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Electromagnetic Frequency Sensitivities

# EMF EFFECTS FROM POWER SOURCES AND ELECTROSMOG

William J. Rea

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# EMF Effects from Power Sources and Electrosmog

## Electromagnetic Frequency Sensitivities Series

Electromagnetic frequencies are everywhere in our daily lives. This brand-new series on EMF describes how having an understanding of the vast combinations of electrical and chemical problems will help in the diagnosis and treatment of electromagnetic sensitivities. This series covers the work of a renowned scientist in the field whose interests range from reversing the dysfunction of chronic illness to optimizing the health of his patients.

*Air Pollution and the Electromagnetic Phenomena as Incitants* is the first in an extensive series written by William J. Rea on electromagnetic sensitivity and the impact of electromagnetic phenomena on our lives. The complete list of books soon to be part of the series is as follows:

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EMF Effects from Power Sources and Fixed Specialized Equipment: Electrosmog

The Physiological Basis of Homeostasis for EMF Sensitivity: Molds, Foods, and Chemicals

Pollutant Entry and the Body's Homeostatic Response to and Fate of the Noxious Stimuli (Dirty Electricity) from Communication Equipment

Basic Science and Science of Clinical Electromagnetic Sensitivity

Physiology of Electrohypersensitivity: EMF Treatment

# EMF Effects from Power Sources and Electrosmog

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# Contents

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Recognition goes the cardiac physiologists and surgeons who worked out the basic tenets of cardiac physiology and who have the greatest advances in cardiac surgery.

This book is further dedicated to the great physiologists like Hartmut Heine, PhD, who discovered the new field of electromagnetic sensitivity—the new epidemic of the twenty-first century. This epidemic follows the problem of chemical sensitivity, for which there are 80,000 chemicals with combinations too numerous to count.

The combinations of electrical and chemical problems are so multitudinous that they are staggering to the clinician. However, a cursory understanding of the combinations of these fields can help clinicians partially understand the problems and thus help in the diagnosis and treatment of electromagnetic sensitivities.

Eventually, new treatments can be developed, eliminating illness, as shown for the healing of bones. A basic understanding of environmentally induced illness and healing must be reached by clinicians before fixed named diseases occur.

We dedicate this book to Professor Cyril Smith, PhD, at the University of Salford in England as well—along with

Dr. Jean Monro, MD, a clinician par excellence, also founder and director of the Breakspear Environmental Hospital in England. She is not only Dr. Rea's colleague and dear friend but is an innovator in keeping environmental medicine alive on the continent of Europe.

Randolph T. and Dickey L. defined the total body pollutant with chemical sensitivity that laid the foundation for understanding increased deficiency and electrical sensitivity for developing their less polluted environmental unit.

Finally, to Sam Milham, who pointed out the effect of dirty electricity on schoolchildren and teachers.

# Special Recognition

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CHAPTER 1

# Electromagnetic Emanations from Power Sources and Fixed Specialized Equipment

## *High-Tension Lines, Electromagnetic Field Towers, and Telephone Towers*

ELECTROMAGNETIC EMANATIONS FROM POWER supplies and their specialized equipment are globally wide at times, often exceeding the total body pollutant load and therefore resulting in physiologic dysfunction. Each power station in the United States is connected to every other. If one area is down, electric

power can be shunted from other power stations throughout the United States. This situation gives continuity of electricity over the whole country, which has been great because there have been few blackouts in the United States for years. However, this also means that people living or working near generator stations and substations, high-tension power lines, and telephone towers will be exposed to larger quantities of electric and magnetic forces because they come from all over the United States. This constant exposure to dirty electricity results in an increase in total body pollutant load and physiologic dysfunction. Not only are there more electrical generating stations and substations involved, there are thousands of permanent high-power lines and telephone facilities that put out high levels of induced electrical impulses and thus dirty electricity. This situation can be bad for people living and working near them. For example, Milham and Stetzer[1] have shown that structures and areas near cell towers have high levels of measurable dirty electricity in their electrical outlets and air.[1]

## GENERAL OVERVIEW OF ELECTRICAL ENVIRONMENTAL INCITANTS (GENERATORS)

Electromagnetic field (EMF) incitants can come from various modalities and are often coupled by the coherence phenomena to the total body pollutant load of incitants such as pollen, foods, molds, mycotoxins, chemicals (natural gas, pesticides), bacteria, and viruses. Thus, the total body pollutant load can at times be so great that it makes it difficult to handle the EMF load. These EMF incitants can come from electrogenerating devices that have large capacities to generate electricity.

All transmitters, computers, compact fluorescent lights, direct current (DC) chargers, and variable speed motors contain switching power supplies.[1] *Dirty electricity is generated by arcing, sparking, and any device that interrupts the current flow.* Each interruption of current flow results in a voltage spike described by the equation $V = L \times di/dt$, where $V$ is the voltage, $L$ is the inductance of the electrical wiring circuit, and $di/dt$ is the rate

of change of the interrupted current. The voltage spike decays in an oscillatory manner. *The oscillation frequency is the resonant frequency of the electrical circuit, and this can be damaging to the sensitive human.*

## MEASUREMENT OF DIRTY ELECTRICITY

The Graham/Stetzer (G/S) microsurge meter measures the average magnitude of the higher-frequency transients. The measurements of *dV/dT* read by the microsurge meter are defined as G/S units. They are a function of voltage and frequency. Thomas Edison began electrifying New York City in 1880, but by 1920, only 34.7% of all U.S. dwelling units and 1.6% of farms had electric service (Table 1.1). By 1945, 78% of all dwelling units and 32% of farms had electric service.[2] This means that in 1940, about three-quarters of the U.S. population lived in electrified residences and one-quarter did not. By 1950, the U.S. vital registration system was essentially complete, in that all 48 contiguous United States were included. Most large U.S. cities were electrified by the turn of the century,

TABLE 1.1 Growth of Residential Electric Service, U.S. 1920–1956, Percent of Dwelling Units with Electric Service

| | All Areas in U.S. | | |
|---|---|---|---|
| **Single** | **City Dwellings** | **Farm Dwellings[a]** | **Urban and Rural Nonfarm Dwellings** |
| 1880 | Edison discovers electricity | | |
| 1920 | 34.7 | 1.6 | 47.4 |
| 1925 | 53.2 | 3.9 | 69.4 |
| 1930 | 68.2 | 10.4 | 84.8 |
| 1935 | 68.0 | 12.6 | 83.9 |
| 1940 | 78.7 | 32.6 | 90.8 |
| 1945 | 85.0 | 48.0 | 93.0 |
| 1950 | 94.0 | 77.7 | 96.6 |
| 1956 | 98.8 | 95.9 | 99.2 |

*Source:* Modified from Milham, S. 2010. *Med. Hypotheses*. 74:337–345.

[a] 10 years longer lifetime than city dwellers in spite of more smoking in rural population.

and by 1940, over 90% of all residences in the northeastern states and California were electrified.[2]

In 1940, almost all urban residents in the United States were exposed to electromagnetic fields in their residences and at work, while rural residents were exposed to varying levels of EMFs, depending on the progress of rural electrification in their states. In 1940, only 28% of residences in Mississippi were electrified, and five other southern states had less than 50% of residences electrified. Eleven states, mostly in the northeast, had residential electrification rates above 90%. In the highly electrified northeastern states and in California, urban and rural residents could have similar levels of EMF exposure, while in states with low levels of residential electrification, there were potentially great differences in EMF exposure between urban and rural residents. It took the first half of the twentieth century for these differences to disappear.[3]

These fixed generators of electricity are permanently large stationary bases using carbon brushes to generate 60 volts of electricity and digital phone energy that are connected by *high-tension wires* or other generators, machines, or electric motors used as communication devices throughout the United States that emanate strong high-frequency dirty electricity in addition to regular electricity. These units are also bases for and/or telephones and telegraphs. Mobile phone towers can be based in fixed areas to allow transmission throughout the country. Computers, cell phones, compact fluorescent lights, halogen lamps, other electrical components, refrigerators, televisions, wireless routers, and dimmer switches can beam or plug into the air by Wi-Fi apparatus throughout an area, creating dirty electricity. Smart meters are being attached to most homes and public buildings, which can compound the problem. All of these substances can create aberrant electrical and magnetic radio frequency impulses that can alter body physiology by increasing the specific and total body pollutant load. Some will create no problems at the low frequency of 50/60 hertz. However, many of these have bursts of high-frequency dirty electricity and power surges that can and do

cause aberrations of the body's physiology. These dirty electricity aberrants are usually in the gigahertz range 1–10. This aberrant impulse can cause all kinds of physiologic changes found in insects, animals, and humans.[3] These alterations in physiology may at first be imperceptible to the individual or result in subtle symptoms that are usually ignored by the individual.

