Expert Report of Andrew A Marino

August 8, 2016

This report was prepared by Andrew A. Marino at the request of Stephen G. Harvey, counsel for Maria Povacz, Laura Sunstein Murphy, Diane and Stephen Van Schoyck, Cynthia Randall, and Paul Albrecht as Complainants in litigation before the Pennsylvania Utility Commission with PECO as the Respondent. For convenience of presentation on complex subject matter, the report is presented in question and answer format**.**

Purpose

Q. What is the purpose of your report?

A. My first purpose is to express my professional opinion that there is a basis in established science for Complainants' concern regarding risks to human health caused by man-made electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters, and to describe the scientific basis of my opinion with particularly.

My second purpose is to express and explain my professional opinion that it would be unreasonable to involuntarily and chronically expose the Complainants to the electromagnetic energy emitted by smart meters. Scientific evidence indicates that the neurological syndrome of electromagnetic hypersensitivity exists. There is a reasonable basis to believe that the symptomatology of the Complainants and its relation to smart-meter electromagnetic energy is factual. There is a basis in established science to

support the Complainants' concerns that future exposure to smart-meter energy will worsen their already precarious medical conditions. Ample scientific evidence indicates that the aforementioned exposure would be a risk to the health of the Complainants.

Qualifications

Q. What are your qualifications to express these opinions.

A. I earned a PhD in biophysics in 1968 and a JD in 1974. My curriculum vitae is attached as Exhibit 1. Briefly, from 1964 to 2014, I worked full-time teaching and performing research in the area of experimental biology that deals with the role of natural electromagnetic energy in animals and human beings, and with the effects of man-made electromagnetic energy on animals and human beings. I retired from those duties in 2014 and began working on developing commercial technology capable of obtaining clinical diagnostic information from measurements of the electroencephalogram, which is the natural electromagnetic energy emitted by the brain.

Q. Where did you conduct your research on electromagnetic energy?

A. For the first sixteen years of my career, at the Veterans Administration hospital in Syracuse, New York. For the next thirty-three years, my research laboratory was in the LSU medical school in Shreveport Louisiana, where I served full-time as a professor in the departments of orthopedic surgery, neurology, and cellular biology and anatomy.

Q. Regarding your teaching responsibilities, what did you teach, and to whom?

A. To medical students, I taught musculoskeletal medicine, the scientific basis of medicine, experimental biology, human research methods, and the legal-ethical responsibilities of physicians. To graduate students I taught the cognitive structure of science, which is the framework within which researchers make valid observations and attach meaning to them, and I taught particular techniques of experimental biology. To medical residents and medical fellows I taught specialized subjects, for example, methods of analysis of the electrical activity of the brain, and general subjects, for example how to formulate a clinically relevant hypothesis and then answer it by means of an animal or human experiment.

Q. What area of science is relevant to the issue of health risks posed by smart meters?

A. The general area is experimental biology, by which I mean the scientific method for finding reliable knowledge about living systems.

Q. Did you author peer-reviewed scientific publications in your area of expertise?

A. I wrote many peer-reviewed publications dealing with all aspects of electromagnetic energy, including its biological effects on humans, animals, cells, its biophysical effects on biological molecules, and its engineering

characteristics. These publications are listed in my curriculum vitae which is attached as Exhibit 1.

Q. What is electromagnetic energy?

A. It is one of the four basic forces in the universe. Electromagnetic energy is present within all living things; it regulates the function of every cell in the body and serves as one of the two basic languages of the brain, the heart, the nervous system, and the musculoskeletal system. Electromagnetic energy occurs naturally in the environment, for example, the earth's magnetic field, and has a profound influence on all basic biological phenomena including growth regulation and control, circadian rhythms, and spatial orientation. Since the beginning of the twentieth century, and particularly after the end of World War II, the levels of man-made electromagnetic energy occurring in the general and work-place environments have risen dramatically as a result of man's economic and social activities.

Q. What activities?

A. The things that characterize and define modernity: the telegraph, radio, television, radar, powerlines, cell phones, wireless networks, smart meters, and innumerable other similar examples.

Q. What kind of human experiments did you do, and why?

A. In clinical research involving patients suffering from orthopedic diseases, mu colleagues and I applied simulated natural electromagnetic energy for the purpose of bringing about cures. In laboratory research, we exposed clinically normal volunteers to simulated man-made electromagnetic energy of the type and at the levels that are pervasively present in the environment. Our goal was to obtain fundamental knowledge about how the human body detected the presence of man-made electromagnetic energy.

Q. What was the objective of the laboratory research that involved the normal volunteers?

A. There are three basic kinds of theories regarding how man-made electromagnetic energy can affect the human beings and animals. Each theory hypothesizes a different process regarding how the energy interacts with the living system. My objective was to test the theory that the process is *sensory transduction,* which is how the body detects all other signals including light, sound, heat, pressure, and pain. Previous research by my colleagues and I had indicated that transduction was a likely process by which the body detected electromagnetic energy, See *Electromagnetism and Life* (Exhibit 1) and Exhibit 2 at No. 75, 90, 94, and 98.

Q. Were the experiments completely safe for the volunteers?

A. The present scientific evidence regarding the health risks due to man-made electromagnetic energy link *chronic exposure* to disease. By that term I mean exposure that is continuous and/or continual. The volunteers were exposed to the energy for only about ten minutes. That information was presented to them in a written informed-consent document whose content was approved by an impartial committee, as required by federal law. They were told that there were no known risks because exposure would last for only a few minutes, but the volunteers were not told that the experiment was completely safe. Such statements cannot be proven and are therefore not permitted in consent forms for human studies.

Q. What were the results of the experiments?

A. Briefly, that human beings have the sensory capability to detect man-made electromagnetic energy of the type present in the general environment, including the type produced by smart meters. Information concerning the presence of the energy in the subject's environment is transmitted to the brain, where it is processed. These publications are listed in Exhibit 2 at No. 60, 61, 64,68, 69, 70, 74, 75, 83, 84, 94, 96, 97, 100, and 102.

Q. What were the consequences in the volunteers after they detect the electromagnetic energy?

A. Systems in the body discarded the information because it served no useful purpose for the body, by which I mean an evolutionarily conditioned purpose. Information contained in light or sound, as examples, is key to the survival of animals and humans. In contrast, man-made electromagnetic energy in the environment has no biological benefit. From a physiological perspective purpose the energy is a kind of pollution because it was not put in place with the intention of affecting the human body. The key point of the experiments was to prove that the information entered the body, which is an absolutely necessary step for any adverse changes to eventually develop.

Q. If the information is discarded, how can adverse effects subsequently develop?

A. One possibility is that process of discarding information has a physiological cost. Discarding information is an adaptive process, but the ability of the body to adapt is finite. If that ability is exceeded the result can be clinically recognizable stress and/or stress-related disorders. Such conditions, in turn, promote the development of disease.

Q. How many times does the adaptive process need to occur before adverse effects occur?

A. We did not address that question in our experiments. Within the framework of these experiments I can say only that the information activates various cells in the brain, but not the cells that produce consciousness. We know

that was the case because the volunteers were always unaware of the presence of the energy to which they were exposed, even though it changed the electrical activity of their brains.

Q. Would you briefly describe how you did these experiments and what you measured?

A. I designed and built an apparatus that permitted me to expose the volunteers to man-made electromagnetic energy. During the experiment I continuously recorded the electroencephalogram from six locations on the scalp. The energy was turned on and off according to a timing pattern that was unknown to the volunteer. Using technical methods of data analysis that I developed with colleagues, we compared the electrical activity in the brain that occurred in the presence and absence of the energy. In essentially every volunteer, we found to a statistical certainty that the brain activity differed between the two conditions, meaning that each volunteer had detected the energy, which is a condition precedent to all biological effects caused by man-made electromagnetic energy.

Q. What kind of animal experiments did you do, and why?

A. I did experiments on rats, mice, rabbits, and fish. Different experiments were done for different purposes.

One purpose was to test my hypothesis regarding the physiological process by which chronic exposure to man-made electromagnetic energy can

ultimately lead to human disease and disorders. There are several basic kinds of theories. Our theory was that exposure was a stress on the body, and that if the stress continued too long the body's inherent protective and adaptive mechanisms would ultimately break down, resulting in clinical disease. We tested our theory by measuring endpoints in rats and mice that would be expected to be altered if the electromagnetic energy were a stressor, and we were successful.

Another purpose was to determine the anatomical location of the cells in the body that actually detected the man-made electromagnetic energy. There are two basic kinds of theories regarding this issue, one holding that *all* cells can detect the energy, the other that only specialized cells can detect the energy, similar to specialization that accounts for the detection of light, sound, taste, pressure, and pain. We favored the latter theory and tested it using rabbits, which are sufficiently large that the energy can be reasonably localized, permitting assessment of whether the rabbits' brain electrical activity is altered when the energy was present. These studies were successful.

A third purpose was to test my hypothesis regarding the biophysical process responsible for detection of environmental-level man-made electromagnetic energy. There are three major types of theories in this area. One theory holds that none exists. This theory originated in Germany during World War II, and is outmoded even though it remains as the basis of the present FCC rules regarding safety of cellphones and smart meters. A second theory envisions direct effects of the energy on the DNA of the subject. A third theory is based on the process of sensory transduction, which I described hereinabove.

My colleagues and I conducted experiments with fish to test whether a particular biophysical process could account for the sensory-transduction of low-frequency electromagnetic energy, and we were successful.

The results of the experiments I described can be found in Exhibit 2 at No. 1, 54, 66, 76, 85, 86, 88, 89, 92, 92, 99, 102, 104, 110, 111, 112, 118, 119, and 120.

Q. Why did you use fish?

A. Because the methodology we used, one of the most advance techniques presently used in experimental biology, would have been impossible in any other animal species.

Q. Is the biophysical process you described the same one that accounts for how the electromagnetic energy from smart meters is detected?

A. No. It cannot serve as a biophysical explanation for detecting smart-meter energy. But in a recent human experimental study I presented evidence for a different biophysical process that can provide such an explanation (Exhibit 2 at No. 1).

Electromagnetic Energy

Q. Are there different types of electromagnetic energy?

A. At an engineering level there is an infinity of technically different types of electromagnetic energy. Essentially, at an engineering level, every kind of

energy-emitting device emits a different type of energy, as does every brand of each such device. But with respect to the issue of health risks posed by exposure to man-made electromagnetic energy, including that emitted by smart meters, there is no material difference among the infinity of technically different types because there is no empirical evidence that they produce different kinds of biological effects. Consequently the technical differences are irrelevant, at least for the purposes of assessing human health risks.

Q. What is the basis of you opinion that they are irrelevant?

A. There is a large scientific literature regarding the effects on human beings and animals caused by man-made environmental electromagnetic energy, but the literature contains no credible indication that the effects are related to differences in the technical type of the electromagnetic energy. Actually the opposite is true, as I first pointed out in 1982, in *Electromagnetism & Life* (see Exhibit 1).

Q. What do you mean when you say that the opposite is true?

A. In my book I presented clear evidence that the same biological effect could be produced by technically different types of man-made electromagnetic energy. Since the book was published there have been many confirmations of my original conclusion. From animal studies we can now see that essentially any biological system in the body can be altered by environmental-strength levels of

any technical type of electromagnetic energy. See Exhibit 2 at No. 7, 16, 18, 19, 23, 29, 35, 48, 51, 67, 72, 82, 87, 88, 89, 91,92, 93,122, 128 and 140.

Q. You said there were no technically different types of electromagnetic energy as regards evaluating health risks of man-made electromagnetic energy. Are there general types of electromagnetic energy?

A. Yes. I think it is useful to divide man-made electromagnetic energy into two classes, based on the biophysics of the process by which the human body detects them (see Exhibit 2 at No 1 and 76). Almost all commercial sources of electromagnetic energy fall into one or both classes, which I will call *low frequency* and *high frequency*. Examples of sources in the low-frequency class include low-voltage and high-voltage powerlines, household wiring, electric blankets, electric lights, computers, battery chargers, arc welders, and electric cars. Examples of sources in the high-frequency class include radio and television signals, radar, microwave ovens, wireless networks, computers, cellphones, and smart meters. Both classes of electromagnetic energy can cause the same biological effects in animals and human beings, meaning that the risks suggested by the observed effects are more or less the same for the two classes

Health Risks Due to Man-made Environmental Electromagnetic Energy

Q. When you said that there is a basis in established science for serious concern regarding risks to human health caused by man-made electromagnetic energy in the environment, what did you mean by “established science.”

A. I meant the two types of peer-reviewed publications that are the primary repository of our scientific knowledge about living systems including, of course, knowledge about the effects of electromagnetic energy on living things. The two types are *experimental studies* and *epidemiological studies*.

Q. What are experimental studies?

A. Experimental studies are well-established formal procedures for generating knowledge about nature. Generally, they involve the randomization of subjects to groups that are or are not exposed to the factor of interest, electromagnetic energy for example, measurement of a chosen biological parameter, statistical comparison of the measurements between the two groups, and a conclusion regarding whether or not the energy caused a change in the parameter measured. Such studies produce the most reliable type of scientific knowledge because they can rationalize the existence of cause-and-effect-relationships. As with all scientific studies, experimental studies have fundamental limitations.

Q. What are epidemiological studies?

A. They are non-experimental studies in which pre-existing information such as health data collected by government agencies is analyzed to assess whether a particular disease or disorder is statistically associated with a factor of interest, smoking for example. Such studies produce the most relevant type of scientific knowledge regarding health risks of electromagnetic energy because their

conclusions apply directly to human beings. Nevertheless their probative value is far more limited compared with experimental studies. This limitation arises directly from the logical structure of epidemiological studies.

Q. What do you mean?

A. Epidemiological studies are inherently incapable of evidencing a cause/effect relationship. The strongest kind of a conceptual link epidemiological studies can yield is that of an *association*. Associations sometimes foreshadow causal connections, sometimes not, and the investigator never knows which conclusion is correct

Q. What do you mean by “heath risk” and how is its existence determined scientifically?

A. By that term I mean a factor or condition that is reasonably suspected of contributing to the development of human disease or disorder.

There are two scientific methods for producing evidence that a specific factor or condition is a health risk. The traditional method for evaluating novel factors or conditions is to expose animals to the factor or condition and observe what happens. This method is commonly used to evaluate the safety of herbicides, pesticides, and cosmetics, food additives, and the safety of drugs.

Epidemiological studies constitute the second scientific method. They come into play when the factor or condition is not novel, but rather is generally present in the human environment. If the factor or condition is a risk factor, then a

natural experiment will have actually been performed, and evidence of possible adverse associations should be discoverable by studying sick people and assessing whether they had more of the factor or condition than did people who didn't get sick.

Public concern about a factor or condition is sometimes triggered by an epidemiological study that seems to suggest that the factor or condition is associated with the occurrence of a human disease or disorder. Typically the concern is amplified because there is no experimental evidence from animal studies showing safety.

Q. Is this what happened to the manufacturers of smart meters?

A. Yes. Many independent investigators throughout the world did epidemiological studies of the possible health risks of man-made electromagnetic energy from various sources, and these investigators reported that the energy was associated with a wide range of human diseases and disorders. See Exhibit 2 at No. 2, 15, 20, 21, 22, 25, 31, 32, 33, 38, 40, 41, 42, 44, 46, 47, 49, 62, 63, 71, 73, 79, 81. 82, 87, 95, 113, 121, 129, 130, and 133.

Q. Is the list exhaustive?

A. No.

Q. Why do you conclude that there is a basis in established science for serious concern regarding risks to human health caused by man-made

electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters?

A. Because both methods in experimental biology for assessing whether a factor or condition is a possible health risk, namely experimental studies and epidemiological studies, individually and together, indicate that man-made environmental electromagnetic energy is a health risk. Numerous peer-reviewed scientific studies in experimental biology involving the effects of man-made electromagnetic energy, including the type produced by smart meters, have shown that such energy causes a wide range of biological effects on the endocrinological, immunological, cardiovascular, hematological and neural systems of the body, and on growth and healing. The results of these studies are the best evidence obtainable by means of the scientific method regarding the possible existence of health risks to humans. Consequently these studies directly support the conclusion that exposure to man-made electromagnetic energy is a health risk to humans. In addition, many independent epidemiological studies indicate that man-made environmental electromagnetic energy is associated with a broad range of human diseases and disorders, especially cancer. It is difficult for me to imagine what further evidence would be needed to establish that there is a basis in established science for serious concern regarding risks to human health caused by man-made electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters.

Electromagnetic Hypersensitivity

Q. What is electromagnetic hypersensitivity?

A. It is a physiological condition in which the affected person experiences musculoskeletal, immunological, and/or neurological symptoms that flare or intensify upon exposure to man-made electromagnetic energy in the environment.

Q. Can you be more specific regarding what the symptoms are?

A. There are many reports in the literature in which investigators have listed or classified the symptoms. See Exhibit 2 at No. 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 24, 26, 30, 31, 32, 33, 34, 36, 38, 39, 40, 41, 45, 52, 55, 57, 63, 65, 77, 123, 124, 125. 126, 127, 134, 135, 136, 137, 138, 139. Essentially, the list consists of all the undesirable somatic reactions that human beings can experience. The complaint that people who suffer from electromagnetic hypersensitivity have in common is that they feel discomforted and/or unwell. They exhibit a general syndrome of just being sick, as opposed to exhibiting symptoms that are pathognomonic for a particular disease.

