The inadequacy of the ICNIRP Guidelines governing human exposure to the microwave emissions of GSM/TETRA Base-stations.

G J Hyland

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Associate Fellow
Department of Physics
University of Warwick*, UK

Executive Member
International Institute of Biophysics*
Neuss-Holzheim, Germany

I. Introduction

I.1. Current UK Government policy concerning human exposure to the electromagnetic fields emitted by mobile telecommunication Base-stations – as contained in PPG8 (Revised) – is based on compliance with the safety levels published [**1**] by the International Commission for Non-Ionising Radiation Protection (ICNIRP). Para.30 of PPG8 (Revised) states:

> '*In the Government's view*, *if a proposed mobile phone base station meets the ICNIRP guidelines for public exposure it should not be necessary for a local planning authority, in processing an application for planning permission or prior approval, to consider further the health aspects and concerns about them.*'

The ICNIRP guidelines, however, *only* ensure that exposure to radiation of the kind used in Mobile telephony does not result in an adverse degree of body heating. Since the amount of heating increases with the *intensity* of the radiation, it is *intensity* that the guidelines limit to ensure that the level of heating does not exceed what the body's thermoregulatory mechanism can 'cope with' (*See Appendix A*).

Typical outdoor intensities in the vicinity of a Base-station (and, *a fortiori*, those in the *interior* of neighbouring buildings) are, however, so very *far below* (often by factors of many thousands) the ICNIRP thermal guideline values of 4.5W/m^2 and 9W/m^2, at 900MHz and 1800MHz, respectively, that the possibility of body overheating can here be *totally ruled out.*

Thus, in the case of Base-stations, the ICNIRP guidelines afford protection against what is *not* actually a hazard. At the same time, however, they leave those exposed vulnerable to health problems that might be provoked by any **non**-thermal influences that the radiation might have on the human body, which 'slip through the net' afforded by these purely thermal guidelines, particularly influences that – *unlike* heating - are *contingent* on aliveness.

*** The views expressed below are those of the author, and do not necessarily represent those of the Institutions with which he is affiliated.**

That this is indeed the case is evidenced by the many inter-consistent reports of health problems - not only in humans, but also in animals – that correlate with exposure to the emissions of Base-stations, and which cannot possibly due to heating.

The prevailing 'official ' view, however, is that these problems *cannot* be attributed to proximity to a Base-station, since, in publicly accessible places nearby, the intensity is only a tiny fraction of the guideline value. An example of this position is to be found in Para.1.33 of the Final Report (the *Stewart* Report) of the Independent Expert Group on Mobile Phones (IEGMP), which states [**2**]:

> '*We conclude that the balance of evidence indicates that there is no general risk to the health of people living near base stations on the basis that exposures are expected to be small fractions of guidelines.*'

How then are the reports of health problems to be taken? There are at least two possibilities:

a) To accept the 'official' position, which means that the reports of ill-health must be dismissed as being of psychosomatic origin.

b) To take the reports of ill-health seriously, and enquire if they could possibly be due to effects of exposure *other than* those addressed by the guidelines, namely to effects other than heating - *i.e.* to **non-thermal** influences of the radiation. Indeed, the possibility of such is acknowledged in the much less frequently cited Para.6.44 of the Stewart Report [**2**], which states:

> '*Although it seem highly unlikely that the low levels of RF radiation from base stations would have significant, direct adverse effects on health,* ***the possibility of harm from exposures insufficient to cause important heating of tissues cannot yet be ruled out with confidence****. Furthermore, the anxieties that some people feel when this uncertainty is ignored can in themselves affect well-being possibility.*' (My emphasis)

It is this possibility of *non-thermal* influences that will be considered here, and it will be seen that there is much evidence in support of the reality of such influences. Furthermore, given that the adverse health effects reported by some exposed people are of a kind that are consistent with these non-thermal influences, it is difficult to continue to dismiss the former as psychosomatic. It must thus be concluded that GSM/TETRA telecommunication technology, as currently regulated by the ICNIRP safety guidelines, is less than safe, and constitutes a risk to public health because these guidelines afford **absolutely no protection** against **non**-thermal biological influences exerted by the kind of radiation emitted by the associated Base-stations. Indeed, such a conclusion is consistent with Para.6.41 of the section of the Stewart Report [**2**] dealing with the Application of the Precautionary Approach to Mobile Phone Technology, which states:

> *'On its own, adoption of the ICNIRP exposure guidelines will not allow fully for current gaps in scientific knowledge, and particularly the possibility of, as yet, unrecognised thermal or non-thermal adverse effects at lower levels of exposure.'*

This statement is reinforced in Para.6.44 of the section of the Stewart Report [**2**] dealing *explicitly* with Base-stations, wherein is stated the following:

> '*Although it seem highly unlikely that the low levels of RF radiation from base stations would have significant, direct adverse effects on health,* ***the possibility of harm from exposures insufficient to cause important heating of tissues cannot yet be ruled out with confidence****. Furthermore, the anxieties that some people feel when this uncertainty is ignored can in themselves affect well-being possibility.*' (My emphasis)

Rather than introducing additional (but arbitrary) safety factors into the ICNIRP Guidelines, in attempt to realise at higher degree of safety, the Stewart Report [**2**] makes the following recommendation in Para.6.61:

> '*We recommend that in making decisions about the siting of base stations, planning authorities should have power to ensure that the RF fields to which the public will be exposed will be kept to the lowest practical levels that will be commensurate with the telecommunications systems operating effectively.*'

This strategy is know as the *ALARA* Principle (*A*s *L*ow *A*s *R*easonably *A*chievable), and it should be noted that PPG8 assumes that Operators *already* comply with this (*See Section A4.3 of Appendix A*).

I.2. On the other hand, in continental Europe (and also elsewhere), in an attempt to ensure a higher degree of safety in the case of GSM installations, a number of countries (and even *regions* within certain countries, such as Salzburg [**3**], in Austria, Paris [**4**], in France, and also Castilla-La Mancha [**5**], in Spain) have opted to adopt exposure limits that are significantly more stringent than those of ICNIRP. For example, in Italy (see *Gazzetta Ufficiale della Repubblica Italiana*, 28th August 2003, Serie generale: No. 199, Art.3.2, *p*.26), the national public limit for people exposed for more than 4 hours daily is **90** times **lower** than the ICNIRP value (for 1800MHz), whilst the Salzburg limit for this frequency is a factor of **9000** lower! *See Appendix B for a comprehensive list of exposure limits for different countries.*

I.3. In connection with the Salzburg limit (of **1mW/m^2**) it is important to appreciate that since it is based only on consideration of the effect on human sleep patterns of exposure to the emission of mobile phone *Handsets*, it cannot be considered as *totally* comprehensive; indeed, subsequent refinements, based on Case Studies of adverse health impacts on people actually living near to GSM *Base-stations* [**6**], have led to *Land Salzburg* to propose a new value (0.01mW/m^2) that is 100 times lower.