When the electromagnetic load is too burdensome, the patient may develop *hypersensitivity* to electricity, which may be the harbinger of a fixed named disease such as depression, brain alterations (memory loss), insomnia, suicidal inclinations, arteriosclerosis, malignancy, neurovascular degenerative disease, vasculitis, infertility, and so on.

Overexposure to environmental incitants, both chemical and electromagnetic loads, is coupled with nutritional deficiencies and genetic metabolic defects to create these diseases and malfunctions of the twenty-first century. This combination keeps the individual from obtaining the optimum function that is desired through a lifetime.

## DISEASES OF CIVILIZATION AND ELECTROMAGNETIC FIELDS

The diseases of civilization, or lifestyle diseases, include cardiovascular disease, arteriosclerosis, vasculitis, cancer, and diabetes and are thought to be caused by changes in diet, exercise habits, and lifestyle that occur as countries industrialize. *Milham*[3] *thinks the critical variable that causes radical changes in mortality and morbidity accompanying industrialization is electrification.* We think it is a combination of both chemicals and EMF. It is often observed that natural gas and pesticides are precursors to electrical hypersensitivity. Beginning in 1979 with the work of Wertheimer and Leeper,[4] there has been increasing evidence that some facet of electromagnetic field exposure is associated epidemiologically with an increased incidence of leukemia; certain other cancers; and noncancers like Alzheimer's disease, Parkinson's, multiple sclerosis, amyotrophic lateral sclerosis, and suicide.[4] These diseases

are observed to be partially due to disruption to the cell membrane, resulting in the change of calcium channels through the membrane, allowing toxins to enter, causing disruption in normal physiology. With the exception of a small part of the electromagnetic spectrum from infrared through visible light, ultraviolet light, and cosmic rays, the rest of the spectrum is humanmade and foreign to human evolutionary experience. Milham[3] suggests that from the time Thomas Edison started his direct current electrical distribution system in the 1880s in New York City until now, when most of the world is electrified, electricity has carried high-frequency voltage transients that caused and continue to cause what are considered the normal diseases of civilization. Even today, many of these diseases are absent or have very low incidences in places without electricity.

Death rates due to tuberculosis, typhoid fever, diphtheria, dysentery, influenza, pneumonia, and measles fell sharply in this period and account for most of the decline in the causes in death rate.[3] Milham[3] shows all malignant neoplasms (Figure 1.1),

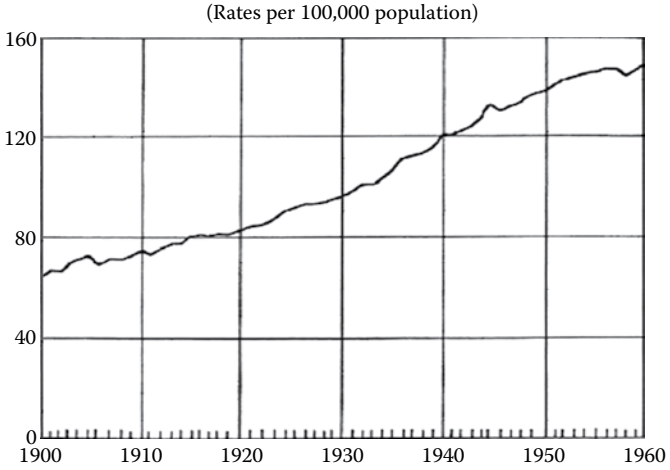


FIGURE 1.1 Death rates for malignant neoplasms: death registration states, 1900–1932, and United States, 1933–1960.

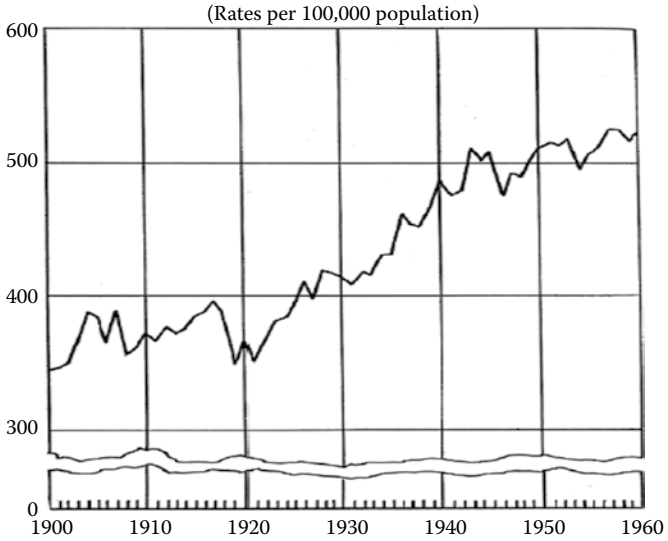


FIGURE 1.2 Death rates for major cardiovascular renal diseases: death registration states, 1900–1932, and United States, 1933–1960.

cardiovascular diseases (Figure 1.2), and diabetes (Figure 1.3) had gradually increasing death rates.[3] In 1900, heart disease and cancer were fourth and eighth in a list of the 10 leading causes of death. By 1940, heart disease had risen to first and cancer to second place, and they have maintained that position ever since. This shows that for all major causes of death examined, except motor vehicle accidents, there was a sizable urban excess in 1940 deaths. The authors of the extensive 69-page introduction to the 1930 mortality statistics volume noted that cancer rates for cities were 58.2% higher than those for rural areas.[3] They speculated that some of this excess might have been due to rural residents dying in urban hospitals. In 1940, deaths by place of residence and occurrence were presented in separate volumes. In 1940, only 2.1% of all deaths occurred for residents of one state dying in another state. The 1940 volume presents correlation coefficients for the relationship between death rates by urban or rural area of each state and the percent of residences in each state's electric service.

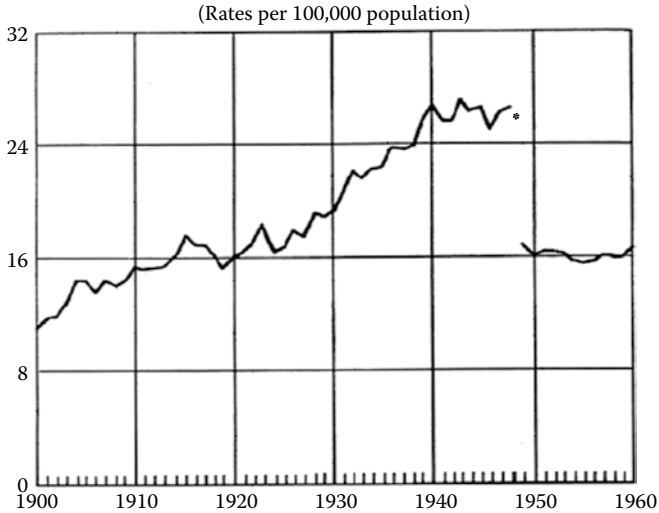


FIGURE 1.3 Death rates for diabetes mellitus: death registration states, 1900–1932, and United States, 1933–1960.

There was no correlation between residential electrification and total death rate for urban areas, but there was a significant correlation for rural areas ($r = 0.659$, $p = <09.0001$).

When Edison and Tesla opened the Pandora's box of electrification in the 1880s, the U.S. vital registration system was primitive at best and infectious disease death rates were falling rapidly. *City residents had higher mortality rates and shorter life expectancy than rural residents.*[5] Rural white males in 1900 had an expectation of life at birth of over 10 years longer than urban residents.[5]

Although the authors of the 1930 U.S. vital statistics report noted a 58.2% cancer mortality excess in urban areas, it raised no red flags. The census bureau residential electrification data was obviously not linked to the mortality data. Epidemiologists in that era were still concerned with communicable diseases.

Court Brown and Doll report[6] the appearance of the childhood leukemia age peak in 1961, 40 years after the U.S. vital statistics

mortality data on which it was based was available. Milham[3] reports a cluster of childhood leukemia[7] a decade after it occurred, only because he looked for it. Real-time or periodic analysis of national or regional vital statistics data is still only rarely done in the United States.

