Shocking News (dba) is a registered publisher of science-based information dedicated to publ i ic awareness of electric and magnetic fields
(EMF) in the living environment and their effects on the health and welfare of humans and animals. Editor is Don Hillman, Ph.D.,Professor
Emeritus, Department of Animal Science, with help from wife Mary, MS, Michigan State University, East Lansing, MI. Don is a member of the
American Society of Agricultural Engineers and The American Dairy Science/Animal Science Association. Telephone: (517) 351-9561.

1

Exposure to Electric and Magnetic Fields (EMF) Linked to Neuro-Endocrine Stress Syndrome: Increased Cardiovascular Disease, Diabetes, & Cancer

By Donald Hillman, Ph.D., Professor Emeritus, Michigan State University
Published by Shocking News,1 No. 8 Email: donag1@aol.com November 2005

Discovery of EMF in My Home.

A cellular telephone company's request to place additional signal generators-transmitters and antennae on the East Lansing-Okemos Water Tower led to concerns about health risks to citizens in the community and a decision to measure the electrical output from the cellular phone installation. The water tower is located in Patriarche Park across the street from St. Thomas Aquinas School and within 87 to 400 feet of twenty neighborhood homes. Oscilloscope measurements of voltage, frequency, and current on the ground wire from the cell station revealed up to 10 volts (peak-peak), a broad spectrum of harmonic frequencies ranging from 180 hertz to megaHertz radio frequencies (rf) including 1.25 gigaHertz microwaves, with 1.8 amperes (A) of current and 100 or more milliGauss (mG) magnetic fields at the ground wire. Similar readings were on the ground wires and water pipes of at least six homes and the school.The utility mitigated the EMF from the ground wire in my home by installing a dielectric coupling in the water pipe to which the ground wire was attached. These findings were reported to the utility and neighbors in *Shocking News* #7, May, 2005.

EMF - Link to Stress: The present report addresses the physiological connection between the observed increased heart rate and blood pressure, my and neighbors' medical history of cardiovascular disease, diabetes, abdominal aortal aneurysm, diverticulosis, gastro-esophageal acid reflux, and nonHodgkin's lymphoma as evident in an extensive review of literature. The maladies are associated with a broad spectrum of physiological changes involving stimulation of the hypothalamus, pituitary, and adrenal gland secretions mediated through the central nervous system (CNS) which include the brain and spinal cord. Neuroendocrine reactions comprise the autonomic nervous system which monitors internal and external environmental stimulation through the sympathetic and parasympathetic neuro-endocrine system to achieve homeostasis.

My cardiovascular problems began with irregular heart beat (skipping every 4th beat) and corresponding high blood pressure some years earlier for which I was administered daily diltiazem, a calcium ion channel blocker. I have had two quadruple coronary by-pass surgeries ten years apart, abdominal aortal aneurysm repair, prostate reduction surgery, intestinal diverticulosis, gastro-esophageal acid reflux syndrome, and Type II diabetes diagnosed 4 years ago for which I was prescribed daily endogenous insulin-stimulator drugs. I experienced body temperature rise and perspiration (sweats) which subsided without treatment during the night, and joint-muscle pain. My wife has had difficulty sleeping in the house, has had tumors in

the uterus requiring hysterectomy, a gall-bladder ablation, a shrunken kidney, borderline erythrocytic anemia.
A neighbor located 87 feet from the cell tower was suffering from a fibrillating heart, had a heart-valve replaced about five years ago and a pacemaker installed. The pacemaker was replaced after about five years, and a defibrillator was installed to maintain a functional heart rhythm. His wife suffers from multiple sclerosis, a disease associated with scattered demyelination of nerve axons in the central nervous system affecting motor control. Myelin is the insulation coating of nerves that protects them from electrical interference.
The lady next door was currently in the local hospital under chemotherapy and radiation treatment for recurring lymphoma cancer. Her duplex-neighbor lady had surgery for replacement of a knee within the last year and her son, age circa 30 years, is Type-I diabetic using an insulin pump.
Effects of EMF exposure on heart rate and blood pressure were reported by other investigators. Resting blood pressure of ten volunteers increased during exposure to a GSM

SUMMARY – My heart rate increased 29%, systolic blood pressure increased 10%, diastolic blood pressure increased 48%, and body temperature increased while I was sitting on the sofa with my feet in the 20 to 50 milliGauss (mG) magnetic field corona from the ground wire below the floor. I recorded 228 millivolts and 2.44
amperes (A) of electrical current passing through my body during the 35-minute exposure. Lansing Board of Water and Light utility engineers recorded voltage, 1.5 average to 8.8 A maximum current, 200% Total Harmonic
Distortion, and 100-320 mG (10-32 microTesla) magnetic fields for 24-hours at the ground wire in my home. These
exceeded IEEE (Institute of Electrical and Electronic Engineers) 519-1992, standards for harmonic distortion (5%), OHSA Directives for hazardous current (1.0 milliampere) and published values related to cancer.

900 MHz radio-frequency (rf) electromagnetic field for 35 minutes (Braune, S., et al., 1998), and rf fields influenced cardiovascular and hormonal parameters of the autonomic nervous system (Braune et al., 2002). Alteration of diurnal rhythms of blood pressure and heart rate occurred in workers exposed to radio frequency electromagnetic fields in the range 0.738 - 1.503 MHz and 200 - 550 volt/meter (V/m) electric fields, but the changes did not occur in a comparison group at lower exposure levels (Szmigielski et al., 1998). Similar changes in heart rate and heart rate variability occurred in subjects exposed to occupational levels of 50 Hz circular polarized magnetic fields (Sait et al., 1999).
Heart rate and sleep were affected when healthy young men were exposed to 900 MHz spatial peak specific absorption rate (SAR) 1 W/kg simulating exposure to a cellular telephone signal pulsed at a rate of 9 to 14 Hz. While EMF exposure was to the head, workers estimated that exposure of the hypothalamus was 0.1 W/kg, sufficient to affect heart rate and sleep (Huber et al., 2003).
Cardiovascular disease associated with hypertension and ischemia of the heart was 4 to 5 times greater with maximum Odds Ratio 19.1 times higher among men 30 to 39 years of age who were radar trackers in a civil airport compared to coworkers not exposed to EMF (Tikhonova, G. I., 2003). Spectral analysis of heart rate and arterial pressure short-term variability, consists of two major components: low- (LF, 0.04 - 0.15 Hz) and high- (HF, synchronous with respiratory rate). Both heart rate and respiratory rate were modified with sympathetic spinal nerve stimulation (Montano et al., 2001). Modulation of microwave, pulse signals, and continuous wave (CW) magnetic fields

affected frog isolated heart pacemaker function and heart rate due to microwave heating of tissues which occurred over a wide range of microwave frequencies (Pakhomov et al., 1995, 2000). Nocturnal 60 Hz exposure affected heart rhythm (Sastre et al., 1998) and brain frequency magnetic fields altered cardiac autonomic control mechanisms (Sastre et al., 1994). Graham et al. (1994) found a dose response slowing of heart rate and alterations in the latency and amplitude of event-related brain measures derived from electroencephalograms (EEG) when human subjects were subjected to 9 kV/m electric fields and 20 microTesla (μT–Tesla is a measure of the flux density or intensity of a magnetic field) exposure compared to 6 kV, 10 μT, and 12 kV, 30 μT dose combinations in blind studies. This study confirmed earlier reports that a combined 9 kV, 20 μT dose resulted in slowing of heart rate, changes in brain wave potentials, and changes in reaction time during challenge testing of humans (Cook et al., 1992). We measured 8 kV/m at head height below a 46 kV transmission line passing through a barnyard where the owner developed high blood pressure and irregular heart beat near Leslie, MI.

Cardiac sympathetic nerve fibers originate in the intermediolateral columns of the upper five or six thoracic and lower one or two cervical segments of the spinal cord. Changes in heart rate usually involve a reciprocal action of the sympathetic and parasympathetic divisions of the autonomic nervous system. Thus, heart rate increases with a decrease in parasympathetic activity (vagus nerves) and an increase in sympathetic activity; and decreases with the opposite effect as described by Berne et al. (1998). The parasympathetic nervous system does not enervate the body wall but only structures in the head and the thoracic, abdominal, and pelvic cavities. Thus, location of exposure to specific frequencies may be important in the heart response to electrical stimulation. However, stimulation of peripheral efferent nerves affects the heart through the neuro-endocrine system and exogenous signals need not penetrate the heart directly. Similarly the heating effect produced by stimulation of the thyroids (TSH) can account for the specific absorption rate (SAR) temperature increase upon electrical stimulation of intact man or animals.

The EMF Cortisol Connection – Cortisol in blood, heart rate, and blood pressure increased; and release of oxytocin was delayed when dairy cows were exposed to 4.0 and 8.0 mA contact current compared to no exposure in controlled experiments (Gorewit et al., 1984). Cortisol is released from the adrenal gland when ACTH (adrenocorticotropic hormone) is released from the pituitary by electrical stimulation of peripheral nerves. Similarly, oxytocin release from the pituitary stimulates excretion of milk (milk release) from the mammary gland upon stimulation of the udder by suckling or massaging of the udder in preparation for machine-milking. Impaired milk let-down, i.e., incomplete milking, was a common complaint of dairy farmers raising the stray voltage issue. Milk retained in the udder can increase incubation of low-level infections in the udder resulting in increased somatic cell count (SCC) according to Mein (1998) which may result in exclusion of milk from the market. Therefore, "uncontrolled electricity" can cause severe economic consequences for dairy farmers, in addition to affecting the health and milk production of the herd and the family. Epinephrine administration significantly reduced milk yield in heifers and cows but did not inhibit oxytocin release in response to milking. Investigators found that as little as 50 μg epinephrine inhibited mammary blood flow to the udder by as much as 90%

(Gorewit and Aromando, 1984). ACTH, cortisol, oxytocin, and epinephrine are all involved in the chronic electrical-stress syndrome. These responses are activated by chronic stimulation of the autonomic nervous system as described by Berne et al. (1998).

Cortisol Effects on Connective Tissue – Inhibition of collagen synthesis by cortisol produces thinning of the skin and the walls of capillaries. The resultant fragility of the capillaries leads to intracutaneous hemorrhage (Berne et al., 1998). In this regard, a medical officer for an aircraft manufacturer reported finding between 75 and 100 cases of unexplained bleeding tendency, as well as a significant excess of leukemia and brain tumors among workers exposed to low-strength microwaves (Becker, 1990). Collagen in smooth muscle is an important component of blood vessels, the intestinal tract, bone-joint cushions, cartilage and skeletal muscle connectors to bone. Its integrity is impaired by excessive cortisol and cortisol is increased by EMF exposure. A small step of logic allows the conclusion that EMF affects integrity and elasticity of the aorta and other vessels permitting aneurysm, development of weak smooth muscle, gastrointestinal diverticulosis, ulcers, and gastroesophageal acid-reflex syndrome. Joint-muscle pain is a common complaint associated with EMF exposure and diabetes, as experienced by the author. Type I personalities are often

associated with a stress syndrome and cardiovascular disease, etc. EMF exposure is clearly another source of neuro-endocrine stress. Which part will give out first under chronic electro-stress environmental conditions is the diagnostic puzzle.

The increased cortisol in blood of cows during short-term electrical stimulation concurs with results obtained when rats were exposed to 0.5 mW/cm2 for periods of up to 25 months. The exposure was 20 times below the ANSI (American National Standards Institute) and military acceptable standard at the time (A. W. Guy, in Becker, 1990). Blood cortisol of all rats was equal at the beginning, but cortisol of exposed rats increased above controls shortly after the experiment began. By the end of the experimental period, cortisol was lower in exposed rats compared to controls. The cortisol pattern was a typical adrenal response to stress finally resulting in adrenocortical fatigue, as in Addison's disease of humans. While the rats used in the Guy experiments were gnotobiotic (germ and virus free), 18% of the exposed rats had cancers of the pituitary, adrenal, and thyroid glands, and only 5% of the controls had cancer (Becker, 1990; Chou, Guy, et al., 1992). In earlier experiments, serum corticosterone was depressed 31.7 %, while albumen levels increased 28.2%, and body weight was 6.6% lower in rats exposed to150 V/m for 30 days compared to unexposed controls (Marino et al., 1975). Similarly, Imaida et al. (1998) found that mean levels of corticosterone, ACTH, and melatonin were higher for rats exposed to near field TDMA modulated 929.2 MHz RF EMF at 50 pulses/sec, 0.33 duty cycle, than for unexposed controls. The experiment was repeated with rats exposed to TDMA modulated 1.439 GHz RFEMF whole body SARs 0.680-0.453 W/kg for 90 minutes per day, 5 days/wk for 6 weeks. Significant increases were found in the serum levels of corticosterone, ACTH and melatonin in the RFEMF group compared to the sham group. However, no difference was found in the incidence of liver cancer. Cancer of pituitaries and adrenals was not reported (Imaida et al., 1998b, in Heynick et al., 2003).

