

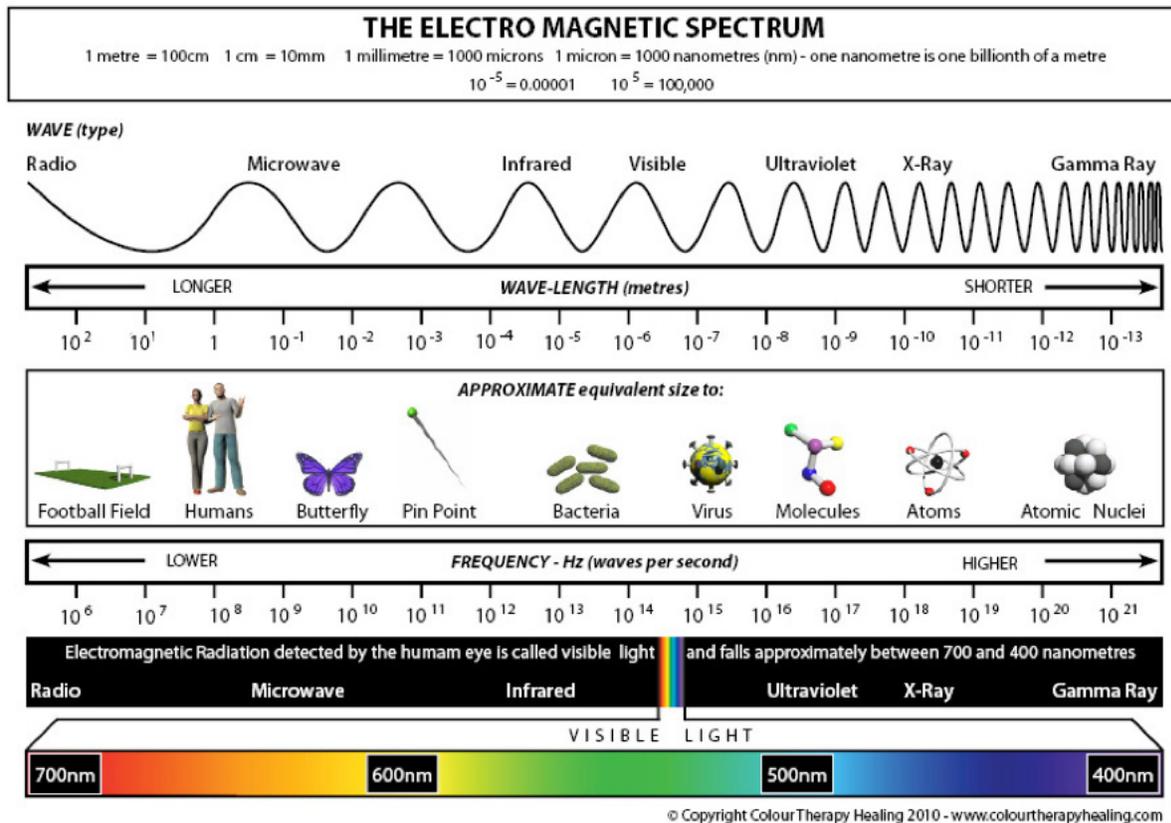
July 5th 2019

Some material represents enhancements by the *Notes* author, David R. Hill, as needed for clarity. Also, the order of material is not identical with the lecture. David Hill's post-graduate work, following his engineering degree, was in the life sciences and Artificial Intelligence.

5G: Compelling Evidence of Great Harm Caused by EMF Exposure and the Mechanisms that Cause Such Harm: Why Safety Guidelines do not Predict Safety²

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) only considers thermal heating effects of non-ionising waveform radiation (just part of the electromagnetic spectrum that ranges from long radio waves (long wavelengths, low frequencies)), through microwaves, infrared radiation, visible radiation (light), to ultraviolet, x-rays, and gamma rays (short wavelengths, high frequencies). The following diagram illustrates some properties of the full electromagnetic spectrum with the position of the small band representing light depicted at the bottom:

The Electromagnetic Spectrum



Note that the energy inherent in the waveforms increases as the frequency increases and the wavelength shortens.