The real surprise in this data set is that cardiovascular disease, diabetes, and suicide, as well as cancer, seem to be strongly related to the level of residential electrification. A community-based epidemiologic study of urban rural differences in coronary heart disease and its risk factors was carried out in the mid-1980s in New Delhi, India, and in a rural area 50 km away.[8] The prevalence of coronary heart disease was three times higher in the urban residents, despite the fact that the rural residents smoked more and had higher total caloric and saturated fat intakes. Most cardiovascular disease risk factors were two to three times more common in the urban residents. Rural electrification projects are still being carried out in parts of the rural area that was studied.[8]

It seems unbelievable that mortality differences of this magnitude could go unexplained for over 70 years after they were first reported and 40 years after they were noticed. Milham[3] thinks that in the early part of the twentieth century, nobody was looking for answers. By the time EMF epidemiology got started in 1979, the entire population was exposed to EMFs. Cohort studies were therefore using EMF-exposed population statistics to compute expected values, and case-control studies were comparing more exposed cases to less exposed controls; that is, the mortality from lung cancer in two-pack-a-day smokers is over 20 times that of nonsmokers but only 3 times that of one-pack-a-day smokers. After 1956, the EMF equivalent of a nonsmoker ceased to exist in the United States. An exception to this is the Amish, who live without electricity. Like rural U.S. residents in the 1940s, Amish males in the 1970s had very low cancer and cardiovascular disease mortality rates.[9]

If the hypothesis and findings outlined here are even partially true, the explosive recent increase in radio frequency radiation

and high-frequency voltage transient sources, especially in urban areas from cell phones and towers, terrestrial antennas, Wi-Fi and WiMAX systems, smart meters, broadband internet over power lines, and personal electronic equipment, suggests that, like the twentieth-century EMF epidemic, we may already have a twenty-first century epidemic of morbidity and mortality underway caused by electromagnetic fields. The good news is that many of these diseases may be preventable by environmental manipulation, if society chooses.

A 4.5-million-dollar Air Force–supported study of pulsed 2450 MHz microwave radiation exposure of germ-free rats shows midlife immune system changes and an increase in benign and malignant tumors in the exposed rats.[10] In cows, the persistent, intermittent electrical shocks associated with stray voltage produce a typical stress syndrome characterized by increase of blood adrenal hormones and cortisol.[11–13] A recent study in mice shows that exposure for 1 hour a day for 14 days to extremely low-frequency magnetic fields (ELF-MFs) caused hyperactivity lasting for 3 months and activation of the dopaminergic D1 receptor in the brain for 1 year.[13] ELF-MF exposure measured for 1 day during pregnancy predicts asthma incidence in offspring up to 16 years later.[14] Early life stress, particularly childhood maltreatment, predicts systemic inflammation and levels of proinflammatory cytokines like interleukin in adulthood.

Evidence that neurotransmitter abnormalities are associated with disease is that there are a number of conditions for which drugs targeting neurotransmitters are used. These include but are not limited to depression, attention deficit hyperactivity disorder (ADHD), schizophrenia, Parkinson's disease, restless leg syndrome, eating disorders, anxiety disorders, insomnia, and chronic fatigue syndrome. *Electrical hypersensitivity has now been described and is rapidly increasing.* This hypersensitivity is described later in this section and certainly involves neurotransmitters as a result of the electrical and chemical situation.[15] The nonaware electrically vulnerable should take a lesson from the electrically hypersensitive

in their awareness of the damaging effects of the different electrical generators of dirty electricity.

A group from Nippon Medical School in Tokyo recently reported that forest environments as compared with city environments reduce blood pressure, urinary adrenaline, noradrenaline, and dopamine and increase natural killer cell activity and expression of anticancer proteins. They thought that these effects might be due to the presence of phytoncides like α- and β-pinene in forest air.[16–18] Their findings may be due to low levels of dirty electricity in the forest as compared with city environments. These results are evidence that the *neuroendocrine and immune systems are linked and function in parallel.* Certainly, we know the case where patient reactions to these terpenes are extremely negative. The type of forest may also be highly significant when talking about the pine family or the maple or oak family of trees.

The most telling observation that electricity can be a problem involves people who live without electricity. The Old Order Amish (OOA) in North American live without electricity. They have less than half the cancer incidence of the U.S. population[19] and about half the type 2 diabetes prevalence as other U.S. citizens despite having the same body mass index.[20] Cardiovascular disease,[21] Alzheimer's disease,[22] and suicide[23] are reported to be less common in the OOA. A pediatric group practices in Jasper, Indiana, that cares for 800 Amish families has not diagnosed a single child with ADHD, and childhood obesity is almost unseen in this population.[24] Remarkably, the life expectancy of OOA has been about 72 years for the past 300 years for both men and women. In 1900, the life expectancy of U.S. males was 46.3 years and 48.3 years for females.[25] Of course, it has changed over the last half-century. If the rest of the U.S. population had the disease incidence and prevalence of the OOA, the U.S. medical care and pharmaceutical industries would collapse.

A joint Korean-US team review of 13 past studies[26] supported two previous reviews, with all three indicating a 20%–235% increase in tumors after 10 or more years of cell phone use.[26]

Over the past few years, investigators have examined cancer clusters on Cape Cod, which has a huge U.S. Air Force radar called PAVE PAWS, and Nantucket, home to a powerful LoranC antenna. Counties in both areas have the highest incidences of all cancers in the entire state of Massachusetts.[27]

The Rajasthan government has banned the installation of some mobile masts in the state. There are seven telecom operators with more than 15,000 masts in the state.[28] The new policy would bar installation of any such mast in a medical or educational institution, and permission would be given only for open spaces like parks and agricultural land.

There has to be some check on these towers, especially in residential and institutional areas. Each will be discussed separately.

## RADIO FREQUENCY FROM BASE STATIONS AND TRANSMISSION TOWER SIGNS AND SENSITIVITY

Base stations and transmission towers are prime generators of EMF and radio frequency (RF) and the sources of dirty electricity. Excessive RF exposure can cause *acute problems* (headaches, insomnia, fatigue, vertigo, tinnitus, etc., and other hypersensitivity symptoms of electrohypersensitivity [EHS]). Excessive RF exposure can also cause *chronic problems* (oxidative stress and inflammation, eventually resulting in male infertility or end-stage diseases such as cancer, arteriosclerosis, and neurodegeneration). *Constant RF transmission is frequently harmful, even at low levels, and should be avoided. Frequent and repetitive intermittent transmissions are also potentially harmful,* and should be avoided. Nocturnal exposures are more problematic than daytime exposures because of RF's potential to suppress nocturnal melatonin secretion and disturb sleep, and because night is the time when individuals rest and heal from stresses (including oxidative stress). Occasional and infrequent daytime exposures are much less likely to cause an increase in chronic problems for the population at large and frequent expanding of EMF-generating apparatuses such as cell

phone, computers, as is so on. Occasional and infrequent daytime exposures are still likely to provoke acute symptoms in a small percentage of the population.

## RECENT DATA ON DIRTY ELECTRICITY

EMF waves can come from a variety of instruments. The evaluation of these emanating from instruments developed after the discovery of radar, but some existed before, like EMF-generating stations, motors, high-tension wires, and transformers, as previously shown. An example of dirty electricity generated from one of these new types of instruments such as TVs, cell towers, cell phones, hair dryers, and so on causing autism and a variety of diseases has been found.

## STRESS SYSTEM DEREGULATION

Another example of dirty electricity effects was in chronic neurotransmitter changes in residents near a new cell tower erected in Rimbach, Austria.[29] Microwave radiation from the tower was presumed to be the active agent of the dirty electricity. Catecholamine neurotransmitters were studied in volunteers over a period of a year and a half. Epinephrine, norepinephrine, dopamine, and phenylethylamine (PEA) all had significant changes in levels, indicating chronic deregulation of the stress system, including the autonomic nervous system, from the dirty electricity. Dopamine levels dropped significantly during the first year of study. PEA levels were unchanged for 6 months and then dropped significantly over the next year. The authors postulated that cell tower radiation generated dirty electricity that resulted in a chronic stress response in the residents, accounting for the great variety of morbidity and mortality that has been reported in residents near cell towers that put out dirty electricity.[29]

## RESPONSES OF THE BODY TO DIRTY ELECTRICITY

The authors of this book have found a deleterious influence in the total body pollutant load of pesticides, natural gas, formaldehyde,

solvents, and many other environmental toxins, all of which cause multisystem damage, making the body's response vulnerable to stray dirty electricity. The ground regulation, immune, and neurovascular systems are the primary targets that respond through electrically charged biological substances such as neurotransmitters, hormones, and peptides, which transmit faster than the speed of light.

It has been known since the 1990s that environmental illness from biological toxins and EHS starts before and shares the process of a disastrous reduction in the nervous system enzyme cholinesterase. Its sudden depletion can cause depression and also suicidal behavior;[30] cardiac arrhythmia; and gastrointestinal, genitourinary, and respiratory dysfunction when one is exposed to dirty electricity.