Q. Are you saying that man-made electromagnetic energy causes the symptoms?

A. Yes, in the but-for sense of causality.

Q. What do you mean by the but-for sense?

A. This is an important point. The available scientific and clinical evidence shows that man-made electromagnetic energy can trigger a symptomatic response in some human beings. Most studies indicate 5-10% of the general population self-report as suffering from electromagnetic hypersensitivity. See Exhibit 2 at No. 141, 142, 143, and 144. The energy isn't a complete causal explanation for the syndrome in the sense that gravity explains why objects fall. In a particular sufferer the energy causes the symptoms in the sense that the symptoms would not exist at that time but for the presence of the energy. Because human beings are all different, the precise level of the energy that can trigger a response, the precise set of symptoms, and their requisite level and duration of exposure differ profoundly among suffers. Presently the precise reasons why some humans report symptoms from man-made electromagnetic energy and others do not, why the symptoms vary from person to person, and how the symptoms depend on the levels and duration of exposure are all unknown. But these unresolved issues do not undermine the scientific conclusion that man-made electromagnetic energy causes the reported symptoms in some human beings.

Q. Including energy from smart meters?

A. Yes. That's the most reasonable inference I can make from the available evidence. There is no empirical evidence whatsoever to suggest that smart meters are somehow different from other sources of electromagnetic energy in

some meaningful way that would eliminate concern about health risks or about triggering hypersensitivity reactions.

Q. Have the possible health risks of smart meters with respect to hypersensitivity been studied in experiments?

A There are no published experimental studies, either by independently-funded investigators or by the industry.

Q. Is electromagnetic hypersensitivity like an allergic reaction?

A. Yes, in the sense that symptoms can flare or intensify when the person suffering from the disorder is exposed to levels of electromagnetic energy that normally don't trigger a symptomatic response in most people. But the condition is probably mediated by an aberration in the body's overall electrical regulatory system, not by an aberration in the body's biochemical-based regulatory systems, such as those that produce type-1 and type-4 allergic reactions.

Q. Is electromagnetic hypersensitivity a new condition that has just begun to appear recently?

A. During the last 35 years I met many people with self-diagnosed electromagnetic hypersensitivity. Public concern about it increased greatly during that period, especially after the increase in man-made energy in the environment that occurred following development of cellphones and wireless networks. Electromagnetic hypersensitivity can now be recognized as a part of

the larger problem regarding the public-health risks of man-made environmental electromagnetic energy.

Q. In what way is it a part of a larger problem?

A. Historically cancer was the focus of the risks due to electromagnetic energy, particularly cancer of the blood from low-frequency energy such as that from powerlines, and brain cancer from high frequency energy such as that from cellphones. Less attention was given to electromagnetic hypersensitivity. There was common notion that the sufferer could fix the problem by simply avoiding exposure to the device that emitted the energy. We can now see that is not always easy to do, as this case shows. Also the rules for diagnosing electromagnetic hypersensitivity have not been finalized in the sense of specific guidelines for use by primary-care physicians.

Q. Have you conducted human studies on electromagnetic hypersensitivity?

A. My colleagues and I conducted a controlled study in which we demonstrated to a statistical certainty that electromagnetic hypersensitivity was a real neurological syndrome, and the results were published See Exhibit 2 at No. 56.

Q. Would you briefly describe the study?

A. The subject was a young female physician with multiple neurologic and somatic symptoms including headaches, hearing and visual disturbances,

subjective sleep disturbances and non-restorative sleep, and musculoskeletal complaints, all of which she reported could be precipitated by exposure to environmental electromagnetic energy and abated by moving away from the energy source. Among the triggering devices she identified were cell phones, computers, powerlines, and various common electrical devices.

During extensive pre-study interviews she credibly explained the reasons for her belief that energy from common environmental sources could provoke symptoms. Her ability to do so was an important consideration in our decision to commit resources to the study, because, in my experience, those who suffer from electromagnetic hypersensitivity are usually not suitable volunteers for a scientific study of the syndrome

After she agreed to medical tests that were appropriate for evaluating her medical condition, she underwent a physical exam, a comprehensive neurologic exam, a clinical electroencephalogram, non-contrast magnetic resonance imaging of the brain, an overnight sleep study with video and expanded EEG montage, a standard laboratory evaluation of serum electrolytes and blood chemistry, liver function tests, and serum fasting cortisol determination. In the judgments of her attending physicians, none of her signs and symptoms supported a diagnosis in terms of any generally recognized specific medical disorder.

When my colleagues and I exposed her to electromagnetic energy in a scientific study under properly controlled conditions, she developed temporal pain, headache, muscle twitching, and skipped heartbeats. All these symptoms

occurred within 100 seconds after initiation of exposure to the energy. The causal link between the electromagnetic energy and the symptoms was proved to greater than a 95% certainty.

Q. How was it possible to be so certain that the subject actually suffered from electromagnetic hypersensitivity?

A. Because the determination was not a subjective clinical diagnosis but rather was based on the use of an objective scientific method, with appropriate use of statistical analysis.

Q. Would you describe how you were able to make that determination?

A. The subject sat in chair in a dark quiet room. The source of the electromagnetic energy was near her head, but she never knew whether or not the source was emitting energy at any particular time. A large number of separate trials were conducted to assess whether she exhibited <u>any</u> symptomatic response to the energy.

Q. What do you mean by a trial?

A. A trial consisted of a 100-second interval during which pulsed electromagnetic energy was or was not applied; the actual condition was chosen by the experimenter but was not known by the subject. When the interval began she had no symptoms. After it ended I interviewed her and asked whether she experienced any symptoms. If yes, I asked her to describe the symptoms, and to

characterize them as *mild* or *moderate.* Then I waited until she told me that the symptoms had abated. When they did we began a new trial. If no symptoms were reported we began the next trial immediately.

Q. What was the reason for doing many trials?"

A. From a scientific perspective it was necessary to compare the subjects self-reported symptoms between times when the energy was present or absent. That is the only possible way to show a causal link.

Q. Did the subject know when the energy was present?"

A. No. She wasn't told, she couldn't perceive it like a sound or a touch, and the experimental equipment was hidden from her view so that she had no cue when the energy was present.

Q. What was the basic result of the study?

A. Her symptoms sometimes began almost immediately after exposure to the energy began, and sometimes after the energy had been present for a few seconds. She reported moderate symptoms in 100% of the trials where the energy was present. She never reported a false result, by which I mean a claim that she had moderate symptoms following an interval where I did not apply the energy, which is called a sham trial.

Q. So the corresponding result for the sham trial was 0%?

A. Correct.

Q. You said that you didn't tell the subject when the electromagnetic energy was being applied. Is it nevertheless possible that she could have perceived it, like a light beam or a touch?

A. Based on our present knowledge, man-made environmental-strength electromagnetic energy is not consciously detected by human beings. We therefore expected that the subject would not be conscious of the presence of the electromagnetic energy that we applied. We conducted a separate study of that question and proved that she was not conscious of the presence of the energy, as expected. That was an important observation because, taken together with the observation showing 100% occurrence of moderate symptoms, the overall results provided our first insight into how the brain of persons suffering from electromagnetic hypersensitivity processes information.

Q. What is this first insight?

A. We showed that the subject was not aware of the energy but that it nevertheless triggered various somatic symptoms. The symptoms must therefore have been generated and controlled by information-processing in her brain that occurred below the level of the cerebral cortex, which is where consciousness is created. Then, as a result of information-processing in lower brain regions, the brain initiated electromagnetic and hormonal signals that initiated responses by

various organs in the body. This is the fundamental way the brain responds when it receives any sensory information, in the presence or absence of awareness, including but not limited to the presence of man-made electromagnetic energy. A prototypical response of the body to the presence of man-made electromagnetic energy is the triggering in the body of a condition known as stress. In most persons, the effect of the stress is not recognized clinically until after the person develops a clinically recognized disease. In hypersensitive persons, in contrast, the initial reactive process in the brain are overactive, and go beyond the initiation of stress, thereby immediately trigger somatic symptoms.

Q. Did you make any other observations that in your opinion are relevant to his case?

A. Yes. Based on our previous studies regarding how human beings and animals detect man-made electromagnetic energy, we expected that pulsed energy would be more effective than non-pulsed energy in producing symptomatic responses, and that was what we observed and reported in the provocation study. Smart meters emit pulsed energy.

Q. What overall conclusion do you draw from this study?

A. That, to a scientific certainty, the neurological syndrome known as electromagnetic hypersensitivity actually exists, as we showed using the scientific and diagnostic procedures I just described.

Q. Couldn't the same tests be done to determine whether the Complainants in this case actually suffer from electromagnetic hypersensitivity?

A. I estimate that the total cost of our study was between $500,000 and $1,000,000. But not only would the cost of performing the study routinely be prohibitive, it would be quite unnecessary.

Q. Why do you say that it would be unnecessary?"

A. Because the objective of our study was not to diagnose electromagnetic hypersensitivity but to accomplish the far more difficult and expensive objective of establishing the existence of the neurological syndrome. Having established that such a syndrome exists, it now becomes the responsibility of clinicians to formulate diagnostic guidelines. Such efforts are underway at institutions around the world. See Exhibit 2 at No. 4, 12, 30, 52, 59, 125, 126, 127, 135, 136, 137, 138, and 19.

After guidelines are developed and put into effect, the result will be a system to diagnose hypersensitivity in specific subjects. I anticipate that the guidelines will include some form of a provocation test, like the RAST for allergies. But as with allergies, the diagnosis will be based on the treating physician's experience and personal observations of the particular patient in relation to the general guidelines, not on an objective scientific study such as the one done by colleagues and me.

The Complainants

Q. Why is the exposure of the Complainants to the electromagnetic energy from smart meters unreasonable?

A. Maria Povacz, Laura Sunstein Murphy, [redacted], and Cynthia Randall all suffer from serious diseases, disorders, and somatic symptomatology. They report that some of their present symptoms are caused by the electromagnetic energy from smart meters, and they express concerns that their present disease conditions are likely to be worsened by exposure to the electromagnetic energy emitted by smart meters. There is a sound basis in experimental biology that supports their concerns regarding the consequences to their health that have occurred and that may occur due to future chronic exposure to the electromagnetic energy emitted by smart meters. Under the conditions pertinent to the conditions of this case, coercing the Complainants to endure these risks and uncertainties is unwarranted, unjustified, and would amount to involuntary human experimentation by PECO. For all these reasons individually and especially taken together, it would be unreasonable to forcibly expose the Complainants to smart-meter electromagnetic energy.

Q. What serious disease and disorders are you referring to and how are they linked to the electromagnetic energy from smart meters?

A. I will answer with respect to the Complainants individually. For purposes of this report, I am assuming that all of the facts referenced herein will be proved by the Complainants through testimony, records, or otherwise.

[redacted]

[redacted] It is the responsibility of a physician to diagnose and treat disease and

their symptoms, not to conduct experiments to determine what caused those conditions. The treatment and advice rendered to a patient by a physician is governed by a consideration of the best interests of the patient. [redacted].

Cynthia Randall

Cynthia was [redacted]. She has been advised by her physician to avoid exposure to electromagnetic energy.

Cynthia is justifiably concerned about the health risks of a smart meter because she has a long history of cancer, and there is strong evidence in the peer-reviewed scientific literature indicating that man-made electromagnetic energy causes stress, and that added stress is strongly counter-indicated in all persons suffering from cancer for the reason that stress initiates complicates and/or exacerbates disease. See Exhibit 2 at No. 2 7, 14, 15, 17, 25, 28, 35, 37, 38, 39, 40, 41, 42, 44, 48, 51, 53, 54, 71, 81, 82, 93, 103, 105, 106, 107, 108, 109, 111, 114, 115, 116, 117, 118, 119, 130, 131, and 140. In the face of the existing

scientific literature and the recommendations of treating physicians, it would be unreasonable for PECO to force Cynthia to undergo chronic exposure to the energy emitted by its smart meters.

Laura Sunstein Murphy

[redacted] A smart meter was installed on her home in 2002, but she was not made aware that the meter was a source of electromagnetic energy. Soon thereafter, and continuing for the next 14 years, she developed a long list of symptoms and medical problems, including [redacted]. In 2015, during litigation occasioned by her refusal to allow installation of a new smart meter, she learned that the original meter had been emitting electromagnetic energy for the past 14 years. For the first time, she took many specific steps to reduce her exposure to the electromagnetic energy but her discomfort continued. Her symptomatology improved when the smart meter was replaced by an analog meter; she felt better, [redacted]. Her symptoms suddenly returned, and after an investigation she learned that PECO had reinstalled a smart meter. After it was once again removed and replaced by an analog meter, her health again began to improve.

In my opinion there is enough scientific information and diagnostic capability to sustain the judgment that Laura symptoms were triggered by smart- meter energy. It is sad that a lay person such as Laura is forced to try to conduct experiments and prove by an excessively high evidentiary standard that a link exists between her symptoms and PECO's smart meter. The striking reality to me is that the remedy Laura seeks seems be a small burden for PECO but a large benefit to her. It is not my intention to opine directly on PECO's burden, but rather to recognize that there are health-related costs associated with the use of smart meters. My opinion is that the state of the science, the context of her symptoms, and opinions of her physician, and the reasonableness of the solution she seeks, taken together, indicate that she should not be forced to chronically endure exposure to smart-meter energy in her own home.

Scientific studies can and have shown the existence of electromagnetic hypersensitivity, but they cannot provide a clinical diagnosis, which is the exclusive province of the diagnosing physician. A diagnosis is an algorithmic approach to a disease or disorder that has been formulated by specialists in the different relevant areas of clinical medicine, and adopted by consensus.

Clinicians cannot presently diagnose electromagnetic hypersensitivity in accordance with any consensus algorithm because none has yet been developed. But even in the absence of a universally established algorithm for a diagnosis, all clinicians have an ethical responsibility to guide and warn their patients, and to err on the side of patient safety. In the present cases, since a physician supports her position, it seems unimaginable that PECO would be permitted to ignore that advice, to Laura's detriment.

Maria Povacz

In 2012, shortly after PECO installed a new smart meter about ten feet from her bedroom, Maria began to [redacted].

She took numerous steps to reduce her exposure to electromagnetic energy, but these measures were not sufficient in relieving her discomfort. In 2014, she was clinically diagnosed with electromagnetic hypersensitivity syndrome. When she travelled abroad, she felt much better. When she returned home, her symptoms resumed.

Maria's case echoes the unfairness that results from failure to respect the recent scientific and clinical developments regarding electromagnetic hypersensitivity. Maria can do no more than she has done to explain what has happened to her body in relation to smart-meter electromagnetic energy. She knows that there are many sources of such energy in the modern world, and that in all likelihood she will still be faced with challenges after the present matter is resolved. Even so, the link between smart-meter energy and her medical condition is sufficiently strong that is reasonable for her to avoid such exposure and unreasonable for PECO to mandate it.

Q. Why would exposure of the Complainants in this case to the electromagnetic energy from smart meters be involuntary human experimentation?

A. Human experimentation is the testing of a scientific hypothesis in an experiment that involve human subjects. If the subjects have not given their written informed consent, the experimentation is involuntary. In my opinion, that is exactly what PECO is doing.

Q. Are their official rules for human experimentation?

A. Yes. They developed after World War II and became codified in federal law in 1976.

Q. What are these rules?

A. Perhaps the best way to answer the question would be to describe how they presently function. There are presently about 800 institutions in the United States, more or less, where human research may be lawfully performed. Assume that investigators at one of these institutions wanted to expose human subjects to the electromagnetic energy from smart meters. The investigators would be required to apply to the institution's research board for human research (IRB) for permission to do the study. The backgrounds of the members of the IRB are specified by law, as are the extensive procedural rules that must be followed. Principal among them are the requirements that the investigators provide a written description of exactly what they plan to do, and that they secure written

informed consent from each volunteer in the study, using a form specifically approved by the IRB in which full disclosure is made regarding all aspects of the study, especially including the risks. It is not legally possible to claim that there are no risks. It is also not legally possible for investigators to conduct a study without following these rules.

PECO is intentionally exposing human subjects to the electromagnetic energy from smart meters, which is something that cannot be done by any research institution in the United States without first securing permission and consent within the context of federal laws. The upshot is a Kafkaesque situation in which *bona fide* investigators cannot study the risks of smart-meter electromagnetic energy unless they follow stringent rules, especially the rule involving consent, and yet PECO can involuntarily expose human subjects in the absence of any oversight whatsoever. Equally disturbing, PECO has not disclosed any plan to collect health data as it tests its hypothesis that exposure to its energy is safe, an omission that guarantees PECO will never find evidence of adverse effects.

Q. Have you personally had any experience with the IRB?

A. All of my human studies were approved by my institution's IRB, I served as a member of the IRB for ten years, five years as its chairman.

PECO Experts

Q. Have you read the curriculum vitae of Dr. Mark Israel?

A. Yes.

Q. What is his specialty?

A. He is a pediatrician with a sub-specialty in oncology.

Q. Is he also an experimental biologist?

A. Yes. He has co-authored many peer-reviewed publications in his area of expertise.

Q. What is his area as assessed from his publications?

A. The biochemistry and molecular biology of cancer.

Q. Did you find any evidence to suggest that he has worked in the area of experimental biology that deals with the biological effects on electromagnetic energy?

A. No

Q. Have you read Dr. Israel's testimonies dated May 18, 2016 and May 20, 2016?

A. Yes.

Q. What do you understand his conclusion to be?

A. That neither Maria Povacz nor Laura Sunstein Murphy have been harmed by PECO's smart meters, and that neither of them will be harmed in the future.

Q. What do you understand to be the bases for these conclusions?

A. His conclusion that the Complainants have not been harmed was based on his medical evaluation of the testimony of the Complainants.

Q. What was the basis of his conclusion that the Complainants will not be harmed in the future by electromagnetic energy from smart meters?

