

# Electrophobia and Misconceptions of Non-Ionizing Radiation Hazards

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*The public is protected through the enforcement of environmental regulations and standards which are based on solid scientific data.*

## Headlines on Non-Radiation Health Effects

The public is exposed daily to dramatic headlines on the radio, TV, and newspapers regarding severe health consequences associated with human exposure to radio frequency (RF) radiation and extremely low frequency (ELF) fields. Commercial advertisements are purposely fueling the "electrophobia fire" to promote sales of a "radiation filter" for computer monitors, a "shielding case" for a cellular telephone, commercial measurements of electromagnetic radiation leakage from domestic microwave-ovens, etc. Headlines noted in print media have included: "Killing Fields," "Warning, Electricity Can Be Hazardous to Your Health," "Electromagnetic Fields from Appliances - Danger to Your Health," "Currents of Death: Power Lines, Computer Terminals, and the Attempt to Cover Up Their Threat to Your Health."

An example of how the media inflames the public fear of RF radiation was demonstrated during a popular TV show called "Popolitica" (broadcast on the Israeli First TV Channel, November 18, 1996). The TV program dealt with "possible RF radiation adverse effects to residents who live near radio base stations." Several experts with various academic backgrounds participated and expressed their apprehension on this topic. (In this author's opinion, none of the experts was a real expert on the topic - radiation hazards to personnel -

as was evident from the discussions).

The word that came from this broadcast was rather demonizing of RF radiation as affecting human health. "I am ready to put the base station antennas on the roof of my house," said one journalist who admitted that he is not an expert in the show's main topic. (However, he is known to possess a superb analytical mind.) Unfortunately, this journalist was the only attendee who balanced the general electrophobic mood that prevailed among the other guests on the TV show. The "experts" had launched their radiation-phobias, aiming to convince the viewers and they were probably quite successful.

The average viewer of this talk show could have been convinced that residents who live or stay at the vicinity of radio base stations might experience adverse health effects as terrible as cancer, that there is a worldwide conspiracy to hide from the public potential harmful effects of exposure to RF radiation, and that present international radiation safety guidelines (IRPA<sup>3</sup>, IEEE<sup>4</sup>, NRB<sup>5</sup>, etc.) said to be based on a broad scientific database are, in fact, misleading the public.

One of the "experts" added a theory of his own that has never been substantiated with a scientific work. He stated that "interaction of RF and microwave radiation with living tissues might yield induced currents onto the nervous system and at individual biological cells..." At a subsequent Israeli parliament committee meeting another "ex-

pert" stated, "... I observed with my own eyes how an irradiated (RF radiations) healthy human cell turns into a carcinogenic cell in less than 30 minutes..."

Indeed, the demonic messages which are relayed to the general public by so-called experts frighten the general public, who subsequently increase public pressure on municipal authorities to prohibit base station installation in their communities. Unfortunately, these kinds of actions are becoming quite common.

## The Consequences

Let us pause for a moment from the "witch hunting" approach and consider objectively the inevitable consequences of preventing the deployment of base stations: without proper deployment of radio relays across the country, modern services which rely on wireless technology will face increasing difficulties in meeting the high quality and low-cost standards expected by their customers. Essential services which could be affected include TV and radio broadcasts, cellular telephone networks, microwave links, and computer networks such as the Internet. Disruptions to such services would certainly adversely affect the public, which would no longer be able to attain the best possible cost-effective wireless service.

The growing electrophobia inevitably brings about several consequences,

*Continued on page 236*

most of which have negative ramifications for our modern society. Due to public electrophobia and increased difficulties with situating base stations in residential areas, the proliferation of wireless communication technology has slowed down in the U.S. and in many other developed countries.

According to analysts' predictions, the increase in cellular telephone users was expected to be much greater than it is presently; people's fear of the radiation emitted by hand-held transceivers has considerably reduced the number of potential users.

Due to public pressure, research organizations are using funds to study non-ionizing radiation effects. These funds could be better spent on urgently needed remedies and therapies to real diseases that affect human health, quality of life, and average life span.

Radio frequency emitting equipment is undergoing redesign and modification, although radiation levels do not exceed permissible radiation safety levels as per IEEE C95.1-1991 Standard.<sup>3</sup>

Schools and other public institutions are being relocated away from power lines. Similarly, high voltage power lines are being rerouted away from residential areas.