All these biological processes have their inherent timing, repair, and defensive responses, especially during pregnancy and brain development, but for any biological entity process at any time. Hence, the industry "safety" standards with which government regulators collaborate are totally theoretical. The subsequently constructed safety standards for normal and dirty electricity date to 1962 when nobody knew the difference between heat-producing radiation and microwave radiation, and cell phones did not exist.

In 2002, Santini reported significant increases in such symptoms in individuals living closer than 300 meters to cell towers;[31,32] others find safety at 500 meters. The Russians say 2 kilometers, and they have been studying this the longest, so American data on 300–500 meters may be inadequate for true long-term protection.

In Poland, Bortkiewicz finds a similar increase in symptoms among residents near cell towers. Symptoms showed equal association with proximity of the tower regardless of whether the subject suspected such a casual association.[33,34] It has been observed in some areas of the United States, especially in newer building areas of business, that cell towers and cell emissions for different generators like Wi-Fi and smart meters may be within a few hundred feet, resulting in emanations from different angles that would hit an individual at the same time. We don't know the consequences of these multiple

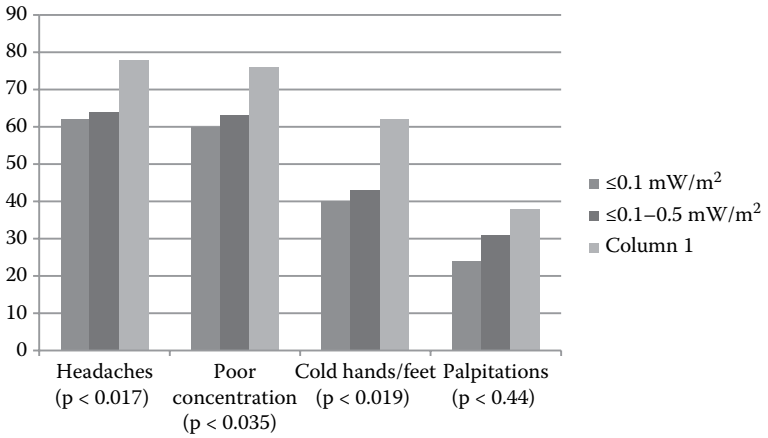


FIGURE 1.4 Percentage of subjects reporting symptoms, stratified by RF exposure levels as measured in subject's bedroom. (From Hutter, H. P. et al. 2006. *Occup. Environ. Med.* 63(5):307–313.[37])

angle bursts, but these have to be evaluated and studied carefully to be sure they don't cause brain alterations, arteriosclerosis, cancers, or cardiovascular and neurodegenerative diseases. If they trigger hypersensitivity, they will be carriers for adverse EMFs. Common sense would tell one that random frequencies from different sources might not be efficacious.

*Examples of one-direction EMF from unidirectional transmissions were seen.* In two studies, Abelin[35] and Altpeter[36] find evidence of disruption of sleep cycles and melatonin physiology by RF transmission during the operation and subsequent shutdown of the shortwave radio transmitter in Schwarzenburg, Switzerland.

## Correlation of Signal Tower EMF Emissions and Symptoms—Austria (Figure 1.4)

In a study done in urban and rural sites in Austria, Hutter[37] finds a clearly significant correlation between exposed signal power density and headaches and concentration difficulties—despite the fact that maximum measured power densities were only 4.1 mW/m²(= 0.41 uW/cm²,) well below established "safe" limits.

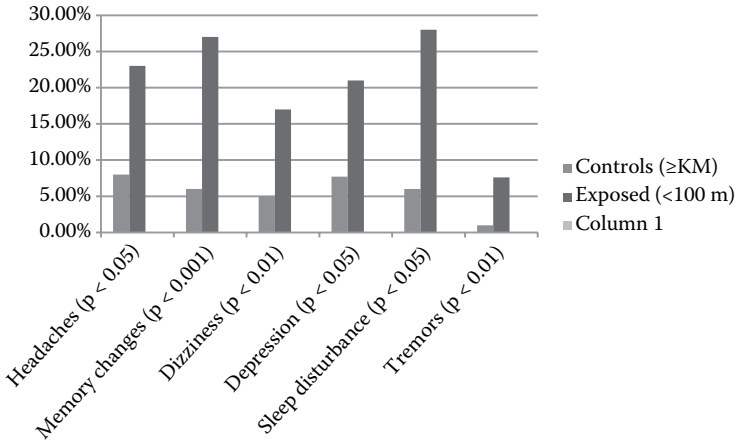


FIGURE 1.5 Percentage of subjects reporting symptoms, stratified by proximity to city's first cell phone tower. (From Abdel-Rassoul, G. et al. 2007. *Neurotoxicology* 28(2):434–440.[38])

## Cell Tower EMF Emission and Symptoms—Egypt (Figure 1.5)

In Egypt, a study of inhabitants living near the first cell phone tower in the city of Shebeen El-Kom found a significant increase in headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance, with lower performance on tests of attention and short-term auditory memory.[38]

Research at the military radar installation in Akrotiri, Cyprus, showed that residents of exposed villages had markedly increased incidence of migraine, headache, dizziness, and depression, and significant increases in asthma, heart problems, and other respiratory problems.[39]

Studies in Murcia, Spain, yielded similar findings, and based on measured exposures, the authors suggested that safe levels of indoor exposure should not exceed 1 uW/m$^2$ (0.0001 uW/cm$^2$).[40,41]

In a study of residents of Selbitz, Bavaria, researchers found statistically significant increases in multiple health symptoms that demonstrated a dose-response relationship with cell phone tower transmissions. Individuals living within 400 meters of the cell

phone tower had significantly more symptoms than those living >400 meters from the tower. Individuals living within 200 meters of the tower had significantly higher symptoms than those living between 200 and 400 meters from the tower.[42] Two recent reviews provide a detailed overview of research in this area.[43,44]

## SOURCES OF DIRTY ELECTRICITY AND DISTANCE FROM GENERATORS

Dirty electricity readings are highest closest to the generating station and cell tower and fall away with distance. Generating stations, fixed motors, and cell towers creating dirty electricity are some of the causes of immune and nonimmune homeostatic dysfunction generated by dirty electricity. All cell towers and electrical generation stations have switching power supplies to convert the grid alternating current (AC) into direct current to operate the cell tower transmitter and charge the batteries used for backup power during grid outages. These switching power supplies interrupt the AC current flow and create dirty electricity (high-frequency voltage transients), which flows back into the grid and can cause all the entities previously discussed.[45] High-tension wires, telephone and cell towers, and substations create dirty electricity.

## CELL TOWERS

An interesting example of EMF stress is shown in problems that occurred at the Olympia library close to the Rimbach cell tower in Switzerland. Here, there were only very low levels of microwave exposure in this library environment. The neurotransmitter changes in the Olympia library employees and in residents near the Rimbach cell tower were also caused primarily by cell tower dirty electricity. There was a gradual increase in urinary dopamine and PEA in the Olympia librarians. After a dirty electricity cleanup, when the cell tower was modified to decrease dirty electricity, there was a sharp contrast, seen as a decline in these neurotransmitters.[45]

The ADHD-like symptoms in children in a classroom near a cell tower were changed by modifying dirty electricity exposure, while cell tower microwave exposure was constant. Levels of a neuromodulator, β-PEA, are lower in the urine of children with ADHD.[46]

The mortality patterns linking EMF exposure to the diseases of civilization were evident long before the development of microwave transmitters in the 1940s. An Egyptian group[47] has reported that plasma adrenocorticotropic hormone and serum cortisol levels decreased over a 6-year period in people exposed to cell phones or cell phone base stations compared with controls.

Buchner and Eger's[29] surmise that the morbidity and mortality associated with cell tower EMF exposure are mediated through a chronic oxidative stress reaction seems accurate and suggests that the body recognizes EMF as a foreign invader and mounts an acute stress response to it.[29] With chronic exposure and oxidative stress, neuroendocrine and immune system deregulation results in a wide spectrum of human morbidity and mortality. Milham's[1] work shows that increasing dirty electricity in an office environment results in increased urinary levels of dopamine and PEA in exposed persons. This is evidence that dirty electricity and probably other types of EMF exposure act as initiators and propagators of illness.[29] It is clear that electromagnetic effects from power sources and specialized equipment can trigger and propagate disease processes. Changes in electrical delivery are being sought throughout the world.