A. The basis appears to be a medical evaluation of a literature review that he conducted regarding the biological effects of electromagnetic energy.

Q Do you know him to be a worker in the field of biological effects of electromagnetic energy?

A. No. As best I can tell, he became seriously interested in the area at about the time this litigation commenced.

Q Do you have any opinion regarding his "medical evaluation" of the Complainants?

A Dr. Israel uses the term "medical evaluation" equivocally. At times he seems to employ the orthodox meaning, that of a conclusion of a treating

physician, but he is not a treating physician bound by ethical duty to advance the best interest of the patient.

Q. What other way does Dr. Israel employ the term?

A. He sometimes employs “medical evaluation” idiosyncratically to mean, judging from context, that he reads the scientific literature dealing with the experimental biology of electromagnetic fields, the epidemiological studies dealing with that topic, and the opinion of various agencies and blue-ribbon committees, and evaluates that literature using his skills as a physician, leading him to opine that the Complainants have not been injured by exposure to smart meters and even in the future they will not be injured by smart-meter energy. When Dr. Israel uses “medical evaluation“ in this sense, to mean the analysis of peer-reviewed scientific publications by a physician who has not actually done research on the subject in question I have a definite opinion, namely that it is ineffective and fruitless. Science and medicine each have rules for generating and recognizing knowledge, and the two systems are different. Confounding the two sets of rules, as he did, is unhelpful and unfortunate, and ultimately impossible. He clearly rejects the idea of electromagnetic hypersensitivity, but he didn’t get to that conclusion by conducting an authoritative scientific analysis of the literature based on familiarity and experience in the area.

Q. In your opinion, how did he reach that conclusion?

A. I cannot tell from his testimony. But I can say with considerable confidence it didn't come from scientific analysis. Then he rationalized his choice by cherry-picking published studies that fit his mindset, particularly the work of Rubin. Dr. Israel's reliance on Rubin was to me the clearest possible indication that he does not know the territory related to the health risks of electromagnetic energy.

Q. Are you familiar with Rubin's work?

A. Yes.

Q. What is your understanding of what he is and what he says about electromagnetic hypersensitivity?

A. He is a psychologist who claims that electromagnetic hypersensitivity is a form of mental illness.

Q. What kind of mental illness?

A. A psychosomatic disorder, by which he seems to mean that the sufferers only imagine that their symptoms are caused by man-made electromagnetic energy.

Q. Does he claim that the symptoms aren't real?

A. No. That's not possible because symptoms are subjective. He acknowledges that the sufferer might actually have symptoms, but he denies the possibility that the symptoms might be caused by man-made electromagnetic energy. He employs the term "idiopathic environmental intolerance" to underscore his point that the trigger is some unknown factor in the environment, except that it can't be manmade electromagnetic energy.

Q. Have you had any contact with Rubin?

A. Not directly. The Bioelectromagnetics Society invited us both to appear at their annual meeting in 2015 and debate the issue of electromagnetic hypersensitivity. I accepted, but Rubin declined, so the debate never took place.

Q. Have you had any indirect contact with him?

A. Following publication of our provocation study, he wrote twice to the journal editor, commenting on what he believed to be errors in our work. We pointed out the errors in his analyses of our work and the entire correspondence was published in the journal See Exhibit 2 at 43 and 50.

Q. Would you explain the relation between your work and his work?"

A. The nominal purpose of his experiments was to find electromagnetic hypersensitivity. But he didn't find it so he concluded essentially that it didn't exist. But in science a negative result is universally acknowledged as having low

probative value, because anybody can find nothing. Special talent or training is not needed. The upshot is that a hundred negative studies can be conclusively refuted by one valid positive result. This is why negative studies are usually not published. Our one study showed that he was wrong to interpret his observations to mean that electromagnetic hypersensitivity did not exist.

Q. In your opinion, why did his studies fail?

A. In Rubin's perspective, the only way to scientifically prove that man-made electromagnetic energy could cause somatic symptoms in self-diagnosed sufferers was to first pick a symptom to be studied. Then, after assembling a group of self-diagnosed sufferers who had that particular symptom, he designed the statistical structure of his study such that the cause/effect link between the energy and the symptom could not be detected unless the symptom was precisely reproducible in each subject during repeated trials, and also in all subjects. This design was a near certain guarantee that he would not find what he professed to be seeking because sufferers are human beings, not machines, and they do not react like machines. Consequently, at the statistical level, Rubin simply averaged away reality, like the man with his feet in a fire and his head in a block of ice who reported that his body temperature was normal, on average.

Q. How did your study differ in this regard?

A. We assumed that any symptoms triggered by the energy we applied would be specific to the subject, rather than universal reactions that were similar

in nature and intensity to the reactions of all true hypersensitivity sufferers. We allowed for the possibility that the same subject could exhibit different symptoms during independent trials. For example, if a sufferer reported knee pain in the first trial, fatigue or weakness in the second, and a headache in the third, we counted the results as three reports of a link between exposure and a hypersensitivity reaction, Rubin would count the reports as a failure to find a link because the symptoms were all different. Finally, we used the experimental subject as her own control. That was the purpose of the sham trials.

Q. You said the subject's symptoms were mild or moderate. Did she have any severe symptoms?

A. Yes. That happened, depending on how long she was exposed and on the level of the electromagnetic energy I applied. But our study was not intended to address the issue of symptom severity, but rather to prove the existence of a causal link between electromagnetic energy and symptoms. To accomplish this objective, it was necessary to conduct a sufficient number of independent trials to be able to show to a statistical certainty that she reported symptoms more often during actual exposure intervals compared with sham intervals, which were the intervals when the energy was not applied. When the symptoms were severe they did not abate for hours, which made it impractical to do the study. During a period of about a week, by trial and error, I learned how low to set the energy level so that her symptoms following a 100-second exposure would abate in less than about 15 minutes. Our identification of that threshold made it possible to

achieve our study objective, but it also precluded us from studying the link between exposure and severe symptoms.

Q. Overall, do you disagree with Dr. Israel's analysis?

A. Yes. I think that Dr. Israel's testimony was polemical not analytical. Essentially he doesn't accept the existence of electromagnetic hypersensitivity. I think his perspective is understandable because the research area involving electromagnetic bioeffects is far from his routine responsibilities as a physician. Nevertheless it is not credible for him to enter this field, make a "medical evaluation," and then ask to be believed because he is a doctor, which is what it seems to me that he did.

Q. Have you read the curriculum vitae of Dr. Christopher Davis?

A. Yes.

Q. What is his specialty?

A. He is an engineer.

Q. Is he also an experimental biologist?

A. No, but his research-related activities have been heavily supported by many industrial and government agencies, and he has co-authored many peer-reviewed publications in his area of expertise.

Q. What is his area of expertize as assessed from his publications?

A. Engineering support. He has assisted investigators studying many different kinds of problems. For examples, the solid-state, viscoelastic, light-transmission, and electrical properties of various materials, and the dynamics of wireless networks.

Q. Did you find any evidence to suggest that he has worked in the area of experimental biology that deals with the biological effects on electromagnetic energy.

A. No

Q. Have you read the testimonies of Dr. Davis dated May 18, 2016 and May 20, 2016?

A. Yes.

Q. What did you understand was the substance of what he said?

A. That smart meters emit electromagnetic energy, that the energy is not unusual, and that the energy is safe because the FCC says so.

Q. Do you agree with what you understood him to say?

A. I agree that smart meters emit energy. I don't agree with the assertion that the energy is not unusual because, in the context he used it, the claim is misleading.

Q. Why is it misleading?

A. Because what is or is not “unusual” depends completely on the frame of reference. If the symptoms of the Complainants is frame of reference, the energy is unusual because at least some of their symptoms didn’t develop in the absence of the smart-meter energy. If the frame of reference is the natural world as it existed before man-made electromagnetic energy was invented, smart-meter energy is unusual because it is about a billion times stronger than the corresponding natural level, more or less. If the reference frame is the location in the houses of the Complainants where the smart meters will be installed, then it is unusual because the resulting energy at those locations will be about a million times stronger compared with the pre-installation levels, more or less.

Q. Why do you disagree with Dr. Davis’s testimony concerning the FCC?

A. Because it is misleading. According to the FCC, smart meters and cellphones are safe when manufactured according to the presently mandated emission levels. But the FCC defines an emission level as “safe” if it doesn’t result in adverse biological effects caused by heating or cooking of the exposed subject. Nowhere does the FCC say that smart meters are safe with regard to physiological changes cause by physical processes other than heating or cooking. That claim is unsupportable and counter-scientific, and has not been made by the FCC. Dr. Davis’s testimony is pregnant with the notion that the FCC says smart meters are safe with respect to all possible mechanisms, which is not the case.

Q. Dr. Davis testified that he agrees with the FCC statement on its website that adverse biological effects from non-thermal exposure levels of electromagnetic energy are ambiguous and unproven. Do you agree?

A. I am familiar with what the FCC means by “ambiguous” and “unproven, with the legal context that governs its jurisdiction, with the extent to which the experiments the FCC is required by law to consider are specifically designed to create ambiguity, and with the overwhelming economic and sociological consequences if the FCC were to say otherwise. In my opinion, in the context of this case, the FCC issue is a red herring.

Q. Dr. Davis testified that installation of a smart meter wouldn’t increase the amount of electromagnetic energy in the house where it was installed. Do you agree?

A. No. When electromagnetic energy is created at a specific location, the laws of physics almost always require that it add to, not cancel, any preexisting electromagnetic energy. There are exceptions, but they do not apply to context relevant this case.

Q. Dr. Davis testified that there have been many reports by expert panels whose consensus is that there is no consistent, reproducible evidence that electromagnetic energy causes any biological effects. Do you agree?

A. Yes, but considering the purpose for which he offered the testimony, it is extremely misleading.

Q. What do you mean, why is it misleading?

A. The thrust of his testimony is to assert that all experts agree that man-made electromagnetic energy in environment, including but not limited to smart meters, doesn't cause any biological effects. I know or have known many such experts, perhaps most, either personally or by reading their publications, and I can say without any qualification that their consensus is the opposite of the one Dr. Davis has asserted. Even more counterfactual, Dr. Davis trusts that the experts on the panels he cited were disinterested, but historically that has almost never been the case.

Q What do you understand to be Dr. Davis's testimony regarding the possibility that smart meters can cause human disease or trigger hypersensitivity reactions?

A. I believe he conceptualizes that the only possible biological effects from man-made electromagnetic energy occur by means of heating or cooking tissues. Since smart meters can't cause those effects, they must be safe.

Q. Do you agree with him?

A. No, because his premise is wrong. There is a very large data base of empirical studies in experimental biology that demonstrates beyond reasonable doubt that biological effects can occur at levels of man-made electromagnetic energy actually present in the environment

Q. What do you understand to be Dr. Davis's testimony regarding his measurements of man-made electromagnetic energy actually present in the environment, including levels produced by smart meters.

A. I believe he conceptualizes that the results of brief, spatially and temporally localized measurements at particularly chosen locations can adequately characterize the electromagnetic environment of the homes of the Complainants, and he did so to in a manner that, at least on the surface tends to trivialize the concerns of the Complainants.

Q. Do you agree with him?

A. No. His testimony in this regard was highly misleading.

Q. In what way?

A. In two ways. He testified that the electromagnetic energy from PECO 's smart meter in Ms. Povacz was 246 times smaller than the level in New Hope, PA. But that comparison was strongly dependent on the locations of the measurements. If he made the measurements at different locations from the smart meter and at different locations in New Hope, he could easily have found that the level in Ms. Povacz house was 246, or even 2046, times greater than the level in New Hope. A meaningful comparison of ambient levels is extremely difficult. Dr. Davis didn't even come close to accomplishing this task. Second, I think that Dr. Davis's testimony created the false impression that time is not a material factor in an attempt to establish a comparison. At virtually all

representative points in the general environment, the actual levels of man-made electromagnetic energy vary over extremely wide ranges. A variation of 1,000,000% would not be unusual, and a variation of 1,000% would be extremely common. In so far as I could determine, Dr. Davis did not consider this factor.

Q. What do you understand to be Dr. Davis's testimony regarding the relation between how much of a change in the existing level of electromagnetic energy caused by smart meters must occur before the matter of health risks is raised?

A. I understood him to mean that if the PECO energy levels were low compared with some reference value then the PECO energy wouldn't matter from a health perspective.

Q. Do you agree with him?

A. No. I understand his perspective. He is an engineer and his professional activities involves working with what are called linear systems, by which I mean things that follow laws whereby if a little change does something, then a change ten times as much will do ten time more. Virtually every system in the world of an engineer works that way. But animals and human beings are nonlinear systems, buy which I mean that their laws can allow things to happen which cannot happen in linear systems. For example, human beings can exhibit very strong responses to very small stimuli in the complete absence of a proportion between the cause and the effect. Dr. Davis's assumption that the stimulus-response relationships of human beings are governed by linear laws is wrong. See Exhibit

2 at No. 84, 88, and 89. Consequently he has no rational basis to argue that PECO's energy is too small to matter.

Opinions of Agencies

Q. In forming the opinions you expressed here, have you taken into consideration the official positions of government agencies regarding safety regulations concerning electromagnetic energy?

A. I know about those positions generally, but for at least two reasons they have not had a significant impact on my opinions. First, their positions are far behind the present state of the science. They are based on out-moded concepts which the independent workers who study the effects of electromagnetic energy that I know do not regard as reasonable. Second, the legal structure of federal law as regards the toxic side-effects of man-made environmental electromagnetic energy effectively requires the agencies to discount the health risks due to man-made electromagnetic energy in the environment.

Q. What legal structure are you referring to?

A. The Radiation Control for Health and Safety Act of 1968. See Exhibit 2 at No 78.

Q. What does that law have to do with the issues in this case?

A. In 1962, following the birth of thousands of armless and legless babies in Europe caused by thalidomide that had been sold to pregnant women, the US Congress required drug companies to provide pre-market scientific evidence of

the safety of new drugs. In 1968, Senator Rogers, of Florida proposed applying the same social principle to devices that emitted man-made electromagnetic energy into the environment. His proposal, The Radiation Control for Health and Safety Act of 1967, would have authorized the government to perform research and regulate the safety of all devices that emitted man-made electromagnetic energy. But opponents of this principle, the industries that manufactured and sold energy-emitting devices, successfully argued that the health impact of man-made electromagnetic energy should be assessed subsequent to marketing. This policy shifted the burden of proof to the party asserting injury and was subsequently adopted by all federal agencies. Each relevant federal agency therefore begins with the assumption of safety, and requires any aggrieved litigant to prove non-safety.

Q. In forming the opinions you expressed here, have you taken into consideration the official positions of private national and international agencies regarding safety regulations concerning electromagnetic energy?

A. I know about their positions generally, but they have not had a significant impact on my opinions because their positions are far behind the present state of the science, and are invariably heavily biased in favor of industry positions. In addition, in all the cases that know about, the decisions of the agencies were star-chamber processes in which those with opposing views were excluded.

Q. Is it your opinion that the only ethical basis for assessing the health risks of electromagnetic energy from devices such as smart meters is knowledge gained from animal studies?

A. Yes, at least with regard to prospective studies.

Q. What do you mean?

A. We suspect that the energy from such devices is a serious health risk. More definitive studies are needed, but such studies will be expensive, and there is no independent source of funds for independent investigators to perform the needed studies. This vacuum is presently being filled by epidemiological studies, which are retrospective analyses of databases of unfortunate persons who have already died or developed disease. Because of their logical structure, epidemiological studies can never answer the basic questions. But far worse is the fact that industry and government are intentionally relying on such studies to provide an answer. In my view, that intention amounts to an egregiously unacceptable form of involuntary human experimentation.

Q. Are the needed animal studies being performed?

A. No. In the US, pursuant to the policy that established by the Radiation Control Law in 1968, such studies are generally regarded a private responsibility. There are no sufficient funds for independent investigators to carry out such studies.

Conclusion

Q. What are your conclusions?

A. First, here is a reasonable basis in established science for the Complainants' concern regarding risks to human health caused by man-made electromagnetic energy in the environment, including the type of electromagnetic energy emitted by smart meters. These health risks are heightened in the very young, the very old, and in those with preexisting diseases or disorders.

Second, electromagnetic hypersensitivity is a documented neurological condition in which the affected person experiences musculoskeletal, immunological, and/or neurological symptoms that noticeably flare or intensify upon exposure to man-made electromagnetic energy in the environment. About 5-10% of the general public are self-reported to suffer from this disorder.

Third, the Complainants were forced into the almost impossible position of conducting experiment on themselves to prove to PECO's satisfaction that their claims of a link between their symptoms and electromagnetic energy from smart meters were sufficiently credible as to warrant some remediable action by PECO.

Fourth, there is no justifiable reason for PECO to doubt the reality of the Complainants' symptoms, to question their intentions in seeking relief, or to not respect and implement the advice they received from their physicians that exposure to smart-meter energy should be avoided.

Fifth, chronic exposure to the electromagnetic energy from smart meters causes risks to human health that go far beyond the capability of the energy to trigger hypersensitivity reactions in sensitive persons. A large literature in

experimental biology indicates that man-made electromagnetic energy, including that from smart meters, causes biological effects involving every essentially physiological process that occurs in living organisms. A large literature in nonexperimental biology shows that man-made electromagnetic energy, including that from smart meters, is associated with a plethora of human diseases. People who suffer from pre-existing conditions are particularly vulnerable, and all the Complainants suffer from such conditions.

Sixth, PECO's claim that the FCC has pronounced smart meter safe is spurious because the FCC has made that statement only with regard to the heating and cooking effects of electromagnetic energy. The Complainants have made no claims that smart meters are like microwave ovens.