Ionising radiation is radiation that has enough energy to affect the atomic structure of materials on which it impinges by removing electrons, breaking molecular bonds, and reconfiguring molecules. The top end of the ultraviolet range, plus x-rays, and gamma rays have the required energy and are therefore ionising radiation. Both non-ionising and ionising radiation may be referred to as Electromagnetic Radiation, or EMR for short

What is missing from the restricted view of the ICNIRP is the fact that when dealing with biological materials such as comprise human bodies—namely cells, the cell metabolism (cell activity and nutrition) depends, amongst other things, on the manipulation of voltage-controlled gates in the cell membranes that are normally controlled internally, as, for example, when a nerve impulse travels down a nerve by the mechanism of depolarisation followed by repolarisation; or nutrients and waste pass in and out of a cell. The depolarisation/repolarisation process which forms the travelling nerve impulse depends on the passage of ions to and fro across the tubular nerve cell membrane form-

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² The original paper on which Professor Pall's lecture was based is available at:

<https://www.radiationresearch.org/wp-content/uploads/2018/06/EU-EMF2018-6-11US3.pdf>

ing the transmission path—the axon, from the nerve cell to its destination on a muscle fibre end-plate or dendrite(s). The gate processes can be disrupted by very small electrical voltage applied from outside, voltage technically known as Electromotive Forces, or Electromagnetic Fields—EMFs for short. It turns out that there are inherent amplifying processes in the voltage gate mechanisms that amplify any spurious externally applied EMFs, and this was a key point made by Professor Pall. An important focus was on the Voltage-Controlled Calcium Gates that allow Calcium ions to flood into the affected cell. Statements such as: “Non-ionizing radiation consists of photons that do not have enough energy to break chemical bonds including the chemical bonds of DNA.” are technically correct, but totally misleading for the reasons just given. Applying EMR is a very effective way of disrupting, and sometimes healing biological systems (amongst others).

A further point that seems absent from the ICNIRP safety assessment is that research has shown that pulsed radiation has a much greater effect than steady radiation. In fact, part of the safety criterion approved by ICNIRP actually averages the radiation strength over a 6 minute period, which drastically underestimates the likely short energetic pulse effect. [It could be that ICNIRP is not concerned about this because it believes the applied EMF does not penetrate very deeply into the mass of the body, which is largely made of water, but where are the experiments to show that this is true at the millimeter wavelengths involved in 5G. In any case what about the damage in the surface layers.]

Another point Professor Pall raised is that the tabulated safety levels for safe levels of EMR, even accepting the suspect measurements basis, seem hard to justify (for example, occupational exposure limits are five times the public exposure limits, and limbs are rated at twice the values for the head and torso) The latter differences also seem to suggest that the EMR does penetrate fairly extensively. Also, 5G radiation is significantly more energetic than earlier systems (2G, 3G, and 4G), but in 2009 ICNIRP specifically rejected an update to the guidelines they had published in 1998.³

The effects of EMR on the human population include: lowered fertility; neurological deficits including effects on brain structure; DNA damage which enables cancer and germ-line effects; interference with cell apoptosis (interference with naturally programmed cell death) leading to reproductive and degenerative problems; increased oxidative stress—itsself a cause of all kinds of problems; endocrine/hormonal disruption; excessive intracellular calcium; and cardiac effects—arrhythmias, bradycardia (slowed heart beat), and even cardiac arrest. It should be noted that these effects have cross-links to each other implying cross-reinforcement.

Canada was the first country to determine that pulsed EMR was usually more active than continuous EMR of the same intensity. The ICNIRP averaging process makes this effect even more important to take into account. Nanosecond pulses simply disappear in the current safety analysis.

There is yet another flaw in the ICNIRP safety analysis. Pairs of very short pulses are super-additive. That is the two together have a greater effect than might be assumed as the simple sum of the two pulses by themselves, since the quantities that add are vectors, not scalars.

Nine papers (cited in Professor Pall’s full paper referenced at the start) have shown that there are specific exposure windows—that is the exposure intensity *versus* effect is highly non-linear. An exposure that is lower *or higher* can have less effect than exposure at the levels in the given intensity window. Also there are specific frequency windows showing similar characteristics. And finally there is the problem that human cells are not inert receptors of incoming energy, as already discussed. Safety limits cannot ignore the active biophysical response to applied EMR, including the fact that there are biophysical mechanisms that amplify the effect of very small EMFs. Taking into account the dielectric effect of the fatty cell membrane, and the very small dimensions, the effect can be very large.⁴

It is absurd to deny there can be direct adverse effects of EMR incidence on the human body when direct therapeutic effects of EMR are well documented.⁵ Figure 1 below diagrams some of the biological effects produced by EMR

3 It is noteworthy that in its 2009 revision of the EMR safety guidelines, ICNIRP baldly stated: “However, it is the opinion of ICNIRP that the scientific literature published since the 1998 guidelines has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields.