## MOBILE PHONE MASTS AND TELEPHONE TOWERS CAN CAUSE SEVERE PROBLEMS, AS SHOWN THROUGHOUT THE WORLD

Paralleling metallic telephone facilities, people may be exposed to high levels of induced 60 Hz. This longitudinal current is of sufficient magnitude to cause damage to equipment and personnel exposed long enough at either end because these substances also create dirty electricity. It can present a shock hazard or a chronic

exposure current of this dirty electricity to personnel and people living around it. These dirty currents may cause damage to copper cable facilities as a result of overstressed dielectric levels from pair-to-pair, pair-to-shield, and shield-to-ground connections. In addition, the frequency spectrum produced by such interference will most likely disrupt communications as well as damaging the immune and nonimmune environmental receptor systems of humans. These currents reduce the level of security and reliability of circuits serving power substations and can harm individuals. The emission of stray or dirty electricity from these generating systems, substations, telephone towers, and high-tension wires can cause problems in the EMF-sensitive patient and for those who are normally functioning but susceptible. Unaware people can't perceive the devastating consequences such as cancer, arteriosclerosis, and neurodegenerative diseases that can occur long term with constant exposure to dirty electricity. High-tension stations and wires can put thousands of volts (7200) into the air, which are reduced to 220 or 120 volts for safety.

The value of reducing current provided by the power company may or may not include the effects of other supply lines, overhead ground wires, or other paralleling conductors that could reduce the effects of a power line fault but still give the adverse effects of dirty electricity. The major emphasis should be on determining the actual mutual impedance between the power distributing circuit and the telephone distributing circuits. Unfortunately, it usually isn't.

If the exposure is not reasonably parallel, the total exposure should be sectionalized and the mutual impedance of each section should be determined. The voltage sum of all sections will be the value added to the substation ground potential rise (GPR), which may exceed dirty electricity levels that are supposed to produce no health effects. Symptoms will be produced in the electrically sensitive patient, and these individuals should be listened to in order to determine the extent of the dirty electricity and its effect on humans.

*Fiber optic-based cable facilities are immune to power induction and thus appear safer for the exposed individual* (Table 1.2).

TABLE 1.2 Fixed Generators of High-Frequency Electromagnetic Smog (Dirty Electricity)

1. Electrogenerating stations—brushes and variable motors used as communications, split range
2. Substations
3. High-tension wires—carrying 7200 volts
4. Cell towers
5. Supply lines
6. Ground wires
7. Telephone lines
8. Mobile phone masts—wireless meters
9. Power line telecommunications
10. Radio and TV transmitters

*Note:* Each power station is connected to others in the United States.

Many positive changes in the environment have occurred with informed people throughout the world. However, negative changes have also occurred. For a positive example, mobile phone masts erected in County Donegal, Ireland, will have to be a least 1 kilometer away from schools (as of 2010) in order to prevent susceptibility. Also, certain frequencies have been harnessed to heal wounds and bones[48] and shock people to relieve arrhythmia and cardiac arrest. Intradermal provocation-neutralization techniques have been used on 20,000 food-, mold-, and chemically sensitive patients at the Environmental Health Center–Dallas to help heal inflammation.

Another example of positive change was when Madridiario reported that Leganes City Council, in a large town near Madrid, approved limiting mobile phone masts to 0.6 V/m or a peak power density of 0.1 microwatt per square centimeter. It also guarantees monitoring levels and providing data in real time to citizens. Surveillance will be specially controlled in sensitive places such as inside homes, workplaces, schools, hospitals, and generally any area possibly occupied by the same person for a period of more than 6 hours.[49]

In France, in May 2009, a committee (COMOP) was established to oversee experimental reduction in electromagnetism from

phone masts. It was announced that 238 towns had volunteered to reduce exposure to 0.6 V/m, and 16 were chosen for the experiment. Reduction to 0.6 V/m (0.1 uW/cm$^2$) is the preliminary stage recommended by the BioInitiative Report. The long-term aim is 0.1 V/m (0.003 uW/cm$^2$).[50]

According to a news article in *Málaga Hoy*, there were 43 cases of cancer, 35 of which resulted in death, among the 350 inhabitants of Perez Los Cortijos living meters away from a mobile phone mast next to the watchtower in Benajarafe near the town of Velez-Málaga, Spain.[51]

In France, the director-general of Bouygues Telecom said that he was ready to set a new limit of 6 V/m indoors, as required in Italy. This would mean about 20 V/m outdoors, a considerable reduction on the obsolete hearing limits of the International Commission on Non-Ionizing Radiation Protection (ICNIRP).[51]

Limits in Salzburg, Austria, and Valencia, Spain, are 0.6 V/m outdoors (BioInitiative); in Luxemburg and some parts of Belgium 3 V/m; in Eastern Europe on average 6 V/m; in Russia 4.3 V/m; in China 6 V/m (in the process of modification); in some parts of New Zealand 1.2.75 V/m; in Switzerland 4 V/m for the 900 MHz range and 6 V/m for 1800 MHz, and for both together in multiband 5 V/m; in Lithuania, 100 times lower than in France.[51]

iBurst agreed to shut down its disputed Craigavon tower on the November 16 for 2 weeks to see if the health symptoms described by some of the residents dissipated, "including nausea, skin irritations, vomiting, headaches and sleep disorders." Those with rashes expressed that it had taken 6 weeks for the rash to heal after moving out of their homes, getting medical input, and sleeping away completely from the tower.[51]

The remaining skin texture was yet to heal even after this amount of time. Russia insists on a 2-km buffer between towers and residential properties, while New Zealand requires 500 m. Cape Town family practitioner Dr. Emdin wrote in the South African journal *Natural Medicine* in 2007: "Exposure of young children to electromagnetic field radiation may be more detrimental to

their health than to adults, especially during development and maturation of the central nervous and immune systems and the critical organs."[51] Last year, Dr. Clark presented findings on a study that showed where cell phone radiation tower levels were high, 10% of that species disappeared from the landscape.[51]

## HUMAN DISTURBANCE FROM GENERATORS

If there are problems in other areas where power is drawn from, like electromagnetic smog or ground currents, they may interfere with the 60 Hz generated for that structure, giving stray electricity. This connection and the generated aberrant dirty electrical activity (usually high frequency) can cause disruption of human physiology and trigger ill health such as hypersensitivity to electronic output, cancer, arteriosclerosis, and other nonmalignant degenerative diseases, especially neurodegeneration like Alzheimer's, multiple sclerosis, and Parkinson's disease. Again, these illnesses are coupled with the total and specific body pollutant load, which will measure the severity and lethality of the illness over a period of years (Figure 1.6).

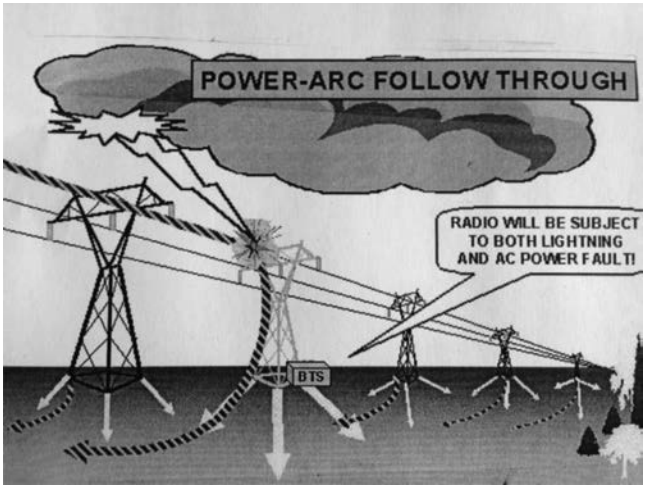


FIGURE 1.6 Dirty electricity generated while using good electricity.

Prior to 1993, laboratory studies using volunteers were confined primarily to studies of cutaneous and auditory perception and effects resulting from localized and whole-body hearing.[52] Guy et al., for example, determined a threshold for the auditory perception of pulsed RF as used in radar as 16 μJ $kg^{-1}$ energy absorption per pulse in the head.[53] With regard to the effects of RF absorption by the whole body, this was addressed largely in the context of thermoregulation. It was known that healthy individuals can sustain an increase in body temperature up to an upper safe limit of 39°C, at which level the heart rate is considerably elevated and the sweat rate is about 1 liter per hour.[52] However, chemically and EMF-sensitive patients have difficulty in sweating and are frequently cold: this phenomenon may not apply constantly to them. In addition, early studies on the exposure of patients and volunteers to RF fields in magnetic resonance imaging systems reported that whole-body specific absorption rates (SARs) of up to 4 $kg^{-1}$ for 20–30 minutes resulted in body temperature increases in the range of 0.1–0.5°C.[54–56]

In subsequent years, the rapid increase in wireless telecommunications, particularly those used in mobile telephony, initiated a number of research programs that included volunteer studies on the possible effects of wireless.