Note that the level of exposure in each of the above cases

was less than the 1.6 W/kg SAR allowed by the FCC and Congressional Telecommunications Act of 1996. The ANSI standard was lowered from 10 mW/cm2 to the present permissible 1.6 W/kg specific absorption rate (SAR) in 1982 on the basis of "new" information. Apparently, it should be lowered again on the same basis, and technology for controlling exposure needs improvement.

Experimental chronic exposures with intact live animals support the hypothesis that pituitary, adrenal, and pineal glands are affected by modulated, pulsed signals as produced by cell phone signal generators, electronic devices using switch mode power supplies, and by power line 60 Hz, 4 to 8 mA contact current. Current and EMF on the ground wire, water pipes, and kitchen sink 1.68 ± 1.0 A, average of 26 measurements in East Lansing homes was comparable to EMF in the living area and current on the ground wire and bathtub in studies conducted by EPRI, the Electric Power Research Institute (Kavet et al., 2005, 2000, 1999).

The pituitary gland produces hormones and neurotransmitters that affect essentially all functions of the body. In addition to ACTH stimulating the adrenal glands (glucose energy supply) and oxytocin stimulating mammary muscle [and uterine contractions at parturition], the pituitary produces thyroid stimulating hormone (TSH) which controls the release of thyroid hormones and determines metabolic rate and heat production, somatotrophic hormone (growth hormone) which influences body mass, protein and energy utilization (i.e., conversion to milk production, and growth), gonadotrophins: follicle stimulating hormone (FSH) causes growth of the ovarian follicles and stimulates spermatogenesis in the testes; luteinizing hormone (LH) transforms ovarian tissue into corpus luteum which produces progesterone and inhibits the estrus cycle following ovulation. Retained CLs are common in dairy cattle and impair reproduction. Prolactin (PRL) initiates milk synthesis of mammary cells. Antidiuretic hormone (ADH) regulates electrolyte concentrations in the blood and water excretion by the kidneys. The neurotransmitters involved in afferent impulses to the hypothalamus are largely, norepinephrine, acetylcholine, as well as serotonin the most important neurotransmitter in the brain.

Serotonin is also secreted by the pineal gland in the hypothalamus, and serotonin receptors are responsive to EMF exposure (Johnson et al., 2003; Sieren et al., 2004). Dopamine, acetylcholine, (-aminobutyric acid, and the opioid peptide $-endorphin act as neurotransmitters for efferent impulses to the median eminence of the neurohypophysis. These impulses regulate the discharge of releasing hormones or inhibiting hormones into the adjacent capillaries. Virtually all of the tropic hormones from the adenohypophysis cause changes in the concentrations of either peripheral target gland hormones (thyroid, adrenal, gonadal) or of substrates, such as glucose or free fatty acids.

The enormous influences of chronic cortisol stimulation on body functions are well known in medical circles but the influence of environmental EMF on the neuro-endocrine stress syndrome and human health has been overlooked, perhaps because the pieces to the complex puzzle have not been assembled recently.

Chronic excessive stimulation of either sympathetic or parasympathetic control mechanism causes a stress reaction involving the central nervous system, through stimulation of peripheral nerves and activation of the autonomic nervous

system response in the brain and the hypothalamus which contain the pituitary and pineal glands. The pituitary issues hormonal responses in the blood, neurotransmitters, which influence the adrenal glands and the function of virtually all organs in the body (Berne et al., 1998, *Physiology*).

The Diabetes Connection – Cortisol maintains glucose production from protein, *"Although the major impact of cortisol is on liver glycogen, an excess of the hormone eventually increases blood glucose levels. This increase occurs because cortisol powerfully antagonizes the actions of insulin on glucose metabolism. Hence, cortisol inhibits insulin-stimulated glucose uptake in muscle and adipose tissue, and it reverses the insulin suppression of hepatic glucose production.* ***In short, cortisol is an important diabetaogenic, antinsulin hormone. Its primary hyperglycemic and lipolytic and secondary ketonic actions are usually exhibited only when its secretion is greatly stimulated by stress"*** (Berne et al., *Physiology*, 1998).

4

Insulin secretion of pancreatic islet beta-cells was attenuated by exposure of cells to EMF in three of four laboratory experiments, *in vitro,* (Sakurai, et al., 2004). Exposure of insulin to 0.7 V/m electric field of 50 Hz pulsed frequency EMF produced significant time-dependent differences in the conformation of the insulin molecule, reduced the binding capacity to its receptor, reduced the intracellular tyrosine phosphorlation level, and modified gene expression of insulin-signaling pathways and hepatic cell proliferation (Li et al., 2005). Primary deficiency of insulin as a consequence of selective $-cell destruction is known as Type I or insulin-dependent diabetes mellitus. The disease usually results from a genetically conferred vulnerability to an environmental insult that initiates a destructive autoimmune process. Electricity in the environment may be that insult.

An estimated 18 million people in the United States have Type II diabetes. Because a major cause of this form of diabetes is resistance to insulin, the EMF observations by Li et al. (above) offer promising suggestions for mitigating diabetes by following a specific electron diet or reducing electron exposure to specific frequencies and time periods.

The above factors help explain how EMF, millivolts of high frequency Graham/Stetzer Units (Graham, M., 2003) during environmental exposure in the home was related to increased blood glucose of diabetics ($R_2 = 0.83$) and decreased blood glucose and insulin requirements of diabetics when frequency filters were installed in wall outlets to reduce EMF exposure (Havas and Stetzer, 2004). Similarly, the incidence of Type II diabetes was higher among persons living near high power transmission lines and was positively related to an EMF index (mG x time) daily exposure in Australia (Beale et al., 2001).

Milk and milk-fat of cows decreased when exposed to 10 kV/m electrical field and 30 μT magnetic fields (Burchard et al., 2004). Similarly, milk fat was lower from cows exposed to 1-5 and 8-12 mA contact current during milking (Aneshansley et al., 1992). Because insulin is necessary for absorption of glucose into mammary cells, and glucose is essential for milk-fat synthesis, cows exposed to EMF and contact current may have been diabetic.

Cortisol facilitates fat metabolism, supports responsiveness of the vascular tree, modulates central nervous system function, and profoundly affects the immune system. In addition to its effect on glucose and fat metabolism, Berne et al. highlighted the following specific effects of cortisol: **Effects on muscle.** Cortisol maintains the contractility and work performance of skeletal and

cardiac muscle. [Remember that short-term stress increases cortisol and long-term EMF stress results in adrenocortical fatigue]. **Effects on bone**. Cortisol inhibits bone formation by several mechanisms: reduces Type I collagen formation; decreases the rate of differentiation of osteoprogenitor cells to active osteoblasts; decreases the absorption of calcium from the intestinal tract by antagonizing vitamin D_3. The result of these actions is a reduction in the availability of calcium for bone mineralization. Thus, one major consequence of excess cortisol production is an overall reduction in bone mass (osteoporosis). **Effects on the vascular system.** *Cortisol is required for the maintenance of normal blood pressure.* [However electrical stress increased cortisol, blood pressure and heart rate of cows and humans as noted above.] **Effects on the kidney.** *Cortisol influences the rate of glomerular filtration. The hormone is also essential for rapid excretion of a water load.* In the absence of cortisol, the synthesis and secretion of antidiuretic hormone (ADH) are increased and its action on renal tubules is enhanced; free-water clearance is diminished and dilution of the urine is limited. Diabetes insipidus, the inability to produce concentrated urine and frequent urination (Gotta-Go syndrome) is the hallmark of ADH deficiency. **Effects on the central nervous system**. Cortisol modulates excitability, behavior, and mood of individuals; the electrical activity of neurons is influenced. Both Type I and Type II glucocorticoid receptors (GRs) are present in various areas of the brain, particularly in the limbic system and the hippocampus. Cortisol decreases rapid eye movement (REM) sleep but increases both slow-wave sleep and time spent awake. In excess, cortisol can cause insomnia, strikingly elevate or depress moods, decrease memory and hippocampal volume and memory function. EMF affected sleep in experimental trials (Akerstedt et al., 1999; Huber et al., 2003, 2004) and student behavior in the classroom (Havas & Stetzer, 2004) and electrohypersensitive persons had higher heart rate and heart rate variability (Lyskov, 2001). Cortisol also specifically decreases the ability to detect a salty taste and dampens acuity to gustatory, olfactory, auditory, and visual stimuli. On the other hand, cortisol improves the ability to integrate those sensations that are perceived and to organize appropriate responses. **Effects on the fetus.** *Cortisol facilitates in utero maturation of the central nervous system, retina, skin, gastrointestinal tract, and lungs.* (See Berne et al. for details). However, in a study of 1583 pregnant women, those using computers more than 20 hours per week had 40% more miscarriages compared with female workers who did not use computers (Goldhaber et al., 1988). Prenatal development of the central nervous system is a particularly sensitive marker of heat-induced developmental abnormalities and can be correlated with heat-induced behavioral deficits (Saunders and McCaig, 2005). Body heat increased during EMF electrical exposure. Extensive reviews of EMF effects on reproduction, embryonic and fetal development were published by Brent 1999; Heynick et al., 2003; and Levin 2003). **Effects on inflammatory and immune response.** *Cortisol has a profound influence on the complex set of reactions evoked by tissue trauma, chemical irritants, infection, or foreign proteins.* **The EMF Cancer Link** – Cortisol inhibits recruitment of circulating leukocytes to trauma or infection sites, decreases phagocytic and antibacterial activity of circulating neutrophils, i.e., increases neutrophils release from bone marrow but decreases their effectiveness for controlling disease, and (EMF decreases AMP to ATP energy transfer in neutrophils), decreases number of circulating eosinophils, decreases number of thymus

derived T-lymphocytes, and depresses the immune system response to invading organisms or substances such as viruses. Melatonin a hormone secreted from the pineal gland is associated with the function of the circadian clock which regulates sleeping, and many related functions of the body. Leukemia and lymphomas (tumors) are characterized by the abnormal proliferation and reduced differentiation of developing lymphocytes and other blood cells in peripheral blood, bone marrow, and tumor tissues. The diagnostic report for the lymphoma patient revealed: "cytogenetics tests of bone marrow

cells were abnormal in culture cells stimulated by lymphoid mitogens. Two of the metaphases were abnormal due to multiple structural and numerical aberrations characterized by additional material on the short arm of one chromosome 2, trisomy 3 with one being abnormal, rearrangements of 6q, 8p and trisomy for chromosomes 7 and 18 and 2 markers. The spectrum of abnormalities are most consistent with the presence of a lymphoma or other lymphoid disorder. Skin biopsies of both lower left leg lateral and medial section morphological features were consistent with diffuse large B cell lymphoma. Otherwise, the patient was a chromosomally normal female, Karyotype 46,XX ."

Cytotoxicity of a T-lymphocyte line against lymphoma target cells was inhibited by exposure of the lymphocytes to 450 MHz field sinusoidally amplitude-modulated at frequencies between 3 and 100 Hz (Lyle et al., 1983). Exposure of the effector cells to the field prior to adding them to the target cells in the cytolytic assay resulted in a similar inhibition, suggesting a direct interaction of the field with the cytolytic T lymphocytes (Lyle et al., 1993). This corresponds to changes in immunological response of B- and T-lymphocytes to mitogens after long term chronic exposures reported by Guy et al. (1985) and was similar to the failed lymphoblast response to staphyloccus *aureus* antigens in cows exposed to low-level intermittent electricity for two-weeks in a report to Advisors to the Minnesota Public Utilities Commission (Reinemann et al., 1999).

Secondly, changes in the absolute numbers and ratios of CD4+/CD8+ lymphocytes in favor of CD8+ cells of cows at Farm A housed under a 380 kV transmission line exposed to 1.98 to 3.28 :T magnetic fields compared to cows at a distant Farm B considered zero exposed, except in brief periods (3 min × 4 times/day) during which 0.2 to 0.7 μT were present while a feed distributor was running. Investigators found that the mean values of CD8+ and CD6+ leucocyte sub-populations were significantly higher in cows from the exposed farm. Two typologies of CD8+, called Dim and Bright in function of the cytofluorescence analysis, are evident in the exposed farm whereas the population remained single in the not-exposed farm. Melatonin concentrations are higher during darkness and decrease during daylight. Melatonin is believed to produce strong oncostatic, immunological, and antioxidant functions in the blood. EMF exposure has decreased melatonin concentrations in blood, or urinary excretion of its metabolite, in humans sleeping under an electric blanket (Wilson et al., 1990), electrical workers exposed to 60 Hz magnetic fields while working in substations or on 3-phase conductors (Burch et al., 2003), women exposed to visual display units (computer monitors) during office work (Arnetz and Berg, 1996), in dairy cattle exposed to overhead EMF (Burchard, 2003), and in laboratory animals (Reiter, 1994).