Until 1995, about \$23 billion dollars were spent on scientific studies that investigated possible health effects of non-ionizing radiation exposure. The current estimate of funds that will be spent before 2010 in research of non-ionizing radiation effects and associated topics approaches a trillion dollars. Imagine the benefits that could be gained by the civilized world if funding for health topic research was channeled based on objective criteria and truly urgent needs rather than on public fears and fuzzy threats!

How is electrophobia spreading? What lessons can we draw from recent history about public fears from newly introduced technologies? Are there effective methods to confront electrophobia? What are the rules that scientists and engineers should employ in order to lessen public electrophobia? The following deals with these questions

and proposes methods for better understanding electrophobia and ways to diminish it.

## History of RADHAZ Awareness

In 1913 Karl Franz Nagleschmidt (1875-1952) invented the use of radio-frequency waves for hyperthermia therapy. This method has been augmented throughout the years and encompasses many different kinds of radiation and electricity usages in medical treatments, including: hyperthermia therapy of deep biological tissues; fighting contamination diseases via hyperthermia; surgeries associated with electrification of tissues; detection of cancerous tumors; rapid healing of broken bones; removing skin stains; and hiding sub-skin blood veins.

For many years after Karl Franz Nagleschmidt introduced his invention, nobody paid any attention to the potential hazards associated with the exposure of live biological tissues to non-ionizing radiation. On the contrary, it was clear then that irradiating unhealthy tissues with radio frequency waves miraculously healed the affected tissues and helped to restore health and fitness. Many patients enjoyed this unique therapy technique and it is still used worldwide. New medical treatments based on radio frequency waves are being developed and successfully utilized on humans.

Hazards of electromagnetic radiation to personnel (HERP) awareness date to the early 1940s and stem from morale problems among U.S. Navy sailors caused by rumors and fear of

radar. During World War II, two surveys on radiation hazards to personnel were commissioned by the military. The U.S. Navy Medical Bulletin reported in 1943 on one of the surveys and concluded that "...there has been no clinical evidence of damage to these personnel..." The second survey (1945), found "...no evidence..." of abnormalities, and therefore "...no cause for alarm."

However, in 1948, research at the Mayo Clinic confirmed reports of cataracts on the eyes of dogs caused solely by microwave energy. At the same time, military research reported a link between microwaves, cataracts and testicular degeneration in dogs. The medical community then believed that the beneficial effects were more important than any hazard and the need for a safety standard was ignored. This attitude continued into the 1950s. In April 1953, U.S. Navy officials convened a meeting with the goal of determining "tolerance dosages." Based on thermal effects, permissible exposure levels ranged from 0.1 mW/cm<sup>2</sup> to 10 mW/cm<sup>2</sup>. This was quickly accepted and all official communications thereafter gave 10 mW/cm<sup>2</sup> as the permissible level, a figure that would form the basis for ANSI/IEEE C95.1 more than a decade later.

In 1972, with the support of the Institute of Electrical and Electronic Engineers (IEEE), the Committee on Man and Radiation (COMAR) was established. The prime objective of COMAR now, as then, is to "evaluate information published on the effects of non-ionizing radiation on biological systems." The committee promulgated its position on non-ionizing ra-

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diation effects on human health via scientific papers and the media. In the mid-1970s COMAR stated its concern about possible hazardous radiation leakage from microwave ovens and called to establish a radiation safety standard for them. COMAR and the Federal Drug Administration (FDA) worked together to issue a standard that limited radiation leakage from domestic microwave ovens. With minor changes, this standard was adopted by most of the standard institutions throughout the world.

In spite of COMAR efforts to alleviate public misconceptions and fears of non-ionizing radiation, public electrophobia has grown. Toward the late 1980's, adverse health effects speculated to have been a result of chronic exposure to 50/60 Hz mag-

netic fields from overhead power lines in residential areas made frightening headlines, some of which have been mentioned.