I.4. It must be stressed that since, at present, the only way to establish *non*-thermal exposure limits is *empirically*, an unavoidable degree of uncertainty necessarily currently surrounds any recommended value. The existence of such uncertainty increases the significance of the Precautionary Principle in this field, implementation of which is, according to the Stewart Report, most simply achieved by ensuring that the emissions are maintained as *low as possible*, consistent with operability of the mobile phone network.

I.5. In rationalising the introduction of exposure limits significantly lower than those based on thermal heating (such as the Salzburg value) it should be recalled that non-thermal effects themselves are often characterised by a non-zero threshold intensity, which is typically at least *1000 times* ***lower*** than that associated with the onset of thermal heating, on which existing safety guidelines are based (*For further details, see Section III.11.2).*

II. Reported adverse health effects near Base-stations

II.1. Anecdotally reported health effects include increased incidences of:

- Sleeping disorders.
- Memory / concentration problems.
- Headaches.
- Anxiety.
- Seizures in people (particularly, pre-adolescent children) who already suffer from epilepsy.
- Nose bleeds, especially amongst young children attending a school where there is a Base-station.
- Unexplained clusters of human cancers in the vicinity of certain GSM Base-stations [**7**], whose **non**-involvement remains to be established.
- Much reduced neutrophil counts, which **reverse** in the **absence** of exposure. (A *neurophil* is a kind of white blood cell, important to the immune system, which engulfs bacteria.)

The last mentioned effect is particularly important in that it is an ***objective quantifier*** *of an adverse effect - in particular, on the immune system - of exposure to GSM radiation from a Base-station, and thus cannot (possibly unlike some of the other effects) be dismissed as psychosomatic.* Indeed, an extensive programme of blood testing is now underway in Germany, as part of the 'Human Ecological Social Economical (HESE) Project' [**8**].

II.2. A number of these symptoms have been the subject of two recently published pilot epidemiological studies [**9**], the results of which display a high degree of consistency.

II.3. Of particular importance to establishing the *non*-psychosomatic nature of these symptoms are anecdotal reports [**10**] of health problems that actually *predate* knowledge of the presence of a Base-station in the vicinity, the onset of which, only retrospectively, was found to coincide with the commissioning of the Base-station. Another important feature in this respect is that symptoms are often found to subside

when the sufferers remove themselves from the vicinity of the mast, but *reappear* upon their return.

II.4. Further valuable support for the *non*-psychosomatic nature of these symptoms problems in humans comes from reports of health problems in animals - particularly cattle [**11**], which are found to be adversely affected, again in a *reversible* way, when exposed to GSM Base-station radiation. Given the often-enhanced electromagnetic sensitivity of certain animals (and also of birds and other creatures, such as bees), these reports could well be valuable warning portents that should not be ignored.

II.5. The seriousness with which such reports of ill-health (which can only be due to **non**-thermal influences of the radiation) are taken in some quarters is reflected in a number of recent developments:

a) The **Freiburger Appeal** [**12**]: This Appeal was published in October 2002 by the Interdisciplinary Society for Environmental Medicine (Germany), in response to the 'dramatic' rise in the number of reports of health problems (including cancer, cardiac disorders and neuro-degenerative diseases), which the 59 original Charter signatories claim, after detailed investigations, to be associated with exposure of their patients to electromagnetic fields of various kinds - in particular those used in mobile telephony. The Appeal has so far been endorsed by over 1000 medical doctors throughout Germany.

b) The **Catania Resolution** [**13**]: This document was signed by 16 eminent scientists of international standing from 7 different countries, following a conference in Sicily in September 2002. The first and fourth clauses of the Resolution state, respectively: '*Epidemiological and in vivo and in vitro experimental evidence demonstrates the existence for electromagnetic field (EMF) induced effects, some of which can be adverse to health*', and: '*The weight of evidence calls for preventive strategies based on the Precautionary Principle. At times the Precautionary Principle may involve prudent avoidance and prudent use*'.

c) The **Salzburg Resolution** [**3**]: In 2000, the first international conference dedicated to public health issues connected with exposure to Base-station emissions was held in Salzburg, resulting in the 'Salzburg Resolution', the 19 signatories of which include both scientists and public health doctors from 10 countries. To adequately protect against Base-station emissions, the Salzburg Resolution recommends that *outdoor* exposure should be **below 1mW/m^2** (equivalent to 0.6 volts per metre, V/m) in publicly accessible areas surrounding such an installation.

d) A **Statement by a Body of Doctors** [**14**]: Recently, in the UK, group of medical doctors has urged the removal of a Base-station currently under construction, prompted by fears of adverse health impacts on exposed children.

e) A **Swiss Review of RF/Microwave Health Literature** [**15**]. This review, on behalf of the Swiss environmental agency (BUWAL), by the Institute of Social and Preventative Medicine in Basel, concluded that **there is a potential for health effects at levels below the ICNIRP guideline values**. In response, the Swiss government has developed a systematic, differentiated framework

(based on 5 categories: established, probable, possible, unlikely and unclassifiable) to facilitate to application of the Precautionary Principle to uncertain health risks.

f) The **Paris Charter** [**4**]. This Charter, which was signed on 20th March 2003 by 3 mobile phone operators and the City of Paris, limits public exposure, averaged over 24 hours, to 2V/m, at both 900MHz and 1800MHz (at which frequencies the ICNIRP limits are 41V/m and 58V/m, respectively). The new Parisian limit is equivalent - at 900MHz (1800MHz) - to an intensity of about $0.01 W/m^2$ ($0.1 W/m^2$), which is only a factor of 10(100) higher than the value recommended by the Salzburg Resolution.

II.6. It should be noted that the precise location from a mast at which any particular limit is exceeded depends on how powerful the antennae are, their height above ground-level, the orientations of the main beams (defined by their horizontal and vertical angular widths), the location and concentration of '**side-lobes**' (subsidiary emissions that are much more localised in the immediate vicinity of a mast), the height above ground level of the location of concern (*e.g.* a second/third storey bedroom), and the local topography. Accordingly, it is impossible to cite a *universally* applicable 'safe distance'. It should be especially noted that the existence of side-lobes **invalidates** the familiar claim – *e.g.* [**16**] - that the safest place for a mast is actually on a school roof.

II.7. There is thus abundant evidence of genuine concern amongst reputable scientists and medical doctors that exposure to the emissions of Base-stations is **not** without risk to public health. In the UK, Prof. L Challis, Deputy Chairman of the IEGMP and Chairman of Mobile Telephone Health Research (MTHR), said in a recent interview [**17**] that …. '*The Government wants us to say that these masts are completely safe and aren't dangerous, but we can't say that*.'

Elsewhere in Europe, the response to this concern has assumed a more concrete form, with a number of countries (and even *regions* within certain countries (*loc. cit*), such as France and also Spain), having chosen to adopt exposure limits that are significantly more stringent than those of ICNIRP (*See Section I.2*).