A study conducted in Denmark (Olson et al., 1993) investigated 1707 cases of leukemia, brain tumors, and malignant lymphomas recorded in the Danish cancer registry and were restricted to children of less than 15 years at diagnosis. Controls were selected at random from the central population registry. The study revealed that exposure to magnetic fields (in the order of 0.4 μT, (4 mG) increased cancer. The risk for lymphoma was already increased for fields above 0.1 μT (1 mG). In a study by Robinette et al., (1980) on naval personnel and radio operators it was shown that workers in this occupation had a higher than normal risk for brain cancer. Mortality from cancer was increased close to air force bases compared with other places. It was concluded that this was due to the proximity of radar installations. Similarly, the rate of brain tumors was higher among navy radar operators than among other appropriate controls following the Korean War (Lin, 1985, in Becker, 1990).

EMF-Cancer (Direct Evidence) – Electrical currents had been traced from utility down-ground wires to water pipes where 180 Hertz current combined with 3rd, 5th, and 7th harmonics in the living areas of homes were positively associated with cases of leukemia, lymphoma, and brain tumors where victims had died in Denver, Colorado (Kuane et al., 2002). Positive associations between power line EMF and leukemia, lymphoma, brain tumors, spontaneous miscarriages, alzheimer, and suicide of electrical workers, etc. were reported by California Department of Health Services. For access to some 400 references see (Neutra et al., 2002) at the website listed below or address in the references at the end of this article. Many articles have appeared since 2001 when the California reference list was compiled. Childhood and adult leukemia, lymphoma, and brain tumors have been associated with odds ratios 2 to 4 times greater risk among persons exposed to 4 mG or higher EMF (Kaune et al., 2002; Neutra et al., 2001; Ahlbom et al., 2000; Villeneuve et al., 2000; Robinson et al., 1999; Coghill, 1996; Verschaeve, 1995; Fechting and Ahlbom, 1993; London et al., 1991; Loomis et al., 1990; Thomas et al., 1987; Savitz et al., 1988; and Wertheimer and Leeper, 1979, 1982, 1995). Furthermore, efforts were made to identify possible confounders, that could bias the results of these studies (e.g., air pollution, socio-economic conditions, water quality, traffic patterns, static magnetic fields and resonance models, but no evidence of such confounders has been identified.

Horst et al. (2004) found that persons living within 400 meters of a cellular phone tower had 3 times more cancer than those living more than 400 meters from the tower. Our evidence showing the high frequency EMF typical of the rf and microwaves produced by the cell phone signal generator transmitter measured from the ground wire, and measured on the ground wires and water pipes of a neighbor lady with nonHodgkin's lymphoma, concurs with the results of Ontario, Canada Hydro Electric employees. Incidence of nonHodgkin's lymphoma was 3 to 4 times higher in the top thirty percent exposure-time index of electrical employees based on measured electric fields (thresholds 10 and 40 V/m) compared to administrative and office employees with low exposure (Villeneuve et al., 2001).

Electro-Sensitivity of people is now recognized as a physical impairment by government health authorities in the United Kingdom and Sweden. The UK Health Protection Agency (HPA) recognized that people can suffer nausea, headaches, and muscle pains when exposed to electromagnetic fields from mobile phones, electricity pylons and computer

screens. They recognize that general practitioners (GPs) are not generally aware of the electro-sensitivity syndrome and HPA will provide guidelines for GPs to follow in diagnosing the disease.

Doctors may need to examine EMF in the home, and perhaps in their own office to identify the sources and will need to add EMF meters to their instrument bag to confirm a diagnosis.

Development of cardiovascular disease, diabetes, and nonHodgkin's lymphoma of the immediate occupants in this study is consistent with recognition of health authorities that chronic disease "Cancer, Cardiovascular, and Diabetes" account for two-thirds of the $1.55 billion spent on health care in this country and are increasing, according to the Center for Disease Control (Lansing State Journal, 10/02/05). Secondly, our finding supports the likelihood of increased risk of other major diseases caused by excessive exposure to EMF.

National Institutes of Environmental Health mentioned possible EMF associations with sudden cardiac death, dementia, suicide (NIEHS, Portier and Wolf, 1998), and spontaneous abortion (Li et al., 2002, and Lee et al., 2002) as reported by California Department of Health Services (Neutra et al., 2002, p. 10) on website:

http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html

Some of the California EMF findings and Michigan's 51,000 new cancer cases per year were in Shocking News #2, May, 2004, and are on the website www.electricalpollution.com

Sources of EMF – The Ground Wire in Homes, Schools and Workplaces – Our electrical data concur with studies by EPRI (Electric Power Research Institute), the research arm of the power industry. Kavet el al. (2000) found strong correlations with the average magnetic field in the living area and the 24-hour average net current on the service drop (the ground wire) and the number of service drops on the same transformer. Similarly, Kavet (2005) found that EMF in living areas was correlated with volts on water pipes, and volts on the bath tub. Excessive voltage and current was on water pipes, the kitchen sink, bathtub, sheet metal air ducts, chair springs, and bed springs in our home (Shocking News #7).

Modern Household Appliances and Office Equipment with electronic controls, i.e., heating and air conditioning units, television, VDUs (computer monitors), printers, copy machines, MRI, digital clocks, microwave ovens, TV, radio, refrigerators, stoves, etc., produce harmonics and emit large amounts of EMF to distances of 1 to 6 feet from the appliance in our home.

C G/S meter readings from wall outlets in Kellogg Center, MSU were 700 to 1760 G/S Units, while in my home they now read 15 to 20 G/S Units, down from 120-200 (units of high frequency current) in wall outlets.

Mitigation of EMF has been achieved by:

1. Installing a dielectric union (rubber insulated connector) in the water pipe to which the ground wire is connected. Some homes may already have this isolation. You need to know if yours does. If it was built before 1975, it may not have a dielectric connection and magnetic fields on the ground wire and water pipes could be very high.
2. Installation of high frequency filters in the wall outlets of homes can dramatically reduce the EMF from the outlets and the EMF environment in living areas. Contact dave@stetzerelectric.com
3. Installation of a shielded neutral isolation transformer between the utility (source) and the customer (end-user) service connection will prevent the high frequency signals

from passing from the utility wires to your home or business circuits. This should be required of all businesses that produce a large amount of high frequency residue (dirty electricity) on the ground wire.
4. Improved maintenance of utility (primary) and/or customer (secondary) wiring to reduce resistance on circuits by installing adequately sized transformers, and neutral to the substation wire conductors serving customers. Most utility engineers know what to do, but executive $ objectives often take precedence over risks to human health and life.

CONCLUSIONS

Excessive electrical current and high frequency rf and microwave magnetic fields were tracked via oscilloscope measurements from the cellular telephone station at the water tower in Patriarche Park. Signals were on the utility ground wire and radiating into the living areas of homes and a school in East Lansing. Heart rate, heart rhythm, and blood pressure were affected during exposure to electromagnetic fields (EMF) in a home. Similarly, occupational exposure and controlled laboratory studies confirm these findings. Diabetes, NonHodgkin's lymphoma, and other health impairments that occurred to residents near the park, plus leukemia, and brain tumors have been associated with EMF in other studies. Cardiovascular disease, diabetes mellitus and impaired immunity are typical physiological responses to neuroendocrine stress. Pituitary and adrenal gland responses to both contact current and electromagnetic current have been demonstrated in humans and animals. Excessive current and mG of magnetic fields were observed at ten homes in the area. Recorded measurements were outside of IEEE stands for power quality and OSHA standards for electrical hazards. Methods for mitigation of environmental contamination are known and should be encouraged by utilities and government agencies responsible for electrical safety and human health.

Michigan Public Service Commission promulgated Rules R460.2701 to RR460.2708, etc. would not require utilities to identify any electrical problem other than 60 Hertz, steady state voltage or current, and would not require using appropriate instruments to detect the problems in the East Lansing community or elsewhere in the state. Further, the MPSC proposed rules will have the effect of using the power of the state to allow utilities to avoid their responsibility to protect citizens and residents from unhealthy and unwanted electrical damage.

References

Ahlbom, N., M. Day, E. Feychting, J. Roman, J. Skinner, M. Dockerty, M. Linet. 2000. A pooled analysis of magnetic fields and childhood leukaemia, *British Journal of Cancer* 83(5):692-698.

Akerstedt, T., B. Arnetz, G. Ficca, L. E. Paulson, A. Kallner. 1999. A 50 Hz electromagnetic field impairs sleep. J. Sleep Res 8:77-81.

Aneshansley, D. J., R. C. Gorewit, and L. R. Price. 1992. Cow sensitivity to electricity during milking. J. Dairy Sci 75:2733-2741.

Bawin, S. M., L. K. Kaczmarek, and W. R. Adey. 1975. Effects of modulated VHF fields on the central nervous system. Space Biol. Lab, Braqin Research Institute, U. CA, Los Angeles, Annals NY Academy of Science 247:74-81.

Beale, Ivan L., Neil E. Pearce, Roger J. Booth, and Sandra A. Heriot. 2001. Association of health problems with 50 hz magnetic fields in

human adults living near power transmission lines. *J. Australian College of Nutritional & Environmental Medicine* 20(2):9-12 and 15-30.

Becker, Robert O. 1990. *Cross Currents*, The Perils of

Electropollution– the Promise of Electromedicine. Jeromy P. Tarcher/Perigee Books, The Putnam Publishers, New York, NY.
Berne, Robert M., Matthew N. Levy, Bruce M. Koeppen, and Bruce A. Stanton. 1998. *Physiology.* Fifth Edition, Mosby, ©Elsevier Inc., Philadelphia, PA, USA.
Braune, S., C. Wrocklage, J. Raczek, T. Gailus, and C. H. Lucking. 1998. Resting blood pressure increased during exposure to a radiofrequency electromagnetic field. *Lancet* 351:1857-1858.
Braune, S., A. Reidel, J. Schulte-Monting, and J. Raczek. 2002. Influence of a radio-frequency electromagnetic field on cardiovascular and hormonal parameters of the autonomic nervous system in healthy individuals. *Radiat. Res.* 158:352-356.
Brent, R. L. 1999. Reproductive and teratological effects of low frequency electromagnetic fields. A review of in vivo and invitro using animal models. Teratology 59:261-286.
Brzenzinski, Ammon. 1997. Melatonin in Humans, mechanisms of disease. Frank H. Epstein, Editor, *The New England Journal of Medicine* 336(3):186-195.
Burch, James B., J. S. Reif, C. W. Noonan, and Michael G. Yost. 2000. Melatonin metabolite levels in workers exposed to 60 Hz magnetic fields: work in substations and with 3-phase conductors. *J Occup Envir Med* 42:136-142.
Burchard, Javier F. 2003. Electric and magnetic field research at McGill University. *Proceedings: Stray voltage and Dairy Farms.* NRAES, Cooperative Extension Service, P.O. Box 4557, Ithaca, New York.
Burchard, Javier, J. H. Monardes, and D. H. Nguyen. 2003. Effect of 10 kV/m and 30 μT, 60 Hz, electric and magnetic fields on milk production and feed intake in nonpregnant dairy cattle. *Bioelectromagnetics* 24:557-562.
Calogero, Stelletta, Giuseppe Basso, Barbara Michelotto, Paola De Nardo, Francesco Santin, Marta Benedetti, and Massimo Morgante. 2004. Effects of extremely low frequency electromagnetic fields exposition on circadian rhythms and distribution of some leucocyte differentiation antigens in cows. Presentation, International Conference of Veterinary Clinicians, Quebec City, Quebec, Canada, July 2004. Contact: Department of Veterinary Clinical Science, Faculty of Veterinary Medicine, Padova and Clinic of Pediatric Oncoematology, University of Padova, Institute Superior di Sanita, Italy.
Chou, C. K., A. W. Guy, L. L. Kunz, L. B. Johnson, J. J. Crowley, and J. H. Krupp. 1992. Long- term, low-level microwave radiation of rats. Bioelectromagnetics 13:469-496.
Chen, Gang, Brad L. Upham, Wei Sun, Chia Ching Chang, Edward J. Rothwell, Kun-Mu Chen, Hiroshima Yamasaki, and James E. Trosko. 2000. Effects of Electromagnetic Field Exposure on Chemically Induced Differentiation of Friend Erythroleukemia Cells. *Environmental Health Perspectives* 108:967-972.
Chen, K-M, A. Samuel, and R. Hoopengarner. 1974. Chromosomal aberrations of living cells induced by microwave radiation. Environ Lett 6:37- 46.
Coghill, Roger. 1996. A Case-Control Study of Electric and Magnetic Fields in the Bedplace of Children Diagnosed with Leukaemia. UK, Biophysics 41:806-816 and the European Journal of Cancer Prevention 5:3-10.
Cook, Mary R., Charles Graham, Harvey D. Cohen, and Mary M. Gerkovich. 1992. A replication study of human exposure to 60-Hz fields: Effects on neurobehavioral measures. *Bioelectromagnetics* 13:261-265.
Eger, Horst, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, Helmut Volt. 2004. The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer. Umwelt-