Milham[57] gives the history of health and disease with the onset of humanmade electrification of the earth. Though the ubiquitous distribution of toxic chemicals throughout the earth has been complete and clearly influences health both positively and negatively, as we have shown throughout these books, some of the triggering agents of illness have been found. *Chemicals have been associated with a large proportion of diseases of the twenty-first century.* Electromagnetic experience is primary in the initiation of some diseases. This EMF phenomenon, coupled with chemical overexposure, mold, mycotoxin, and microbial species invasion, is now the new complete instigator of disease (Figure 1.7).

In 2001, Ossiander and Milham[58] presented evidence that the childhood leukemia mortality peak at ages 2–4 that emerged in

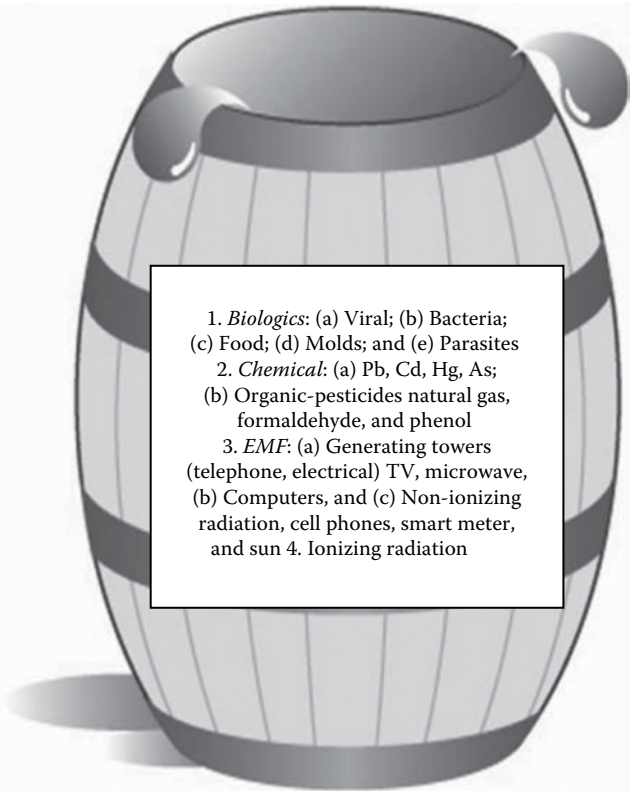


FIGURE 1.7 EMF Their Components that Increase Total Toxic (Body) Load (Burden).

the United States in the 1930s was correlated with the spread of residential electrification in the first half of the twentieth century in the United States. While doing the childhood leukemia study, Milham[58] noticed a strong positive correlation between the level of residential electrification and the death rate by state due to some adult cancers in the 1930 and 1940 vital statistics. *At the time, a plausible electrical exposure agent and a method for its delivery within residences was lacking.* However, in 2008, Milham[58] coauthored a study of a cancer cluster in school teachers at a California middle school, which indicated that high-frequency

voltage transients (also known as dirty electricity) were a potent universal carcinogen with cancer risks over 10.0 and significant dose-response for a number of cancers. These carcinogens have frequencies between 2 and 100 kHz. These findings are supported by a large cancer incidence study in 200,000 California school employees that showed that the same cancers and others were in excess in California teachers statewide.

Power frequency magnetic fields (60 Hz) measured at the school were low and not related to cancer incidence, while classroom levels of high-frequency voltage transients measured at the electrical outlets in the classrooms accurately predicted a teacher's cancer risk. These fields are potentially present in all wires carrying electricity and are an important component of ground currents returning to substations, especially in rural areas. This finding of high-frequency transients helped explain the fact that professional and office workers, like the school teachers, have high cancer incidence rates. It also explained why indoor workers had higher malignant melanoma rates, why melanoma occurred on parts of the body that were never exposed to sunlight, and why melanoma rates are increasing while the amount of sunshine reaching earth is stable or decreasing due to air pollution. A number of very different types of cancer had elevated risk in the La Quinta school study, in the California school employee study, and in other teacher studies.[60] *The only other carcinogenic agent that acts like this is ionizing radiation.*[61]

## OTHER GENERATORS OF TOXIC ELECTROMAGNETIC FIELDS

Among the many devices that generate dirty electricity are compact fluorescent light bulbs, halogen lamps, wireless routers, dimmer switches, and other devices using switching power supplies.[61] Any device that interrupts current flow generates dirty electricity. These will be discussed in the next section. Arcing, sparking, and bad electrical connections can also generate high-frequency voltage transients. Except for dimmer switches, most of

these devices did not exist in the first half of the twentieth century. However, early electric generating equipment and electric motors used commutators, carbon brushes, and split rings, and would inject high-frequency voltage transients into the 60 Hz electricity being generated and distributed.[61]

With newly recognized electrical exposure agents and means for their delivery, Milham[58] decided to examine whether residential electrification in the United States in the first half of the last century was related to any other causes of death.[61] Most cancers showed increasing mortality in this period, and many are still increasing in incidence in the developed world.[61]

Dirty electricity can be measured using an oscilloscope of a multimeter set for peak-to-peak voltage or a microsurge meter that provides a digital readout (Graham/Stetzer units) and is easily used by nonprofessionals. G/S capacitive filters short out high frequencies and reduce transients on electrical wiring with an optimal filtering capacity between 4 and 100 kHz. (Microsurge meters and filters are available.)

*Milham and Stetzer have observed that structures near cell towers have high levels of measurable dirty electricity in their electric outlets and in air.*[1]

Dirty electricity was shown to be a potent universal carcinogen in a study of cancer in teachers at La Quinta Middle School in California.[59] A single year of employment at the La Quinta school increased cancer incidence by 21%. In 2010, Milham and Morgan reported a studied cluster of cancers in personnel at Vista del Monte Elementary School in North Palm Springs, CA, with a cell tower on campus within a few feet of a classroom wing. The cancer cases were overrepresented in the classroom wing closest to the cell tower. *The dirty electricity readings were highest in classrooms closest to the cell tower base and decreased linearly with distance from the cell tower base.*[62,63] Cell tower microwave radiation decreased with the square of the distance from the transmitter. A fourth-grade teacher at this school complained that her students

were hyperactive and unteachable. Filtering the dirty electricity of this classroom made an immediate and dramatic improvement in student behavior. The teacher removed and plugged in the filters a number of times and reported that she could change student behavior in about 45 min.[63] At this time, the cell tower was functioning normally, and classroom microwave levels were high. *This finding suggests that the behavioral response of the students was driven by dirty electricity and not the cell tower microwaves.*

Unfortunately, historical U.S. mortality and electrification data suggest that all the so-called diseases of civilization, including cancer, cardiovascular disease, diabetes, and suicide, are caused or influenced by electromagnetic field exposure, most likely dirty electricity.[63] This was observable in U.S. mortality records very early in the twentieth century before the invention of microwaves. However, few people paid attention to it.

Hillman was involved in over 100 "stray voltage" dirty electricity cases in cows in Michigan and throughout the United States starting in about 1982.[64] Nearly all of the cases were settled out of court, thus making it impossible for the public to benefit from the findings.

## RADAR

Revolutionary technology got its start during World War II. Based on primary work by British scientists, radar is credited with having allowed the British air force to survive the war. Radar was immediately put to work by air traffic controllers and the military to track moving objects and weather patterns. The first radar machines were simple affairs based on the fundamental work of British scientists who produced what were called magnetrons, or vacuum tubes. Cylinders of uniform shape, inside each magnetron sits a hollow cathode, the outer surface of which carries radionuclide metals of barium or strontium oxides in a nickel matrix. When heated through its center, this matrix emits electrons that flow through the center of the cylinder.

At a radius somewhat larger than the outer radius of the cathode is a concentric cylindrical anode. The anode serves two functions: (1) to collect electrons emitted by the cathode and (2) to store and guide microwave energy. The anode consists of a series of quarter-wavelength cavity resonators symmetrically arranged around the cathode.

A radial electric field (perpendicular to the cathode) is applied between cathode and anode. This electric field and the axial magnetic field (parallel and coaxial with the cathode) introduced by pole pieces at either end of the cathode provide the required crossed-field configuration.

Early systems depended on high-frequency radio waves to detect German planes by bouncing radio signals off objects and measuring how long it took for the signal to return, hence the name radar, for radio detection and ranging. Like many things in science, the fact that radar could be used to cook foods in what today are called microwave ovens arose from an accidental discovery.

