

# How Exposure to GSM & TETRA Base-station Radiation can Adversely Affect Humans

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It is perfectly true that the levels of microwave radiation in publicly accessible locations near GSM and TETRA<sup>1</sup> Base-stations comply, by many factors of 1000, with the current safety guidelines set by the International Commission for Non-Ionising Radiation Protection (ICNIRP).<sup>2</sup> These limits are, however, purely thermally based - *i.e.* they simply limit the *intensity* of the radiation to ensure that the amount of tissue heating by absorption of microwave radiation is not in excess of what the body can cope with. If heating were the *only* effect of the radiation, existing guidelines would afford the public adequate protection against the emissions of Base-stations; unfortunately, however, this is not the case. For microwaves are waves, and, as such, have properties other than solely intensity. In particular, the pulsed microwave radiation used in the GSM and TETRA systems of telecommunication has a number of rather well defined *frequencies* that facilitate its discernment by the alive human organism, and *via* which the organism can, in turn, be affected in a purely *non-thermal* way. This is so because the alive human organism (and *only* the alive one) itself supports a variety of oscillatory electrical biological/ biochemical activities, each characterised by a specific frequency, *some of which happen to be close to those found in the GSM / TETRA signals*; this coincidence makes these bioactivities potentially *vulnerable to interference*. It comes about because these oscillatory electrical activities play a role akin to the tuned circuits in a radio, making the living organism an **electromagnetic instrument of great and exquisite sensitivity** that is able to 'recognise' and discern the presence of the radiation '*informationally*' by decoding (demodulating) its various frequency characteristics, including those of any amplitude modulations. *Since these activities are involved in bio-communication and in the control and regulation of bio-processes essential to well-being, it is reasonable to anticipate that it is the functionality of the alive organism that is impaired by exposure to radiation of sub-thermal intensity containing bioactive frequencies*; this contrasts strongly with the situation at thermal levels where actual material *damage* to DNA, cells and tissue can occur. It is to be stressed, however, that unlike heating, non-thermal (informational) influences are possible only when the organism is alive: the Dead have no electrical brain activity with which an external electromagnetic field can interfere!

The frequency of the radiation that is used to carry the voice information (messages) in both GSM and TETRA lies in the microwave band - a frequency range in which processes as fundamental as cell division can be interfered with - the somewhat lower carrier frequencies characterising the TETRA radiation facilitating its deeper penetration into tissue. On the other hand, the *rates* at which the microwaves are emitted in distinct groups of flashes (or pulses) happen to be close to the frequencies of some of the brain's own electrical and electrochemical rhythms; accordingly, these can be amplified, interfered with, and even entrained by the radiation. In the case of GSM, the basic 'flash rate' is 217Hz, but the flashes are emitted in groups of 25 at the rate of 8.34Hz – a frequency

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<sup>1</sup> The GSM (Global System for Mobile Communications – used for wireless consumer devices) and TETRA (Terrestrial Trunk Radio System – used for public safety/police communications) systems deployed in Europe employ technology similar to PCS/Digital in the United States.

<sup>2</sup> In the U.S. human exposure to RF/MW radiation is regulated by the Federal Communications Commission (FCC) based on standards developed by the private organizations, American National Standards Institute (ANSI) and the Institute of Electrical and Electronics Engineers (IEEE). The status of the Non-ionizing Radiation Committee at the National Council on Radiation Protection and Measurement (NCRP), which has contributed to the setting of the U.S. RF exposures guidelines in the past, is in flux.

that lies in the range of the human *alpha brain wave activity*. In the case of TETRA, on the other hand, the nature of the pulsing is somewhat different, but is again characterised by low frequencies that are here close to 70Hz and 17Hz – the latter, in particular, characterising the much more accentuated pulsing of the emissions of vehicularly mounted antennae. 17Hz is very close to the frequency (16Hz) at which there are reports of a *significant increase in loss (efflux) of calcium from brain cells* - thereby potentially undermining the integrity of the nervous system - and to the frequency at which seizures can be provoked in photosensitive epileptics by a light flashing at between 15-20 times per second (*see below*).