Medizin-Gesellschaft 17, 4, 2004 (Germany).
Fechting, M., and A. Ahlbon. 1993. Magnetic fields and cancer in children residing near Swedish high-voltage power lines. Am J. Epidemiol. 138:467-481, 1993.
Goldhaber, M. K., Michael Polen, and Roert Hiat. 1988. Miscarriages of women using computers in the workplace. Amer. J Industrial Med 13:695.
Gorewit, R. C. and Aromando. 1984. Mechanisms involved in the adrenalin induced blockade of milk ejection in dairy cattle. Proc. Expt. Biol. Med.
Gorewit, R. C., D. V. Henke Drenkerd, and N. R. Scott. 1984. Physiological Effects of Electrical Current on Dairy Cows. *Stray Voltage: Proceedings of the National Stray Voltage Symposium.* American Soc. of Agricultural Engineers, St. Joseph, MI.
Graham, Charles, Mary R. Cook, Harvey D. Cohen, and Mary M. Gerkovich. 1994. Dose response of human exposure to 60 Hz electric and magnetic fields. *Bioelectomagnetics* 15:447-463.
Graham, Martin. 2002. Mitigation of electrical pollution in the home. Memorandum No. UCB/ERL MO2/8, 19 April 2002. Electronics Research Laboratory, College of Engineering, University of California, Berkeley, CA 94720.
Graham, Martin. 2003. A microsurge meter for electrical pollution research. Memorandum No. UCB/ERL MO3/3. 19 February 2003. Electronics Research Laboratory, College of Engineering, University of California, Berkeley, CA 94720.
Havas, Magda, and Dave Stetzer. 2004. Graham/Stetzer Filters Improve Power Quality in Homes and Schools; Reduce Blood Sugar Levels Among Diabetics; etc. International Conference on Childhood Leukaemia, London, England, Sept. 6-10, 2004.
Havas, Magda, and David Stetzer. 2004. Dirty electricity and electrical hypersensitivity: five case studies. World Health Organization Workshop on Electrical Hypersensitivity. October 24-25, 2004. Prague, Czech Republic.
Heynick, Louis N., Sheila A. Johnson, and Patrick A. Masson. 2003. Radio frequency electromagnetic fields: Cancer, Mutagenesis, and Genotoxity.Bioelectromagnetics Supplement 6:S74-S100.
Hillman, D. 2005. Magnetic fields in homes and school: source and mitigation in our home. *Shocking News* #7, 750 Berkshire Lane, East Lansing, MI 48823.
Hillman, Donald, Charles L. Goeke, and Richard Moser. 2004. Electric and magnetic fields (emf) affect milk production and behavior of cows: results using shielded-neutral isolation transformer. 12th International Conference on Production Diseases in Farm Animals, Michigan State University, East Lansing, MI.
Hillman, D., D. Stetzer, M. Graham, C. H. Goeke, K. Mathson, H. H. VanHorn, and C. J. Wilcox. 2003. Relationship of electric power quality to milk production and behavior of dairy cattle. Paper No. 033116, *Amer. Soc. Agr. Engineers*, St. Joseph, MI (DVD available).
Huber, Reto, Jurgen Schudererm Thomas Grat, Kathrin Jutz, Alexander A. Borbely, Niels Kuster, and Peter Achermann. 2003. Radio frequency electromagnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate. *Bioelectromagnetics* 24: 262-276.
Huber, R., T. Graf, K. A. Cote, L. Wittmann, E. Gallmann, D. Matter, et al. 2000. Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG. NeuroReport 11:3321-3325.
IEEE, 519-1992. *Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.* Institute of Electrical and Electronics Engineers, Piscataway, N.J.
Imaida, K., M. Taki, T. Yamaguchi, T. Ito, S-I Watanabi, K. Wake, A.

Aimoto, Y. Kamimuri, N. Ito, T. Shirai. 1998a.. Lack of promoting effects of the elecrtomagnetic near-field used for cellular phones
8
(929.2 MHz) on rat liver carcinogenesis in a medium-term liver bioassay. Carcinogenesis 19:311-314.
Illnerova, Helena, Milena Buresova, and Jiri Presl. 1993. Melatonin rhythm in human milk. J Clin Endocrinol Metab 77: 838-841.
Kaune, W. T., T. Dovan, R. I. Kavet, D. A. Savitz, and R. R. Neutra. 2000. Study of High- and Low-Current-Configuration Homes From the 1988 Denver Childhood Cancer Study. Bioelectromagnetics 23:177-188.
Kavet, R., L. E. Zaffanella, J. P. Daigle, and K. L. Ebi. 2000. The Possible Role of Contact Current in Cancer Risk Associated with Residential Magnetic Fields. Bioelectromagnetics 21:538-553.
Kavet, Robert. 2005. Review: Contact Current Hypothesis: Summary of Results to Date. Bioelectromagnetics Supplement 7:S75-S85.
Kennedy, Barry. 2000. *Power Quality Primer*, McGraw-Hill, New York, NY.
Lefcourt, A. M., and R. M. Akers. 1982. Endocrine responses of cows subjected to controlled voltages during milking. Journal of Dairy Science 65:2125-2130.
Levin, Michael. 2003. Bioelectromagnetics in Morphogenesis. Bioelectromagnetics 24:295-315.
Li, Chung-Yi., and Fung-Chang Sung. 2003. Association between occupational exposure to power frequency electromagnetic fields and amyotrophic lateral sclerosis: A Review. American Journal of Industrial Medicine 43:212-220.
Li, Lejun, Yuwen Dai, Ruohong Xia, Shude Chen, and Denjiang Qiao. 2005. Pulsed electric field exposure of insulin induces antiproliferative effects on human hepatocytes. Bioelectromagnetics 26:1-9.
Lefcourt, A. M. and R. M. Akers. 1982. Endocrine responses of cows subjected to controlled voltages during milking. Journal of Dairy Science 65:2125-2130.
Li, Chung-Yi., and Fung-Chang Sung. 2003. Association between occupational exposure to power frequency electromagnetic fields and amyotrophic lateral sclerosis: A Review. American Journal of Industrial Medicine 43:212-220.
Lyskov, Eugene, Monica Sandstrom, and Kjell Hansson Mild. 2001. Provocation study of persons with perceived electrical hypersensitivity and controls using magnetic field exposure and recording of electrophysiological characteristics. *Bioelectromagnetics* 22:457- 462.
OSHA. 1997. Directives, CPL 2-1.18A - Enforcement of the Electrical Power Generation, Transmission, and Distribution Standard. Effective Date: Oct. 20, 1997. Occupational Safety and Health Administration. U. S. Department of Labor, Washington, D.C.
Phillips, Jerry L., Wendell P. Winters, and Loyce Rutledge. 1986. *In vitro* exposure to electromagnetic fields: changes in tumour cell properties. Int. J. Radiat.Biol., 49(3):463-469.
Polk, C. 2001. Cows, Ground Surface Potentials and Earth Resistivity. *Bioelectromagnetics* 22:7-18.
Polk, Charles, and Elliot Postow. *Handbook of Biological Effects of Electromagnetic Fields*. 2nd Ed., CRC Press, 1995.
Marino, Andrew A., R. Michael Walcott, Robert Chervenak, Frances Jourd'Heull, Erik Nilson, and Clifton Frilot II. 2000. Nonlinear Response of the Immune System to Power Frequency Magnetic Fields. *Am. J Physiol Regul Integr Comp Physiol* 279:R761-R768.
Marino, Andrew A., Thomas J. Berger, B. Peter Austin, Robert O. Becker, and Francis X. Hart. 1977. *In vivo* Bioelectrochemical changes associated with exposure to extremely low frequency electric fields. *Physiological Chemistry and Physics*, 9 (4&5).

Mein, G. A. 1998. Relationship Between Milking Machine and Mastitis. In: *Large Dairy Herd Management* by C. J. Wilcox and H. H. Van Horn, University Press, Gainesville, Florida.
Montano, N., C. Cogliati, V. J. Dias da Silva, T. Gnecchi-Ruscone, and A. Malliani. 2001. Sympathetic rhythms and cardiovascular oscillations. *Auton Neurosci* 90:29-34.
Neutra, Raymond R., Vincent Del Pizzo, and Geraldine Lee. 2002. An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) from Power Lines, Internal Wiring, Electrical Occupations and Appliances. California Department of Health Services EFM Program, 1515 Clay Street, Oakland, California 94612.
Pakhomov, A. G, B. V. Dubovick, I. G. Degtyariov, A. N. Pronkevich. 1995. Microwave influence on the the isolated heart function: I Effect of modulation. *Bioelectromagnetics* 16:241-249.
Reilly, J. Patrick. 1998. *Applied Bioelectricity From Electrical Stimulation to Electropathology.* Springer-Verlag, New York, adapted from same title, Cambridge University Press. 1992.
Reiter, R. J. 1994. Melatonin suppression by static and extremely low frequency electromagnetic fields: Relationship to the reported increased incidence of cancer. Rev. Environ Health 10, 171-186.
Sait, M. L., et al. 1999. A study of heart rate and heart rate variability in human subjects exposed to occupational levels of 50 Hz circular polarized magnetic fields. *Med Eng Phys* 21(5):361-369.
Sakurai, Tomonori, Akira Sataka, Shoichiro Sumi, Kazutomo Inoue, and Junji Miyakoshi. 2004. An Extremely Low Magnetic Field Attenuates Insulin Secretion From the Insulinoma Cell Line, RINm. *Bioelectromagnetics* 25:160-166.
Sastre, A., M. R. Cook, and C. Graham. 1998. Nocturnal exposure to intermittent 60 Hz magnetic fields alters human cardiac rhythm. *Bioelectromagnetics* 19:98-106.
Sastre, A., C. Graham, and M .R. Cook. 2000. Brain frequency magnetic fields alter cardiac autonomic control mechanisms. *Clin Neurophysiol* 111:1942-1948.
Saunders, Richard D., and C. D. McCaig. 2005. Developmental Effects of Physiologically Weak Electric Fields and Heat: An Overview. Bioelectromagnetics Supplement 7:S127-S132.
Sieron, Aleksander, Lukasz Labus, Premyshaw Nowak, Grzegorz Cieslar, Halina Brus, Artur Durczok, Tomasz Zagzit, Tichard Kostrzewa, and Ryszard Brus. 2004. Alternating extremely low frequency magnetic field increases turnover of dopamine and serotonin in rat frontal cortex. *Bioelectromagnetics* 25:426-430.
Szmigielski, S., A. Bortkiewicz, E.Gadzicka, M. Zmyslony, R. Kubacki. 1998. Alteration of diurnal rhythyms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields. *Blood Press Monit* 3(6):323-330.
Tikhonova, G. I. 2003. Heart Disease of personnel of the civil aircraft radio-tracking system in Russia. Radiatsionnaia biologiia, radiocologiia/ Rossiiskaia akademia nauk. Sept-Oct., 433(5):559-64. Research Institute of Occupational Health, Moscow, 105275 Russia.
Van Wijngaarden, E., et al. 2000. Exposure to electromagnetic fields and suicide among electrical utility workers: a nested case-control study. Occup Environmental Med. 57:258-263.
Variani, Katia, et al. 2000. Effect of Pulsed EMF on A_{2a} Adenosine Receptors in Human Neutrophils. British Journal of Pharmacology, 136:57-66.
Verschaeve, L. 1995. Can non ionizing radiation induce cancer? *The Cancer Journal* 8(5):237-249. Flemish Institute for Technological Research (VITO), Belgium.
Villeneuve, Paul J., et al. 2000. Non-Hodgkin's lymphoma among electric utility workers in Ontario: the evaluation of alternative indices of exposure to 60 hz electric and magnetic fields. Occup Environ Med 57:349-357.

Wertheimer, Nancy, and Ed Leeper. 1979. Electric wiring configurations and childhood cancer. American Journal of Epidemiology, © Johns Hopkins University School of Hygiene and Public Health.
Wertheimer, N. W., and E. Leeper. 1982. Adult cancer related to electrical wires near the home. *Int. J. Epidemiol.* 11:345.
Wertheimer, N. W., and E. Leeper. 1986. Possible effects of electric blankets and heated waterbeds on fetal development. *Bioelectromagnetics* 7:13.
Wilson, Bary W., Cherylyn W. Wright, James F. Morris, Raymond L. Buschbom, Donald P. Brown, Douglas L. Miller, Rita Sommers-Flannigan, and Larry E. Anderson. 1990. Evidence for an effect of elf electromagnetic fields on human pineal gland function. *Journal of Pineal Research* 9:259-269.