III. Why the reported health problems could be due to influences of the radiation other than heating

III.1. The possibility that the microwave radiation used in the GSM/TETRA systems of mobile telephony can exert *non*-thermal influences arises as follows. Firstly, because microwaves are simply one particular realisation of electromagnetic *radiation* (another, which is more familiar, being visible *light*, relative to which microwaves lie on the *far* side of the infrared) they have properties *other than* solely intensity; in the case of light, intensity is equivalent to 'brightness'. In addition to brightness, however, light has the property of *colour*, which is determined by the *frequency* of the radiation (900/1800MHz, in the case of GSM, and near 400MHz, in the case of TETRA). Secondly, a light can be used to transmit **information** by flashing it on an off (pulsed) in a certain prescribed way, the information, which is encoded by the sender in the flash pattern, being subsequently decoded by another person (the

receiver), as happens in the case of Morse Code.

III.2. Even though the intensity of Base-station radiation is far too low to entail any heating, the amount of energy absorbed (which is proportional to intensity) can still be sufficient to effect subtle (conformational) changes in the molecular architecture [**18**] of entities such as proteins (particularly if a *frequency* of the radiation matches or is close to that of an organised (collective) electrical vibration of a bio-molecule) that can result in alterations to biochemistry (such as enzyme activity) of a kind that, in principle, could have health implications. A good example of a biological phenomenon that is initiated by conformational change is **vision**.

III.3. In the case of an *alive* organism, other possibilities of a **non-thermal** influence arise because a living system *itself* supports a variety of oscillatory electrical/ biochemical activities, each characterised by a specific frequency, some of which happen to be *close* to those found in the GSM/TETRA signals – a coincidence that makes these bioactivities potentially vulnerable to being interfered with in various (non-thermal) ways [**19**].

III.4. In both cases (*See Sections III.2 and III.3*), the (non-thermal) influence arises essentially because the systems are able 'recognise' the incoming radiation through its well-defined (coherent) frequency characteristics (*See Section III.5.1*). In the first case, this entails the possibility of a *selective* absorption of energy (by vibrations having the 'right' frequency), whilst in the second case it is more appropriate to interpret the non-thermal effect as an **informational** influence.

III 5.1. It is important to appreciate that the pulsed microwave radiation used in the GSM and TETRA systems of telephony differs from electromagnetic fields of natural origin (such as light from the Sun) through its high degree of *coherence* (It is this property that characterises the light from a laser). This means that the kind of radiation used in GSM/TETRA is characterised by a number of *very precisely defined* **frequencies –** a feature that can greatly enhance its impact on the biochemistry of the body, and facilitate its discernment (*see Section III.11.1*) against the (highly incoherent) heat radiation that is emitted by the body, depending on its physiological temperature. These frequencies range from the (very high) ones that define the radiation as *microwave* (300MHz to 300GHz), through the (very much lower) ones that reflect the way in which (in order to increase the number of Handsets with which a given Base-station can simultaneously communicate) the radiation is transmitted in distinct short 'bursts' or pulses, to the even lower frequencies that characterise the way in which (for certain technical reasons) these bursts are organised into distinct groups, called 'frames' and 'multi-frames'.

As we shall see, some of these lower frequencies happen to be close to those that characterise certain bioelectrical activities that the body supports *when it is alive* - a coincidence that makes these bioactivities potentially *vulnerable to being affected in various ways* [**19**], as already noted above.

III.5.2. A possible contributory factor to this vulnerability could well be the fact that life on Earth has evolved in a virtual *absence* of *natural* (*i.e*. essentially *in*coherent)

microwave radiation: the intensity of solar radiation at the frequency and over the bandwidth used in Mobile Telephony is a factor of 10^{13} lower than that typically found several hundred metres from a Base-station. Not only do we thus have no evolved immunity to this kind of radiation – and, *a fortiori*, to the highly **coherent** microwave radiation of very recent technological origin - but it is also possible that its environmental absence has actually been exploited by Nature to ensure that the regulation and control of bioprocesses essential to life are (or, until recently, *were*) protected from any *external* deleterious electromagnetic interference.

III.6. The frequencies of the radiation that is used to carry (by appropriate modulations) the voice information (messages)/data in GSM/TETRA mobile telephony lie in the *microwave* band (either 900 or1800MHz, in the case of GSM, and near 400MHz, in the case pf TETRA) - a frequency range in which there is some evidence (particularly at higher microwave frequencies [**20**]) that processes as fundamental as cell division can be interfered with in various ways. In the case of TETRA, the use of a lower carrier frequency entails deeper penetration of the radiation into tissue than occurs with GSM.

III.7. On the other hand, the signals emitted by a Base-station are characterised [**21**] by a number of *much lower* frequencies (*See Section III.7.1*), some of which happen to be close to those of some of the brain's own electrical and electrochemical rhythms. Accordingly, these rhythms can be (resonantly) amplified (perhaps to a biologically unacceptably high level), interfered with (similar to the case of radio reception), and even entrained by the radiation – *i.e.* forced to operate at frequencies that are 'unnatural', in that they differ from those that characterise the *natural* rhythms of the (non-exposed) body, thereby possibly compromising homeostasis.

III.7.1. The GSM burst repetition rate of 1.74kHz is very close to the frequency (the so-called 'nuclear magnetic resonance frequency) at which the quantum mechanical spin of a proton precesses in the Earth's (static) magnetic field. Protons are the majority component of water (which is itself the dominant component of living systems), and irradiation of living systems by low intensity microwaves modulated at this NMR frequency has been found to influence and potentiate certain bioprocesses, such as causing a doubling in the rate of cell division, and an associated reduction in the size of the daughter cells [**22**]; a possible mechanism for such effects could be 'spin-orbit' coupling, *via* which the resonating spins affect the quantum mechanical orbitals upon which chemical bonding, and in turn, enzymatic activity, depends. The GSM frame repetition rate of 217Hz, on the other hand, is close to that of coherent (synchronous) electrical oscillations that have been found in rat hippocampal slices, *in vivo* [**23**]; the hippocampus is involved in learning, memory, spatial awareness and epilepsy. Of particular significance, however, is that some of the much *lower* frequencies that characterise the *multi*-frame structures of the GSM signals happen to be close to those of some of the brain's own electrical and electrochemical rhythms, as recorded by the Electroencephalogram (EEG); accordingly, these rhythms can be (resonantly) amplified (perhaps to a biologically undesirably high level), interfered with (similar to the case of radio reception), and even entrained by the radiation – *i.e.* forced to operate at frequencies that are 'unnatural', in that they differ from those that characterise the *natural* rhythms of the (non-exposed) body, thereby possibly compromising homeostasis.