Seventh, PECO has claimed that expert committees have pronounced smart meters safe, but PECO has not acknowledged the blatant conflicts-of-interests that infect such committees nor the serious limitations on their reports, such as the failure to address much of the relevant literature.

Eighth, PECO proposes to expose human beings to smart-meter electromagnetic energy over their objection under conditions that would not be acceptable to any institution in the United States where human experimentation can lawfully be performed. Consequently, coercing the Complainants to endure the risks and uncertainties of such exposure is unwarranted, unjustified, and would amount to involuntary human experimentation by PECO.

Exhibit 1

CURRICULUM VITAE

Andrew A. Marino, PhD

304 Caddo Street

Belcher, LA 71004

E-mail: andrewamarino@gmail.com

EDUCATION

Ph.D., Biophysics, Syracuse University, Syracuse, NY, 1968

J.D., Law, Syracuse University College of Law, 1974

POSITIONS HELD

Research Biophysicist, Veterans Administration Medical Center, Syracuse, New York, 1964-1981

Assistant Professor, Department of Orthopaedic Surgery, SUNY Upstate Medical Center, Syracuse, New York, 1972-1981

Assistant Professor, Department of Orthopaedic Surgery, Louisiana State University Medical Center, Shreveport, Louisiana, 1981-1985

Associate Professor, Department of Orthopaedic Surgery, Louisiana State University Medical Center, Shreveport, Louisiana, 1985-1989

Professor: Department of Neurology, Louisiana State University Health Sciences Center, Shreveport, Louisiana, 2010 to 2014

Department of Cellular Biology and Anatomy, Louisiana State University Medical Center, Shreveport, Louisiana, 1989 to 2014

Department of Orthopaedic Surgery, Louisiana State University Health Sciences Center, Shreveport, Louisiana, 1989-2010

Manager: ABR Analytics, 2014 to present

BAR MEMBERSHIP:

New York, 1975-present

Louisiana, 1995-present

BOOKS

1. Electromagnetism & Life. with R.O. Becker. State University of New York Press, Albany, 1982.
2. Electric Wilderness. A.A. Marino and J. Ray. San Francisco Press, San Francisco, 1986.
3. Modern Bioelectricity. A.A. Marino, ed. Marcel Dekker, New York, 1988.

4. Going Somewhere: Truth About a Life in Science. Andrew Marino. Cassandra Publishing, Belcher, LA, 2010.
5. Electromagnetism & Life, Facsimile Edition. A.A. Marino and R.O. Becker. Cassandra Publishing, Belcher, LA, 2010.
6. Electric Wilderness, Facsimile Edition. A.A. Marino and J. Ray. Cassandra Publishing, Belcher, LA, 2011.

LAW REVIEW

1. The Scientific Basis of Causality in Toxic Tort Cases. A.A. Marino & L.E. Marino. Dayton Law Review, vol. 21, pp.1-62, 1995.

PATENTS

1. United States Patent No. US 6,547,746 B1: Method and Apparatus for Determining Response Thresholds. Andrew A. Marino. April 15, 2003.

PAPERS

189. Trigeminal neurons detect cellphone radiation: thermal or nonthermal is not the question. A.A. MARINO, P.Y. Kim & C. Frilot II. Electromagnetic Biology and Medicine. Published online ahead of print, 2016.
188. Analysis of brain recurrence. C. Frilot II, P.Y. Kim, S. Carrubba, D.E. McCarty, A.L. Chesson Jr. & A.A. MARINO. in Recurrence Quantification Analysis, Understanding Complex Systems. C.L. Webber Jr. & N. Marwan, eds. Springer International Publishing Switzerland, 2014.
187. Two-group classification of patients with obstructive sleep apnea based on analysis of brain recurrence. P.Y. Kim, D.E. McCarty, L. Wang, C. Frilot II, A.L. Chesson Jr. & A.A. MARINO. Clin. Neurophysiol. 125:1174–1181, 2014.
186. Recurrence analysis of the EEG during sleep accurately identifies subjects with mental health symptoms. D.E. McCarty, N.M. Punjabi, P.Y., Kim, C. Frilot II & A.A. MARINO. Psych. Res. 224:335–340, 2014.
185. The fingerprint of rapid eye movement: its algorithmic detection in the sleep electroencephalogram using a single derivation. D.E. McCarty, P.Y. Kim, C. Frilot II, A.L. Chesson Jr. & A.A. MARINO. Clin. EEG Neurosci. Published online ahead of print at http://eeg.sagepub.com/content/early/2014/11/13/1550059414544738, Nov. 13, 2014.
184. Sensory transduction of weak electromagnetic fields: role of glutamate neurotransmission mediated by NMDA receptors. C. Frilot II, S. Carrubba & A.A. MARINO. Neuroscience 258:184–191, 2014.
183. The link between vitamin D metabolism and sleep medicine. D.E. McCarty, A.L. Chesson Jr., S.K. Jain & A.A. MARINO. Sleep Med. Rev. 18:311–319, 2014.
182. EEG recurrence markers and sleep quality. L. Wang, P.Y. Kim, D.E. McCarty, C. Frilot II, A.L. Chesson Jr., S. Carrubba & A.A. MARINO. J. Neurol. Sci. 331:26–30, 2013.
181. Nocturnal hypoxemia biomarker predicts sleepiness in patients with severe obstructive sleep apnea. A. Uysal, C. Liendo, D.E. McCarty, P.Y. Kim, C. Paxson, A.L. Chesson Jr. &

A.A. MARINO. Sleep Breath., 2013. [Epub ahead of print.] DOI 10.1007/s11325-013-0851-2.

180. Electromagnetic hypersensitivity syndrome revisited again. A.A. MARINO. Int. J. Neurosci. 123:593–594, 2013.

179. Nonspecific pain is a marker for hypovitaminosis D in patients undergoing evaluation for sleep disorders: a pilot study. D.E. McCarty, A. Reddy, Q. Keigley, P.Y. Kim, S. Cohen & A.A. MARINO. Nature and Science of Sleep 5:37-42, 2013.

178. Vitamin D deficiency, sleep, sleep disruption, and daytime neurocognitive impairment. D.E. McCarty & A.A. MARINO. in Handbook of Nutrition, Diet and Sleep. V.R. Preedy, V.B. Patel & L.-A. Le, eds. Wageningen Academic Publishers, The Netherlands, 353-368, 2013.

177. Evaluation of interspinous process distraction device (X-STOP) in a representative patient cohort. S. Patil, M. Burton, C. Storey, C. Glenn, A. MARINO & A. Nanda. World Neurosurg. Apr 5, 2012 [Epub ahead of print].

176. Vitamin D, race, and excessive daytime sleepiness. D.E. McCarty, A. Reddy, Q. Keigley, P.Y. Kim & A.A. MARINO. J. Clin. Sleep Med. 8:693-697, 2012.

175. Continuous EEG-based dynamic markers for sleep depth and phasic events. S. Carrubba, P.Y. Kim, D.E. McCarty, A.L. Chesson, Jr., C. Frilot & A.A. MARINO. J. Neurosci. Meth.208:1-9, 2012.

174. Increased determinism in brain electrical activity in association with multiple sclerosis. S. Carrubba, A. Minagar, A.L. Chesson, Jr., C. Frilot II & A.A. MARINO. Neurol. Res. 34:286-290, 2012.

173. Response to Letter to the Editor Concerning “Electromagnetic Hypersensitivity: Evidence for a Novel Neurological Syndrome” A.A. MARINO, S. Carrubba & D.E. McCarty. Int. J. Neurosci. 2012. epub ahead of print Jan 9, 2012.

172. Electromagnetic hypersensitivity: evidence of a novel neurological syndrome. E. McCarty, S. Carrubba, A.L. Chesson, Jr., C. Frilot II, E. Gonzalez-Toledo & A.A. MARINO. Int. J. Neurosci. 121:670-676, 2011.

171. Transient and steady-state magnetic fields induce increased fluorodeoxyglucose uptake in the rat hindbrain. C. Frilot II, S. Carrubba & A.A. MARINO. Synapse 65:617-623, 2011. Published online ahead of print December 28, 2010.

170. Numerical analysis of recurrence plots to detect effect of environmental-strength magnetic fields on human brain electrical activity. S. Carrubba, C. Frilot II, A.L. Chesson Jr. & A.A. MARINO. Med. Eng. Phys. 32:898-907, 2010.

169. Simulated MR magnetic field induces steady-state changes in brain dynamics: implications for interpretation of functional MR studies. A.A. MARINO, S. Carrubba, C. Frilot II, A.L. Chesson Jr. & E. Gonzalez-Toledo. Magn. Reson. Med. 64;349-357, 2010.

168. Multiple sclerosis impairs ability to detect abrupt appearance of a subliminal stimulus. S. Carrubba, A. Minazar, E. Gonzalez Toledo, A.L. Chesson, C. Frilot II & A.A. MARINO. Neurolog. Res.32:297-302, 2010.

167. Mobile-phone pulse triggers evoked potentials. S. Carrubba, C. Frilot II, A.L. Chesson Jr. & A.A. MARINO. Neurosci Lett. 469:164–168, 2010.

166. Pathophysiology of osteoarthritis: evidence against the viscoelastic theory. S. Dunn, O.V. Kolomytkin & A.A. MARINO. Pathobiology 76:322–328, 2009.

165. The electric field is a sufficient physical determinant of the human magnetic sense. S. Carrubba, C. Frilot, II, F.X. Hart, A.L. Chesson, Jr. & A.A. MARINO. Int. J. Radiat. Biol. 85:622–632, 2009.

164. The effects of mobile-phone electromagnetic fields on brain electrical activity: a critical analysis of the literature. A.A. MARINO & S. Carrubba. Electromagnetic Medicine and Biology 28:250-274, 2009.

163. Evidence that transduction of electromagnetic field is mediated by a force receptor. A.A. MARINO, S. Carrubba, C. Frilot & A.L. Chesson Jr. Neurosci. Lett. 452:119–123, 2009.

162. Magnetosensory function in rats: localization using positron emission tomography. C. Frilot II, S. Carrubba & A.A. MARINO. Synapse 63:421–428, 2009.

161. Neurobiophysics. O.V. Kolomytkin & A.A. MARINO. In Handbook of Molecular Biophysics. Methods and Applications. H.G. Bohr, Ed. Wiley VCH, 2009, pp. 523–556.

160. Hyaluronan-binding receptors: possible involvement in osteoarthritis. S. Dunn, O.V. Kolomytkin, D.D. Waddell & A.A. MARINO. Mod. Rheumatol. 19:151–155, 2009.

159. Method for detection of changes in the EEG induced by the presence of sensory stimuli. S. Carrubba, C. Frilot, A.L. Chesson Jr. & A.A. MARINO. J. Neurosci Methods. 173:41–46, 2008.

158. Design and implementation of a system-based course in musculoskeletal medicine for medical students. K. Bilderback, J. Eggerstedt, K.K. Sadasivan, L. Seelig, R. Wolf, S. Barton, R. McCall, A.L. Chesson, Jr. & A.A. MARINO. J. Bone Joint Surg. 90:2292–2300, 2008.

157. The effects of low-frequency environmental-strength electromagnetic fields on brain electrical activity: a critical review of the literature. S. Carrubba & A.A. MARINO. Electromag. Biol. Med. 27:83–101, 2008.

156. Magnetosensory evoked potentials: consistent nonlinear phenomena. S. Carrubba, C. Frilot, A.L. Chesson, Jr., C.L. Webber, Jr., J.P. Zbilut & A.A. MARINO. Neurosci. Res. 60:95–105, 2008.

155. Hyaluronan suppresses IL-1ß-induced metalloproteinase activity from synovial tissue. D.D. Waddell, O.V. Kolomytkin, S. Dunn & A.A. MARINO. Clin. Orthop, 465:241–248, 2007.

154. Chronic knee effusions in patients with advanced osteoarthritis. D.D. Waddell & A.A. MARINO. J. Knee Surg. 20:181–184, 2007.

153. Nonlinear EEG activation by low-strength low-frequency magnetic fields. S. Carrubba, C. Frilot, A.L. Chesson & A.A. MARINO. Neurosci. Lett. 417:212–-216, 2007.

152. Glycoproteins bound to ion channels mediate detection of electric fields: a proposed mechanism and supporting evidence. O.V. Kolomytkin, S. Dunn, F.X. Hart, C. Frilot, D. Kolomytkin & A.A. MARINO. Bioelectromagnetics 28:379–385, 2007.

151. Evidence of a nonlinear human magnetic sense. S. Carrubba, C. Frilot II, A.L. Chesson Jr. & A.A. MARINO. Neuroscience 144:356–367, 2007.

150. Detection of nonlinear event-related potentials. S. Carrubba, C. Frilot, A. Chesson & A.A. MARINO. J. Neurosci. Meth. 157:39–47, 2006.

149. Assessment of immunologic mechanisms for flare reactions to Synvisc®. A.A. MARINO, D.D. Waddell, O.V. Kolomytkin, S. Pruett, K.K. Sadasivan & J.A. Albright. Clin. Orthop. 442:187–194, 2006.

148. External suction drainage in primary total joint arthroplasties. L.M. Gehrig, K.K. Sadasivan, A.A. MARINO & J.A. Albright. Am. J. Orthop. 34:164–166, 2005.

147. Effect of low-frequency magnetic fields on brain electrical activity in human subjects. A.A. MARINO, E. Nilsen, A.L. Chesson Jr., & C. Frilot. Clin. Neurophysiol. 115:1195–1201, 2004.

146. Increased intercellular communication through gap junctions may contribute to progression of osteoarthritis. A.A. MARINO, D.D. Waddell, O.V. Kolomytkin, W.D. Meek, R. Wolf, K.K. Sadasivan & J.A. Albright. Clin. Orthop. 422:224–232, 2004.

145. Localization of electroreceptive function in rabbits. A.A. MARINO, E. Nilsen & C. Frilot. Phys. Behav. 79:803–810, 2003.

144. Granulomatous inflammation after Hylan G-F 20 viscosupplementation of the knee. A.A MARINO, S. Dunn & D.D. Waddell. J. Bone Joint Surg. 850A:2051–2052, 2003.

143. Nonlinear changes in brain electrical activity due to cell-phone radiation. A.A. MARINO, E. Nilsen & C. Frilot. Bioelectromagnetics 24:339–346, 2003.

142. Extracellular currents alter gap junction intercellular communication in synovial fibroblasts. A.A. MARINO, O.V. Kolomytkin & C. Frilot. Bioelectromagnetics 24:199–205, 2003.

141. Comment on “Proposed test for detection of nonlinear responses in biological preparations exposed to RF energy.” A.A. MARINO & C. Frilot. Bioelectromagnetics 24:70–72, 2003.

140. Action potentials from neuroblastoma cells in weak magnetic fields. H. Sonnier, O. Kolomytkin & A. MARINO. Neuroscience Letters 337:163–166, 2003.

139. Nonlinearity in biological systems: How can physics help? A.A. MARINO & C. Frilot. In Energy and Information Transfer in Biological Systems (F. Musumeci, L.S. Brizhik, and M.-W. Ho, eds.) World Scientific Press, 2002, pp. 245–263.

138. Unifying the immune and neuroendocrine systems. S.B. Pruett & A.A. MARINO. Trends Endocrinol. Metabol. 13:273, 2002.

137. Consistent magnetic-field induced dynamical changes in rabbit brain activity detected by recurrence quantification analysis. A.A. MARINO, E. Nilsen & C. Frilot. Brain Res. 951:301–310, 2002.

136. IL-1ß-induced production of metalloproteinases by synovial cells depends on gap-junction conductance during the early stage of signal transduction. O.V. Kolomytkin, A.A. MARINO, D.D. Waddell, J.M. Mathis, R.E. Wolf, K.K. Sadasivan & J.A. Albright. Am. J. Physiol: Cell Physiol. 282:C1254–C1260, 2002.

135. Nonlinear determinism in the immune system. In vivo influence of electromagnetic fields on different functions of murine lymphocyte subpopulations. A.A. MARINO, R.M. Wolcott, R. Chervenak, F. Jourd’heuil, E. Nilsen & C. Frilot II. Immunol. Invest. 30:313–334, 2001.

134. Nonlinear dynamical law governs magnetic field changes in lymphoid phenotype. A.A. MARINO, R.M. Wolcott, R. Chervenak, F. Jourd’heuil, E. Nilsen & C. Frilot II. Bioelectromagnetics 22:529–546, 2001.

133. Coincident nonlinear changes in the endocrine and immune systems due to low-frequency magnetic fields. A.A. MARINO, R.M. Wolcott, R. Chervenak, F. Jourd’heuil, E. Nilsen, C. Frilot II & S.B. Pruett. NeuroImmunoModulation 9:65–77, 2001.

132. Sensory transduction as a proposed model for biological detection of electromagnetic fields. H. Sonnier & A.A. MARINO. Electro- and Magnetobiology 20:153–175, 2001.

131. In the eye of the beholder: The role of style of thought in the determination of health risks from electromagnetic fields. Andrew A. MARINO. Frontier Perspectives 9:22–27, 2000.

130. Nonlinear response of the immune system to power-frequency magnetic fields. A.A. MARINO, R.M. Wolcott, R. Chervenak, F. Jourd'heuil, E. Nilsen & C. Frilot II. Am. J. Physiol Regulatory Integrative Comp. Physiol. 279:R761–R768, 2000.

129. Effect of soft-tissue trauma on the early periosteal response of bone to injury. P.S. Landry, A.A. MARINO, K.K. Sadasivan & J.A. Albright. J. Trauma 48:479–483, 2000.