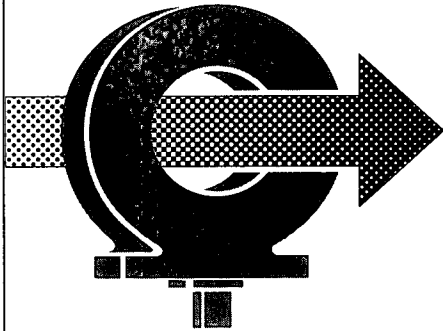
In the United States, Europe, and other countries, articles in the scientific and popular press expressed concerns about possible childhood leukemia and

manic-depression due to chronic exposure to 50/60 Hz magnetic fields in residential areas. Some of these articles recommended "prudent avoidance" to

exposure from power-lines magnetic fields and to pursue the safety concept of "as low as reasonably achievable (ALARA)" that predominate exposure to ionizing radiation (e.g., X-and gamma rays). The ALARA exposure concept, in conjunction with exposure to very low frequency fields, created in people's minds an association between these two radiation types which are both, indeed, electromagnetic energy forms but are not the same in terms of

the adverse effects they might cause in biological tissue.

In an article titled "Fields of Fear" by Gary Taubesc and a recent article<sup>1</sup>



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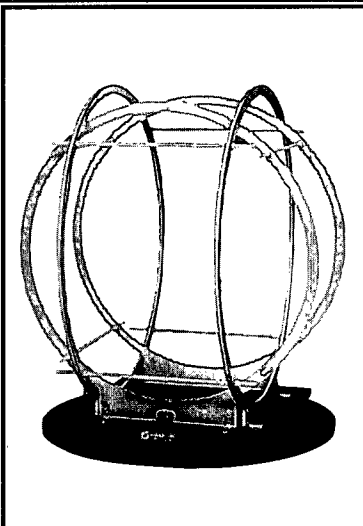
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titled "Electrophobia" by Eleanor R. Adair, the authors indicate that "...most people want to believe that electromagnetic fields are unhealthy," and that "...common people do not differentiate between 50/60Hz fields, RF and microwave radiation, visible light, laser beams, X and gamma rays, etc." Generally, people who are not involved in related areas of science and physics would usually not be aware of the differences between electric field, magnetic field and electromagnetic radiation and between non-ionizing and ionizing radiation.

In 1990 and 1992, in response to the concerns that had increased during the previous decade, the British Institute of Electrical Engineers (IEE), Health and Safety Committee established a working group to "review all currently available evidence to the possible biological effects of low-level, low-frequency electromagnetic fields associated with overhead power distribution cables, house wiring, domestic appli-

ances and VDUs and submit a report on the findings."

In June 1994 the working party published its findings.<sup>2</sup> Using scientific criteria, each relevant paper was reviewed and assessed by a working group member whose expertise was most appropriate. The committee scrutinized 245 papers, including 40 epidemiology papers, 69 animal studies, 55 cellular studies, 19 medical applications and 62 miscellaneous papers. The working group conclusions were quite amazing: about 99% of the reviewed papers were classified as artifacts; in other words, they failed to comply with scientific criteria required to validate findings.

The IEE committee stated "...the literature has added little to the understanding of the biological effects of low-level, low-frequency electromagnetic fields. Inconclusive epidemiological evidence has continued to appear but animal and cellular studies have failed to elucidate any

mechanism or consistent trend in results. There still remains no well accepted experiment that shows any effect of these low-level field and dos-response curves have yet to be demonstrated."

## NRC

The National Research Council (NRC) Committee (USA) on the Possible Effects of Electromagnetic Fields on Biologic Systems had examined more than 500 studies on electric and magnetic fields (EMF) biological effects spanning 17 years of research. The committee focused on the health studies of low-frequency electric and magnetic fields common in homes. Sources of exposure include transmission and distribution lines and electric appliances, including shavers, hair dryers, video display terminals, and electric blankets. In late 1996, NRC concluded in their report that "...no conclusive evidence that electromagnetic fields

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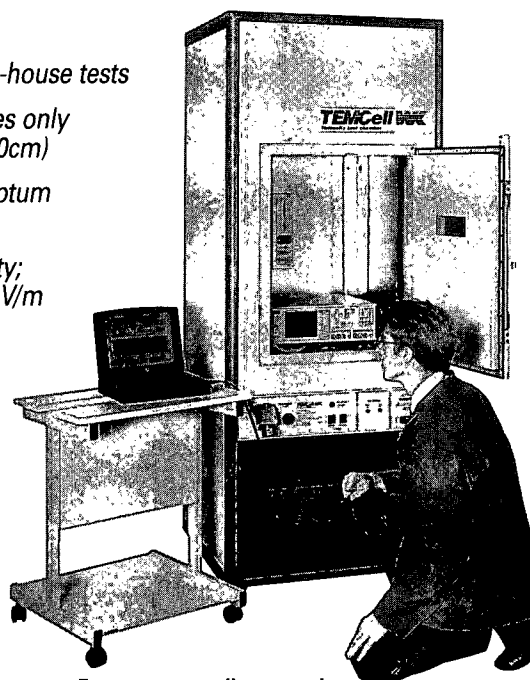