III.7.2. In the case of TETRA [**24**], the much lower burst repetition frequency (70.4Hz) lies in the range (40-120Hz) of electrical muscular activity, as recorded by Electromyography (EMG), whilst the 17.6Hz pattern that characterises the much *more accentuated* pulsing of the emissions of vehicularly mounted transmitters and, to a much lesser extent, ***also*** **that of the Base-stations** is very close to the frequency (16Hz) at which sub-thermal RF/microwave radiation that is amplitude modulated in various ways is reported, sometimes **even under** *in vitro* conditions, to cause: (*i*) a s*ignificant* increase in leakage (efflux) of calcium from brain cells; since calcium ions trigger the release of neurotransmitters, any disturbance in the delicate balance of this chemical could well undermine the integrity of the nervous (and also the immune) system; it should be noted, however, that it has been found that this effect is reproducible only under certain exposure conditions [**25**], (*ii*) elevated levels [**26**] of Ornithine Decarbolylase (ODC), a (rate limiting) enzyme that plays an important role in DNA replication, and possibly also in cancer promotion (*See Section IV.3*), and (*iii*) opposing (and thus possibly stress inducing) effects [**27**] on the principal inhibitory and excitatory neuro-mediating brain chemicals that underpin the activity of the central nervous system. In addition, it should further be noted that the TETRA frame repetition rate (17Hz) is (*i*) close to the frequency at which seizures can be provoked in people suffering from photosensitive epilepsy by exposure to a light, flashing at between 15-20 times per second (*see Section V.4*), and (*ii*) in the range of frequencies (the so-called 'beta' brain-wave band) that characterise the electrical activity of the human brain during periods of concentrated mental activity, and also in REM (Rapid Eye Movement) sleep (*See Section V.2*), during which important restorative processes in the body and information processing by the brain take place. Finally, the TETRA multi-frame frequency repetition frequency (0.98Hz) is close that of the human heart beat.

III.8. Particularly disturbing is that the low frequencies that characterise certain aspects of the GSM/TETRA pulsing are close to those at which it is known that human mood and behaviour can be influenced in a number of ways (ranging from depression/docility to rage), depending on the kind/ frequency of modulation used [**28**], it being actually possible to induce sounds, and even words, intercranially by appropriate modulations of the microwave signal [**29**].

III.9. It is apparent from the foregoing that the existence of endogenous biological oscillatory electrical activities in a living organism means that it is an **electromagnetic instrument of great and exquisite sensitivity** that is able to decode (demodulate) certain frequency characteristics (in particular, low frequency amplitude modulations) of an external electromagnetic field, provided they are close to the frequencies of endogenous bioelectrical activities. In this way, the alive organism is able to 'recognise' and discern the presence of such signals '*informationally*', and, in turn, be affected in a purely *non*-thermal way [**30**].

III.10. It cannot be stressed too strongly that non-thermal effects are **not** to be regarded simply as thermal effects that are too weak to entail any measurable rise in temperature. Rather, they are a consequence of a fundamentally *quite different* kind of interaction between the irradiating radio-frequency/microwave field and the biological system from that which causes heating; the latter is primarily dependent on the intensity of the electromagnetic (microwave) field, and occurs whether the body is

alive *or* dead. The quite different nature of non-thermal effects is evident from the fact that they cannot be replicated by conventional heating methods; indeed, non-thermal influences of exposure to microwave/radio-frequency radiation often result in changes that are in 'opposite directions' to those produced by heating; for example, the fertility of nematode worms is decreased by heating, but is *increased* by irradiation with microwave radiation at sub-thermal intensities [**31**]. Accordingly, at higher intensities, it is quite possible for non-thermal effects to be obliterated by thermal influences, which explains the seemingly paradoxical finding that many non-thermal effects actually become more pronounced as the intensity is reduced [**20**]. In addition, non-thermal effects invariably exhibit a *much sharper* dependence on the *frequency* of the radiation than do thermal effects, which are, instead, primarily dependent on *intensity* [**20**]. Other characteristics of non-thermal effects that distinguish them from thermal effects are that they often occur only within a certain range (or 'window') of intensities, and manifest themselves only after a certain duration of irradiation [**20**].

III.11.1. Despite their much sharper dependence on frequency, the occurrence of non-thermal effects is still contingent on a minimum (threshold) intensity [**20**], however. A fundamental intensity threshold is set by the requirement that the signal (which is not perfectly coherent) be discernible against the level of the (incoherent) thermal radiation emitted by a body appropriate to its physiological temperature. In the case of microwave radiation at 1GHz and a physiological temperature (of an *alive* human) of 37^{o}C, this minimum intensity is only 10^{-16} W/cm^2 – a value, which, it should be noted, is close to the thresholds of human sight, hearing and EEG response [**32**]. Accordingly, the ability of the alive body to discern the emissions of Base-station emissions – the intensity of which, at certain publicly accessible places in the vicinity, is well above this threshold - is not at all reliant on a sensitivity that is in any way superior to those that it already possess (quite undisputedly) in respect of *other* physiologically significant fields.

III.11.2. On the other hand, threshold intensities associated with the onset of non-thermal effects in mono-cellular organisms, such as *E.coli*, are very much higher [**20**] than the value cited above; they are, nevertheless, still at least *1000 times lower* than that associated with the onset of thermal heating upon which existing safety guidelines are based, as already noted above in Section I.2.2.

III.11.3. This multi-parameter feature could well account for difficulties experienced in some attempts to replicate certain non-thermal effects: having only the 'correct' frequency is not necessarily sufficient to ensure success. Another factor that militates against reproducibility is often the existence of some crucial difference in experimental protocol that effectively undermines the fidelity of the intended replication; thus the reason why it has not proved possible to replicate some experiments is precisely because the experiments in question have not *actually* been replicated. This is particularly so in the case of *in vivo* experiments involving entire organisms, where physiological/immunological/genetic identical subjects cannot be guaranteed.

IV. Non-thermal effects and biological functionality

IV.1. Since the control and regulation of bioprocesses essential to well-being involves a highly sophisticated form of *bio-communication* of an electromagnetic kind, it is reasonable to anticipate that it is the **functionality** of the alive organism that is most likely to be affected by exposure to external electromagnetic radiation of sub-thermal intensity containing bioactive frequencies. Experience in the case of exposure to GSM radiation suggests that the interference is with bioprocesses that are intended to afford *natural protection **against** adverse health effects*. This contrasts strongly with the situation at thermal levels (and also with ionising radiation, such a gamma rays) where actual material *damage* to DNA, cells and tissue can occur. It is to be stressed again, however, that unlike heating, non-thermal influences *of an informational* kind are possible only when the organism is **alive**: the Dead have no electrical brain activity, for example, with which an external electromagnetic field can interfere!

IV.2. Examples of such functional impairment include (*i*) the reduction in the level of melatonin secretion [**33**], which is non-thermally provoked by exposure to GSM radiation, there being ***no*** actual *material damage* to the secreting pineal gland, (*ii*) a possible effect on the thermoregulatory functioning of the hypothalamus, which would be consistent with the sensation of *overheating* reported by some people resident in the vicinity of a Base-station, despite the very low (sub-thermal) level of radiation to which they are exposed.