128. Gap junctions in human synovial cells and tissue. O.V. Kolomytkin, A.A. MARINO, K.K. Sadasivan, W.D. Meek, R.E. Wolf, V. Hall, K.J. McCarthy & J.A. Albright. J. Cell. Physiol. 184:110–117, 2000.

127. Resting potential of excitable neuroblastoma cells in weak magnetic fields. H. Sonnier O.V. Kolomytkin & A.A. MARINO. Cell. Molec. Life Sci. 57:514–520, 2000.

126. Programmed cell death in post-traumatic bone callus. M.L. Olmedo, P.S. Landry, K.K. Sadasivan, J.A. Albright & A.A. MARINO. Cell. Molec. Biol. 46:89–97, 2000.

125. Review of "Applied Bioelectricity: From Electrical Stimulation to Electropathology," by J. Patrick Reilly. Quart. Rev. Biol. 74:371, 1999.

124. Neurobiophysics. H. Sonnier & A.A. MARINO. in Encyclopedia of Applied Physics, Update 1, Wiley-VCH Publishers, Inc., pp. 401–405, 1999.

123. Regulation of osteoblast levels during bone healing. M.L. Olmedo, P.S. Landry, K.K. Sadasivan, J.A. Albright, W.D. Meek, R. Routh & A.A. MARINO. J. Orthop. Trauma 13:356–362, 1999.

122. Intracellular signaling mechanisms of interleukin-1ß in synovial fibroblasts. O.V. Kolomytkin, A.A. MARINO, K.K. Sadasivan, R.E. Wolf & J.A. Albright. Am. J. Physiol. 276 (Cell Physiol. 45):C9–C15, 1999.

121. Repair of fascial defects in dogs using carbon fibers. D.M. Morris, J. Hindman & A.A. MARINO. J. Surg. Res. 80:300–303, 1998.

120. Low-frequency electromagnetic fields alter the replication cycle of MS2 bacteriophage. J. Staczek, A.A. MARINO, L.B. Gilleland, A. Pizarro & H.E. Gilleland, Jr. Current Microbiology 36:298–301, 1998.

119. Interleukin-1ß switches electrophysiological states of synovial fibroblasts. O.V. Kolomytkin, A.A. MARINO, K.K. Sadasivan, R.E. Wolf & J.A. Albright. Am. J. Physiol., 273 (Regulatory Integrative Comp. Physiol. 42):R1822–R1828, 1997.

118. Electromagnetic fields can affect osteogenesis by increasing the rate of differentiation. P.S. Landry, K.K. Sadasivan, A.A. MARINO & J.A. Albright. Clin. Orthop., 338:262–270, 1997.

117. Electromagnetic fields enhance chemically-induced hyperploidy in mammalian oocytes. J.B. Mailhes, D. Young, A.A. MARINO & S.N. London. Mutagenesis, 12:347–351, 1997.

116. Apoptosis is coordinately regulated with osteoblast formation during bone healing. P. Landry, K. Sadasivan, A. MARINO & J. Albright. Tissue & Cell 29(4):413–419, 1997.

115. Piezoelectricity in the human pineal gland. S.B. Lang, A.A. MARINO, G. Berkovic, M. Fowler & K.D. Abreo. Bioelectrochem. Bioenerg. 41:191–195,1996.

114. Comments on "Short exposures to 60 Hz magnetic fields do not alter MYC expression in HL60 or Daudi cells" by Saffer and Thurston (Radiat. Res. 144:18–25, 1995). Radiat. Res. 145:513–515, 1996.

113. Bone injury response: an animal model for testing theories of regulation. P.S. Landry, A.A. MARINO, K.K. Sadasivan & J.A. Albright. Clin. Orthop. 332:260–273, 1996.

112. Low-level EMFs are transduced like other stimuli. A.A. MARINO, G.B. Bell & A. Chesson. J. Neurolog. Sci. 144:99–106, 1996.

111. Elemental diet and IV-TPN-induced bacterial translocation is associated with loss of intestinal mucosal barrier function against bacteria. E.A. Deitch, D. Xu, M.B. Naruhn, D.C. Deitch, Q. Lu & A.A. MARINO. Ann. Surg. 221:299–307, 1995.

110. Electromagnetic fields in the classroom. A.A. MARINO, in The Healthy School HandbookN. Miller, ed., NEA Professional Library, Washington, DC, 221–241, 1995.

109. Different outcomes in biological experiments involving weak EMFs: Is chaos a possible explanation? A.A. MARINO. Am. J. Physiol. 268 (Regulatory Integrative Comp. Physiol. 37: R1013–R1018, 1995.

108. Time-dependent hematological changes in workers exposed to electromagnetic fields. A.A. MARINO. Am. Ind. Hyg. Assoc. J. 56:189–192, 1995.

107. Neurobiophysics. A.A. MARINO, in Encyclopedia of Applied Physics, Vol. 11, VCH Publishers, Inc., pp. 297–322, 1994.

106. Electrical potential measurements in human breast cancer and benign lesions. A.A. MARINO, D.M. Morris, M.A. Schwalke, I.G. Iliev & S. Rogers. Tumor Biology 15:147–152, 1994.

105. Treatment of tendon injuries in Thoroughbred racehorses using carbon-fiber implants. K.P. Reed, S.S. van den Berg, A. Rudolph, J.A. Albright, H.W. Casey & A.A. MARINO. J. Vet. Sci. 14:371–377, 1994.

104. A comparative study of osseointegration of titanium implants in corticocancellous block and corticocancellous chip grafts in canine ilium. D. Lew, A.A. MARINO, J.M. Startzell & J.C. Keller. J. Oral Maxillofac. Surg. 52:952–958, 1994.

103. Association between cell membrane potential and breast cancer. A.A. MARINO, I.G. Iliev, M.A. Schwalke, E. Gonzalez, K.C. Marler & C.A. Flanagan. Tumor Biology 15:82–89, 1994.

102. Frequency-specific responses in the human brain caused by electromagnetic fields. G.B. BellA.A. MARINO & A.L. Chesson. J. Neurol. Sci. 123:26–32, 1994.

101. Frequency-specific blocking in the human brain caused by electromagnetic fields. G.B. Bell, A.A. MARINO & Andrew L. Chesson. NeuroReport 5:510–512, 1994.

100. Potassium channels in epithelial cells. I.G. Iliev & A.A. MARINO. Cell. and Mol. Biol. Res. 39:601–611, 1993.

99. Electromagnetic fields, cancer, and the theory of neuroendocrine-related promotion. A.A. MARINO. Bioelectrochem. Bioenerg. 29:255–276, 1993.

98. Alterations in brain electrical activity caused by magnetic fields: detecting the detection process. G.B. Bell, A.A. MARINO & A.L. Chesson. Electroencephalog. Clin. Neurophysiol. 83: 389–397, 1992.

97. Electrochemical modification of tumor growth in mice. D.M. Morris, A.A. MARINO & E. Gonzalez. J. Surg. Res. 53:306–309, 1992.

96. Electrical states in the rabbit brain can be altered by light and electromagnetic fields. G. Bell, A.A. MARINO, A. Chesson & F. Struve. Brain Res. 570:307–315, 1992.

95. Human sensitivity to weak magnetic fields. G. Bell, A.A. MARINO, A. Chesson & F. Struve. Lancet 338:1521–1522, 1991.

94. The effect of electrical stimulation on bone formation around hydroxyapatite implants placed on the rabbit mandible. D. Lew & A. MARINO. J. Oral Maxillofac. Surg. 49:735–739, 1991.

93. Use of carbon fibers in the reconstruction of knee ligaments. P. Demmer, M. Fowler & A.A. MARINO. Clin. Orthop. 271:225–232, 1991.

92. Meta-analysis of multi-generational studies in mice exposed to power-frequency electric fields. A.A. MARINO. J. Bioelectricity 9:213–231, 1990.

91. Partizanist discrimination in California favors electric power companies (Editorial). A.A. MARINO. J. Bioelectricity 9:v-vii, 1990.

90. Bioelectricity. A.A. MARINO. Collier's Encyclopedia, 1990.

89. Beauty and a beast (Editorial). A.A. MARINO. J. Bioelectricity 9(1):v, 1990.

88. Use of carbon fibers for repair of abdominal-wall defects in rats. D.M. Morris, A.A. MARINO, R. Haskins, R. Misra, S. Rogers, S. Fronczak & J.A. Albright. Surgery 107:627–631, 1990.

87. Exposure system for the production of uniform magnetic fields. G.B. Bell & A.A. MARINO. J. Bioelectricity 8:147–158, 1989.

86. Trust me, I'm a doctor (Editorial). A.A. MARINO. J. Bioelectricity 8(2):v, 1989.

85. Piezoelectricity in cementum, dentin, and bone. A.A. MARINO & B.D. Gross. Arch. Oral Biol. 34:507–509, 1989.

84. Negative studies and common sense (Editorial). A.A. MARINO. J. Bioelectricity 8(1):v, 1989.

83. Use of carbon fibers for the repair of bowed tendons: a preliminary report. S.S. van den Berg, K.P. Reed & A. MARINO. J. Equine Surg. 8:339–340, 1988.

82. Quasi-static charge interactions in bone. A.A. MARINO, J. Rosson, E. Gonzalez, L. Jones, S. Rogers & E. Fukada. J. Electrostatics 21:347–360, 1988.

81. Environmental electromagnetic fields and public health. A.A. MARINO, in Foundations of Modern Bioelectricity, A.A. MARINO, ed., Marcel Dekker, New York, 965–1044, 1988.

80. Direct current and bone growth. A.A. MARINO, in Foundations of Modern Bioelectricity, A.A. MARINO, ed., Marcel Dekker, New York, 657–709, 1988.

79. Are powerline fields hazardous to health? A.A. MARINO. Public Power 45:1820, 1987.

78. Electric man and the work of Björn Nordenström. A.A. MARINO. J. Appl. Nutr. 39:106–108, 1987.

77. Silver-nylon cloth: In vitro and in vivo evaluation of antimicrobial activity. E.A. Deitch, A.A. MARINO, V. Malakanok & J.A. Albright. J. Trauma 27:301–304, 1987.

76. Slow healing fractures: can they be prevented? G. Fontanesi, G.C. Traina, F. Giancecchi, I. Tartaglia, R. Rotini, B. Virgili, R. Cadossi, G. Ceccherelli & A.A. MARINO. Ital J Orthop Traumatol 12(3):371–385, 1986.

75. Health risks from electric power facilities. A.A. MARINO, in Proceedings of International Utility Symposium, Health Effects of Electric and Magnetic Fields, Ontario Hydro, Toronto, 1986.

74. Orthopaedic applications of carbon fibers. A.A. MARINO, Stephen Fronczak, Clarence Boudreaux, Douglas N. Lyles, E. Michael Keating & James A. Albright. IEEE Eng. Med. & Biol. 5:31–34, 1986.

73. Electrical stimulation of mandibular osteotomies in rabbits. A.A. MARINO, B. Gross & R.D. Specian. Oral Surg. Oral Med. Oral Path. 62:20–24, 1986.

72. Electrical treatment of Lewis lung carcinoma in mice. A.A. MARINO & D.M. Morris. J. Surg. Res. 41:198–201, 1986.

71. Functional repair of rabbit gastrocnemius tendons using carbon fibers. E.M. Keating, A.A. MARINO, J.A. Albright & R.D. Specian. Clin. Orthop. 209:292–297, 1986.

70. Penetration of electric fields into a concentric-sphere model of biological tissue. F.X. Hart & A.A. MARINO. Med. & Biol. Eng. & Comput. 24:105–108, 1985.

69. Chronic electromagnetic stressors in the environment: A risk factor in human cancer. A.A. MARINO & D.M. Morris. J. Environ. Sci. C3(2):189–219, 1985.

68. Electromagnetic energy in the environment and human disease. A.A. MARINO. Clin. Ecol. 3(3):154–157, 1985.

67. Electromagnetic fields and public health. A.A. MARINO, in Assessments and Viewpoints on the Biological and Human Health Effects of Extremely Low Frequency Electromagnetic Fields, American Institute of Biological Sciences, Arlington, Va., 205–232, 1985.

66. We need a science court (Editorial). A.A. MARINO. J. Bioelectricity 4: vii, 1985.

65. Electric silver antisepsis. A.A. MARINO, E.A. Deitch & J.A. Albright. IEEE Trans. Biomed. Eng. BME-32:336–337, 1985.

64. Electrochemical properties of silver-nylon fabrics. A.A. MARINO, V. Malakanok, E.A. Deitch, J.A. Albright & R.D. Specian. J. Electrochem. Soc. 132:68–72, 1985.

63. Public health aspects of the energy flux of high-voltage powerlines. F.X. Hart & A.A. MARINO. Innov. Tech. Bio. Med. (French) 5:636–640, 1984.

62. We need a science court. A.A. MARINO. J. Bioelectricity 4: vii, 1985.

61. Electrical augmentation of the antimicrobial activity of silver-nylon fabrics. A.A. MARINO, E.A. Deitch & J.A. Albright. J. Biol. Phys. 12:93–98, 1984.

60. The use of carbon fibers in ligament repair: mechanical and biological properties. J.A. Albright, E.M. Keating & A.A. MARINO. Schumpert Med. Q. 3:16–24, 1984.

59. Electrical stimulation in orthopaedics: past, present and future. A.A. MARINO. J. Bioelectricity, 3: 235–244, 1984.

58. Weak electrical fields affect plant development. A.A. MARINO, F.X. Hart & M. Reichmanis. IEEE Trans. Biomed. Eng. BME 30: 833–834, 1983.

57. Silver nylon: a new antimicrobial agent. E.A. Deitch, A.A. MARINO, T.E. Gillespie & J.A. Albright. Antimicrob. Agents Chemother. 23: 356–359, 1983.

56. Bioelectric considerations in the design of high-voltage power lines. M. Reichmanis & A.A. MARINO. J. Bioelectricity 1: 329–338, 1982.

55. ELF dosage in ellipsoidal models of man due to high-voltage transmission lines. F.X. Hart & A.A. MARINO. J. Bioelectricity 1: 129–154, 1982.

54. Electret-induced bone formation in rats. A.A. MARINO, J. Cullen, R.O. Becker & E. Fukada, in Frontiers of Engineering in Health Care, B.A. Cohen, ed., 220–222, 1981.

53. Environmental power-frequency magnetic fields and suicide. F.S. Perry, M. Reichmanis, A. MARINO, & R. Becker. Health Phys. 41: 267–277, 1981.

52. Separating disputes over facts from disputes over values. A. Mazur, A.A. MARINO & R.0. Becker, in The Dynamics of Technical Controversy, A. Mazur, Communications Press, Inc., Washington D.C., 1981.

51. Sensitivity to change in electrical environment: a new bioelectric effect. A.A. MARINO, J.M. Cullen, M. Reichmanis, R.O. Becker & F.X. Hart. Am. J. Physiol. 239 (Regulatory Integrative Comp. Physiol. 8): R424–427, 1980.

50. Piezoelectricity in collagen films. A.A. MARINO, J.A. Spadaro, E. Fukada, L.D. Kahn & R.O. Becker. Calcif. Tissue Int. 31: 257–259, 1980.

49. Power frequency electric field induces biological changes in successive generations of mice. A.A. MARINO, M. Reichmanis, R.O. Becker, B. Ullrich & J.M. Cullen. Experientia 36: 309–311, 1980.

48. Relation between suicide and the electromagnetic field of overhead power lines. M. Reichmanis, F.S. Perry, A.A. MARINO & R.O. Becker. Physiol. Chem. Phys. 11: 395–403, 1979.

47. Kirlian photography: potential for use in diagnosis. A.A. MARINO, R.O. Becker & B. Ullrich. Psychoenerg. Syst. 3: 47–54, 1979.

46. Fracture healing in rats exposed to extremely low frequency electric fields. A.A. MARINO, J.M. Cullen, M. Reichmanis & R.O. Becker. Clin. Orthop. 145: 239–244, 1979.

45. Separating factual disputes from value disputes in controversies over technology. A. Mazur, A.A. MARINO & R.O. Becker. Technology in Society 1: 229–237, 1979.

44. Space osteoporosis: an electromagnetic hypothesis. A.A. MARINO, R.O. Becker, F.X. Hart & F. Anders, Jr. Aviat. Space Environ. Med. 50: 409–410, 1979.

43. Laplace plane analysis of impedance on the H meridian. M. Reichmanis, A.A. MARINO & R.O. Becker. Am J Chin Med 7(2): 188–193, 1979.

42. Laplace plane analysis of skin impedance: a preliminary investigation. M. Reichmanis, A.A. MARINO & R.O. Becker. J. Electrochem. Soc. 125: 1765–1768, 1978.

41. Effect of electrostatic fields on the chromosomes of Ehrlich ascites tumor cells exposed in vivo. J.T. Mitchell, A.A. MARINO, T.J. Berger & R.O. Becker. Physiol. Chem. Phys. 10: 79–85, 1978.

40. High voltage lines: hazard at a distance. A.A. MARINO & R.O. Becker. Environment 20 (9): 6–15, 1978.

39. Power frequency electric fields and biological stress: a cause-and-effect relationship. A.A. MARINO, J.M. Cullen, M. Reichmanis & R.O. Becker, in Biological effects of extremely low frequency electromagnetic fields. Proc. 18th Hanford Life Sciences Symposium, Richland Wash., U.S. Dept. of Energy. DOE symposium series; 50: 258–276, 1978.

38. Evaluation of electrical techniques for stimulation of hard tissue growth. R.O. Becker, J.A. Spadaro & A.A. MARINO. Bull. Prosthetics Res. BPR 10–29: 133–136, 1978.