Shocking News (dba) is a registered publisher of science-based information dedicated to publi ic awareness of electric and magnetic fields
(EMF) in the living environment and their effects on the health and welfare of humans and animals. Editor is Don Hillman, Ph.D.,Professor
Emeritus, Department of Animal Science, with help from wife Mary, MS, Michigan State University, East Lansing, MI. Don is a member of the
American Society of Agricultural Engineers and The American Dairy Science/Animal Science Association. Telephone: (517) 351-9561.

Exposure to Electric and Magnetic Fields (EMF) Linked to Neuro-Endocrine Stress Syndrome: Increased Cardiovascular Disease, Diabetes, & Cancer

By Donald Hillman, Ph.D., Professor Emeritus, Michigan State University

Published by Shocking News,1No. 8 Email: donag1@aol.com November 2005

Discovery of EMF in My Home.

A cellular telephone company's request to place additional signal generators-transmitters and antennae on the East Lansing-Okemos Water Tower led to concerns about health risks to citizens in the community and a decision to measure the electrical output from the cellular phone installation. The water tower is located in Patriarche Park across the street from St. Thomas Aquinas School and within 87 to 400 feet of twenty neighborhood homes. Oscilloscope measurements of voltage, frequency, and current on the ground wire from the cell station revealed up to 10 volts (peak-peak), a broad spectrum of harmonic frequencies ranging from 180 hertz to megaHertz radio frequencies (rf) including 1.25 gigaHertz microwaves, with 1.8 amperes (A) of current and 100 or more milliGauss (mG) magnetic fields at the ground wire. Similar readings were on the ground wires and water pipes of at least six homes and the school.The utility mitigated the EMF from the ground wire in my home by installing a dielectric coupling in the water pipe to which the ground wire was attached. These findings were reported to the utility and neighbors in *Shocking News* #7, May, 2005.

EMF - Link to Stress:The present report addresses the physiological connection between the observed increased heart rate and blood pressure, my and neighbors' medical history of cardiovascular disease, diabetes, abdominal aortal aneurysm, diverticulosis, gastro-esophageal acid reflux, and nonHodgkin's lymphoma as evident in an extensive review of literature. The maladies are associated with a broad spectrum of physiological changes involving stimulation of the hypothalamus, pituitary, and adrenal gland secretions mediated through the central nervous system (CNS) which include the brain and spinal cord. Neuroendocrine reactions comprise the autonomic nervous system which monitors internal and external environmental stimulation through the sympathetic and parasympathetic neuro-endocrine system to achieve homeostasis.

My cardiovascular problemsbegan with irregular heart beat (skipping every 4th beat) and corresponding high blood pressure some years earlier for which I was administered daily diltiazem, a calcium ion channel blocker. I have had two quadruple coronary by-pass surgeries ten years apart, abdominal aortal aneurysm repair, prostate reduction surgery, intestinal diverticulosis, gastro-esophageal acid reflux syndrome, and Type II diabetes diagnosed 4 years ago for which I was prescribed daily endogenous insulin-stimulator drugs. I experienced body temperature rise and perspiration (sweats) which subsided without treatment during the night, and joint-muscle pain. My wife has had difficulty sleeping in the house, has had tumors in

the uterus requiring hysterectomy, a gall-bladder ablation, a shrunken kidney, borderline erythrocytic anemia.
A neighbor located 87 feet from the cell tower was suffering from a fibrillating heart, had a heart-valve replaced about five years ago and a pacemaker installed. The pacemaker was replaced after about five years, and a defibrillator was installed to maintain a functional heart rhythm. His wife suffers from multiple sclerosis, a disease associated with scattered demyelination of nerve axons in the central nervous system affecting motor control. Myelin is the insulation coating of nerves that protects them from electrical interference.
The lady next door was currently in the local hospital under chemotherapy and radiation treatment for recurring lymphoma cancer. Her duplex-neighbor lady had surgery for replacement of a knee within the last year and her son, age circa 30 years, is Type-I diabetic using an insulin pump.
Effects of EMF exposure on heart rate and blood pressure were reported by other investigators. Resting blood pressure of ten volunteers increased during exposure to a GSM

SUMMARY – My heart rate increased 29%, systolic blood pressure increased 10%, diastolic blood pressure increased 48%, and body temperature increased while I was sitting on the sofa with my feet in the 20 to 50 milliGauss (mG) magnetic field corona from the ground wire below the floor. I recorded 228 millivolts and 2.44 amperes (A) of electrical current passing through my body during the 35-minute exposure. Lansing Board of Water and Light utility engineers recorded voltage, 1.5 average to 8.8 A maximum current, 200% Total Harmonic Distortion, and 100-320 mG (10-32 microTesla) magnetic fields for 24-hours at the ground wire in my home. These exceeded IEEE (Institute of Electrical and Electronic Engineers) 519-1992, standards for harmonic distortion (5%), OHSA Directives for hazardous current (1.0 milliampere) and published values related to cancer.

900 MHz radio-frequency (rf) electromagnetic field for 35 minutes (Braune, S., et al., 1998), and rf fields influenced cardiovascular and hormonal parameters of the autonomic nervous system (Braune et al., 2002). Alteration of diurnal rhythms of blood pressure and heart rate occurred in workers exposed to radio frequency electromagnetic fields in the range 0.738 - 1.503 MHz and 200 - 550 volt/meter (V/m) electric fields, but the changes did not occur in a comparison group at lower exposure levels (Szmigielski et al., 1998). Similar changes in heart rate and heart rate variability occurred in subjects exposed to occupational levels of 50 Hz circular polarized magnetic fields (Sait et al., 1999).
Heart rate and sleepwere affected when healthy young men were exposed to 900 MHz spatial peak specific absorption rate (SAR) 1 W/kg simulating exposure to a cellular telephone signal pulsed at a rate of 9 to 14 Hz. While EMF exposure was to the head, workers estimated that exposure of the hypothalamus was 0.1 W/kg, sufficient to affect heart rate and sleep (Huber et al., 2003).
Cardiovascular diseaseassociated with hypertension and ischemia of the heart was 4 to 5 times greater with maximum Odds Ratio 19.1 times higher among men 30 to 39 years of age who were radar trackers in a civil airport compared to coworkers not exposed to EMF (Tikhonova, G. I., 2003). Spectral analysis of heart rate and arterial pressure short-term variability, consists of two major components: low- (LF, 0.04 - 0.15 Hz) and high- (HF, synchronous with respiratory rate). Both heart rate and respiratory rate were modified with sympathetic spinal nerve stimulation (Montano et al., 2001). Modulation of microwave, pulse signals, and continuous wave (CW) magnetic fields

affected frog isolated heart pacemaker function and heart rate due to microwave heating of tissues which occurred over a wide range of microwave frequencies (Pakhomov et al., 1995, 2000). Nocturnal 60 Hz exposure affected heart rhythm (Sastre et al., 1998) and brain frequency magnetic fields altered cardiac autonomic control mechanisms (Sastre et al., 1994). Graham et al. (1994) found a dose response slowing of heart rate and alterations in the latency and amplitude of event-related brain measures derived from electroencephalograms (EEG) when human subjects were subjected to 9 kV/m electric fields and 20 microTesla (μT–Tesla is a measure of the flux density or intensity of a magnetic field) exposure compared to 6 kV, 10 μT, and 12 kV, 30 μT dose combinations in blind studies. This study confirmed earlier reports that a combined 9 kV, 20 μT dose resulted in slowing of heart rate, changes in brain wave potentials, and changes in reaction time during challenge testing of humans (Cook et al., 1992). We measured 8 kV/m at head height below a 46 kV transmission line passing through a barnyard where the owner developed high blood pressure and irregular heart beat near Leslie, MI.

Cardiac sympathetic nerve fibers originate in the intermediolateral columns of the upper five or six thoracic and lower one or two cervical segments of the spinal cord. Changes in heart rate usually involve a reciprocal action of the sympathetic and parasympathetic divisions of the autonomic nervous system. Thus, heart rate increases with a decrease in parasympathetic activity (vagus nerves) and an increase in sympathetic activity; and decreases with the opposite effect as described by Berne et al. (1998). The parasympathetic nervous system does not enervate the body wall but only structures in the head and the thoracic, abdominal, and pelvic cavities. Thus, location of exposure to specific frequencies may be important in the heart response to electrical stimulation. However, stimulation of peripheral efferent nerves affects the heart through the neuro-endocrine system and exogenous signals need not penetrate the heart directly. Similarly the heating effect produced by stimulation of the thyroids (TSH) can account for the specific absorption rate (SAR) temperature increase upon electrical stimulation of intact man or animals.

The EMF Cortisol Connection – Cortisol in blood, heart rate, and blood pressure increased; and release of oxytocin was delayed when dairy cows were exposed to 4.0 and 8.0 mA contact current compared to no exposure in controlled experiments (Gorewit et al., 1984). Cortisol is released from the adrenal gland when ACTH (adrenocorticotropic hormone) is released from the pituitary by electrical stimulation of peripheral nerves. Similarly, oxytocin release from the pituitary stimulates excretion of milk (milk release) from the mammary gland upon stimulation of the udder by suckling or massaging of the udder in preparation for machine-milking. Impaired milk let-down, i.e., incomplete milking, was a common complaint of dairy farmers raising the stray voltage issue. Milk retained in the udder can increase incubation of low-level infections in the udder resulting in increased somatic cell count (SCC) according to Mein (1998) which may result in exclusion of milk from the market. Therefore, "uncontrolled electricity" can cause severe economic consequences for dairy farmers, in addition to affecting the health and milk production of the herd and the family.

Epinephrine administration significantly reduced milk yield in heifers and cows but did not inhibit oxytocin release in response to milking. Investigators found that as little as 50 μg epinephrine inhibited mammary blood flow to the udder by as much as 90%

(Gorewit and Aromando, 1984). ACTH, cortisol, oxytocin, and epinephrine are all involved in the chronic electrical-stress syndrome. These responses are activated by chronic stimulation of the autonomic nervous system as described by Berne et al. (1998).

Cortisol Effects on Connective Tissue – Inhibition of collagen synthesis by cortisol produces thinning of the skin and the walls of capillaries. The resultant fragility of the capillaries leads to intracutaneous hemorrhage (Berne et al., 1998). In this regard, a medical officer for an aircraft manufacturer reported finding between 75 and 100 cases of unexplained bleeding tendency, as well as a significant excess of leukemia and brain tumors among workers exposed to low-strength microwaves (Becker, 1990). Collagen in smooth muscle is an important component of blood vessels, the intestinal tract, bone-joint cushions, cartilage and skeletal muscle connectors to bone. Its integrity is impaired by excessive cortisol and cortisol is increased by EMF exposure. A small step of logic allows the conclusion that EMF affects integrity and elasticity of the aorta and other vessels permitting aneurysm, development of weak smooth muscle, gastrointestinal diverticulosis, ulcers, and gastroesophageal acid-reflex syndrome. Joint-muscle pain is a common complaint associated with EMF exposure and diabetes, as experienced by the author. Type I personalities are often

associated with a stress syndrome and cardiovascular disease, etc. EMF exposure is clearly another source of neuro-endocrine stress. Which part will give out first under chronic electro-stress environmental conditions is the diagnostic puzzle.

The increased cortisol in blood of cows during short-term electrical stimulation concurs with results obtained when rats were exposed to 0.5 mW/cm2 for periods of up to 25 months. The exposure was 20 times below the ANSI (American National Standards Institute) and military acceptable standard at the time (A. W. Guy, in Becker, 1990). Blood cortisol of all rats was equal at the beginning, but cortisol of exposed rats increased above controls shortly after the experiment began. By the end of the experimental period, cortisol was lower in exposed rats compared to controls. The cortisol pattern was a typical adrenal response to stress finally resulting in adrenocortical fatigue, as in Addison's disease of humans. While the rats used in the Guy experiments were gnotobiotic (germ and virus free), 18% of the exposed rats had cancers of the pituitary, adrenal, and thyroid glands, and only 5% of the controls had cancer (Becker, 1990; Chou, Guy, et al., 1992). In earlier experiments, serum corticosterone was depressed 31.7 %, while albumen levels increased 28.2%, and body weight was 6.6% lower in rats exposed to150 V/m for 30 days compared to unexposed controls (Marino et al., 1975). Similarly, Imaida et al. (1998) found that mean levels of corticosterone, ACTH, and melatonin were higher for rats exposed to near field TDMA modulated 929.2 MHz RF EMF at 50 pulses/sec, 0.33 duty cycle, than for unexposed controls. The experiment was repeated with rats exposed to TDMA modulated 1.439 GHz RFEMF whole body SARs 0.680-0.453 W/kg for 90 minutes per day, 5 days/wk for 6 weeks. Significant increases were found in the serum levels of corticosterone, ACTH and melatonin in the RFEMF group compared to the sham group. However, no difference was found in the incidence of liver cancer. Cancer of pituitaries and adrenals was not reported (Imaida et al., 1998b, in Heynick et al., 2003).