IV.3. Other important examples arise in the case of cancer. 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 certain effects observed *in vitro* such as chromosome aberrations/micronuclei formation [**34**], and for the alteration in the amount of DNA fragmentation caused by (non-thermal) irradiation [**35**], although it should be noted that exposure conditions do not always conform to those of GSM. It has recently been hypothesised [**36**] that the *over*-expression (in the short-term) of heat shock proteins (HSPs) in human [**37**] (and also animal) cells exposed to GSM radiation actually inhibits natural programmed cell death (apoptosis), thereby allowing cells (such as pre-cancerous ones) that should have 'committed suicide' to *continue* to live and develop; this hypothesis[1] is currently being tested experimentally [**38**]). Under-expression (associated with *chronic* exposure), on the other hand, can adversely affect [**39**] the natural repair of DNA breakage.

V. From non-thermal effects to adverse health effects

V.1. Whilst the occurrence of non-thermal effects does *not*, of course, *necessarily* entail any adverse health consequences, there is, nevertheless, a *disturbing*

[1] Another *possible* contributory factor is the increased level [**26**] of an enzyme (Ornithine Decarboxylase, *ODC*) that has been found to occur under exposure to certain kinds of microwave fields, which, however, *differ* from that used in GSM telephony. For *ODC* has been implicated in tumour *promotion.*

consistency [**19**] between some of these non-thermal bio-effects and the (predominantly *neurological*) nature of many of the adverse health reactions reported by certain people (involuntarily) exposed, long-term, to the radiation from Base-stations. As already noted above, there is now, in the case of GSM Base-stations, an increasing amount of evidence of such health problems, both published [**9**] and anecdotal [**10**]; in the case of TETRA, on the other hand, anecdotal evidence is only now starting to emerge [**10**].

V.2. Of particular concern is the way in which this radiation (non-thermally) affects *brain function* – specifically, its electrical activity, its electro-chemistry, and the blood/brain barrier - and degrades the *immune system*. Thus, for example, the exposure to GSM and similar radiation is known to:

(*i*) Alter the natural rhythms of the brain's electrical activity, as measured by EEG [**40**].

(*ii*) Disturb the delicate balance of chemicals in the brain – in particular, the dopamine-opiate system [**41**].

(*iii*) Increase the permeability of the human blood brain barrier [**42**, **43**], thereby facilitating the passage of chemical toxins from the blood into brain fluid.

It should be noted that (*ii*) and (*iii*) are medically considered [**44**] to underlie headache, one of the most persistently reported effects. Furthermore, the recent discovery [**43**] that associated with the increased permeability of the BBB are regions of 'dark neurones', indicating actual damage to brain cells, is cause for concern, particularly in the case of children, since ……'*it may, in the long run*, *result in reduced brain reserve capacity*' [**43**]; the possibility of premature aging must also be considered, with associated negative effects manifesting themselves already in middle age.

In addition, the duration of REM sleep (during which important restorative processes and information processing take place) is shortened by exposure to radio-frequency radiation [**45**], whilst, as already noted, there is a reduced secretion of melatonin [**33**], both of which are consistent with reports of sleep disruption and concentration problems. Reduction in melatonin levels is also consistent with anecdotal reports of an elevated incidence of certain cancers in some exposed people; for melatonin is an oncostatic hormone – *i.e.* a hormone that protects against cancer[2], particularly in females.

V.3. Also in connection with cancer, the following should be noted:

a) The *in vivo* finding that exposure to pulsed GSM radiation (of an intensity comparable to that realised during mobile phone use) promotes [**47**] the development of cancer in mice that have been genetically engineered to have a predisposition to cancer.
(*b*) The 2-3-fold increase in the incidence of a rare form of tumour (*Epithelial*

[2] In this connection, the ability [**46**] of melatonin to *block* the effect of exposure to low intensity microwaves on DNA fragmentation (*See* Section IV.5.3) is particularly significant.

Neuroma) in the *periphery* of the human brain - where the penetration of the radiation from the Handset is greatest (the laterality of the tumours correlating with that of Handset use) - which has been found in an epidemiological study in the USA [**48**].

(*c*) The increased incidence of brain tumours amongst users of mobile phones of various kinds found in recently published Swedish epidemiological studies [**49-51**]. The highest incidence was found [**49**, **50**] in the case of the older, higher powered analogue phones, which, having been available for a longer time, permit the effects of exposure over a rather longer period to be studied[4]). In the case of digital phones (including cordless 'DECT' phones), on the other hand, where no *significant* increased risk was found overall (due to relatively short time that digital phones have been available), an increasing trend is, nevertheless, discernible with increasing latency period; furthermore, it was found that ipsilateral exposure to a digital phone *did* increase the risk significantly [**50**]. In a third publication [**51**], an increased risk of Acoustic Neuroma was reported, although it did not reach statistical significance, owing to the small number of cases involved; an increasing trend is, nevertheless, again discernible with increasing latency period.

V.4. In connection with reports of an increased incidence of seizures in some epileptic children when exposed to the emissions of GSM Base-stations, it should be remembered that exposure to a light (such as that from a stroboscope) flashing at a rate somewhere between 15-20 times per second can provoke seizures in the 5% minority of epileptics who suffer from photosensitive epilepsy. Visible light and microwaves are, however, simply different realisations of electromagnetic radiation, and the microwave radiation used in GSM telephony similarly 'flashes' (pulses) – in the case of TETRA at 17.6Hz, which is within the 15-20Hz range cited above, and is a rate that the brain is able to recognise [**40**]; furthermore, unlike visible light, pulsed microwaves are *not* reliant on the eye and optic nerve to access the brain, since they can penetrate the skull *directly*.

V.5. It is important to appreciate that the contents of Sections V.2 & V.3, which pertain to exposure to the emissions of GSM *handsets*, are **not** necessarily irrelevant to the consideration of the effects of exposure to the very much weaker radiation from a Base-station, since, despite the fact that the public is here exposed to the *far*-field (as opposed to the near-field, as is the case during Handset use) the ***informational*** content of the (much weaker) Base-station signals (*i.e.* certain low frequency 'patterns' that the brain can 'recognise', and, in turn, respond to) is *very similar* to that of the (much stronger) signals emitted by a GSM Handset: *there is the **same** amount of information in a weak signal as in a strong one*, provided, of course, that the weak signal is not so weak as to be undetectable, which given the considerations of Section III.11.1 must be deemed unlikely!

[4] It is sometimes argued that, even in the case of analogue phones, exposure 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 might be promoted or initiated in certain susceptible people; it should be appreciated, however, that existing latency estimates are not necessarily relevant here, since they are based on experience under **non**-exposed conditions.