What the Mobile Phone Industry and the various Regulatory Bodies (such as the NRPB and ICNIRP)\*\* dispute is that the very weak, pulsed microwave radiation used in GSM and TETRA exerts any **non**-thermal biological influences that entail *adverse health reactions*. Their conviction that, provided the intensity of the radiation complies with the ICNIRP safety guidelines, human exposure to this kind of radiation is innocuous is, however, based, firstly, on the erroneous belief that electromagnetic fields should be regarded as toxins to the body - rather than an integral feature of its living state - and, secondly, on an outdated ‘linear’ mindset, which prejudices the conclusion that exposure to weak radiation (below guideline levels) can entail *only* correspondingly weak effects, and *vice versa*. The invalidity of the latter is clearly indicated by the existence of the ‘*informational*’ influences referred to above, which, being contingent on our aliveness, are inherently **non**-linear effects: any attempt to understand such effects from a purely linear perspective are thus doomed, in that they are impotent to address the most discriminating feature of all, namely, the ‘*aliveness*’ of the system under consideration.

The importance of ensuring *non-thermal* electromagnetic compatibility between mobile phone radiation and energised electronic equipment, such as that in aircraft and hospitals, for example, is, of course, generally accepted and respected. Ironically, however, the same does *not* yet obtain in the case of the alive human organism, despite (i) the fact that the latter *is itself* an electromagnetic instrument *par excellence*, as already mentioned, and (ii) the existence of a wide variety of non-thermal bio-effects induced by low intensity microwave radiation (both pulsed and continuous) that have been revealed by many experiments, enjoying varying degrees of corroboration<sup>3</sup>, which have been performed over the last 30 years on many different kinds of living organisms – including humans - most of which have been published in international, peer reviewed scientific journals.

Of particular concern is the way in which this radiation non-thermally affects *brain function* – specifically, its electrical activity (EEG), its electro-chemistry, and the blood/ brain barrier - and degrades the *immune system*. For these *non-thermal* influences are of a kind that are **consistent** with the nature of some of the adverse health reactions reported both by some users of mobile phones and by some people (involuntarily) exposed long-term to the radiation from Base-stations. Thus, for example, the radiation is known to affect the dopamine-opiate system of the brain and to increase the permeability of the blood brain barrier (thereby facilitating the passage of chemical toxins into brain fluid), both of which are medically considered to underlie headache – one of the most persistently reported adverse health effects. Similarly, the duration of REM sleep is shortened by exposure to radio-frequency radiation, whilst nocturnal secretion of melatonin is partly inhibited, both of which are consistent with reports of sleep disruption and concentration problems. Furthermore, the possibility of deliberately provoking epileptic seizures in certain animals by exposing them to pulsed microwave radiation is consistent with reports of an increased incidence of seizures in some epileptic children when exposed to the emissions of GSM Base-stations. The latter finding is not at all unreasonable, given the known ability of a visible light (such as a stroboscope) flashing at a rate somewhere between 15-20 times per second to provoke seizures in the 5% minority of epileptics who are photosensitive. For visible light and microwaves are both simply different realisations of electromagnetic radiation, and the microwave radiation used in GSM and TETRA similarly ‘flashes’ (pulses) at rates that the brain is able to recognise; unlike visible light, however, pulsed microwaves are not reliant on the eye and optic nerve to access the brain, since they can penetrate the skull *directly*.

<sup>3</sup> Difficulties in replication can often be traced to some crucial difference in experimental protocol that effectively undermines the fidelity of the purported replication; thus the reason why some experiments have not been replicated is precisely because *they have not been rigorously replicated!*

brain, where the radiation from the handset most easily penetrates (the laterality of which correlates with that of handset use), which has been found in a recent epidemiological study in the USA.

Another possible contributory factor to sleeping problems is the phenomenon of so-called ‘microwave hearing’, whereby people (even those who are clinically totally deaf) can discern buzzing/clicking sounds in their heads when exposed to low energy, pulsed microwaves.

It should be noted that although microwave radiation is non-ionising – *i.e.* does not have enough energy to break chemical bonds, particularly in DNA – it can, nevertheless, *functionally* interfere with the natural processes involved in DNA replication and *repair*, by subtly altering molecular conformation (architecture), for example; this could well account, respectively, for the reports of chromosome aberrations / micronuclei formation and for the increased amount of DNA fragmentation observed under irradiation. Similarly, the finding that exposure to pulsed GSM radiation (of an intensity comparable to that realised during mobile phone use) promotes the development of cancer in mice that have been genetically engineered to have a predisposition to cancer is consistent with other studies showing an *over*-expression of heat shock proteins (HSPs) in both human and animal cells exposed to GSM radiation; for HSPs are known to inhibit natural programmed cell death (apoptosis), whereby cells that should have ‘committed suicide’ *continue* to live. Taken together, these various effects are, in turn, consistent with the 2-3-fold increase in the incidence of a rare form of cancer in the periphery of the human brain, where the radiation from the handset most easily penetrates (the laterality of which correlates with that of handset use), which has been found in a recent epidemiological study in the USA.

