waves and there are thousands of published scientific papers covering studies of exposed tissue samples (e.g. cells), animals and people. It is not difficult to find contradictory results in the literature, and an important role of the HPA Radiological Protection Division (RPD) is to develop judgments [sic] on the totality of the evidence in controversial areas of the science.¹⁸

Unlike the FDA, the HPA points to contradictory science regarding cell phone radiation. The reassurance is that they're paying attention, not that cell phones very likely don't cause harm. The HPA goes on to cite the National Radiological Protection Board (NRPB), which reviews the science and recommends standards. The NRPB and with it the HPA explicitly adopt a precautionary standard. With regard to children, the NRPB's 2004 report recommends that

in the absence of new scientific evidence, the recommendation in the Stewart Report on limiting the use of mobile phones by children remains appropriate as a precautionary measure.¹⁹

In 2004 the International Association of Fire Fighters (*IAFF*) decided that they will not permit cell phone antennas on fire houses. The decision was made by resolution at the IAFF's annual delegate assembly. The resolution directed the International to review the potential health risks from cell antennas. If the science demonstrated a risk, then the union would oppose the use of fire stations as sites for cell antennas until further science demonstrated that cell antennas are safe.²⁰

¹⁷ In April 1999 the UK's Ministry of Health formed the Independent Expert Group on Mobile Phones to evaluate the safety of cell phones. Chaired by Sir William Stewart, the commission of independent scientists (which became known as the Stewart Group) reported in May 2000 that enough scientific evidence existed to be concerned about health risks from "subtle effects on biological functions, especially those of the brain." The Stewart Group noted in particular that children would be more susceptible to harm. See the Stewart Group's report *Independent Expert Group on Mobile Phones*. Chilton, Oxfordshire, UK: National Radiological Protection Board. 2000. and website: *Independent Expert Group on Mobile Phones* accessed July 3, 2006 at <http://www.iegmp.org.uk>.

¹⁸ Health Protection Agency. *Mobile Telephony and Health: Health Protection Advice* accessed July 3, 2006 at http://www.hpa.org.uk/radiation/understand/information_sheets/mobile_telephony/health_advice.htm.

¹⁹ National Radiological Protection Board. Chilton, Oxfordshire, UK: National Radiological Protection Board. 2004., p. 11.

²⁰ International Association of Fire Fighters. *International Association of Fire Fighters, Division of Occupational Health, Safety and Medicine*. 2005.

The resolution was passed in August 2004. In April 2005 the union's Health and Safety Department completed the review of the science. They found more than ample evidence to conclude that the union should oppose cell antennas on fire stations. The position paper included 49 references and a bibliography of 40 citations.²¹ Based on that evidence, the resolution cites a wide range of effects experienced by fire fighters:

- slowed reaction times,
- lack of focus,
- lack of impulse control,
- severe headaches,
- anesthesia-like sleep,
- sleep deprivation,
- depression,
- tremors, and
- vertigo.²²

Three things are worth noting about the substance of the resolution and the union's official position. First, the fire fighters were focused on their ability to do their job. Second, fire fighters were involuntarily exposed to a health risk. And third, the fire fighters oppose cell antennas on fire stations until they are proven safe.

The decision that the fire fighters faced — a decision we all face — is how to evaluate the safety of wireless technologies and decide what level of involuntary risk we are willing to take.²³

- Use it unless there's good evidence that it's harmful.
- Or don't use it until there's good evidence that it's safe.

So consider this: 47% of independently funded studies found cancer effects, 69% found effects on cell function, 77% found effects on electrical signaling in the body, and 83% found physiological and behavioral effects. Suppose you have several hundred marine biologists study your swimming pool. 47% (or 69% or 77% or 83%) of the biologists say you've got a shark in your pool. Would you dive in? Would you let your kids dive in?²⁴

RFR Exposures

Citywide WiFi is only the latest RFR wireless technology to place us involuntarily at risk. Cell phone networks are the best known, which include personal digital assistants (*PDA*s) such as the Blackberry™. Wireless networks at home and at the office are newer than cell phones and are another RFR exposure. Even if you don't have one, your neighbor might and that will expose you. Also relatively new are the Bluetooth technologies used for applications such as hands-free

²¹ Ibid. pp. 13-38. Dr. Lai's database was used as a resource.

²² Ibid. p. 13

²³ For an excellent discussion of how to evaluate environmental risk, see Mary O'Brien's *Making Better Environmental Decisions* O'Brien, Mary. *Making Better Environmental Decisions: An Alternative to Risk Assessment*. Cambridge, Massachusetts: MIT Press. 2000.