37. Hazard at a distance: effects of exposure to the electric and magnetic fields of high voltage transmission lines. A.A. MARINO & R.O. Becker. Med. Res. Eng. 12: 6–9, 1978.

36. Electromagnetic pollution. R.O. Becker & A.A. MARINO. The Sciences, January, 1978, pp. 14, 15, 23.

35. In vivo bioelectrochemical changes associated with exposure to ELF electric fields. A.A. MARINO, T.J. Berger, B.P. Austin, R.O. Becker & F.X.Hart. Physiol. Chem. Phys. 9: 433–441, 1977.

34. Evaluation of electric techniques for stimulation of hard tissue growth. R.O. Becker, J.A. Spadaro & A.A. MARINO. Bull. Prosthetics Res. BPR 10–27: 180–184, 1977.

33. Biological effects of extremely low frequency electric and magnetic fields: a review. A.A. MARINO & R.O. Becker. Physiol. Chem. Phys. 9: 131–147, 1977.

32. Energy flux along high voltage transmission lines. F.X. Hart & A.A. MARINO. IEEE Trans. Biomed. Eng. BME-24: 493–495, 1977.

31. Laplace plane analysis of transient impedance between acupuncture points Li-4 and Li-12. M. Reichmanis, A.A. MARINO & R.O. Becker. IEEE Trans. Biomed. Eng. BME-24: 402–405, 1977.

30. Clinical experiences with low intensity direct current stimulation of bone growth. R. O. Becker, J.A. Spadaro & A.A. MARINO. Clin. Orthop. 124: 75–83, 1977.

29. Electrical osteogenesis: an analysis. A.A. MARINO & R.O. Becker. Clin. Orthop. 123: 280–282, 1977.

28. Laplace plane analysis of impedance between acupuncture points H-3 and H-4. M. Reichmanis, A.A. MARINO & R.O. Becker. Comp. Med. East & West 5: 189–195, 1977.

27. Biophysics of animal response to an electrostatic field. F.X. Hart & A.A. MARINO. J. Biol. Phys. 4: 123–143, 1976.

26. Evaluation of electrochemical information transfer system. I. Effect of electric fields on living organisms. A.A. MARINO, T.J. Berger, B.P. Austin & R.O. Becker. J. Electrochem. Soc. 123: 1199–1200, 1976.

25. The effect of continuous exposure to low frequency electric fields on three generations of mice: a pilot study. A.A. MARINO, R.O. Becker & B. Ullrich. Experientia 32: 565, 1976.

24. Photoconductivity in bone and tendon. R.G. Fuller, A.A. MARINO & R.O. Becker. Biophys. J. 16: 845–846, 1976.

23. Electrophysiological correlates of acupuncture points and meridians. R.O. Becker, M. Reichmanis, A.A. MARINO & J.A. Spadaro. Psychoenerg. Syst. 1: 105–112, 1976.

22. DC skin conductance variation at acupuncture loci. M. Reichmanis, A.A. MARINO & R.O. Becker. Am. J. Chin. Med. 4: 69–72, 1976.

21. Electrical correlates of acupuncture points. M. Reichmanis, A.A. MARINO & R.O. Becker. IEEE Trans. Biomed. Eng. BME-22: 533–535, 1975.

20. Piezoelectricity in hydrated frozen bone and tendon. A.A. MARINO & R.O. Becker. Nature 253: 627–628, 1975.

19. Electrostatic field induced changes in mouse serum proteins. A.A. MARINO, T.J. Berger, R.O. Becker & F.X. Hart. Experientia 30: 1274–1275, 1974.

18. Electrical stimulation of articular cartilage regeneration. B. Baker, J.A. Spadaro, A.A. MARINO & R.O. Becker. Ann. N. Y. Acad. Sci. 238: 491–499, 1974.

17. Electric field effects in selected biologic systems. A.A. MARINO, T.J. Berger, J.T. Mitchell, B.A. Duhacek & R.O. Becker. Ann. N. Y. Acad. Sci. 238: 436–444, 1974.

16. Effect of selected metals on marrow cells in culture. A.A. MARINO, T.J. Berger, R.O. Becker & J.A. Spadaro. Chem. Biol. Interactions 9: 217–223, 1974.

15. Piezoelectricity in bone as a function of age. A.A. MARINO & R.O. Becker. Calc. Tiss. Res. 14: 327–331, 1974.

14. Piezoelectricity and autoinduction. A.A. MARINO & R.O. Becker. Clin. Orthop. 100: 247–249, 1974.

13. Lung damage in mice following intraperitoneal injection of butylated hydroxytoluene. A.A. MARINO & J.T. Mitchell. Proc. Soc. Exp. Biol. Med. 140: 122–125, 1972.

12. Dupuytren's contracture: some associated biophysical abnormalities. E. Berg, A.A. MARINO & R O. Becker. Clin. Orthop. 83: 144–148, 1972.

11. Origin of the piezoelectric effect in bone. A.A. MARINO, S.C. Soderholm & R.O. Becker. Calc. Tiss. Res. 8: 177–180, 1971.

10. Piezoelectric effect and growth control in bone. A.A. MARINO & R.O. Becker. Nature 228: 473, 1970.

9. Evidence for epitaxy in the formation of collagen and apatite. A.A. MARINO & R.O. Becker. Nature 226: 652–653, 1970.

8. The effect of electric current on rat tail collagen in solution. A.A. MARINO & R.O. Becker. Calc. Tiss. Res. 4: 330–338, 1970.

7. Temperature dependence of the electron paramagnetic resonance signal in tendon collagen. A.A. MARINO & R.O. Becker. Nature 222: 164–165, 1969.

6. Correction concerning electron paramagnetic resonance in human bone mineral. A.A. MARINO & R.O. Becker. Nature Feb 15;221(181): 661, 1969.

5. Role of water in some biophysical properties of skeletal tissues. R.O. Becker & A.A. MARINO. In Biology of the Mouth, Publication No. 89, Am. Assoc. Adv. Sci., 135–143, 1968.

4. Mechanically induced free radicals in bone. A.A. MARINO & R.O. Becker. Nature 218: 466–467, 1968.

3. Dielectric determination of bound water of bone. A.A. MARINO, R.O. Becker & C.H. Bachman. Phys. Med. Biol. 12: 367–378, 1967.

2. Evidence for direct physical bonding between the collagen fibers and apatite crystals in bone. A.A. MARINO & R.O. Becker. Nature 213: 697–698, 1967.

1. The electron paramagnetic resonance spectra of bone and its major components. R.O. Becker & A.A. MARINO. Nature 210: 583–588, 1966.

ABSTRACTS & REPLIES

58. Hypoxia and sleepiness in patients with OSA. A. Uysal, C. Paxson, C. LIendo, A.L. Chesson Jr., D.E. McCarty, C. Jenks, H. Batra, L. Wang, Y. Kim & A.A. MARINO. SLEEP 35 (Abstract Suppl.): A185, 2012.

57. EEG complexity is altered in patients with CPAP-induced REM rebound. L. Wang, D.E. McCarty, S. Carrubba, A. Uysal, A.L. Chesson Jr. & A.A. MARINO. SLEEP 35 (Abstract Suppl.): A129, 2012.

56. Development and validation of a continuous EEG-based marker for sleep depth. A.A. MARINO, S. Carrubba, D.E. McCarty, A.L. Chesson Jr., Y. Kim & C. Frilot. SLEEP 35 (Abstract Suppl.): A127, 2012.

55. Constitutive and IL-1ß-induced expression of metalloproteinases by synovial lining cells mediated by gap-junction intercellular communication. O.V. Kolomytkin, A.A. MARINO, D.D. Waddell, R.E. Wolf, K.K. Sadasivan & J.A. Albright. 50th Annual Meeting, Orthopedic Research Society, March 7-10, 2004.

54. Hyaluronan suppresses IL-1ß-induced metalloproteinase activity from synovial lining cells in patients with osteoarthritis. A.A. MARINO, D.D. Waddell, O.V. Kolomytkin, K.K. Sadasivan & J.A. Albright. 50th Annual Meeting, Orthopedic Research Society, March 7-10, 2004.

53. Review of "A Survivor's Guide to Reversing Cancer: A Journey from Cancer to Cure," by Dr. Gerald H. Smith. A.A. MARINO. Frontier Perspectives 13:53, 2004.

52. Effect of hyaluronans on cytokine-induced metalloproteinase activity secreted by synovial lining cells from patients with osteoarthritis. S. Dunn, D.D. Waddell, O.V. Kolomytkin & A.A. MARINO. Hyaluronan 2003, October 11-15, 2003, Cleveland, Ohio, p. 128.

51. Letter to the Editor: Granulomatous inflammation after Hylan G-F 20 viscosupplementation of the knee. A.A. MARINO, S. Dunn & D.D. Waddell. J. Bone Joint Surg. 85-A:2051–2052, 2003.

50. Reply to Dr. Adair's comment. A.A. MARINO. Bioelectromagnetics 24:442, 2003.

49. Reply to Chen et al. (Letter to the Editor). A.A. MARINO, S. Dunn & D.D. Waddell. J. Bone Joint Surg. 85A:2051-2053, 2003.

48. Gap junctions in osteoarthritis. W.D. Meek, A.A. MARINO, D.D. Waddell, O.V. Kolomytkin, R. Wolf, K.K. Sadasivan & J.A. Albright. Molecular Biology of the Cell 13S:1212, 2002.

47. Effect of concentration and molecular weight of hyaluronan on interleukin-1-induced matrix metalloprotease activity. S. Dunn, O. Kolomytkin, D. Waddell & A. MARINO. Osteoarthritis and Cartilage 10 (Suppl. A):S46, 2002.

46. Unifying the immune and neuroendocrine systems. S.B. Pruett & A.A. MARINO. Trends in Endocrinology & Metabolism 13:273, 2002.

45. Gap junctions in osteoarthritis (Poster No. P490). D.D. Waddell, A.A. MARINO, O.V. Kolomytkin, W.D. Meek, R.E. Wolf, K.K. Sadasivan & J.A. Albright. Proceedings of the American Academy of Orthopaedic Surgeons 2002 Annual Meeting, February 13-17, Dallas Texas, p. 574, 2002.

44. Culture of embryos in an environment shielded from exposure to electro-magnetic fields has no effect on IVF outcome. C.J. Turczynski, C. Chang, W. Hovis, A. MARINO & S.L. London. Fertility & Sterility 72 (Suppl. 1):S16, 1999.

43. Review of "Applied Bioelectricity: From Electrical Stimulation to Electropathology," by J. Patrick Reilly. A.A. MARINO. Quarterly Rev. Biol. 74:371, 1999.

42. The fine structure of apoptosis in bone healing. B. Meek, R. Routh, A. MARINO, P. Landry, K. Sadasivan & O. McClain. FASEB J., 12(5):A1107, 1998.

41. Non-linear effects of 60-Hz magnetic fields on lymphoid phenotype. A.A. MARINO, F. Jourd'heuil, M.R. Wolcott & R. Chervenak. FASEB J., 12(5):A1081, 1998.

40. Interleukin-1ß is transduced by synovial fibroblasts via a pathway involving Protein kinase C and Ca2+ influx. K. Sadasivan, O. Kolomytkin, A. MARINO, R. Wolf & J. Albright. FASEB J., 12(4):A437, 1998.

39. Gap Junctions in human synovial tissue. O. Kolomytkin, K. Sadasivan, A. MARINO, R. Wolf & J. Albright. FASEB J., 12(4):A377, 1998.

38. The effect of IL-1ß on bone healing. M.L. Olmedo, P.S. Landry, A.A. MARINO, K.K. Sadasivan & J.A. Albright. Transactions of the 43rd Annual Meeding, Orthopaedic Research Society, San Francisco, CA, Feb. 9-13, 1997, p. 257.

37. Low-level EMFs are transduced like other stimuli. A.A. MARINO. XXXIII International Congress of Physiological Sciences, St. Petersburg, Russia, L047.07 (Abstract), 1997.

36. "Brain sand" - Piezoelectric crystals in the pineal gland of the brain. S.B. Lang, A.A. MARINO & G. Berkovic. Abstracts of the Tenth International Symposium on the Applications of Ferroelectrics, East Brunswick, NJ, Aug. 18-21, 1996, p. 185.

35. Study of noncentrosymmetric crystals found in the pineal gland of the brain. S.B. Lang, A.A. MARINO & G. Berkovic. Abstracts of the 3rd European Conference on Applications of Polar Dielectrics, Bled, Slovenia, Aug. 26-29, 1996, p. 182.

34. Reply to Riegler, et al. (Letter to the Editor). A.A. MARINO & E.A. Deitch. Ann. Surg. 223:448-449, 1996.

33. The EMF bioeffects debate results from a paradigmatic shift. A.A. MARINO. Abstracts from the 18th Annual Meeting of the Bioelectromagnetics Society, Victoria, B.C., Canada, 1996.

32. Effect of 60 Hz magnetic fields on lymphoid phenotype. A.A. MARINO, R.M. Wolcott & R. Chervenak. Abstracts from the 18th Annual Meeting of the Bioelectromagnetics Society, Victoria, B.C., Canada, 1996.

31. EMF effects on viral replication: A possible explanation for the conflicting reports regarding protein synthesis. J. Staczek, H.E. Gilleland, Jr., L.B. Gilleland & A.A. MARINO. Abstracts from the 18th Annual Meeting of the Bioelectromagnetics Society, Victoria, B.C., Canada, 1996.

30. Comments on "Short exposures to 60 Hz magnetic fields do not alter MYC expression in HL60 or Daudi cells." A.A. MARINO. Radiation Res. 145(4): 513-515, 1996.

29. Management of osteolytic metastases and impending or pathologic fracture of the femur. F.L. Ampil, K.K. Sadasivan, A.A. MARINO & H.W. Chin. Abstracts from the XXIX World Congress of the International College of Surgeons, London, 1994.

28. Transient electromagnetic fields alter growth rate of rabbit synoviocytes (HIG-82) in vitro. A.A. MARINO, I. Iliev, J.P. Mains, F.X. Hart & R. Wolf. FASEB J. 8(4):A398, 1994.

27. rhIL-1ß alters membrane potential in rabbit synoviocytes (HIG-82) in vitro. I. Iliev, A. MARINO, K. Sadasivan & R. Wolf. FASEB J. 8(4):A138,1994.

26. DC magnetic field alters membrane potential in IEC-18 epithelial cells. I. Iliev & A. MARINO. FASEB J. 7(3):A353, 1993.

25. Classical and modern bioelectricity. A.A. MARINO. Medicine in Small Doses, CME, LSUMC-S, Vol. 12, May, 1991.

24. Development of a diagnostic test for sensitivity to electromagnetic fields based on quantitative analysis of brain waves. A.A. MARINO, G.B. Bell & A. Chesson. Proc. 9th Annual Intl. Symposium on Man and His Environment in Health and Disease, p. 35, 1991.

23. Potential health risks due to powerline and substation electric and magnetic fields: Miskic Subdivision. A.A. MARINO. Environmental Impact Report, Santa Cruz, CA, 1990.

22. On the relationship between surface electrical potentials and cancer. A.A. MARINO, D.M. Morris & T. Keys. J. Bioelectricity 8:279, 1989.

21. Percutaneous electrical treatment of large malignant tumors in mice. D.M. Morris & A.A. MARINO. Proc. 13th Ann. Surgical Symposium, Assoc. of VA Surgeons, San Antonio, Texas, 39, 1989.

20. Tissue reaction to high-strength polyethylene fibers used in functional repair of rabbit gastrocnemius tendons. A.A. MARINO, E.L. Anglin, R.B. Misra & S. Fronczak. Orthop. Trans. 10: 261, 1986.

29. Role of electricity as an adjunct to management of orthopaedic infection. A.A. MARINO & J.A. Albright, in Current Status of Electricity in the Clinical Sciences, Univ. of Connecticut (Orthopaedic Surgery), pp. 29-30, 1985.

18. Medically significant effects of electromagnetic radiation. A.A. MARINO, in Electromagnetic Fields and Biomembranes, Sofia University, Sofia (Bulgaria), 90-92, 1986.

17. Long-term tissue reaction to carbon fibers. A.A. MARINO & S.J. Fronczak. (Extended Abstract), in Biomedical Engineering V: Recent Developments, Proc. 5th Southern Biomedical Engineering Conference, 530-533, 1986.

16. Biological reaction to high-strength polyethylene implants. A.A. MARINO, E.L. Anglin, R.P. Misra & C. Boudreaux. Trans. 32nd Annual ORS 11: 105, 1986.

15. Uptake of Tc-99m MDP at fracture sites in rabbits following electrical stimulation. M.J. Wood, A.A. MARINO, C. Ashley & M.M. Hackley. Official Proceedings of the Annual Meeting of the Radiological Society of North America, Washington, DC, 1985.

14. Regrowth of rabbit Achilles tendons around carbon-fiber implants. R.D. Specian, A.A. MARINO & J.A. Albright. Anat. Rev. 211(3): A182-A183, 1985.

13. Electromagnetic pollution. A.A. MARINO, in Transactions of the 3rd Annual International Symposium on Man and his Environment, Human Ecology Research Foundation of the Southwest, Dallas, Texas, 1985.

12. The Battelle studies: an analysis. A.A. MARINO & Maria Reichmanis, in Proceedings of the 6th Annual Meeting of the Bioelectromagnetics Society, p. 15, 1984.

11. Health aspects of environmental electromagnetism. A.A. MARINO, in Transactions of the 2nd Annual International Symposium, Man and His Environment, Wadley Institutes, Dallas, TX, 1984.