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*play a role in the development of cancer, reproductive and developmental abnormalities, or learning and behavioral problems."*<sup>5</sup>

## Contributing Factors

Nevertheless, public electrophobia exists. Risk misconception is the major contributing factor to public electrophobia. Misconception of a 'risk' stems from known psychological factors that influence apprehension of risk associated with a given threat. The following three examples illustrate this point.

### NATURAL VERSUS INDUSTRIAL RISK

An example of this dichotomy is suntanning, which actually involves exposure of the human skin to excessive ultraviolet (UV) radiation. Bands B and C of the UV spectra are considered ionizing radiation and might promote skin cancer (melanoma). However, since this comes from a natural source – the sun – many people are willing to take the risk or ignore it. On the other hand, RF radiation from a radio base station with an antenna erected in a residential area is perceived as an "industrial" risk, subsequently causing fears and health concerns among the residents although it usually emits low-power non-ionizing radiation.

### VOLUNTARY VERSUS COMPULSORY RISK

In spite of the dreadful statistics of fatalities and injured people due to traffic accidents, modern society will never give up the advantages of motorized transportation – cars, trains, ships and aircraft flights. In many modern countries, traffic accidents are the main cause of death. Nonetheless, we are willing to accept the risk and continue using motorized transportation. We take this risk voluntarily and therefore we do not fear it as much as we fear a less severe risk that is forced upon us, such as exposure to radio waves emitted from a local base station.

Residents living near the transmit-

ting antennas are usually not asked to give their consent to operate a radio base station (such as for a cellular radio relay station) near their houses. Many cases against radio service providers are brought to court by concerned residents. In most of these cases the court permits the resumption of broadcasting, as it can be proven through relatively accurate radiation measurements that the RF radiation levels in the neighborhood are well below the permissible radiation levels set forth by national and international standards and regulations.

### FAMILIAR VERSUS EXOTIC RISK

Many people, including this author, are willing to accept familiar risks, such as inhaling cigarette smoke, consuming unhealthy foods that contain fat and cholesterol, crossing a busy road, and driving a car above the legal speed limit. These are only a few of the familiar risks that illustrate the difference in attitudes and perceptions of familiar risks compared with the perceptions of exotic risk, such as getting hit by a falling meteor or being caught in a volcanic eruption. As Gary Tubes stated, for many people exposure to RF radiation is an exotic risk, and as such, it generates fears that are out of proportion in comparison to familiar risks.

## Scientists' Responsibility

The public's scientific ignorance and misperception of the risks associated with non-ionizing radiation plays into the hands of "interested experts" who take advantage of public concerns and fears. Self-proclaimed experts can gain publicity, power and funds by manipulating public fears using the media. In general, demonizing a "threat" (not only RF radiation hazards but also other threats) helps to sell papers, increase ratings of TV and radio shows, and promote "safety products," such as a radiation filter for video display terminals (VDT) and a special

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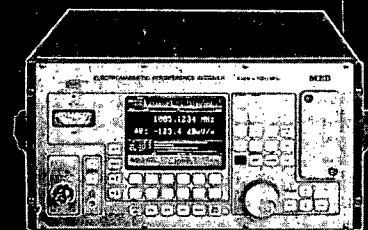
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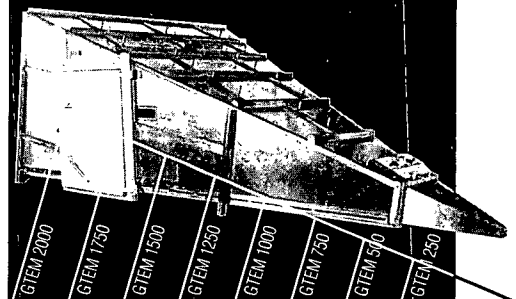
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cellular phone case that "protects the brain from cellular phone radiation."