²⁴ Some might rightfully howl at this analogy. An "exposure" to a shark is nothing like an exposure to RFR. No analogy is perfect. So consider another. Hundreds of microbiologists test your pool water for cholera and 47% find it. Or hundreds of chemists test your pool water for a powerful toxin with both short-term and long-term effects, something like mercury, and 47% find it at various concentrations. Sharks are just so much more dramatic. And the analogy makes the same point: how much agreement among scientists do you need to be assured that something is safe?

telephone headsets which operate using RFR. The familiar cordless phone is another RFR exposure that might put you at as much risk as a cell phone.²⁵

What these technologies share is reciprocal receiving and transmitting of RFR signals between an end-user device and antennas that link the device to a network. There are three characteristics of these RFR signals that are believed to contribute to the biological and health effects of wireless technologies: signal strength, frequency, and modulation.²⁶

Citywide WiFi uses a signal strength similar to cell phones. Signal strength is measured in watts, a standard unit of energy. Wireless networks for the home and office have less signal strength (although they can be increased with boosters) while Bluetooth devices and cordless phones have even less strength.

All of these technologies use roughly the same frequency band: 0.3 to 3 GHz. *GHz* stands for *gigahertz*. A *hertz* is a standard measure of electromagnetic radiation created by sending an alternating electrical current through an antenna that is one cycle per second. A gigahertz is one billion cycles per second. The higher the GHz, the faster the current alternates.

An alternative way of measuring RFR is in wavelength. Wavelengths have an exact and inverse relationship to frequency: higher frequencies correspond to shorter wavelengths. Visible light is electromagnetic radiation with higher frequencies and shorter wavelengths than RFR, with red light having a lower frequency and longer wavelength than blue light.

Modulation refers to whether the signal comes at a constant frequency (as in AM radio and analog cell phone systems) or in pulses (as in FM radio and digital cell phones). All digital wireless technologies are pulsed.

Risk increases with signal strength. The frequencies used by wireless technologies are to some extent “ideal” for affecting our bodies because the wavelengths are at a human scale. Digital (pulsed) signals are of greater risk than analog signals.²⁷

Short-term, high-intensity exposures to wireless RFR have received the most research attention, in particular the acute affects of cell phones. Far fewer studies have looked at long-term effects of cell phone use let alone the use of other wireless devices. Even less studied are the effects of the low-intensity, persistent exposure to RFR from cell phone and WiFi antennas.

Electrohypersensitivity

Much of the discussion about RFR health effects is framed as a concern with people who are electrohypersensitive. Unlike immune-mediated hypersensitivity that responds to allergens, electrohypersensitivity is a reaction to nonionizing electromagnetic radiation from video display

²⁵ Although the signal strength from cordless phones is far less than cell phones, people tend to use them for longer periods of time: exposure per unit time is less for the cordless phone, but the total exposure is equivalent to that of a cell phone. A European study found equivalent cancer risks for cell phone users and cordless phone users. Hardell, Lennart, Michael Carlbert and Kjell Hansson Mild. Pooled Analysis of Two Case-Control Studies on Use of Cellular and Cordless Telephones and the Risk of Malignant Brain Tumours Diagnosed in 1997-2003. *Int J Oncol.* 2006. 28(2): 502-18.

²⁶ Lai, Henry. Biological Effects of Radiofrequency Electromagnetic Fields. In *Encyclopedia of Biomaterials and Biomedical Engineering*. G.L. Bowlin and G. Wnek: Taylor & Francis Books. 2005.

²⁷ Ibid.

monitors, cell phones, cordless phones, wireless routers, or other RFR source. Characteristic symptoms of electrohypersensitivity can include:²⁸

- localized heat and tingling,
- dry upper respiratory tract and eye irritation,
- brain fog, headache, and nausea,
- swollen mucus membranes,
- muscle and joint pain,
- heart palpitations, and
- progressively severe sensitivity to light.

Critics argue that electrohypersensitivity is not a physical ailment but a psychological one. Research led by Olle Johansson, MD at the Karolinska Institute in Stockholm identified changes in mast cells in electrohypersensitives.²⁹ So Dr. Johansson exposed rats to RFR exposures similar to his human subjects, assuming that the rat psyche is not predisposed to produce the symptoms of electrohypersensitivity. The study produced results similar to what he found in human subjects: enlarged mast cells aggregated close to the surface of the skin. Dr. Johansson went further and tested both electrohypersensitives and nonsensitives human subjects in similar exposures. Though the nonsensitives had no hypersensitivity symptoms, the mast cells in their skin showed the same behavior as electrohypersensitives, although the effect was less severe.³⁰ Based on this research, Dr. Johansson and his colleague Shabnam Gangi proposed one mechanism for the health effects of RFR as an immunological response, hypothesizing as to how this mechanism affects internal organs such as the cardiovascular and neurological systems.³¹

In *The Invisible Disease*,³² Finnish journalist Gunni Nordström associates electrohypersensitivity with multiple chemical sensitivity and chronic fatigue syndrome. People in Sweden made electrohypersensitivity a public health issue when cathode ray tube-based video display monitors were introduced into offices. The rise of Silicon Valley — both in the original Silicon Valley and the

²⁸ See Johansson, Olle. Screen Dermatitis and Electrosensitivity: Preliminary Observations in the Human Skin. In *Electromagnetic Environments and Health in Buildings*. D. Clements-Croome. New York: Spon Press. 2004: Chapter 20., Nordström, Gunni. *The Invisible Disease: The Dangers Fo Environmental Illnesses Caused by Electromagnetic Fields and Chemical Emissions*. New York: O Books. 2004., and Swedish Association for the Electrosensitive accessed October 5, 2006 at http://www.feb.se/index_int.htm.