10. Carbon-fiber reconstruction of Achilles tendons in rabbits. A.A. MARINO, V. Malakanok, J. Albright, B. Specian & M. Keating, in Transactions of the 30th Annual ORS Meeting 9: 367, 1984.

9. Silver nylon cloth; in vitro evaluation of antimicrobial activity. E.A. Deitch & A.A. MARINO, in Transactions American Burn Association, p. 58, 1984.

8. Electrical augmentation of the anti-bacterial activity of silver-nylon. A.A. MARINO, V. Malakanok, E.A. Deitch & J. Albright, in Transactions of the 3rd Annual Meeting of the Bioelectrical Repair and Growth Society 3: 36, 1983.

7. Electrical properties of silver-nylon. A.A. MARINO, V. Malakanok, E.A. Deitch & J. Albright, in Transactions of the 3rd Annual Meeting of the Bioelectrical Repair and Growth Society 3:36, 1983.

6. Electrical stimulation in orthopaedics: past, present and future. A.A. MARINO, in Transactions of the First Annual Meeting of the International Society of Bioelectricity 1: 3, 1983.

5. Reply to comments of Robert F. Smith. A.A. MARINO, Maria Reichmanis, F.S. Perry & R.O. Becker. Health Phys. 44: 700, 1983.

4. Reply to comments on “environmental power-frequency magnetic fields and suicides”. A.A. MARINO, F.S. Perry & R.O. Becker. Health Phys. 44(6): 698-699, 1983.

3. The electrical environment produced at bone fracture sites by inductive coupling. F.X. Hart & A.A. MARINO, in Transactions of the 2nd Annual Meeting of the Bioelectrical Repair and Growth Society 2: 70, 1982.

2. Silver-nylon: a new anti-bacterial agent. A.A. MARINO, E.A. Deitch & J.A. Albright, in Transactions 2nd Annual Meeting, Bioelectrical Repair and Growth Society 2: 54, 1982.

1. The foundations of bioelectricity. A.A. MARINO. J. Bioelectricity I:iii, 1982.

Exhibit 2

REFERENCES

1. MARINO, A.A., Kim, P.Y. and Frilot II, C. Trigeminal neurons detect cellphone radiation: thermal or nonthermal is not the question. Electromagn. Biol. Med. Published online ahead of print. doi: 10.1080/15368378.2016.1194294, 2016.

2. Baliatsas, C., van Kamp, I., Bolte, J., Kelfkens, G., van Dijk, C., Spreeuwenberg, P., Hooiveld, M., Lebret, E. and Yzermans, J. Clinically defined non-specific symptoms in the vicinity of mobile phone base stations: a retrospective before–after study. Sci. Total Environ. 565:714–720, 2016.

3. Hojo, S., Tokiya, M., Mikuki, M., Kanatani, K.T., Takagi, A., Tsurikisawa, N., Kame, S., Katoh, T., Tsukiuchi, T. and Kumano, H. Development and evaluation of an electromagnetic hypersensitivity questionnaire for Japanese people. Bioelectromagnetics doi: 10.1002/bem.21987, 2016.

4. Hillert L. Hypersensitivity to electricity; Symptoms, risk factors and therapeutic interventions. Thesis. Karolinska Institutet, Stockholm. https://openarchive.ki.se/xmlui/bitstream/handle/10616/38013/thesis.pdf?sequence=1&isAllowed=y. Accessed August 4, 2016. 2001

5. Medeiros, L.N. and Sanchez, T.G. Tinnitus and cell phones: the role of electromagnetic radiofrequency radiation. Braz. J. Otorhinolaryngol. 82(1):97–104, 2016.

6. Mortazavi, S.M. and Mortazavi, S.A. Tinnitus and cell phones: the role of electromagnetic radiofrequency radiation. Braz. J. Otorhinolaryngol. 82(2):248–249, 2016.

7. Bakacak, M., Bostanci, M.S., Attar, R., Yildirim, O.K., Yildirim, G., Bakacak, Z., Sayar, H. and Han, A. The effects of electromagnetic fields on the number of ovarian primordial follicles: an experimental study. Kaohsiung J. Med. Sci. 31(6):287–292, 2015.

8. Carpenter, D.O. The microwave syndrome or electro-hypersensitivity: historical background. Rev. Environ. Health 30(4):217–222, 2015.

9. Chiu, C.T., Chang, Y.H., Chen, C.C., Ko, M.C. and Li, C.Y. Mobile phone use and health symptoms in children. J. Formos Med. Assoc. 114(7):598–604, 2015.

10. Johansson O. Electrohypersensitivity: State-of-the-art of a fundamentalimpairment. Electromagnetic Biol. Med. 25: 235-258, 2006

11. Ghosn, R., Yahia-Cherif, L., Hugueville, L., Ducorps, A., Lemaréchal, J.D., Thuróczy, G., de Seze, R. and Selmaoui, B. Radiofrequency signal affects alpha band in resting electroencephalogram. J. Neurophysiol. 113(7):2753–2759, 2015.

12. Hedendahl, L., Carlberg, M. and Hardell, L. Electromagnetic hypersensitivity—an increasing challenge to the medical profession. Rev. Environ. Health 30(4):209–215, 2015.

13. Johansson, O. Electrohypersensitivity: a functional impairment due to an inaccessible environment. Rev. Environ. Health 30(4):311–321, 2015.

14. Lerchl, A., Klose, M., Grote, K., Wilhelm, A.F., Spathmann, O., Fiedler, T., Streckert, J., Hansen, V. and Clemens, M. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem. Biophys. Res. Commun. 459(4):585–590, 2015.

15. Mahmoudabadi, F.S., Ziaei, S., Firoozabadi, M. and Kazemnejad, A. Use of mobile

phone during pregnancy and the risk of spontaneous abortion. J. Environ. Health Sci. Eng. 13:34, 2015.

16. Malkemper, E.P., Eder, S.H., Begall, S., Phillips, J.B., Winklhofer, M., Hart, V. and Burda, H. Magnetoreception in the wood mouse (*Apodemus sylvaticus*): influence of weak frequency-modulated radio frequency fields. Sci. Rep. 4:9917, 2015.

17. Meo, S.A., Alsubaie, Y., Almubarak, Z., Almutawa, H., AlQasem, Y. and Hasanato, R.M. Association of exposure to radio-frequency electromagnetic field radiation (RF-EMFR) generated buy mobile phone base stations with glycated hemoglobin (HbA1c) and risk of type 2 diabetes mellitus. Int. J. Environ. Res. Public Health 12(11):14519–14528, 2015.

18. Qi, G., Zuo, X., Zhou, L., Aoki, E., Okamula, A., Watanebe, M., Wang, H., Wu, Q., Lu, H., Tuncel, H., Watanabe, H., Zeng, S. and Shimamoto, F. Effects of extremely low-frequency electromagnetic fields (ELF-EMF) exposure on B6C3F1 mice. Environ. Health Prev. Med. 20(4):287–293, 2015.

19. Rafati, A., Rahimi, S., Talebi, A., Soleimani, A., Haghani, M. and Mortazavi, S.M. Exposure to radiofrequency radiation emitted from common mobile phone jammers alters the pattern of muscle contractions: an animal model study. J. Biomed. Phys. Eng. 5(3):133–142, 2015.

20. Roggeveen, S., van Os, J., Viechtbauer, W. and Lousberg, R. EEG changes due to experimentally induced 3G mobile phone radiation. PLoS One 10(6):e0129496, 2015.

21. Tabrizi, M.M. and Bidgoli, S.A. Increased risk of childhood acute lymphoblastic leukemia (ALL) by prenatal and postnatal exposure to high voltage power lines: a case control study in Isfahan, Iran. Asian Pac. J. Cancer Prev. 16(6):2347–2350, 2015.

22. Zarei, S., Mortazavi, S.M., Mehdizadeh, A.R., Jalalipour, M., Borzou, S., Taeb, S., Haghani, M., Mortazavi, S.A., Shojaei-Fard, M.B., Nematollahi, S., Alighanbari, N. and Jarideh, S. A challenging issue in the etiology of speech problems: the effect of maternal exposure to electromagnetic feilds on speech problems in the offspring. J. Biomed. Phys. Eng. 5(3):151–154, 2015.

23. Zhang, Y., Li, Z., Gao, Y. and Zhang, C. Effects of fetal microwave radiation exposure on offspring behavior in mice. J. Radiat. Res. 56(2):261–268, 2015.

24. Zheng, F., Gao, P., He, M., Li, M., Tan, J., Chen, D., Zhou, Z., Yu, Z. and Zhang, L. Association between mobile phone use and self-reported well-being in children: a questionnaire-based cross-sectional study in Chongqing, China. BMJ Open 5(5):e007302, 2015.

25. Carlberg, M. and Hardell, L. Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones. Int. J. Environ. Res. Public Health 11(10):10790–10805, 2014.

26. Carpenter, D.O. Excessive exposure to radiofrequency electromagnetic fields may cause the development of electrohypersensitivity. Altern. Ther. Health Med. 20(6):40–42, 2014.

27. Choi, S.B., Kwon, M.K., Chung, J.W., Park, J.S., Chung, K. and Kim, D.W. Effects of short-term radiation emitted by WCDMA mobile phones on teenagers and adults. BMC Public Health 14:438, 2014.

28. Frilot II, C., Carrubba, S. and MARINO, A.A. Sensory transduction of weak electromagnetic fields: role of glutamate neurotransmission mediated by NMDA receptors. Neuroscience 258:184-191, 2014.

29. Huang, C.Y., Chuang, C.Y., Shu, W.Y., Chang, C.W., Chen, C.R., Fan, T.C. and Hsu, I.C. Distinct epidermal keratinocytes respond to extremely low-frequency electromagnetic fields differently. PLoS One 9(11):e113424, 2014.

30. Lamech, F. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: a case series. Altern. Ther. Health Med. 20(6):28–39, 2014.

31. Liu, H., Chen, G., Pan, Y., Chen, Z., Jin, W., Sun, C., Chen, C., Dong, X., Chen, K., Xu, Z., Zhang, S. and Yu, Y. Occupational electromagnetic field exposures associated with sleep quality: a cross-sectional study. PLoS One 9(10):e110825, 2014.

32. Liu, K., Li, Y., Zhang, G., Liu, J., Cao, J., Ao, L. and Zhang, S. Association between mobile phone use and semen quality: a systemic review and meta-analysis. Andrology 2(4):491–501, 2014.

33. Movvahedi, M.M., Tavakkoli-Golpayegani, A., Mortazavi, S.A., Haghani, M., Razi, Z., Shojaei-Fard, M.B., Zare, M., Mina, E., Mansourabadi, L., Nazari-Jahromi, Safari, A., Shokrpour, N. and Mortazavi, S.M. Does exposure to GSM 900 MHz mobile phone radiation affect short-term memory of elementary school students? J. Pediatr. Neurosci. 9(2):121–124, 2014.

34. Nordin, S., Neely, G., Olsson, D. and Sandström, M. Odor and noise intolerance in persons with self-reported electromagnetic hypersensitivity. Int. J. Environ. Res. Public Health 11(9):8794–8805, 2014.

35. Reale, M., Kamal, M.A., Patruno, A., Costantini, E., D'Angelo, C., Pesce, M. and Greig, N.H. Neuronal cellular responses to extremely low frequency electromagnetic field exposure: implications regarding oxidative stress and neurodegeneration. PLoS One 9(8):e104973, 2014.

36. Redmayne, M. and Johansson, O. Could myelin damage from radiofrequency electromagnetic field exposure help explain the functional impairment electrohypersensitivity? A review of the evidence. J. Toxicol. Environ. Health B Crit. Rev. 17(5):247–258, 2014.

37. Aboul Ezz, H.S., Khadrawy, Y.A., Ahmed, N.A., Radwan, N.M. and El Bakry, M.M. The effect of pulsed electromagnetic radiaiton from mobile phone on the levels of monoamine neurotransmitters in four different areas of rat brain. Eur. Rev. Med. Pharmacol. Sci. 17(13):1782–1788, 2013.

38. Byun, Y.H., Ha, M., Kwon, H.J., Hong, Y.C., Leem, J.H., Sakong, J., Kim, S.Y., Lee, C.G., Kang, D., Choi, H.D. and Kim, N. Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study. PLoS One 8(3):e59742, 2013.

39. Carpenter, D.O. Human disease resulting from exposure to electromagnetic fields. Rev. Environ. Health 28(4):159–172, 2013.

40. Hardell, L., Carlberg, M., Söderqvist, F. and Mild, K.H. Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. Int. J. Oncol. 43(6):1833–1845, 2013.

41. Huang, J., Tang, T., Hu, G., Zheng, J., Wang, Y., Wang, Q., Su, J., Zou, Y. and Peng, X. Association between exposure to electromagnetic fields from high voltage transmission lines and neurobehavioral function in children. PLoS One 8(7):e67284, 2013.

42. Mahram, M. and Ghazavi, M. The effect of extremely low frequency electromagnetic

fields on pregnancy and fetal growth, and development. Arch. Iran Med. 16(4):221–224, 2013.

43. MARINO, A.A. Electromagnetic hypersensitivity syndrome revisited again. Int. J. Neurosci. 123:593–594, 2013.

44. Mortazavi, S., Parsanezhad, M., Kazempour, M., Ghahramani, P., Mortazavi, A. and Davari, M. Male reproductive health under threat: short term exposure to radiofrequency radiations emitted by common mobile jammers. J. Hum. Reprod. Sci. 6(2):124–128, 2013.

45. Nordin, S., Palmquist, E., Claeson, A.S. and Stenberg, B. The environmental hypersensitivity symptom inventory: metric properties and normative data from a population-based study. Arch. Public Health 71(1):18, 2013.

46. Redmayne, M., Smith, E. and Abramson, M.J. The relationship between adolescents' well-being and their wireless phone use: a cross-sectional study. Environ. Health 12:90, 2013.

47. Shamsi Mahmoudabadi, F., Ziaei, S., Firoozabadi, M. and Kazemnejad, A. Exposure to extremely low frequency electromagnetic fields during pregnancy and the risk of spontaneous abortion: a case-control study. J. Res. Health Sci. 13(2):131–134, 2013.

48. Umur, A.S., Yaldiz, C., Bursali, A., Umur, N., Kara, B., Barutcuoglu, M., Vatansever, S., Selcuki, D. and Selcuki, M. Evaluation of the effects of mobile phones on the neural tube development of chick embryos. Turk. Neurosurg. 23(6):742–752, 2013.

49. Frei, P., Mohler, E., Braun-Fahrländer, C., Frölich, J., Neubauer, G., Röösli, M. and QUALIFEX-team. Cohort study on the effects of everyday life radio frequency electromagnetic field exposure on non-specific symptoms and tinnitus. Environ. Int. 38(1):29–36, 2012.

50. MARINO, A.A., Carrubba, S. and McCarty, D. Response to Letter to the Editor concerning "Electromagnetic hypersensitivity: evidence for a novel neurological syndrome". Int. J. Neurosci. 122(7):402–403, 2012.

51. Misa Agustiño, M.J., Leiro, J.M., Jorge Mora, M.T., Rodríguez-González, J.A., Jorge Barreiro, F.J., Ares-Pena, F.J. and López-Martín, E. Electromagnetic fields at 2.45 GHz trigger changes in heat shock proteins 90 and 70 without altering apoptotic activity in rat thyroid gland. Biol. Open 1(9):831–838, 2012.

52. Hillert L, N. Berglind, B.B. Arnetz, T. Bellander. Prevalence of selfreported hypersensitivity to electric or magnetic fields in a population-based questionnaire survey. Environ Helath 28: 33-41, 2002

53. Touitou, Y. and Selmaoui, B. The effects of extremely low-frequency magnetic fields on melatonin and cortisol, two marker rhythms of the circadian system. Dialogues Clin. Neurosci. 14(4):381–399, 2012.

54. Frilot II, C., Carrubba, S. and MARINO, A.A. Transient and steady-state magnetic fields induce increased fluorodeoxyglucose uptake in the rat hindbrain. Synapse 65:617–623, 2011.

55. Seitz H, D. Stinner, Th. Eikmann, C. Herr and M. Röösli. Electromagnetichypersensitivity and subjective health complaints associated withelectromagnetic fields of mobile phone communication - A literature review published between 2000 and 2004. Sci Total Environ. 349:45-55, 2005.

56. McCarty, D.E., Carrubba, S., Chesson Jr., A.L., Frilot II, C., Gonzalez-Toledo, E. and MARINO, A.A. Electromagnetic hypersensitivity: evidence for a novel neurological syndrome. Int. J. Neurosci. 121:670–676, 2011.

57. Röösli, M. and Hug, K. Wireless communication fields and non-specific symptoms of ill health: a literature review. Wien Med. Wochenschr. 161(9–10):240–250, 2011.

58. Volkow, N.D., Tomasi, D., Wang, G.J., Vaska, P., Fowler, J.S., Telang, F., Alexoff, D., Logan, J. and Wong, C. Effects of cell phone radiofrequency signal exposure on brain glucose metabolism. JAMA 305(8):808-–813, 2011.

59. Carpenter, D.O. Electromagnetic fields and cancer: the cost of doing nothing. Rev. Environ. Health 25(1):75–80, 2010.

60. Carrubba, S., Frilot II, C., Chesson Jr., A.L. and MARINO, A.A. Mobile-phone pulse triggers evoked potentials. Neurosci. Lett. 469:164–168, 2010.

61. Carrubba, S., Frilot II, C., Chesson Jr., A.L. and MARINO, A.A. Numerical analysis of recurrence plots to detect effect of environmental-strength magnetic fields on human brain electrical activity. Med. Eng. Phys. 32(8):898–907, 2010.