## MICROWAVE OVEN

Spencer understood that these invisible small rays could be used to move water molecules: basically to generate heat sufficient to cook anything that contained fluid. Thus was born the radar range, or microwave oven.[65]

Today, microwave ovens are standard upscale devices in kitchens around the world. Microwave ovens basically work by subjecting water or other polarized materials in food to heat generated by electromagnetic waves of about 2.4 megahertz (MHz), moving water molecules around and cooking things from the inside out. One hertz is 1 cycle per second, about the rate of the resting human heart of a well-conditioned adult. A megahertz is a million cycles per second, faster than anyone could count and the speed at which the brains of computers (microprocessors) usually work. Gigahertz is $10^9$ hertz cycles per second. Modern phones work as fast as computers, sending out between 800 million and 2.4 billion cycles per second, quite close to the power needed to cook an egg.

## "MICROWAVE SICKNESS"

Acute symptoms provoked by microwave radiation were first described by Russian medical researchers in the 1950s. They described a constellation of symptoms including headache, ocular dysfunction, fatigue, dizziness, sleep disorders, dermatographism, cardiovascular abnormalities, depression, irritability, and memory impairment.[66] These symptoms are not usually from foods transmitted to those of EMF sensitivity.

In the years between 1953 and 1978, the Russian government harassed the U.S. embassy in Moscow by targeting it with radiation from a microwave transmitter. Concern about health effects led to a detailed study by Lilienfeld.[67]

The abnormalities found in this study were an embarrassment to the U.S. government, since the levels of exposure experienced by embassy staff were on the order of 2 to 28 microwatts/cm$^2$, a level dramatically below the described U.S. safety standards for microwave exposure. The conclusions of the study were altered to soft-pedal any abnormal findings.[68,69]

However, outside epidemiologic analysis of the Lilienfeld report's published data showed that exposed embassy staff experienced a statistically significant excess of several problems, including depression, irritability, difficulty in concentrating, memory loss, ear problems, skin problems, vascular problems, and other health problems. Symptom incidence increased significantly with accrued years of exposure.[69,70] These observations were not correlated with EMF sensitivity syndrome because Smith and Monro[71] hadn't yet described it.

In 2007, Germany initiated a policy of reducing the use of computed tomography (CAT) scans because of their demonstrated cancer-causing properties and because their use increased health care costs (directly and through additional cancer incidence) by 80% in 40 years. It followed logically that last year Germany banned energy-efficient compact florescent light (CFL) bulbs because their carcinogenic radiation exceeds European exposure limits. Many

jurisdictions in the United States are now framing legislation to deal both with the bulbs' unacceptable levels of radiation and the difficulty of their disposal because of the high mercury content threatening the ground water.

The European Union's September 2009 report on EMFs stressed the "serious and irreversible damage to health and environments" from EMF radiation and called on all member states to take precautionary action. Shortly afterward, the possibility of outlawing the use of cell phones for children under 18 was discussed in the EU parliament.

Switzerland, Finland, Luxemburg, and Austria supply their schools with totally EMF radiation–safe fiber optic technology for their internet and communication needs. Israel has similar legislation in the works. Those countries also set the maximum level of exposure between 5 and 10 micro W/cm$^2$ as "safe."[72]

Having been nearly wiped out when asbestos-related claims became undeniable in the 1990s, the cell-phone industry was informed it would not be backed when radiation hits the fan, as it must. The trigger for this decision was the United Kingdom's 2005 Stewart Commission, whose chair, citing worldwide research demonstrating harm to children's brains from cell phones, told the mobile phone industry to "refrain from promoting the use of mobile phones for children."

## MICROWAVES AND MOBILE PHONES: PHYSIOLOGIC CHANGES

The intensity levels of exposure to microwaves (MWs) from mobile telephones are lower than the ICNIRP standards, which are based on thermal effects of acute MW exposures.[73] However, effects of prolonged exposure to nonthermal (NT) MWs at intensities comparable with those of mobile phones have also been observed in many studies that indicate a relationship between nonthermal microwave exposure and permeability of the brain-blood barrier,[74] cerebral blood flow,[75] stress response,[76] and neuronal damage.[77] The data obtained

by the comet assay[78,79] and the micronuclei assay[80–82] imply possible genotoxic effects of NT MWs, whereas other studies did not support this genotoxicity.[83] Experimental data have indicated that nonthermal microwave effects occur depending on several physical parameters, including carrier frequency, polarization, modulation, and intermittence.[84] Differences in these physical parameters and biological variables, including genetic background and physiologic state, may explain various outcomes of studies with NT MWs.[85,86]

A recent review of available epidemiologic studies concluded that the use of mobile phones for <10 years is associated with increased risk of ipsilateral gliomas and acoustic neuromas.[87] For a long time, stem cells have been considered an important cellular target for the origination of cancer—both tumors and leukemia.[88,89] Gliomas are believed to originate from stem cells in the brain.[90] DNA double-strand breaks (DSBs) and their misrepair are critical molecular events resulting in chromosomal aberrations, which have often been associated with the origination of various leukemias and tumors, including gliomas.[91] Only one study on possible MW-induced DSBs in stem cells is available.[92] Surprisingly, the data obtained in that study by the neutral comet assay suggested that prolonged exposure time abolished the DSB formation observed at the shorter exposure time. Furthermore, the neutral comet assay has limited applicability to detect double standard breaks because similar increases in comet tails may be also caused by nongenotoxic effects that imply changes in chromatin conformation, such as relaxation of DNA loops.[93]

Digital mobile telephone radiation nowadays exerts an intense biological action able to kill cells, damage DNA, or decrease dramatically the reproductive capacity of living organisms. Phenomena like headaches, fatigue, sleep disturbances, memory loss, and so on reported as “microwave syndrome” can possibly be explained by cell death on a number of brain cells during daily exposures from mobile telephone antennas.

## BREAK REPAIRS: DEOXYRIBONUCLEIC ACID

Several proteins involved in double-strand break repair, such as phosphorylated histone, 2A family member X (y-H2AX), and tumor suppressor TP53 binding protein 1 (53BP1), have been shown to produce discrete foci that colocalize to double-strand breakers of DNA referred to as DNA repair foci.[94,95] Analysis of DNA repair foci is currently accepted as the most sensitive and specific technique for measuring DSBs in untreated cells, as well as in cells exposed to cytotoxic agents.[96,97] Through analysis of the DNA repair foci in normal human fibroblasts, Markova et al.[98] were able to detect DSBs induced by a very low dose of ionizing radiation. One cGy results in only 0.4 DSB/cell on average.[98] They have also used this technique to analyze 53P1 foci in human lymphocytes exposed to MWs from global system for mobile communication (GSM)/universal global telecommunications system (UMTS) phones.[99–101]

They found that MW exposure inhibited formation of endogenous 53BP/1-H2AX foci in lymphocytes.[99–101] This inhibition might be caused by a decrease in accessibility of DSBs to proteins because of stress-induced chromatin condensation.[100] *Inability to form DNA repair foci has been correlated to radio sensitivity, genomic instability, and other repair defects.*[102–105] Inhibition of DSB repair may lead to chromosomal aberrations by either illegitimate recombination events[102] or reduced functionality of nonhomologous end-joining.[91] Therefore, if similar effects on endogenous DNA repair foci are detected in stem cells, this might provide a direct mechanistic link to the epidemiologic data showing association of MW exposure with increased cancer risk.

## STEM CELLS AND DOUBLE-STRAND BREAK REPAIR

Although y-H2AX foci have been used to analyze endogenous and induced DSBs in most studies, recent data have indicated that y-H2AX foci may also be produced by chromatin structure alternations and may not contain DSBs.[107–110] Accordingly, some

y-H2AX foci may not associate with DNA damage-response proteins such as 53BP1.[98,100,101,111] High expression of endogenous y-H2AX in pluripotent mouse embryonic stem cells (−100 large y-H2AX foci per cell) was not explained by DSBs, DNA degradation, or apoptosis, but was attributed to the unusual organization of chromatin in mouse embryonic stem cells.[112] The number of endogenous 53BP1 foci (<3 foci/nucleus) appeared normal in mouse embryonic stem cells and is comparable to that found in other cell types.[112] In contrast to y-H2AX foci, which may be produced by the DSB-relevant and DSB-unrelated mechanisms, 53BP1 is relocalized to DSBs along with other DNA damage-response proteins, such as phosphorylated ataxia telangiectasia mutated (ATM), Rad50, and meiotic recombination 11 (MRE11), and there is no indication that DSB-unrelated events would result in the formation of the 53BP1 foci.[113,114] Therefore, in this study, the researchers analyzed only 53BP1 foci as a more relevant marker for DSBs.