4 The work of Tekieh et al. (Tekieh T, Sasanpour P, Rafii-Tabar H. 2016 Effects of electromagnetic field exposure on conduction and concentration of voltage gated calcium channels: A Brownian dynamics study. *Brain Research* **1646**:560-569; also available at <https://www.researchgate.net/publication/304453535>) and Dolphin (e.g. <https://bpspubs.onlinelibrary.wiley.com/doi/full/10.1038/sj.bjp.0706442> and <https://stke.sciencemag.org/content/5/237/pe34>) are relevant here.

5 For example the Health Canada approved iMRS equipment for the relief of pain and other purposes: <https://www.imrs.com/en/system/imrs-systems.html> (accessed 2019-07-08); the use of time-varying electromagnetic fields to regenerate neural tissue: <https://ntrs.nasa.gov/search.jsp?R=20030075722> (accessed 2019-07-08); and the use of electromagnetic fields to promote bone growth when there is difficulty getting a broken bone to heal: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2762251/> (accessed 2019-07-08).

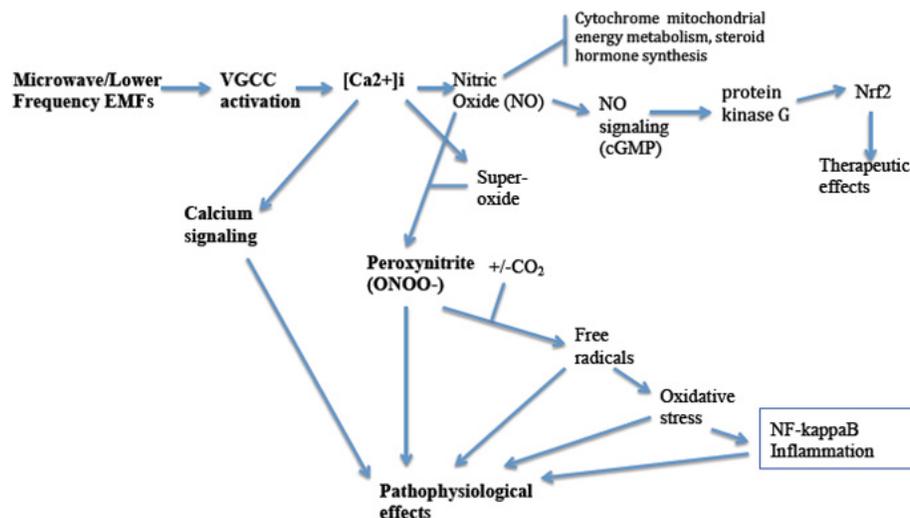


Fig. 1 How EMFs Act via VGCC Activation to Produce Various Effects

induced EMFs as a result of VGCC activation. Some are beneficial (“Therapeutic effects”), but some produce “Pathophysiological” effects (for instance, peroxynitrite formation leads to oxidative stress and inflammation; other effects were noted above and covered in more detail below). It depends on the intensity, frequency, duration and degree of pulsing which effects dominate.

Coupled with the dense widespread dispersion of 5G antennae together with the extraordinary rates of pulsation that can be achieved by the much higher frequencies used in 5G (up to 90 Gigahertz, and even as high as 300 Gigahertz⁶), the effects will be far greater than for existing microwave communication signals, yet 5G is being deployed without the benefit of any meaningful evaluation of the safety of such widely dispersed high-frequency signals.⁷

1. Serious effects arising since the occurrence of widespread EMR exposure

Such effects are more active in children because they have: a higher surface-to-volume ration (being smaller); higher densities of stem cells which are malleable; brains which are still developing; and younger body tissues having greater cellular water allowing deeper penetration. Relevant citations of research accounts related to what follows appear in the full paper, referenced at the start. Note that the various effects are cross-linked. That is there is a synergism between different adverse effects.

1.1 Neurological effects

There is evidence that EMR is implicated in Alzheimer’s disease and other dementias (“digital dementia”) because of the excess intracellular (inside the cell) calcium that is produced. Rats are a valid “model” for human effects of treatments in the medical research world. Rat studies showed that exposing rats even to microwaves induced Alzheimer-like effects—almost 100% conversion of normal rats to rats with some degree of dementia. Remember that the lower frequency microwaves are far less energetic than the millimeter and sub-millimeter 5G radiation.