Note that the level of exposure in each of the above cases

was less than the 1.6 W/kg SAR allowed by the FCC and Congressional Telecommunications Act of 1996. The ANSI standard was lowered from 10 mW/cm2 to the present permissible 1.6 W/kg specific absorption rate (SAR) in 1982 on the basis of "new" information. Apparently, it should be lowered again on the same basis, and technology for controlling exposure needs improvement.

Experimental chronic exposures with intact live animals support the hypothesis that pituitary, adrenal, and pineal glands are affected by modulated, pulsed signals as produced by cell phone signal generators, electronic devices using switch mode power supplies, and by power line 60 Hz, 4 to 8 mA contact current. Current and EMF on the ground wire, water pipes, and kitchen sink 1.68 ± 1.0 A, average of 26 measurements in East Lansing homes was comparable to EMF in the living area and current on the ground wire and bathtub in studies conducted by EPRI, the Electric Power Research Institute (Kavet et al., 2005, 2000, 1999).

The pituitary gland produces hormones and neurotransmitters that affect essentially all functions of the body. In addition to ACTH stimulating the adrenal glands (glucose energy supply) and oxytocin stimulating mammary muscle [and uterine contractions at parturition], the pituitary produces thyroid stimulating hormone (TSH) which controls the release of thyroid hormones and determines metabolic rate and heat production, somatotrophic hormone (growth hormone) which influences body mass, protein and energy utilization (i.e., conversion to milk production, and growth), gonadotrophins: follicle stimulating hormone (FSH) causes growth of the ovarian follicles and stimulates spermatogenesis in the testes; luteinizing hormone (LH) transforms ovarian tissue into corpus luteum which produces progesterone and inhibits the estrus cycle following ovulation. Retained CLs are common in dairy cattle and impair reproduction. Prolactin (PRL) initiates milk synthesis of mammary cells. Antidiuretic hormone (ADH) regulates electrolyte concentrations in the blood and water excretion by the kidneys. The neurotransmitters involved in afferent impulses to the hypothalamus are largely, norepinephrine, acetylcholine, as well as serotonin the most important neurotransmitter in the brain.

Serotonin is also secreted by the pineal gland in the hypothalamus, and serotonin receptors are responsive to EMF exposure (Johnson et al., 2003; Sieren et al., 2004). Dopamine, acetylcholine, (-aminobutyric acid, and the opioid peptide $-endorphin act as neurotransmitters for efferent impulses to the median eminence of the neurohypophysis. These impulses regulate the discharge of releasing hormones or inhibiting hormones into the adjacent capillaries. Virtually all of the tropic hormones from the adenohypophysis cause changes in the concentrations of either peripheral target gland hormones (thyroid, adrenal, gonadal) or of substrates, such as glucose or free fatty acids.

The enormous influences of chronic cortisol stimulation on body functions are well known in medical circles but the influence of environmental EMF on the neuro-endocrine stress syndrome and human health has been overlooked, perhaps because the pieces to the complex puzzle have not been assembled recently.

Chronic excessive stimulation of either sympathetic or parasympathetic control mechanism causes a stress reaction involving the central nervous system, through stimulation of peripheral nerves and activation of the autonomic nervous

system response in the brain and the hypothalamus which contain the pituitary and pineal glands. The pituitary issues hormonal responses in the blood, neurotransmitters, which influence the adrenal glands and the function of virtually all organs in the body (Berne et al., 1998, *Physiology*).

The Diabetes Connection – Cortisol maintains glucose production from protein, *"Although the major impact of cortisol is on liver glycogen, an excess of the hormone eventually increases blood glucose levels. This increase occurs because cortisol powerfully antagonizes the actions of insulin on glucose metabolism. Hence, cortisol inhibits insulin-stimulated glucose uptake in muscle and adipose tissue, and it reverses the insulin suppression of hepatic glucose production.* ***In short, cortisol is an important diabetaogenic, antinsulin hormone. Its primary hyperglycemic and lipolytic and secondary ketonic actions are usually exhibited only when its secretion is greatly stimulated by stress"*** (Berne et al., *Physiology*, 1998).

Insulin secretion of pancreatic islet beta-cells was attenuated by exposure of cells to EMF in three of four laboratory experiments, *in vitro,* (Sakurai, et al., 2004). Exposure of insulin to 0.7 V/m electric field of 50 Hz pulsed frequency EMF produced significant time-dependent differences in the conformation of the insulin molecule, reduced the binding capacity to its receptor, reduced the intracellular tyrosine phosphorlation level, and modified gene expression of insulin-signaling pathways and hepatic cell proliferation (Li et al., 2005). Primary deficiency of insulin as a consequence of selective $-cell destruction is known as Type I or insulin-dependent diabetes mellitus. The disease usually results from a genetically conferred vulnerability to an environmental insult that initiates a destructive autoimmune process. Electricity in the environment may be that insult.

An estimated 18 million people in the United States have Type II diabetes. Because a major cause of this form of diabetes is resistance to insulin, the EMF observations by Li et al. (above) offer promising suggestions for mitigating diabetes by following a specific electron diet or reducing electron exposure to specific frequencies and time periods.

The above factors help explain how EMF, millivolts of high frequency Graham/Stetzer Units (Graham, M., 2003) during environmental exposure in the home was related to increased blood glucose of diabetics ($R_2 = 0.83$) and decreased blood glucose and insulin requirements of diabetics when frequency filters were installed in wall outlets to reduce EMF exposure (Havas and Stetzer, 2004). Similarly, the incidence of Type II diabetes was higher among persons living near high power transmission lines and was positively related to an EMF index (mG x time) daily exposure in Australia (Beale et al., 2001). Milk and milk-fat of cows decreased when exposed to 10 kV/m electrical field and 30 μT magnetic fields (Burchard et al., 2004). Similarly, milk fat was lower from cows exposed to 1-5 and 8-12 mA contact current during milking (Aneshansley et al., 1992). Because insulin is necessary for absorption of glucose into mammary cells, and glucose is essential for milk-fat synthesis, cows exposed to EMF and contact current may have been diabetic.

Cortisol facilitates fat metabolism, supports responsiveness of the vascular tree, modulates central nervous system function, and profoundly affects the immune system. In addition to its effect on glucose and fat metabolism, Berne et al. highlighted the following specific effects of cortisol: **Effects on muscle.** Cortisol maintains the contractility and work performance of skeletal and

cardiac muscle. [Remember that short-term stress increases cortisol and long-term EMF stress results in adrenocortical fatigue]. **Effects on bone**. Cortisol inhibits bone formation by several mechanisms: reduces Type I collagen formation; decreases the rate of differentiation of osteoprogenitor cells to active osteoblasts; decreases the absorption of calcium from the intestinal tract by antagonizing vitamin D_3. The result of these actions is a reduction in the availability of calcium for bone mineralization. Thus, one major consequence of excess cortisol production is an overall reduction in bone mass (osteoporosis). **Effects on the vascular system.***Cortisol is required for the maintenance of normal blood pressure.* [However electrical stress increased cortisol, blood pressure and heart rate of cows and humans as noted above.] **Effects on the kidney.***Cortisol influences the rate of glomerular filtration. The hormone is also essential for rapid excretion of a water load.* In the absence of cortisol, the synthesis and secretion of antidiuretic hormone (ADH) are increased and its action on renal tubules is enhanced; free-water clearance is diminished and dilution of the urine is limited. Diabetes insipidus, the inability to produce concentrated urine and frequent urination (Gotta-Go syndrome) is the hallmark of ADH deficiency. **Effects on the central nervous system**. Cortisol modulates excitability, behavior, and mood of individuals; the electrical activity of neurons is influenced. Both Type I and Type II glucocorticoid receptors (GRs) are present in various areas of the brain, particularly in the limbic system and the hippocampus. Cortisol decreases rapid eye movement (REM) sleep but increases both slow-wave sleep and time spent awake. In excess, cortisol can cause insomnia, strikingly elevate or depress moods, decrease memory and hippocampal volume and memory function. EMF affected sleep in experimental trials (Akerstedt et al., 1999; Huber et al., 2003, 2004) and student behavior in the classroom (Havas&Stetzer, 2004) and electrohypersensitive persons had higher heart rate and heart rate variability (Lyskov, 2001). Cortisol also specifically decreases the ability to detect a salty taste and dampens acuity to gustatory, olfactory, auditory, and visual stimuli. On the other hand, cortisol improves the ability to integrate those sensations that are perceived and to organize appropriate responses. **Effects on the fetus.***Cortisol facilitates in utero maturation of the central nervous system, retina, skin, gastrointestinal tract, and lungs.* (See Berne et al. for details). However, in a study of 1583 pregnant women, those using computers more than 20 hours per week had 40% more miscarriages compared with female workers who did not use computers (Goldhaber et al., 1988). Prenatal development of the central nervous system is a particularly sensitive marker of heat-induced developmental abnormalities and can be correlated with heat-induced behavioral deficits (Saunders and McCaig, 2005). Body heat increased during EMF electrical exposure. Extensive reviews of EMF effects on reproduction, embryonic and fetal development were published by Brent 1999; Heynick et al., 2003; and Levin 2003). **Effects on inflammatory and immune response.***Cortisol has a profound influence on the complex set of reactions evoked by tissue trauma, chemical irritants, infection, or foreign proteins.* **The EMF Cancer Link** – Cortisol inhibits recruitment of circulating leukocytes to trauma or infection sites, decreases phagocytic and antibacterial activity of circulating neutrophils, i.e., increases neutrophils release from bone marrow but decreases their effectiveness for controlling disease, and (EMF decreases AMP to ATP energy transfer in neutrophils), decreases number of circulating eosinophils, decreases number of thymus

derived T-lymphocytes, and depresses the immune system response to invading organisms or substances such as viruses. Melatonin a hormone secreted from the pineal gland is associated with the function of the circadian clock which regulates sleeping, and many related functions of the body. Leukemia and lymphomas (tumors) are characterized by the abnormal proliferation and reduced differentiation of developing lymphocytes and other blood cells in peripheral blood, bone marrow, and tumor tissues. The diagnostic report for the lymphoma patient revealed: "cytogenetics tests of bone marrow

cells were abnormal in culture cells stimulated by lymphoid mitogens. Two of the metaphases were abnormal due to multiple structural and numerical aberrations characterized by additional material on the short arm of one chromosome 2, trisomy 3 with one being abnormal, rearrangements of 6q, 8p and trisomy for chromosomes 7 and 18 and 2 markers. The spectrum of abnormalities are most consistent with the presence of a lymphoma or other lymphoid disorder. Skin biopsies of both lower left leg lateral and medial section morphological features were consistent with diffuse large B cell lymphoma. Otherwise, the patient was a chromosomally normal female, Karyotype 46,XX ."

Cytotoxicity of a T-lymphocyte line against lymphoma target cells was inhibited by exposure of the lymphocytes to 450 MHz field sinusoidally amplitude-modulated at frequencies between 3 and 100 Hz (Lyle et al., 1983). Exposure of the effector cells to the field prior to adding them to the target cells in the cytolytic assay resulted in a similar inhibition, suggesting a direct interaction of the field with the cytolytic T lymphocytes (Lyle et al., 1993). This corresponds to changes in immunological response of B- and T-lymphocytes to mitogens after long term chronic exposures reported by Guy et al. (1985) and was similar to the failed lymphoblast response to staphyloccus*aureus*antigens in cows exposed to low-level intermittent electricity for two-weeks in a report to Advisors to the Minnesota Public Utilities Commission (Reinemann et al., 1999).

Secondly, changes in the absolute numbers and ratios of CD4+/CD8+ lymphocytes in favor of CD8+ cells of cows at Farm A housed under a 380 kV transmission line exposed to 1.98 to 3.28 :T magnetic fields compared to cows at a distant Farm B considered zero exposed, except in brief periods (3 min × 4 times/day) during which 0.2 to 0.7 μT were present while a feed distributor was running. Investigators found that the mean values of CD8+ and CD6+ leucocyte sub-populations were significantly higher in cows from the exposed farm. Two typologies of CD8+, called Dim and Bright in function of the cytofluorescence analysis, are evident in the exposed farm whereas the population remained single in the not-exposed farm. Melatonin concentrations are higher during darkness and decrease during daylight. Melatonin is believed to produce strongoncostatic, immunological, and antioxidant functions in the blood. EMF exposure has decreased melatonin concentrations in blood, or urinary excretion of its metabolite, in humans sleeping under an electric blanket (Wilson et al., 1990), electrical workers exposed to 60 Hz magnetic fields while working in substations or on 3-phase conductors (Burch et al., 2003), women exposed to visual display units (computer monitors) during office work (Arnetz and Berg, 1996), in dairy cattle exposed to overhead EMF (Burchard, 2003), and in laboratory animals (Reiter, 1994).