V.6. It is essential to appreciate, in the case of non-thermal influences contingent on aliveness, that it necessarily follows (similarly to the case of exposure to bacterial infection) that **not everyone will be equally susceptible**, *even when exposed to exactly the same radiation for exactly the same length of time*. For susceptibility depends not only on the radiation, but *also* on the genetic predisposition and neurological/ physiological state of the *individual* when irradiated, such as the stability of electrical brain activity and 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 **certain** people*.

The severity of any such adverse health effects will, of course, again vary from person to person, according to the robustness of their immune systems. This, in turn, undermines the extent to which the underlying non-thermal effects can be considered to be 'established', in the sense required in order for them to be currently eligible for consideration in safety deliberations.

More meaningful is to ask whether there is an established *risk* to human health from exposure to GSM/TETRA radiation: the answer is undoubtedly '**Yes**'. It is probably true to say that if a similar 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; in the case of mobile telephony, however, the authorities appear to be content to presume its *non-thermal* innocuousness ('innocence') until it is proven to be otherwise ('guilty') - when, of course, it will be too late!

V.7. Quite apart from their weaker immune systems, pre-adolescent children are particularly vulnerable – as recognised by the Stewart Report [**2**] - because of the increased rate at which their cells are dividing (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 at 900MHz. Especially 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 (including those hidden in church towers and in illuminated signs, such as those at petrol stations, for example) must be strongly resisted: **financial gain must not be allowed to be the overriding consideration**.

VI. Other related issues

VI.1. Ironically, the reality of a deleterious non-thermal interference between GSM radiation and energised electronic equipment, such as that in aircraft and hospitals, is generally accepted and respected, the use of mobile phones being actually *forbidden* as an extreme measure to ensure that electromagnetic compatibility (EMC) is not compromised. Ironically, however, the same concern does *not* yet extend to the alive human organism, despite (*i*) the fact that the latter *is itself* an electromagnetic instrument *par excellence*, which, as already mentioned, can detect electromagnetic

fields that are millions of times weaker than those found in publicly accessible places around GSM/TETRA Base-stations, (*ii*) the existence of a wide variety of non-thermal bio-effects induced by low intensity microwave radiation (both pulsed and non-pulsed) that have been revealed by many experiments, enjoying varying degrees of corroboration, which have been performed over the last 30 years on many different kinds of biosystems - ranging from cells in test-tubes to the entire living human organism – most of which have been published in international, peer reviewed scientific journals [**30**].

VI.2. The familiar ploy of citing the purported innocuousness of radio and television transmissions (to which we have been exposed for such a long time), in an attempt to support the claim that exposure (over a much shorter time) to the (much less intense) radiation used in mobile telephony is harmless, is flawed on at least three accounts: (*i*) the occurrence, in any case, of certain health problems that correlate with exposure to the radiation from such installations [**52-57**], (*ii*) the fact that, *unlike* that used in GSM, the radiation from TV and radio transmitters is **not** *pulsed*, in particular, in patterns characterised by frequencies that the brain can recognise, and (*iii*) the beam morphologies of the different kinds of installations are quite dissimilar, so that exposures to the different sources cannot be straightforwardly, or even meaningfully, compared. Furthermore, before taking reassurance from the asserted absence of health problems amongst users of TETRA in continental Europe, it should be remembered that there it is often the much *less* biologically active *TETRAPOL* system (as opposed to TETRA) that is used.

VI.3. Quite apart from the objections raised in the preceding Section, however, it can be argued that if examples of TV/radio are to be invoked - despite the fact that their frequency characteristics are *quite different* from GSM (with respect both to the carrier wave and the way in which it is modulated) - it must be equally permissible to cite *other* cases (in which the exposure parameters, apart from intensity, again *differ* from those of GSM radiation) where there is undisputed, documented evidence of adverse health effects. Indeed, it can be argued that GSM radiation should *not* be considered in isolation from other similar kinds of radio-frequency radiation, particularly given the present paucity of epidemiological data pertaining to the effects of exposure specifically to GSM. Two particular cases merit mention:

(*i*) An extensive epidemiological study in the vicinity of the Skrunda Radar installation in Latvia, which has been described as a 'living laboratory', in which the inhabitants of the non-exposed area to the rear of the radar beam acted as the 'control' group. This study was commenced in 1989, after the radar had been in operation for some 20 years, in response to complaints by inhabitants that exposure to the pulsed radio-frequency radiation emitted by the installation was affecting their health. Adverse effects on humans, animals and vegetation of long-term exposure to were subsequently found, including:

a) A significantly higher level of genetic damage in cattle, revealed by blood cell analysis [**58**],

b) Children living in the beam had less developed memory and attention, their reaction times were slower, and their neuromuscular apparatus endurance was decreased [**59**].

(***ii***) The American Embassy in Moscow, which between 1953 and 1976 was irradiated at regular intervals (of 48 hours duration) with pulsed microwaves of an (outside) intensity of about 2μW/cm^2. A re-analysis [**60**], based on information that only became fully available following the Freedom of Information Act, revealed a high incidence of serious illnesses, such as chromosome aberrations in more than half the people sampled (whose average time of residence was typically 2-4-years), and an elevated incidence of leukaemia amongst Embassy staff and their children, particularly.

VI.4. The reviews of official bodies – such as those commissioned by the Royal Society of Canada [**61**] on behalf of *Health Canada*, and the UK [**2**], French [**62**], Dutch [**63**] and Norwegian [**64**] Governments - are open to the general criticism that they fail to adequately address the issue of electromagnetic sensitivities that are *contingent on aliveness*. In addition, they are also regrettably characterised by persistent tendencies to:

i) Conclude (erroneously) from a set of (seemingly) conflicting results (*See* Section III.11.3, however) that there is really no effect.

ii) Put the most negative possible 'spin' on any positive results (that might be suggestive of, or consistent with, possible health problems), demanding further corroboration before accepting them.

iii) Reject positive effects on the grounds either that, in *their* opinion, the experiments are flawed for one reason or another, or because of difficulties in identifying what they consider to be credible mechanisms for the contentious effects.

Whilst such scepticism is, of course, healthy and essential to the progress of reliable science, care must, at the same time, be taken to ensure that valuable potential indicators of positive effects are not missed (or prematurely dismissed), and equally, that *negative* findings (consistent with the safety of the technology) are not automatically deemed exempt from similar scrutiny. At present, there is a definite bias towards regarding any positive results as 'false positives', whilst rarely considering the possibility of 'false negatives' – a dangerous and totally unacceptable state of affairs that is geared to promote a quite unjustified and unrealistic sense of security.

VI.5. A familiar piece of misinformation that here needs to be addressed is the assertion that the emissions of a Base-station are comparable to that of only a 60W light bulb, and thus equally harmless. Quite apart from the fact that the light from a 60W light bulb *can be* harmful to a person with photo-sensitive epilepsy, if it is flashed at an appropriate rate, the comparison is solely based on intensities and neglects three important points:

(*i*) The fact that *more* than one carrier is usually transmitted. Thus, the figure of 60W must be multiplied by the number of carriers that are actually transmitted in any particular case; in order to minimise inter-carrier interference, however, this number is restricted typically to 4 at the most, whence the total output wattage can be a high as 240W.