²⁹ A mast cell is a type of immune cell that stores histamine crystals which are released during an allergic response. The skin of the electrohypersensitives Dr. Johansson examined had an abnormally high concentration of mast cells close to the skin's surface that also had high loads of histamine. In other words, these subject's immune-mediated response is in a reactive state.

³⁰ Johansson, Olle. Screen Dermatitis and Electrosensitivity: Preliminary Observations in the Human Skin. In *Electromagnetic Environments and Health in Buildings*. D. Clements-Croome. New York: Spon Press. 2004: Chapter 20, Johansson, Olle, et al. A Case of Extreme and General Cutaneous Light Sensitivity in Combination with So-Called 'Screen Dermatitis' and 'Electrosensitivity' - a Successful Rehabilitation after Vitamin a Treatment - a Case Report. *Journal of the Australasian College of Nutrition and Environmental Medicine*. 1999. 18(1): 13-6.

³¹ Gangi, Shabnam and Olle Johansson. A Theoretical Model Based Upon Mast Cells and Histamine to Explain the Recently Proclaimed Sensitivity to Electric and/or Magnetic Fields in Humans. *Medical Hypotheses*. 2000. 54(4): 663-71.

³² Nordström, Gunni. *The Invisible Disease: The Dangers Fo Environmental Illnesses Caused by Electromagnetic Fields and Chemical Emissions*. New York: O Books. 2004.

many Silicon Valleys that have developed around the world — gave rise similar health effects among computer manufacturing workers. Researchers observed a relationship between materials used in products and their synergistic reaction with electromagnetic radiation.³³ But both funding for research and data collection on occupational health quickly dried up when these issues came to light.

Electrohypersensitives are not an unlucky few. They are likely harbingers in a complex landscape of environmental risks. Just like any other environmental stressor, RFR affects some people more than others. And as with other environmental stressors, the greater the overall burden, the greater the risk of becoming one of the “unlucky few.”

Citywide WiFi adds to the existing burden of RFR.³⁴ Just as burning more fossil fuels adds to the level of smog, adding more RFR adds to the level of electrosmog. You don’t have to expose your home or your city to the increased burden created by WiFi. There’s a viable alternative: a wired Internet access and network. The hype might make it seem less convenient and more expensive. But what’s a good night’s sleep worth? Or reducing your risk of cancer?³⁵

³³ LaDou, Joseph. Occupational Health in the Semiconductor Industry. In *Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry*. T. Smith, D.A. Sonnenfeld and D.N. Pellow. Philadelphia, PA: Temple University Press. 2006: Chapter 3.

³⁴ The total burden of already existing electrosmog goes beyond send-receive wireless technologies like WiFi and cell phones and includes pedestrian technologies like radio and television broadcast signals. Research by Dr. Johansson and his colleague Örjan Hallberg at the Karolinska Institute looked at the incidence of cancer and other 20th Century illnesses in Europe and the US and found a striking association between the increase in certain cancers during the 20th Century and exposure to RFR as measured by radio and TV broadcasts. Hallberg, Örjan and Olle Johansson. Cancer Trends During the 20th Century. *Journal of the Australasian College of Nutrition and Environmental Medicine*. 2002a. 21(1): 3-8, Hallberg, Örjan and Olle Johansson. Melanoma Incidence and Frequency Modulation (Fm) Broadcasting. *Archives of Environmental Health*. 2002b. 57(1): 32-40, Hallberg, Örjan and Olle Johansson. Fm Broadcasting Exposure Time and Malignant Melanoma Incidence. *Electromagnetic Biology and Medicine*. 2005. 24: 1-8.

³⁵ The *Your Own Health And Fitness* radio show (<http://www.yourownhealthandfitness.org>) has carried several interviews over the past year on RFR health risks and safeguards. Havas, Magda. *Dirty Electricity and Emf Health Dangers*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes, Johansson, Olle. *The Science of RFR Health Risks*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes, Johansson, Olle and Doug Loranger. *Electrosmog*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2005: 60 minutes, Levitt, B. Blake and Jan Newton. *Wireless Public Health Crisis*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes, Sage, Cindy. *Smart Exposures: Understanding Risks from Emf and Rfr*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2005: 60 minutes, Sage, Cindy and B. Blake Levitt. *Where You're Exposed and What to Do: Emf and Rfr*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes, Slesin, Louis. *Emf Health News*. *Your Own Health And Fitness*. L. Berman: KPFA 94.1 FM Berkeley, CA. 2006: 60 minutes.