A study conducted in Denmark (Olson et al., 1993) investigated 1707 cases of leukemia, brain tumors, and malignant lymphomas recorded in the Danish cancer registry and were restricted to children of less than 15 years at diagnosis. Controls were selected at random from the central population registry. The study revealed that exposure to magnetic fields (in the order of 0.4 μT, (4 mG) increased cancer. The risk for lymphoma was already increased for fields above 0.1 μT (1 mG). In a study by Robinette et al., (1980) on naval personnel and radio operators it was shown that workers in this occupation had a higher than normal risk for brain cancer. Mortality from cancer was increased close to air force bases compared with other places. It was concluded that this was due to the proximity of radar installations. Similarly, the rate of brain tumors was higher among navy radar operators than among other appropriate controls following the Korean War (Lin, 1985, in Becker, 1990).

EMF-Cancer (Direct Evidence) – Electrical currents had been traced from utility down-ground wires to water pipes where 180 Hertz current combined with 3rd, 5th, and 7th harmonics in the living areas of homes were positively associated with cases of leukemia, lymphoma, and brain tumors where victims had died in Denver, Colorado (Kuane et al., 2002). Positive associations between power line EMF and leukemia, lymphoma, brain tumors, spontaneous miscarriages, alzheimer, and suicide of electrical workers, etc. were reported by California Department of Health Services. For access to some 400 references see (Neutra et al., 2002) at the website listed below or address in the references at the end of this article. Many articles have appeared since 2001 when the California reference list was compiled. Childhood and adult leukemia, lymphoma, and brain tumors have been associated with odds ratios 2 to 4 times greater risk among persons exposed to 4 mG or higher EMF (Kaune et al., 2002; Neutra et al., 2001; Ahlbom et al., 2000; Villeneuve et al., 2000; Robinson et al., 1999; Coghill, 1996; Verschaeve, 1995; Fechting and Ahlbom, 1993; London et al., 1991; Loomis et al., 1990; Thomas et al., 1987; Savitz et al., 1988; and Wertheimer andLeeper, 1979, 1982, 1995). Furthermore, efforts were made to identify possible confounders, that could bias the results of these studies (e.g., air pollution, socio-economic conditions, water quality, traffic patterns, static magnetic fields and resonance models, but no evidence of such confounders has been identified.

Horst et al. (2004) found that persons living within 400 meters of a cellular phone tower had 3 times more cancer than those living more than 400 meters from the tower. Our evidence showing the high frequency EMF typical of the rf and microwaves produced by the cell phone signal generator transmitter measured from the ground wire, and measured on the ground wires and water pipes of a neighbor lady with nonHodgkin's lymphoma, concurs with the results of Ontario, Canada Hydro Electric employees. Incidence of nonHodgkin's lymphoma was 3 to 4 times higher in the top thirty percent exposure-time index of electrical employees based on measured electric fields (thresholds 10 and 40 V/m) compared to administrative and office employees with low exposure (Villeneuve et al., 2001).

Electro-Sensitivityof people is now recognized as a physical impairment by government health authorities in the United Kingdom and Sweden. The UK Health Protection Agency (HPA) recognized that people can suffer nausea, headaches, and muscle pains when exposed to electromagnetic fields from mobile phones, electricity pylons and computer

screens. They recognize that general practitioners (GPs) are not generally aware of the electro-sensitivity syndrome and HPA will provide guidelines for GPs to follow in diagnosing the disease.

Doctors may need to examine EMF in the home, and perhaps in their own office to identify the sources and will need to add EMF meters to their instrument bag to confirm a diagnosis.

Development of cardiovascular disease, diabetes, and nonHodgkin's lymphoma of the immediate occupants in this study is consistent with recognition of health authorities that chronic disease "Cancer, Cardiovascular, and Diabetes" account for two-thirds of the $1.55 billion spent on health care in this country and are increasing, according to the Center for Disease Control (Lansing State Journal, 10/02/05). Secondly, our finding supports the likelihood of increased risk of other major diseases caused by excessive exposure to EMF.

National Institutes of Environmental Health mentioned possible EMF associations with sudden cardiac death, dementia, suicide (NIEHS, Portier and Wolf, 1998), and spontaneous abortion (Li et al., 2002, and Lee et al., 2002) as reported by California Department of Health Services (Neutra et al., 2002, p. 10) on website:

http://www.dhs.ca.gov/ehib/emf/RiskEvaluation/riskeval.html

Some of the California EMF findings and Michigan's 51,000 new cancer cases per year were in Shocking News #2, May, 2004, and are on the website www.electricalpollution.com

Sources of EMF – The Ground Wire in Homes, Schools and Workplaces – Our electrical data concur with studies by EPRI (Electric Power Research Institute), the research arm of the power industry. Kavet el al. (2000) found strong correlations with the average magnetic field in the living area and the 24-hour average net current on the service drop (the ground wire) and the number of service drops on the same transformer. Similarly, Kavet (2005) found that EMF in living areas was correlated with volts on water pipes, and volts on the bath tub. Excessive voltage and current was on water pipes, the kitchen sink, bathtub, sheet metal air ducts, chair springs, and bed springs in our home (Shocking News #7).

Modern Household Appliances and Office Equipment with electronic controls, i.e., heating and air conditioning units, television, VDUs (computer monitors), printers, copy machines, MRI, digital clocks, microwave ovens, TV, radio, refrigerators, stoves, etc., produce harmonics and emit large amounts of EMF to distances of 1 to 6 feet from the appliance in our home.

C G/S meter readings from wall outlets in Kellogg Center, MSU were 700 to 1760 G/S Units, while in my home they now read 15 to 20 G/S Units, down from 120-200 (units of high frequency current) in wall outlets.

Mitigation of EMF has been achieved by:

1. Installing a dielectric union (rubber insulated connector) in the water pipe to which the ground wire is connected. Some homes may already have this isolation. You need to know if yours does. If it was built before 1975, it may not have a dielectric connection and magnetic fields on the ground wire and water pipes could be very high.
2. Installation of high frequency filters in the wall outlets of homes can dramatically reduce the EMF from the outlets and the EMF environment in living areas. Contact dave@stetzerelectric.com
3. Installation of a shielded neutral isolation transformer between the utility (source) and the customer (end-user) service connection will prevent the high frequency signals

from passing from the utility wires to your home or business circuits. This should be required of all businesses that produce a large amount of high frequency residue (dirty electricity) on the ground wire.
4. Improved maintenance of utility (primary) and/or customer (secondary) wiring to reduce resistance on circuits by installing adequately sized transformers, and neutral to the substation wire conductors serving customers. Most utility engineers know what to do, but executive $ objectives often take precedence over risks to human health and life.

CONCLUSIONS

Excessive electrical current and high frequency rf and microwave magnetic fields were tracked via oscilloscope measurements from the cellular telephone station at the water tower in Patriarche Park. Signals were on the utility ground wire and radiating into the living areas of homes and a school in East Lansing. Heart rate, heart rhythm, and blood pressure were affected during exposure to electromagnetic fields (EMF) in a home. Similarly, occupational exposure and controlled laboratory studies confirm these findings. Diabetes, NonHodgkin's lymphoma, and other health impairments that occurred to residents near the park, plus leukemia, and brain tumors have been associated with EMF in other studies. Cardiovascular disease, diabetes mellitus and impaired immunity are typical physiological responses to neuroendocrine stress. Pituitary and adrenal gland responses to both contact current and electromagnetic current have been demonstrated in humans and animals. Excessive current and mG of magnetic fields were observed at ten homes in the area. Recorded measurements were outside of IEEE stands for power quality and OSHA standards for electrical hazards. Methods for mitigation of environmental contamination are known and should be encouraged by utilities and government agencies responsible for electrical safety and human health.

Michigan Public Service Commission promulgated Rules R460.2701 to RR460.2708, etc. would not require utilities to identify any electrical problem other than 60 Hertz, steady state voltage or current, and would not require using appropriate instruments to detect the problems in the East Lansing community or elsewhere in the state. Further, the MPSC proposed rules will have the effect of using the power of the state to allow utilities to avoid their responsibility to protect citizens and residents from unhealthy and unwanted electrical damage.

References

Ahlbom, N., M. Day, E. Feychting, J. Roman, J. Skinner, M. Dockerty, M. Linet. 2000. A pooled analysis of magnetic fields and childhoodleukaemia, *British Journal of Cancer* 83(5):692-698.

Akerstedt, T., B. Arnetz, G. Ficca, L. E. Paulson, A. Kallner. 1999. A 50 Hz electromagnetic field impairs sleep. J. Sleep Res 8:77-81.

Aneshansley, D. J., R. C. Gorewit, and L. R. Price. 1992. Cow sensitivity to electricity during milking. J. Dairy Sci 75:2733-2741.

Bawin, S. M., L. K. Kaczmarek, and W. R. Adey. 1975. Effects of modulated VHF fields on the central nervous system. Space Biol. Lab, Braqin Research Institute, U. CA, Los Angeles, Annals NY Academy of Science 247:74-81.

Beale, Ivan L., Neil E. Pearce, Roger J. Booth, and Sandra A. Heriot. 2001. Association of health problems with 50 hz magnetic fields in

human adults living near power transmission lines. *J. Australian College of Nutritional & Environmental Medicine* 20(2):9-12 and 15-30.

Becker, Robert O. 1990. *Cross Currents*, The Perils of

Electropollution– the Promise of Electromedicine.Jeromy P. Tarcher/Perigee Books, The Putnam Publishers, New York, NY.
Berne, Robert M., Matthew N. Levy, Bruce M. Koeppen, and Bruce A. Stanton. 1998. *Physiology.* Fifth Edition, Mosby, ©Elsevier Inc., Philadelphia, PA, USA.
Braune, S., C. Wrocklage, J. Raczek, T. Gailus, and C. H. Lucking. 1998. Resting blood pressure increased during exposure to a radiofrequency electromagnetic field. *Lancet* 351:1857-1858.
Braune, S., A. Reidel, J. Schulte-Monting, and J. Raczek. 2002. Influence of a radio-frequency electromagnetic field on cardiovascular and hormonal parameters of the autonomic nervous system in healthy individuals. *Radiat. Res.* 158:352-356.
Brent, R. L. 1999. Reproductive and teratological effects of low frequency electromagnetic fields. A review of in vivo and invitro using animal models. Teratology 59:261-286.
Brzenzinski, Ammon. 1997. Melatonin in Humans, mechanisms of disease. Frank H. Epstein, Editor, *The New England Journal of Medicine* 336(3):186-195.
Burch, James B., J. S. Reif, C. W. Noonan, and Michael G. Yost. 2000. Melatonin metabolite levels in workers exposed to 60 Hz magnetic fields: work in substations and with 3-phase conductors. *J Occup Envir Med* 42:136-142.
Burchard, Javier F. 2003. Electric and magnetic field research at McGill University.*Proceedings: Stray voltage and Dairy Farms.* NRAES, Cooperative Extension Service, P.O. Box 4557, Ithaca, New York.
Burchard, Javier, J. H. Monardes, and D. H. Nguyen. 2003. Effect of 10 kV/m and 30 μT, 60 Hz, electric and magnetic fields on milk production and feed intake in nonpregnant dairy cattle. *Bioelectromagnetics*24:557-562.
Calogero, Stelletta, Giuseppe Basso, Barbara Michelotto, Paola De Nardo, Francesco Santin, Marta Benedetti, and Massimo Morgante. 2004. Effects of extremely low frequency electromagnetic fields exposition on circadian rhythms and distribution of some leucocyte differentiation antigens in cows. Presentation, International Conference of Veterinary Clinicians, Quebec City, Quebec, Canada, July 2004. Contact: Department of Veterinary Clinical Science, Faculty of Veterinary Medicine, Padova and Clinic of Pediatric Oncoematology, University of Padova, Institute Superior di Sanita, Italy.
Chou, C. K., A. W. Guy, L. L. Kunz, L. B. Johnson, J. J. Crowley, and J. H. Krupp. 1992. Long- term, low-level microwave radiation of rats. Bioelectromagnetics 13:469-496.
Chen, Gang, Brad L. Upham, Wei Sun, Chia Ching Chang, Edward J. Rothwell, Kun-Mu Chen, Hiroshima Yamasaki, and James E. Trosko. 2000. Effects of Electromagnetic Field Exposure on Chemically Induced Differentiation of Friend Erythroleukemia Cells.*Environmental Health Perspectives* 108:967-972.
Chen, K-M, A. Samuel, and R. Hoopengarner. 1974. Chromosomal aberrations of living cells induced by microwave radiation. Environ Lett 6:37- 46.
Coghill, Roger. 1996. A Case-Control Study of Electric and Magnetic Fields in the Bedplace of Children Diagnosed with Leukaemia. UK, Biophysics 41:806-816 and the European Journal of Cancer Prevention 5:3-10.
Cook, Mary R., Charles Graham, Harvey D. Cohen, and Mary M. Gerkovich. 1992. A replication study of human exposure to 60-Hz fields: Effects on neurobehavioral measures. *Bioelectromagnetics* 13:261-265.
Eger, Horst, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, Helmut Volt. 2004. The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer.Umwelt-