(*ii*) The beams, however, are *not* emitted uniformly in all directions, but are instead concentrated in specific directions, the degree of directional focussing being quantified through the so-called 'gain' (G) of the antenna, typical values of which, in the case of GSM, range from about 40 to 60 [**2**]. (This applies even in the case of so-called 'omni-directional' antennae, which emit beams that are omni-directional *only* in the horizontal plane; in the vertical plane, the beam *is* directionally orientated by an amount that is determined by its vertical (angular) width – typically, about 10 degrees.) Accordingly, to calculate the power density (intensity) *at the (vertical & horizontal) centre of a beam*, at a distance *d* from the mast using the familiar 'inverse square law', the power, *P*, delivered by the antenna must be multiplied by the gain, *G,* whence the intensity is given by the formula: $PG/4\pi d^2$; thus in the above example with P = 60W and G = 30, the effective directionally focussed power (per single carrier) – the so-called 'effective isotropic radiated power (EIRP), given by the product PG – is 1800W, which is further increased to 7.2kW if 4 carriers are transmitted – a value that is 120 times higher than the 60W cited! The maximum EIRP value permitted by law is 1500W *per carrier*, whilst the maximum number of carriers is 16 (at 1800MHz) and 10 (at 900MHz); in practice, however, the number of carriers is usually restricted to 4 at the most, for the reason mentioned above.

(*iii*) The comparison neglects the all important frequency dimension, in particular the difference in the frequency that characterises the visible light from the light bulb from that which defines the radiation to be (invisible) *microwave* radiation. For whilst the output from such a bulb is, during the day, completely negligible in comparison with visible light of natural origin – *i.e.* that from the Sun – this is not so in the case of the microwave radiation emitted by a Base-station antenna day *and* night, which, several hundred of metres away, is typically **10 billion (10^{13}) times higher** than the microwave radiation that is emitted by the Sun at the same frequency. Accordingly, the emissions of telecommunication Base-stations have caused an enormous (and relatively sudden) alteration in the natural environment (at this frequency) from that in which life on Earth has, over a very much longer time, evolved. The impact of this altered environment on biology is further enhanced by the high coherence of the Base-station radiation, as already noted in Section III.11.1.

VII. Conclusions

On the basis of many inter-consistent reports of adverse health effects in the vicinity of GSM Base-stations, it must be concluded that such installations poses a **real risk** to the health of people resident at nearby. It is to be stressed that this conclusion is not purely personal, but is one that is shared by many eminent scientists of international standing and medical doctors worldwide. Furthermore, my concern is **quite independent** of the theoretical considerations of Section III and IV above, although they *do* serve to enhance the credibility of the disputed non-thermal effects by positing possible mechanisms *via* which such effects might arise and, in turn, influence human health.

The reality of such a risk to public health is not yet officially recognised, however, and those who dare to depart from the 'official' line, by warning of potential dangers to human health posed by *non-thermal influences* of the radiation used in mobile

telephony, are subject to immediate criticism and derision – particularly by those with a vested interest in maintaining the growth of mobile telephony. A good example of this is the ferocious attack [**65**] by the committee of COST281 on my report [**30**] for the EU Parliament (commissioned by STOA).

For governments to be so confident that the ICNIRP guidelines afford a completely adequate degree of protection effectively means one of two things:

1. They simply do *not* appreciate that these guidelines afford protection *only* against over-heating.

2. They do appreciate the purely thermal basis of the guidelines, but believe that overheating is the only way in which adverse health effects can be provoked. Such a belief, however, effectively denies that, when alive, our sensitivity and vulnerability to pulsed microwave radiation are any higher than when we are dead – an attitude that betrays a total lack of appreciation of the fundamental role that electromagnetic interactions play in the biocommunication and control, particularly in the regulation and protection of bioprocesses essential to life and well-being.

Electromagnetic interactions are *not* alien to the alive body, and non-ionising electromagnetic fields below the thermal threshold should not be treated as though they were *toxins*. Unlike the heating effect of exposure to microwaves, which can, if excessive, cause actual material damage, *non-thermal* influences act in a **more subtle way**, *via* their potentiality to interfere with biological **functionality –** in particular, it would appear, with that of bioprocesses which are intended to afford (natural) protection *against* adverse health effects of various kinds.

Clearly, the international scientific community is at present deeply divided even as to the reality of non-thermal effects of the kind of radiation utilised in GSM/TETRA telecommunications, let alone their implications for human health. Wider acceptance of the reality and significance of non-thermal effects and their potentiality to provoke adverse health reactions in some susceptible people is clearly contingent on the prior acceptance that a *living* body has special electromagnetic sensitivities precisely **because** of its *aliveness*. The incorporation of this into safety guidelines requires, however, a much more holistic, integrative approach than that presently used, which effectively fails to recognise the most discriminating feature of all – namely, the aliveness of the people exposed. An example of a sensitivity *peculiar* to the living state is the ability of a flashing light to provoke seizures in photosensitive epileptics; safety guidelines based only on limiting the intensity of the light would afford *absolutely no protection* against this effect, unless, of course, the intensity was so low that the light was not visible.

Given the reluctance of Safety Standard-setting Bodies to address the implications of non-thermal influences of exposure to GSM radiation, particularly those allied to *aliveness*, the only responsible strategy possible at present – which at least implicitly recognises the potential hazard posed by this crucially important, but disputed, dimension of the problem – is to have recourse to a Precautionary Approach. At present, one possibility of implementing such an approach is to ensure that any Base-station is located <u>sufficiently far</u> from

residential areas and 'sensitive' locations - such as schools, children's nurseries, hospitals, old people's homes *etc.* – that the outdoor exposure intensity at these locations at least complies with the Salzburg Resolution [3] limit of 1mW/m^2 – a value which is 4500 (9000) times *lower* than that permitted by the current ICNIRP guidelines [1] for microwave radiation at 900MHz (1800MHz), respectively.

……..

APPENDIX A

The basis of the ICNIRP Guidelines

A1. Water readily absorbs microwave radiation, the electromagnetic energy deposited by the radiation heating up the water; the higher the intensity of the radiation the greater the temperature rise produced. In *living* organisms, however, which are mainly composed of water, their thermoregulatory mechanism attempts to limit the magnitude of this temperature rise by dispersing the deposited energy, through increased blood flow, for example. Provided the rate of energy absorption is not too great, the body's thermoregulatory mechanism succeeds in maintaining temperature homeostasis; however, above a certain rate – the value of which depends on the basal metabolic rate of the organism and the prevailing environmental conditions – the thermoregulatory mechanism is no longer able to maintain homeostasis, and body temperature accordingly starts to rise. It is an established medical fact that there is a limit to the temperature rise that an alive body can sustain before health problems set in, the magnitude of which depends on the physiological condition of the exposed person; this, in turn, can itself depend on prevailing environmental conditions. For example, a temperature rise of 1^{o}C might be fatal to someone who is already suffering from heat stroke, but life-saving to someone with hypothermia. Thus, whilst absorption of microwave energy necessarily always tends to increase temperature, the health consequences can vary from person to person, depending on their physiological condition at the time of exposure. To allow for a reasonable variation between different people, safety factors are incorporated.