It is noteworthy that the age at which such neurological diseases occur was been dropping precipitously in recent times, following the dramatic increase in pervasive EMR coverage. Attention Deficit Hyperactivity Disorder (ADHD) and autism have also been increasing. An effect of VGCC activation—flooding nerve cells with calcium—disrupts the formation, development, and modification of nerve-cell connections—the all-important “synapses”).

1.2 Cellular DNA damage by free radical attack

Three different types of cellular DNA damage are produced as a result of the free radical production. All three types are implicated in autism, and such damage can also lead to cancer.

1.3 Reproductive effects

Lowered fertility; reduced numbers of ovarian follicles and hence eggs; lowered sperm counts; increased spontane-

⁶ A Gigahertz (GHz) is a frequency of 1 billion oscillations a second, each oscillation being a nanosecond from peak to peak. Thus 300 GHz would mean 300 billion oscillations a second, each one 1/300 of a nanosecond from peak to peak, that is 3.3 picoseconds, or 3.3/1,000,000,000,000 seconds. A picosecond is to one second as one second is to approximately 31,689 years!!

⁷ The stated reason for going to such high frequencies, apart from utilising another band in the electromagnetic spectrum, is to get increased data-transmission speed. Both of these increase the *bandwidth* available for communication, but the increased data-transmission speed will allow subscribers to download their high-definition videos in a blink of an eye, rather than a few seconds. The risks far outweigh the benefits.

ous abortion; reduced levels of the three sex hormones, estrogen, progesterone, and testosterone; and reduced libido.

Sperm counts in every developed country are down by 50%. Births are almost universally down below replacement level. In an experiment with mice (also a valid model for human effects) Magras and Xenos found exposure to EMR reduced fertility to zero in 90 to 150 days (Magras IN, Xenos TD. 1997 RF radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 18:455-461). Such consequences are very serious. High-tech Asian countries have seen very large drops in fertility of a magnitude only previously seen before on our planet as a result of the stress of war, famine, or disease. Singapore last year, for example, had a 31% reduction in births. The various alternative explanations, such as changes from agricultural to urban demographics or rising incomes, do not apply, and in any case do not lead to such abrupt changes.⁸

1.4 Brain structure changes

This is an epidemic problem that obviously cross-correlates to other effects. Studies in animals show brain structure changes as a result of EMR exposure. Neurons typically have around 1,000 synaptic connections, but in one study a neuron became completely disconnected, and thus completely non-functional. The animal brains involved (not stated, but probably rats or mice) degenerate at about fifteen times the rate of human brain degeneration. On that basis, it is possible to estimate how long humans have before such effects become serious, and the estimates are not encouraging.

Some concluding trivia, mostly anecdotal

Millimeter and sub-millimeter EMR does produce effects deeply in the body. Creatures with high surface area to volume ratios are more susceptible.

There are US patents on the use of millimeter waves as an insecticide (US Patents 6,073 365, and 6 192 598) for *non-pulsed* EMR—the less active type of EMR.

The Netherlands reported the death of many birds from cardiac arrest as a result of 5G tests. Birds flying through the beam of a microwave relay beam suffered a similar fate.

There have been recent accounts of young athletes and racehorses (29) dying of sudden cardiac arrest.

There is anecdotal evidence of a connection with increasingly uncontrollable wild fires. The connection is plausible because EMR, and especially 5G radiation induces the production of terpenes by plants. Terpenes comprise a large group of flammable, volatile, unsaturated hydrocarbons found in the essential oils of plants, especially conifers and citrus trees (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4410321/> —accessed 2019-07-08). Five cities on the South Korean coast each recently had a massive fire; and then there is the well documented unusual fury of many recent wildfires in areas where such trees are common.

When extra-cellular calcium is reduced as a result of the calcium transfer interference as a result of VGCC disruption, the parathyroid hormone pulls calcium out of the bones to compensate. There have also been accounts of racehorses suffering unexpected broken bones, which is a death sentence for most horses.

I was unable to stay for the questions. Note that the full paper should be consulted for supporting reference citations, additional detail, and to correct the mistakes I surely have made. A short lecture is not the best forum in which to convey the content of a detailed 90-page technical paper to a highly heterogeneous audience, and I would like to thank Professor Pall for doing such a good job.

⁸ Your note-taker jokingly suggests that perhaps they are too busy with the new and enhanced gadgets to have time or interest for sex!