It is important to appreciate that these and other findings pertaining to exposure to the emissions of GSM handsets are *not* irrelevant to the consideration of the effects of exposure to Base-station radiation, since the *informational* content of the latter is the *same* as that of the phone signals; indeed, the increasing number of disturbing reports of rather serious adverse health effects in animals (particularly cattle) exposed to GSM Base-station radiation could well be valuable warning portents that should not be ignored.

It is essential to appreciate, however, that because the possibility of non-thermal influences is dependent on the organism being alive, it necessarily follows that **not everyone will be equally susceptible**, *even when exposed to exactly the same radiation* - susceptibility depending not only on the radiation, but *also* on the genetic predisposition and physiological state of the individual when irradiated, such as the stability of electrical brain activity and the person’s level of stress prior to exposure. Whilst this admittedly makes the occurrence of non-thermal effects more difficult to predict (and hence to regulate against) than is the case with thermal effects, *it does not mean that they can be safely ignored, or that they cannot provoke adverse health reactions in some people*, the severity of which will again vary from person to person, according to the robustness of their immune systems. It is probably true to say that if the same degree of risk and uncertainty as to subjective noxiousness obtained in the case of a new drug or foodstuff, it is unlikely that they would ever be licensed.

Quite apart from their weaker immune systems, children are particularly vulnerable because of the increased rate at which their cells divide (making them more susceptible to genetic damage) and because their nervous system is still developing - the smaller size of their heads and their thinner skulls increasing the amount of radiation that they absorb. Particularly vulnerable to interference by the pulsed microwave radiation used in GSM is their electrical brain-wave activity, which does not settle into a stable pattern until puberty. The use of mobile phones by pre-adolescent children is thus to be strongly discouraged, and the siting of Base-station masts in the vicinity of schools and nurseries strongly resisted: financial gain must not be allowed to be the overriding consideration.

In connection with Base-station exposure, it must be appreciated that it is impossible to cite a unique ‘safe distance’. The only meaningful approach, at present, is to require, in publicly accessible locations near a mast, that the intensity of the radiation should be below the level at which any adverse health effects have so far been reported; including an additional safety factor of 10, a maximum intensity limit of  $10\text{nW/cm}^2$  ( $= 10^{-4}\text{ W/m}^2$  - equivalent to  $0.2\text{V/m}$ ) is indicated. The precise distance from a mast at which this level is realised depends, however, on how powerful are the antennae, the orientations of the main beams *and* their ‘side lobes’ (subsidiary emissions that are much more localised in the immediate vicinity of a mast), and the local topography.

To cite the examples of radio and television transmission in an attempt to support the claim that exposure to the (much less intense) radiation used in mobile telephony is harmless is flawed on at least two accounts: (*i*) the

occurrence, in any case, of certain health problems that correlate with exposure to the radiation from these installations, and (ii) the fact that, *unlike the radiation used in GSM / TETRA installations*, this radiation is **not** emitted in *pulses*, in patterns characterised by frequencies that the brain can recognise. Furthermore, before taking reassurance from an apparent absence of health problems amongst continental users of TETRA, it should be remembered that it is often the much less biologically active *TETRAPOL* (as opposed to TETRA) that is there used.

In conclusion, it can hardly be disputed that to enjoy an acceptable quality of life requires more than simply an absence of terminal disease. Adverse health effects in humans of the kinds already reported worldwide – such as headaches, sleep disruption, impairment of short-term memory, *etc.* - whilst maybe not life-threatening in themselves, do nevertheless have a debilitating effect that undoubtedly affects general well-being, and which in the case of some children could well undermine their neurological and academic development. It should, of course, be stressed that the apparent absence, to date, of more serious pathologies attributable to exposure to the emissions of GSM / TETRA Base-stations is no guarantee of immunity in the long-term. For exposure to this kind of radiation is still in its ‘early days’ in comparison to the much longer latency periods that are generally considered to characterise the kinds of cancers that could well be promoted or initiated in certain people, although it should be appreciated that existing latency estimates, based on experience under **non**-exposed conditions, are not necessarily relevant here.