The differences in the DSB repair pathways between mouse and human stem cells have been described.[115] In general, the comparisons of stem cells across species suggest that significant differences may be observed, so extrapolation from animal stem cell models to human health risk assessment should be done with care.[116,117] For the present study, Markova et al.[98] chose human adipose tissue–derived mesenchymal stem cells (MSCs). This cell type displays multipotency with the ability under the correct conditions to differentiate into lineages that cover a wide range of organs and tissues, such as bone, fat, cartilage, muscle, lung, skin, hepatocytes, and neurons.[118–120] Of note, MSCs are at higher risk of malignant transformation than are embryonic stem cells[89] In contrast to GSM exposure at the frequency of 915 MHz that consistently inhibited DNA repair foci in lymphocytes from 26 persons in total, GSM exposure at 905 MHz did not inhibit DNA repair focus formation, thereby providing evidence that MW effects depend on carrier frequency.[99–101] In previous studies, researchers investigated MW effects on lymphocytes. However, it would be of

interest to analyze the response of human stem cells, which are usually exposed to mobile phone MWs along with differentiated human cells such as lymphocytes and fibroblasts. Therefore, in the present study, researchers exposed human stem cells and primary human fibroblasts to GSM/UMTS MWs at the same frequencies as that used previously in experiments with human lymphocytes.

*Both in fibroblasts and in MSCs, y-irradiation (3 Gy) led to significant increases in 53 BP1 foci caused by radiation-induced DSBs.* In accordance with previously published data,[98] 26 foci/cell were found in fibroblasts 2 hr after irradiation, and a slightly higher level, 32 foci/cell, was detected in MSCs. These results show it is widely accepted that DNA double-strand breaks and their misrepair in stem cells are critical events in the multistage origination of various leukemias and tumors, including gliomas. Studies show whether microwaves from mobile telephones of the GSM and UMTS induce DSBs or affect DSB repair in stem cells. Markova et al. analyzed tumor suppressor TP53 binding protein 1 foci that are typically formed at the sites of DSB location (referred to as DNA repair foci) by laser confocal microscopy.

*Microwaves from mobile phones inhibited formation of 53BP1 foci in human primary fibroblasts and mesenchymal stem cells.* These data parallel previous findings for human lymphocytes. Importantly, the same GSM carrier frequency (915 MHz) and UMTS frequency band (947.4 MHz) were effective for all cell types. Exposure at 905 MHz did not inhibit 53BP1 foci in differentiated cells, either fibroblasts or lymphocytes, whereas some effects were seen in stem cells at 905 MHz. Contrary to this finding in fibroblasts, stem cells did not adapt to chronic exposure during 2 weeks.

*The strongest microwave effects were always observed in stem cells.* This result may suggest both significant misbalance in DSB repair and severe stress response. The findings that stem cells are most sensitive to microwave exposure and react to more frequencies than do differentiated cells may be important for cancer risk assessment and indicate that stem cells are the most relevant cellular model for validating safe mobile communication signals.

## ELECTROMAGNETIC FIELD FILTERS

EMF Stetzerizer filters plugged into 110-volt wall outlets will dramatically reduce high-frequency currents (EMF) from the distribution circuits in the home. Also, use them in an office where computers, printers, copy machines, or other AC/DC power supplies are common. A Graham/Stetzer microsurge meter can be plugged into wall outlets to determine how much high-frequency current is in each circuit. In the Kellogg Center Ballroom, MSU and G/S readings were commonly 1600–2200. The recommended level is somewhere near 50–100 microsurge readings. The change will be obvious when you plug in the Stetzerizer filters. *The EMF filters can, however, catch fire, releasing cadmium as toxic fumes.*

There is a cluster of 35 people with childhood leukemia in a 12-mile area of Clyde, OH. This has been thought to be from dirty electricity.

Scientific evidence implies the need for reconsideration of the current exposure criteria to account for nonthermal effects, which constitute the large majority of the recorded biological and health effects. Since the mobile telephone has become part of our daily life, a better design of base station antenna networks toward the least exposure to residential areas and a very cautious use of mobile phones is necessary.

## POWER LINE TELECOMMUNICATIONS

These devices produce radio interference or "noise" in the high-frequency (HF) dirty electricity range or short-wave band, just above the long-wave/medium-wave (LF/MF) bands. Especially troublesome are HomePlug Powerline Alliance (HPA) adapters, as opposed to Universal Powerline Association (UPA) ones, such as the BT Vision (Comtrend). These can cause interference at 2–30 MHz with other radio uses, such as the BBC short-wave world service, and at 13.56 MHz with RFID readers and home alarms, although some power line telecommunications (PLTs) avoid 27.12 MHz for wireless use. BT Vision Comtrend devices are said to exceed International Special Committee on Radio Interference (CISPR)

regulations by 30 dB, 1000 times the maximum level to protect the radio spectrum from interference. Then how can this protect the individual? Certainly if we want to protect the electrically sensitive or vulnerable, we would eliminate such problems. It has been stated that "some of the research indicated that an access PLT system covering the whole of Greater London would significantly raise the high frequency dirty electricity noise floor in the HF bands as far away as Plymouth, while others claimed it would be detected as far away as Moscow. Of course either distance would be detrimental to some people. They also showed that near to a PLT product, HF reception could be rendered impossible for a radius of several hundred metres." This could interfere with the 20,000 amateur HF radio enthusiasts and 200,000 HF listeners in the United Kingdom, apart from MoD, security, aircraft controllers, and BBC use. "An informal analysis of reported complainants shows that victims are typically up to 150 metres from BT Vision users." [51] However, this is in a poorly informed public and medical professionals and might stretch much farther if people's perception were honed in.

PLT appears to be essentially a radio device using extended wiring antennas; it will apparently work even unplugged, and a household radio receiver will pick up HF transmissions and also VHF elements from several meters. Even BT Vision Support admitted on January 15, 2008, that "RF interference from the adapters is almost certainly what was affecting a customer's wireless keyboard. All electrical devices are subject to regulation." "It must be assumed that the mains supply already carries noise from other apparatus which may approach the limits of EN 55022, even if everything connected is in full compliance with the Directive. For PLT to operate, its signals must be greater than this minimum noise level, and so it must breach these limits, almost by definition. Yet all other mains-connected equipment, such as ITE, medical and household appliances, lighting and so forth is subject to the standard mains conducted emissions limits." [106]

In addition to acute radio interference, there is the problem of *cumulative interference*. "There is a long-distance-interference

problem due to ionospheric reflection carrying PLT interference around the globe. This causes a general increase in the HF dirty electricity noise floor, to which the logical counter-response will be the environmentally undesirable use of higher radio transmitter powers." This "cumulative interference is an inevitable result of the laws of physics, and was demonstrated in practice for analogue cordless phones many years ago."[51]

Humanmade exposures, starting with the discovery of electricity to the invention of Wi-Fi and smart meters, have occurred. This area of electricity has brought great advances to civilization but also more health complications. Any of these can affect the chemically sensitive and chronic degenerative disease patient and the electrically sensitive individual. An accumulative effect may also occur, increasing the total body pollutant load and resulting in many infirmities, including nonmalignant hypersensitive chronic degenerative disease, cancer, and arteriosclerosis. Electric pollution can act jointly with other forms of pollutant—chemical, especially pesticides; natural gas; molds; mycotoxins; and foods—to cause severe reactions and disease processes.

Over the last year, there has been concern about Ofcom's failure to regulate the growing radio interference from PLT. PLT, also called broadband over power line (BPL), power line access (PLA), and power line communications (PLC), uses electronic devices that plug into mains wiring sockets to send broadband digital signals over the electrical wiring in a house. There are now said to be 0.75M such devices in use in the United Kingdom and many more in the United States. They are also known as home plug adapters.

## POWER LINE COMMUNICATIONS

From a public health point of view, PLC is less problematic than RF AMI ("smart meter") communication technology. PLC could be used to reduce operating costs, train customers to conserve electricity using in-house monitors, and record and transmit time of day usage measurements to the utility.

We have turned away from the choice of PLC for two main reasons. First, it won't allow measurement of water meter readings, limiting the reduction of operating costs from elimination of meter reading. Second, PLC as currently designed does not have the bandwidth to sustain rapid "demand/response" control communications.

There are some other technical considerations that make PLC infrastructure more awkward to set up in an environment where some transmission wires are on poles and others are underground.

If "demand/response" were not on the table, and if a total bottom-line analysis of the options included the potential health costs of using RF technology, the financial analysis of the PLC option might look different than it did in the AMI business case prepared by Eugene Water and Electric Board (EWEB). A decision to read the water meters once every 3 months rather than monthly could also realize additional savings if this option were under serious consideration.

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# Electromagnetic Emanations from Power Sources and Fixed Specialized Equipment


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