The correspondence between these misleading messages and hard scientific facts is merely accidental. According to Eleanor Adair,<sup>1</sup> who is also co-chairing the IEEE C95.1 Standard Committee, there is a symbiotic relationship between the public and the media, as the public likes to be fed with dreadful messages and subsequently become scared. The media, on the other hand, likes to promote itself and sell more newspapers, more ads, and increase TV and radio ratings, all of which are possible through the media philosophy that "a good story is a bad story."

When an expert declares, for example, that magnetic fields from overhead power lines might cause childhood leukemia, or that radiation from a cellular phone might cause brain cancer, the public accepts this message with little or no questioning of the validity of the expert's sources. Unfortunately, alarming messages such as these are more interesting and capture more headlines than the "boring" scientific theses regarding RF radiation biological effects and their relationship to our ecosystem, environment and the advancement of technology.

A frequent warning is that "...in the future, science may discover that low-level RF radiation exposure that is presently considered safe actually bears adverse effects. Therefore, caution is warranted." This is a fictional vision, not a scientific outlook. The same caution may be equally applied to other environmental threats and their safety standards such as those that address air and drinking water; ingredients in food, beverages and cosmetics, and pharmaceuticals.

## Summary

The public does not need the patronage of 'raging oracles' to warn us against exposure to radio frequency radiation. The public should be protected through the enforcement of environmental regulations and standards which are based

on solid scientific data and proven health effects versus exposure parameters.

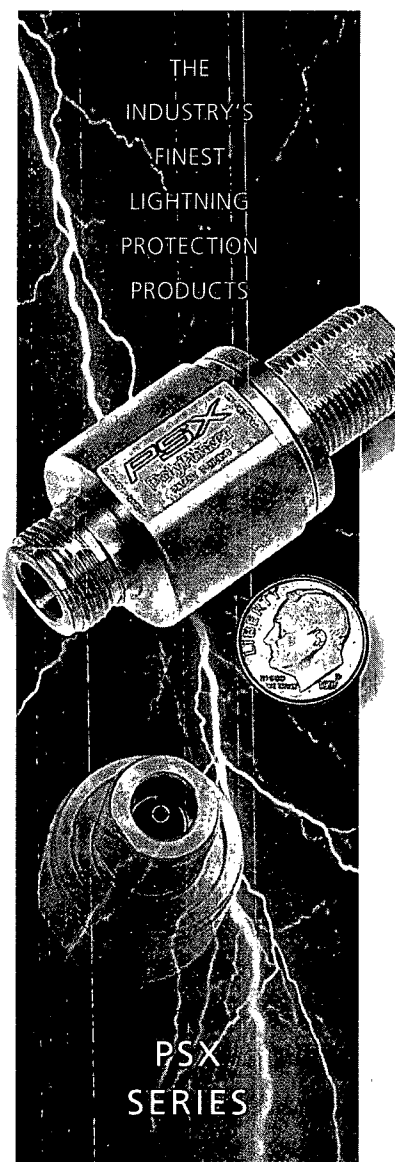
Scientists' responsibility and codes of ethics require that the public receive the most updated and objective information available in serious publications.<sup>3,4</sup> The responsible scientist and engineer can serve society and the community by translating technical information into terms that can be understood by a layperson and thus help to diminish public electrophobia.

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2. "The Possible Biological Effects of Low-Frequency Electromagnetic Fields," IEE Supplements to the Public Affairs Board, Report No. 10, (June 1994).
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5. "No Adverse Health Effects Seen from Residential Exposure to Electromagnetic Fields," National Research Council, Commission on Life Science, Board on Radiation Effects, published in Joint Spectrum Center (JSC) E<sup>3</sup> Bulletin (January 1997).

Since 1976, **MOSHE NETZER** has worked for RAFAEL, the Israeli Armament Development Authority, as a group leader and electromagnetic safety engineer. Mr. Netzer's expertise encompasses EMC in naval platforms, ordnance and communication systems, ESD control in the military and processing industries, radiation hazards to personnel, ordnance and fuel, RF spectrum management, and classic EMC design, analysis and testing. The author of four books and more than 30 technical articles, Mr. Netzer has also developed and presented a series of EMC courses on EMI-related topics. Moshe Netzer is a NARTE-certified EMC engineer, a Senior Member of the IEEE and the immediate past vice-chairman of the Israeli IEEE EMC Chapter. Mr. Netzer is now enjoying his third sabbatical position as a Senior EMC Engineer with R&B Enterprises, West Conshohocken, PA. (610) 825-1960.

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