Medizin-Gesellschaft 17, 4, 2004 (Germany).
Fechting, M., and A. Ahlbon. 1993. Magnetic fields and cancer in children residing near Swedish high-voltage power lines. Am J. Epidemiol. 138:467-481, 1993.
Goldhaber, M. K., Michael Polen, and RoertHiat. 1988. Miscarriages of women using computers in the workplace. Amer. J Industrial Med 13:695.
Gorewit, R. C. and Aromando. 1984. Mechanisms involved in the adrenalin induced blockade of milk ejection in dairy cattle. Proc. Expt. Biol. Med.
Gorewit, R. C., D. V. Henke Drenkerd, and N. R. Scott. 1984. Physiological Effects of Electrical Current on Dairy Cows.*Stray Voltage: Proceedings of the National Stray Voltage Symposium.* American Soc. of Agricultural Engineers, St. Joseph, MI.
Graham, Charles, Mary R. Cook, Harvey D. Cohen, and Mary M. Gerkovich. 1994. Dose response of human exposure to 60 Hz electric and magnetic fields. *Bioelectomagnetics*15:447-463.
Graham, Martin. 2002. Mitigation of electrical pollution in the home. Memorandum No. UCB/ERL MO2/8, 19 April 2002. Electronics Research Laboratory, College of Engineering, University of California, Berkeley, CA 94720.
Graham, Martin. 2003. A microsurge meter for electrical pollution research. Memorandum No.UCB/ERL MO3/3. 19 February 2003. Electronics Research Laboratory, College of Engineering, University of California, Berkeley, CA 94720.
Havas, Magda, and Dave Stetzer. 2004. Graham/Stetzer Filters Improve Power Quality in Homes and Schools; Reduce Blood Sugar Levels Among Diabetics; etc. International Conference on Childhood Leukaemia, London, England, Sept. 6-10, 2004.
Havas, Magda, and David Stetzer. 2004. Dirty electricity and electrical hypersensitivity: five case studies. World Health Organization Workshop on Electrical Hypersensitivity. October 24-25, 2004. Prague, Czech Republic.
Heynick, Louis N., Sheila A. Johnson, and Patrick A. Masson. 2003. Radio frequency electromagnetic fields: Cancer, Mutagenesis, and Genotoxity.Bioelectromagnetics Supplement 6:S74-S100.
Hillman, D. 2005. Magnetic fields in homes and school: source and mitigation in our home. *Shocking News* #7, 750 Berkshire Lane, East Lansing, MI 48823.
Hillman, Donald, Charles L. Goeke, and Richard Moser. 2004. Electric and magnetic fields (emf) affect milk production and behavior of cows: results using shielded-neutral isolation transformer. 12th International Conference on Production Diseases in Farm Animals, Michigan State University, East Lansing, MI.
Hillman, D., D. Stetzer, M. Graham, C. H. Goeke, K. Mathson, H. H. VanHorn, and C. J. Wilcox. 2003. Relationship of electric power quality to milk production and behavior of dairy cattle. Paper No. 033116, *Amer. Soc. Agr. Engineers*, St. Joseph, MI (DVD available).
Huber, Reto, JurgenSchudererm Thomas Grat, Kathrin Jutz, Alexander A. Borbely, NielsKuster, and Peter Achermann. 2003. Radio frequency electromagnetic field exposure in humans: Estimation of SAR distribution in the brain, effects on sleep and heart rate. *Bioelectromagnetics*24: 262-276.
Huber, R., T. Graf, K. A. Cote, L. Wittmann, E. Gallmann, D. Matter, et al. 2000. Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG. NeuroReport 11:3321-3325.
IEEE, 519-1992.*Recommended Practices and Requirements for Harmonic Control in Electric Power Systems*. Institute of Electrical and Electronics Engineers, Piscataway, N.J.
Imaida, K., M. Taki, T. Yamaguchi, T. Ito, S-I Watanabi, K. Wake, A.

Aimoto, Y. Kamimuri, N. Ito, T. Shirai. 1998a.. Lack of promoting effects of the elecrtomagnetic near-field used for cellular phones
8
(929.2 MHz) on rat liver carcinogenesis in a medium-term liver bioassay. Carcinogenesis 19:311-314.
Illnerova, Helena, Milena Buresova, and Jiri Presl. 1993. Melatonin rhythm in human milk. J ClinEndocrinolMetab 77: 838-841.
Kaune, W. T., T. Dovan, R. I. Kavet, D. A. Savitz, and R. R. Neutra. 2000. Study of High- and Low-Current-Configuration Homes From the 1988 Denver Childhood Cancer Study. Bioelectromagnetics 23:177-188.
Kavet, R., L. E. Zaffanella, J. P. Daigle, and K. L. Ebi. 2000. The Possible Role of Contact Current in Cancer Risk Associated with Residential Magnetic Fields.Bioelectromagnetics 21:538-553.
Kavet, Robert. 2005. Review: Contact Current Hypothesis: Summary of Results to Date.Bioelectromagnetics Supplement 7:S75-S85.
Kennedy, Barry. 2000. *Power Quality Primer*, McGraw-Hill, New York, NY.
Lefcourt, A. M., and R. M. Akers. 1982. Endocrine responses of cows subjected to controlled voltages during milking. Journal of Dairy Science 65:2125-2130.
Levin, Michael. 2003. Bioelectromagnetics in Morphogenesis. Bioelectromagnetics 24:295-315.
Li, Chung-Yi., and Fung-Chang Sung. 2003. Association between occupational exposure to power frequency electromagnetic fields and amyotrophic lateral sclerosis: A Review. American Journal of Industrial Medicine 43:212-220.
Li, Lejun, Yuwen Dai, Ruohong Xia, Shude Chen, and DenjiangQiao. 2005. Pulsed electric field exposure of insulin induces antiproliferative effects on human hepatocytes. Bioelectromagnetics 26:1-9.
Lefcourt, A. M. and R. M. Akers. 1982. Endocrine responses of cows subjected to controlled voltages during milking. Journal of Dairy Science 65:2125-2130.
Li, Chung-Yi., and Fung-Chang Sung. 2003. Association between occupational exposure to power frequency electromagnetic fields and amyotrophic lateral sclerosis: A Review. American Journal of Industrial Medicine 43:212-220.
Lyskov, Eugene, Monica Sandstrom, and Kjell Hansson Mild. 2001. Provocation study of persons with perceived electrical hypersensitivity and controls using magnetic field exposure and recording of electrophysiological characteristics. *Bioelectromagnetics* 22:457- 462.
OSHA. 1997. Directives, CPL 2-1.18A - Enforcement of the Electrical Power Generation, Transmission, and Distribution Standard. Effective Date: Oct. 20, 1997. Occupational Safety and Health Administration. U. S. Department of Labor, Washington, D.C.
Phillips, Jerry L., Wendell P. Winters, and Loyce Rutledge. 1986. *In vitro*exposure to electromagnetic fields: changes in tumour cell properties. Int. J. Radiat.Biol., 49(3):463-469.
Polk, C. 2001. Cows, Ground Surface Potentials and Earth Resistivity. *Bioelectromagnetics*22:7-18.
Polk, Charles, and Elliot Postow.*Handbook of Biological Effects of Electromagnetic Fields*. 2nd Ed., CRC Press, 1995.
Marino, Andrew A., R. Michael Walcott, Robert Chervenak, Frances Jourd'Heull, Erik Nilson, and Clifton Frilot II. 2000. Nonlinear Response of the Immune System to Power Frequency Magnetic Fields.*Am. J PhysiolRegulIntegr Comp Physiol*279:R761-R768.
Marino, Andrew A., Thomas J. Berger, B. Peter Austin, Robert O. Becker, and Francis X. Hart. 1977. *In vivo* Bioelectrochemical changes associated with exposure to extremely low frequency electric fields. *Physiological Chemistry and Physics*, 9 (4&5).

Mein, G. A. 1998. Relationship Between Milking Machine and Mastitis. In: *Large Dairy Herd Management* by C. J. Wilcox and H. H. Van Horn, University Press, Gainesville, Florida.
Montano, N., C. Cogliati, V. J. Dias da Silva, T. Gnecchi-Ruscone, and A. Malliani. 2001. Sympathetic rhythms and cardiovascular oscillations. *AutonNeurosci*90:29-34.
Neutra, Raymond R., Vincent Del Pizzo, and Geraldine Lee. 2002. An Evaluation of the Possible Risks from Electric and Magnetic Fields (EMFs) from Power Lines, Internal Wiring, Electrical Occupations and Appliances. California Department of Health Services EFM Program, 1515 Clay Street, Oakland, California 94612.
Pakhomov, A. G, B. V. Dubovick, I. G. Degtyariov, A. N. Pronkevich. 1995. Microwave influence on the the isolated heart function: I Effect of modulation.*Bioelectromagnetics*16:241-249.
Reilly, J. Patrick. 1998. *Applied Bioelectricity From Electrical Stimulation to Electropathology*. Springer-Verlag, New York, adapted from same title, Cambridge University Press. 1992.
Reiter, R. J. 1994. Melatonin suppression by static and extremely low frequency electromagnetic fields: Relationship to the reported increased incidence of cancer. Rev. Environ Health 10, 171-186.
Sait, M. L., et al. 1999. A study of heart rate and heart rate variability in human subjects exposed to occupational levels of 50 Hz circular polarized magnetic fields. *Med EngPhys*21(5):361-369.
Sakurai, Tomonori, Akira Sataka, ShoichiroSumi, Kazutomo Inoue, andJunji Miyakoshi. 2004. An Extremely Low Magnetic Field Attenuates Insulin Secretion From the Insulinoma Cell Line, RINm. *Bioelectromagnetics*25:160-166.
Sastre, A., M. R. Cook, and C. Graham. 1998. Nocturnal exposure to intermittent 60 Hz magnetic fields alters human cardiac rhythm. *Bioelectromagnetics*19:98-106.
Sastre, A., C. Graham, and M .R. Cook. 2000. Brain frequency magnetic fields alter cardiac autonomic control mechanisms. *Clin Neurophysiol*111:1942-1948.
Saunders, Richard D., and C. D. McCaig. 2005. Developmental Effects of Physiologically Weak Electric Fields and Heat: An Overview. Bioelectromagnetics Supplement 7:S127-S132.
Sieron, Aleksander, Lukasz Labus, Premyshaw Nowak, Grzegorz Cieslar, HalinaBrus, ArturDurczok, Tomasz Zagzit, Tichard Kostrzewa, and RyszardBrus. 2004. Alternating extremely low frequency magnetic field increases turnover of dopamine and serotonin in rat frontal cortex. *Bioelectromagnetics*25:426-430.
Szmigielski, S., A. Bortkiewicz, E.Gadzicka, M. Zmyslony, R. Kubacki. 1998. Alteration of diurnal rhythyms of blood pressure and heart rate to workers exposed to radiofrequency electromagnetic fields. *Blood Press Monit*3(6):323-330.
Tikhonova, G. I. 2003. Heart Disease of personnel of the civil aircraft radio-tracking system in Russia. Radiatsionnaiabiologiia, radiocologiia/ Rossiiskaiaakademianauk. Sept-Oct., 433(5):559-64. Research Institute of Occupational Health, Moscow, 105275 Russia.
Van Wijngaarden, E., et al. 2000. Exposure to electromagnetic fields and suicide among electrical utility workers: a nested case-control study. Occup Environmental Med. 57:258-263.
Variani, Katia, et al. 2000. Effect of Pulsed EMF on A_{2a} Adenosine Receptors in Human Neutrophils. British Journal of Pharmacology, 136:57-66.
Verschaeve, L. 1995. Can non ionizing radiation induce cancer? *The Cancer Journal* 8(5):237-249. Flemish Institute for Technological Research (VITO), Belgium.
Villeneuve, Paul J., et al. 2000. Non-Hodgkin's lymphoma among electric utility workers in Ontario: the evaluation of alternative indices of exposure to 60 hz electric and magnetic fields. Occup Environ Med 57:349-357.

Wertheimer, Nancy, and Ed Leeper. 1979. Electric wiring configurations and childhood cancer. American Journal of Epidemiology, © Johns Hopkins University School of Hygiene and Public Health.
Wertheimer, N. W., and E. Leeper. 1982. Adult cancer related to electrical wires near the home. *Int. J. Epidemiol.* 11:345.
Wertheimer, N. W., and E. Leeper. 1986. Possible effects of electric blankets and heated waterbeds on fetal development. *Bioelectromagnetics*7:13.
Wilson, Bary W., Cherylyn W. Wright, James F. Morris, Raymond L. Buschbom, Donald P. Brown, Douglas L. Miller, Rita Sommers-Flannigan, and Larry E. Anderson. 1990. Evidence for an effect of elf electromagnetic fields on human pineal gland function. *Journal of Pineal Research* 9:259-269.