62. Mohler, E., Frei, P., Braun-Fahrländer, C., Frölich, J., Neubauer, G., Röösli, M. and QUALIFEX Team. Effects of everyday radiofrequency electromagnetic-field exposure on sleep quality: a cross-sectional study. Radiat. Res. 174(3):347–356, 2010.

63. Thomas, S., Heinrich, S., von Kries, R. and Radon, K. Exposure to radio-frequency electromagnetic fields and behavioural problems in Bavarian children and adolescents. Eur. J. Epidemiol. 25(2):135–141, 2010.

64. Carrubba, S., Frilot II, C., Hart, F.X., Chesson Jr., A.L. and MARINO, A.A. The electric field is a sufficient physical determinant of the human magnetic sense. Int. J. Radiat. Biol. 85:622–632, 2009.

65. McKinney H. and K. Crofton (2007). SWI-ES survey. A health study on theprevalence of electro-sensitivity condition. Safe wireless initiative.www.safewirelessinitiative.org

66. Frilot II, C., Carrubba, S. and MARINO, A.A. Magnetosensory function in rats: localization using positron emission tomography. Synapse 63:421–428, 2009.

67. Yilmaz A, Yilmaz N, Serarslan Y, Aras M, Altas M, Özgür T, Sefil F. The effects of mobile phones on apoptosis in cerebral tissue: an experimental study on rats. Eur Rev Med Pharmacol Sci. 18(7):992-1000, 2014.

68. MARINO, A.A. and Carrubba, S. The effects of mobile-phone electromagnetic fields on brain electrical activity: a critical analysis of the literature. Electromagn. Biol. Med. 28(3):250–274, 2009.

69. MARINO, A.A., Carrubba, S., Frilot, C. and Chesson Jr., A.L. Evidence that transduction of electromagnetic field is mediated by a force receptor. Neurosci. Lett. 452:119–123, 2009.

70. Carrubba, S. and MARINO, A.A. The effects of low-frequency environmental-strength electromagnetic fields on brain electrical activity: a critical review of the literature. Electromagnetic Biology and Medicine 27:83–101, 2008.

71. Woldańska-Okońska M, Czernicki J, Karasek M. Human stress therapy. The influence of the low-frequency magnetic fields of different parameters on the

secretion of cortisol in men. Int J Occup Med Environ Health. 26:92-101, 2013 2008.

72. Ahmet Koyua, Gokhan Cesura, Fehmi Ozgunera, Mehmet Akdoganb, Hakan Mollaoglua, Sukru Ozenc. Effects of 900 MHz electromagnetic field on TSH and thyroid hormones in rats. Toxicology Letters. 157: 257-262

73. Merzenich, H., Schmiedel, S., Bennack, S., Brüggemeyer, H., Philipp, J., Blettner, M. and Schüz, J. Childhood leukemia in relation to radio frequency electromagnetic fields in the vicinity of TV and radio broadcast transmitters. Am. J. Epidemiol. 168(10):1169–1178, 2008.

74. Carrubba, S., Frilot, C., Chesson Jr., A.L. and MARINO, A.A. Nonlinear EEG activation by low-strength low-frequency magnetic fields. Neurosci. Lett. 417:212–216, 2007.

75. Carrubba, S., Frilot, C., Chesson Jr., A.L. and MARINO, A.A. Evidence of a nonlinear human magnetic sense. Neuroscience 144:356–367, 2007.

76. Kolomytkin, O.V., Dunn, S., Hart, F.X., Frilot, C., Kolomytkin, D. and MARINO, A.A. Glycoproteins bound to ion channels mediate detection of electric fields: a proposed mechanism and supporting evidence. Bioelectromagnetics 28:379-–385, 2007.

77. Otto, M. and von Mühlendahl, K.E. Electromagnetic fields (EMF): do they play a role in children's environmental health (CEH)? Int. J. Hyg. Environ. Health 210(5):635–644, 2007.

78. Tran, V. The Radiation Control for Health and Safety Act of 1968: History, Accomplishments, and Future (2006 Third Year Paper). Harvard Law School. http://nrs.harvard.edu/urn-3:HUL.InstRepos:8846732. Accessed July 20, 2016.

79. Feychting, M. Non-cancer EMF effects related to children. Bioelectromagnetics Suppl. 7:S69–S74, 2005.

80. Kantar Gok D, Akpinar D, Yargicoglu P, Ozen S, Aslan M, Demir N, Derin N, Agar A. Effects of extremely low-frequency electric fields at different intensities and exposure durations on mismatch negativity. Neuroscience. 11;272:154-66, 2014.

81. Johansen, C. Electromagnetic fields and health effects—epidemiologic studies of cancer, diseases of the central nervous system and arrhythmia-related heart disease. Scand. J. Work Environ. Health 30(Suppl. 1):1–30, 2004.

82. Rafati A, Rahimi S, Talebi A, Soleimani A, Haghani M, Mortazavi SM. Exposure to Radiofrequency Radiation Emitted from Common Mobile Phone Jammers Alters the Pattern of Muscle Contractions: an Animal Model Study. J Biomed Phys Eng. 5:133-42, 2015.

83. MARINO, A.A., Nilsen, E., A.L. Chesson Jr. and Frilot, C. Effect of low-frequency magnetic fields on brain electrical activity in human subjects. Clin. Neurophysiol. 115:1195–1201, 2004.

84. MARINO, A.A., Nilsen, E. and Frilot, C. Nonlinear changes in brain electrical activity due to cell-phone radiation. Bioelectromagnetics 24:339–346, 2003.

85. MARINO, A.A., Nilsen, E. and Frilot, C. Localization of electroreceptive function in rabbits. Physiol. Behav. 79:803–810, 2003.

86. MARINO, A.A., Nilsen, E. and Frilot, C. Consistent magnetic-field induced dynamical changes in rabbit brain activity detected by recurrence quantification analysis. Brain Res. 951:301–310, 2002.

87. Knave, B. Electromagnetic fields and health outcomes. Ann. Acad. Med. Singapore 30(5):489–493, 2001.

88. MARINO, A.A., Wolcott, R.M., Chervenak, R., Jourd'heuil, F., Nilsen, E. and Frilot, C. Nonlinear dynamical law governs magnetic field induced changes in lymphoid phenotype. Bioelectromagnetics 22:529–546, 2001.

89. MARINO, A.A., Wolcott, R.M., Chervenak, R., Jourd'heuil, F., Nilsen, E., Frilot, C. and Pruett, S.B. Coincident nonlinear changes in the endocrine and immune systems due to low-frequency magnetic fields. NeuroImmunoModulation 9:65–77, 2001.

90. Sonnier, H. and MARINO, A.A. Sensory transduction as a proposed model for biological detection of electromagnetic fields. Electro- and Magnetobiology 20:153–175, 2001.

91. Staczek, J., MARINO, A.A., Gilleland, L.B., Pizarro, A. and Gilleland, H.E. Low-frequency electromagnetic fields alter the replication cycle of MS2 bacteriophage. J. Current Microbiology 36:298–301, 1998.

92. Landry, P.S., Sadasivan, K.K., MARINO, A.A. and Albright, J.A. Electromagnetic fields can affect osteogenesis by increasing the rate of differentiation. Clin. Orthop. Relat. Res. 338:262–270, 1997.

93. Mailhes, J.B., Young, D., MARINO, A.A. and London, S.N. Electromagnetic fields enhance chemically-induced hyperploidy in mammalian oocytes. Mutagenesis 12(5):347–351, 1997.

94. MARINO, A.A., Bell, G.B. and Chesson, A. Low-level EMFs are transduced like other stimuli. J. Neurol. Sci. 144:99–106, 1996.

95. MARINO, A.A. Time-dependent hematological changes in workers exposed to electromagnetic fields. Am. Ind. Hyg. Assoc. J. 56(2):189–192, 1995.

96. Bell, G.B., MARINO, A.A. and Chesson, A.L. Frequency-specific responses in the human brain caused by electromagnetic fields. J. Neurol. Sci. 123(1–2):26–32, 1994.

97. Bell, G.B., MARINO, A.A. and Chesson, A.L. Frequency-specific blocking in the human brain caused by electromagnetic fields. Neuroreport 5(4):510–512, 1994.

98. MARINO, A.A. Electromagnetic fields, cancer, and the theory of neuroendocrine-related promotion. Bioelectrochem. Bioenerg. 29:255–276, 1993.

99. Bell, G., MARINO, A., Chesson, A. and Struve, F. Electrical states in the rabbit brain can be altered by light and electromagnetic fields. Brain Res. 570(1–2):307–315, 1992.

100. Bell, G.B., MARINO, A.A. and Chesson, A.L. Alterations in brain electrical activity caused by magnetic fields: detecting the detection process. Electroencephalogr. Clin. Neurophysiol. 83(6):389–397, 1992.

101. Bell, G.B., MARINO, A.A., Chesson, A.L. and Struve, F.A. Human sensitivity to weak magnetic fields. Lancet 338(8781):1521–1522, 1991.

102. MARINO, A.A. Meta-analysis of multi-generational studies in mice exposed to power-frequency electric fields. J. Bioelectricity 9:213–231, 1990.

103. MARINO, A.A. Environmental electromagnetic fields and public health, in *Modern Bioelectricity*, A.A. MARINO, Editor. Marcel Dekker: New York. pp. 965–1044, 1988.

104. MARINO, A.A. Direct current and bone growth, in *Modern Bioelectricity*, A.A. MARINO, Editor. Marcel Dekker: New York. pp. 657–709, 1988.

105. MARINO, A.A. Are powerline fields hazardous to health? Yes. Public Power 45:1820, 1987.

106. MARINO, A.A. Health risks from electric power facilities. Presented at International Utility Symposium, Health Effects of Electric and Magnetic Fields, Ontario Hydro, Toronto, Canada, 1986.

107. MARINO, A.A. Electromagnetic energy in the environment and human disease. Clin. Ecol. 3(3):154–157, 1985.

108. MARINO, A.A. Electromagnetic fields and public health, in *Assessments and Viewpoints on the Biological and Human Health Effects of Extremely Low Frequency Electromagnetic Fields*. American Institute of Biological Sciences: Arlington, VA. pp. 205–232, 1985.

109. MARINO, A.A. and Morris, D.M. Chronic electromagnetic stressors in the environment: a risk factor in human cancer. J. Environ. Sci. C3(2):189–219, 1985.

110. MARINO, A.A., Cullen, J.M., Reichmanis, M., Becker, R.O. and Hart, F.X. Sensitivity to change in electrical environment: a new bioelectric effect. Am. J. Physiol. 239(5):R424–R427, 1980.

111. MARINO, A.A., Reichmanis, M., Becker, R.O., Ullrich, B. and Cullen, J.M. Power frequency electric field induces biological changes in successive generations of mice. Experientia 36:309–311, 1980.

112. MARINO, A.A., Cullen, J.M., Reichmanis, M. and Becker, R.O. Fracture healing in rats exposed to extremely low-frequency electric fields. Clin. Orthop. Relat. Res. 145:239–244, 1979.

113. Reichmanis, M., Perry, F.S., MARINO, A.A. and Becker, R.O. Relation between suicide and the electromagnetic field of overhead power lines. Physiol. Chem. Phys. 11(5):395–403, 1979.

114. Becker, R.O. and MARINO, A.A. Electromagnetic pollution. The Sciences Jan.:14, 15, 23, 1978.

115. MARINO, A.A., Cullen, J.M., Reichmanis, M. and Becker, R.O. Power frequency electric fields and biological stress: a cause-and-effect relationship. *Eighteenth Annual Hanford Life Sciences Symposium*, Richland, Washington: Technical Information Center, U.S. Department of Energy. Volume 50, pp. 258–276, 1978.

116. MARINO, A.A. and Becker, R.O. Hazard at a distance: effects of exposure to the electric and magnetic fields of high voltage transmission lines. Med. Res. Eng. 12(5):6–9, 1977.

117. MARINO, A.A. and Becker, R.O. Biological effects of extremely low frequency electric and magnetic fields: a review. Physiol. Chem. Phys. 9(2):131–147, 1977.

118. MARINO, A.A., Berger, T.J., Austin, B.P., Becker, R.O. and Hart, F.X. In vivo bioelectrochemical changes associated with exposure to extremely low frequency electric fields. Physiol. Chem. Phys. 9(4–5):433–441, 1977.

119. MARINO, A.A., Becker, R.O. and Ullrich, B. The effect of continuous exposure to low

frequency electric fields on three generations of mice: a pilot study. Experientia 32(5):565–566, 1976.

120. MARINO, A.A., Berger, T.J., Austin, B.P. and Becker, R.O. Evaluation of electrochemical information transfer system. I. Effect of electric fields on living organisms. J. Electrochem. Soc. 123:1199–1200, 1976.

121. Khurana VG Hardell L Everaert J Bortkiewicz A Carlberg M Ahonen M. Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations. Int Journal of Occupational Environmental Health.16:263–267, 2010

122. Tang J, Zhang Y, Yang L, Chen Q, Tan L, Zuo S, Feng H, Chen Z, Zhu G. Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. Brain Res. 1601:92-101, 2015

123. Eltiti S, Wallace D, Ridgewell A, Zoughou K, Russo R, Sepulveda F, Mirshekar-Syahkal D, Rasor P, Deeble R, Fox E. Does short-term exposure to mobile phone base station signals increase symptoms in individuals who report sensitivity to electromagnetic fields? Environ Health Perspect. 115:1603-1608, 2007

124. Rea WJ, Pan Y, Yenyves EJ, Sujisawa I, Samadi N, Ross GH. Electromagnetic field sensitivity. J Bioelect. 10:241-256, 1991

125. Röösli M. Symptoms of ill health ascribed to electromagnetic field exposure- a questionnaire survey. Int J Hyg Environ Health. 207:141-150, 2004.

126. Röösli M., M. Möser, Y. Baldinini, M. Meier, C. Braun-Fahrlander.Symptoms of ill health ascribed to electromagnetic field exposure- A questionnaire survey. Int. J. Hyg. Environ Health. 207:141-150, 2004.

127. Lamech F. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: A case study. Alter Ther. 20:28-39, 2014

128. Qi G, Zuo X, Zhou L, Aoki E, Okamula A, Watanebe M, Wang H, Wu Q, Lu H, Tuncel H, Watanabe H, Zeng S, Shimamoto F. Effects of extremely low-frequency electromagnetic fields exposure on B6C3F1 mice. Environ Health Prev Med. 2:287-93, 2015

129. Johnson-Liakouris AG. Radiofrequency sickness in the Lillenfeld study: an effect of modulated microwaves? Arch Environ Health. 53:236-238, 1998.

130. Forman SA, Holmes CK, McManamon TV, Wedding WR. Psychological symptoms and intermittent hypertension following acute microwave exposure. J Occup Med. 24: 932-934, 1982

131. Frey AH. Human auditory system response to modulated electromagnetic energy. J Appl Physiol 17:689-692, 1962.

132. Carpenter DO. Human disease resulting from exposure to electromagnetic fields.Rev Environ Health. 28:159-172, 2013.

133. Association between Exposure to Smartphones and Ocular Health in Adolescents. Kim J, Hwang Y, Kang S, Kim M, Kim TS, Kim J, Seo J, Ahn H, Yoon S, Yun JP, Lee YL, Ham H, Yu HG, Park SK. Ophthalmic Epidemiol. 23:269-76, 2016

134. Havas M. Electromagnetic hypersensitivity: biological effects of dirty electricitywith emphasis on diabetes and multiple sclerosis. Electromagn Biol Med.25:259-268, 2006

135. Eltiti S, Wallace D, Zougkou K, et al. Development and evaluation of theelectromagnetic hypersensitivity questionnaire. Bioelectromagnetics.28:137-151, 2007.

136. Schooneveld H, Kuiper J; Dutch Electrohypersensitivity (EHS) Foundation.Electrohypersensitivity (EHS) in the Netherlands—a questionnaire survey. 2007. http://www.powerwatch.org.uk/news/20071218_ehs_netherlands.pdf.Accessed Accessed August 4, 2016.

137. Austrian Medical Association's EMF Working Group. Guideline of the AustrianMedical Association for the diagnosis and treatment of EMF-related healthproblems and illnesses (EMF syndrome): consensus paper of the Austrian

138. Medical Association's EMF Working Group. http://www.vagbrytaren.org/Guideline%20%20AG-EMF.pdf. Accessed August 4, 2016.

139. Electromagnetic and radiofrequency fields effect on human health. American Academy of Environmental Medicinehttps://www.aaemonline.org/pdf/emfpositionstatement.pdf. Accessed August 4, 2016

140. Effects of acute exposure to WIFI signals on heart variability and blood pressure in Albinos rabbit. Sailia L, Haninib A, Smiranib C, Azzouzb I, Azzouza A, Saklyb M, Abdelmelekb H, Bouslamaa Z. Environmental Toxicology and Pharmacology.40; 600–605, 2015.

141. Schröttner, J. and Leitgeb, N. Sensitivity to electricity – Temporal changes in Austria. BMC Public Health 2008, 8:310. Available at: http://www.biomedcentral.com/content/pdf/1471-2458-8-310.pdf (Accessed August 4, 2016).

142. Electromagnetic hypersensitivity. Jamieson, I. European Economic and Social Committee 2014. https://www.dropbox.com/s/yi9blv356so0wbf/IAJ_EMF_BRUSSELS_Revised_0141124A-min.pdf?dl=0. Accessed August, 4, 2016 2014.

143. EM Radiation Research Trust. Electromagnetic Hypersensitivity. 2015

144. Hallberg, O. and Oberfeld, G. Will we all become electrosensitive?. Electro Bio Med 25 (3): 189-91, 2006.