The basis for the ICNIRP exposure limit is the following. It is found, under moderate environmental conditions, that exposure of individuals to microwave radiation of the frequency used in mobile telephony for about 30 minutes results in a whole body temperature rise in excess of 1^{o} C, if the rate of energy deposition per kilogram (the so-called 'specific absorption rate', or SAR) exceeds 4W/kg. To allow for a range of possible conditions, such as high ambient temperature, humidity, or level of physical activity, safety factors of 10 and 50 are invoked for occupational and public exposure, respectively; the resulting safety guideline value (the so-called 'basic restriction') for average whole body exposure of the *general public* is thus set at 0.08W/kg. By mathematical modelling and extrapolation, this (basic restriction) value is translated into a so-called 'reference level', which is the power density[3] (intensity) of the irradiating microwave field necessary to produce this SAR value in an exposed person. The value of this power density depends on the frequency of the radiation, and is 4.5W/m^2 and 9W/m^2 at 900MHz and 1800MHz, respectively.

A2. In justifying the exclusion of any *non-thermal* input into the formulation of their Safety Guidelines, ICNIRP conclude [**1**]:

> '*Overall, the literature on athermal effects of amplitude modulated electromagnetic fields is so complex, the validity of the reported effects so poorly established, and the relevance of the effects to human health is so uncertain, that it is impossible to use this body of information as a basis for*

[3] The rate at which electromagnetic energy from the irradiating microwave field falls on 1 square metre of an exposed person.

setting limits on human exposure to these fields.' (My underlining)

It is to be stressed that this is **not equivalent to denying either the existence of non-thermal influences of this kind of radiation, or their potential to provoke adverse health reactions** - as is often maintained by the Mobile Phone Industry – but simply that in ICNIRP's view (because for the reasons stated) such effects cannot be used as a basis for setting exposure limits. Let us consider each underlined point in turn.

A2.1. As an example of the complexity of athermal (*i.e.* non-thermal) effects, the following statement appears in the paragraph preceding the one from which the above quotation is taken:

> '*Interpretation of several observed biological effects (of this kind of radiation) is complicated by the apparent existence of 'windows' of response in both power and frequency domains. There are no accepted models that adequately explain this phenomenon, which challenges the traditional concept of a monotonic relationship between the field intensity and the severity of the resulting biological effects.'*

An absence of such a monotonic ('dose-response') relationship is, however, actually to be *expected*, since one is dealing with **living** organisms whose very aliveness means that they are far from thermal equilibrium, and hence well beyond the regime where such a monotonic relationship can be expected to hold. Being held far from thermal equilibrium, their response to an external electromagnetic field, for example, necessarily depends on the *state* of the organism at the time when it is exposed - *i.e.* one is dealing with what are known as **non-linear** systems, for which exposure to a weak microwave field does not necessarily entail a correspondingly weak response, or *vice versa,* and for which the 'window' phenomena referred to are actually to be expected (*Recall Section III.4.10*). (In this connection, it should be remembered that the concept of a dose-response relationship is one inherited from toxicology, and as such, is in general, *inappropriate* in the present context. For electromagnetic fields are *not alien* to the alive organism, but play a fundamental and integral role in its organisation and control, as already noted above.)

A2.2. This dependence of non-thermal influences on the state of the alive organism must, in general, be expected to undermine the reproducibility of their detection, thus accounting for the reported effects being (in some cases) '*poorly established*'. Accordingly, such difficulties should, more positively, be considered as a biological fact of life – indeed as a 'hallmark' of aliveness! It should be noted that the 'poorly established' claim is not universally accepted, as evidenced both by the Vienna Resolution [**66**] of 1998, signed by 16 researchers of international standing, by an analysis [**67**] of the ICNIRP document, which claims that it contains….'*a consistent pattern of bias, major mistakes and deliberate misrepresentations'*, and, most recently, by the Catania Resolution of October 2002 [**13**].

A2.3. The least contentious part of the above quotation from the ICNIRP document is, of course, the question of the relevance of non-thermal effects (assuming their existence is accepted) to human health - it being, of course, essential to appreciate that the occurrence *per se* of non-thermal effects does not mean that they *necessarily* entail adverse health consequences, as already stressed in Section V.1

However, as noted in Section V.1 there is a disturbing consistency between some non-thermal effects and the kinds of adverse health problems reported by some people exposed to the microwave emissions of Base-stations. **It should, of course, be further appreciated that ICNIRP's present position is based on pre-1997 data**. Since that time, many more non-thermal effects have been reported, such as increased permeability of the Blood-Brain-Barrier [**42**, **43**], elevated levels of Heat Shock Proteins [**37**, **68**, **69**], and effects [**40**] on brain electrical activity (EEG), all of which must now be taken into consideration.

A3. What the Mobile Phone Industry and the various national governmental Regulatory Bodies (such as the NRPB in the UK) 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 its intensity complies with the ICNIRP safety guidelines, the radiation is *not* harmful to humans derives, however, firstly, from the erroneous view (already noted) that considers electromagnetic fields to be toxins to the body - rather than accepting them as an *integral* feature of its living state - and secondly, from an outdated 'linear' mindset that 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 – *i.e.* they depend not only on the electromagnetic field to which a subject is exposed, but also on the *state* of the individual at the time of exposure: any attempt to understand such effects from a purely linear perspective is thus doomed, in that it is inherently unable to address the most discriminating feature of all, namely, the '***aliveness***' of the system under consideration.

A4. Further consideration of the 'official' position

A4.1. It is common for the mobile phone companies to claim – on the basis of *selective* extracts from the recommendations of 'official' bodies, such as the IEGMP, and from documents containing Government Guidance on the Planning Process, such as PPG8 (Revised) - that provided exposure is below guideline levels it is harmless, and need not even be considered in the context of prior approval. Several examples of such selectivity are given below:

A4.1.1. The following extract from PPG8(Revised) - Paragraph 30 of 'Planning Policy' - is often used by LPAs in an attempt to relieve themselves of health considerations:

> '*In the Government's view, if a proposed mobile phone base station meets the ICNIRP guidelines for public exposure it should not be necessary for a local planning authority, in processing an application for planning permission or*

prior approval, to consider further the health aspects and concerns about them.

Omitted, however, is the preceding section (Paragraph 29) of PPG8(Revised), which is arguably necessary in order that PPG8(Revised) *as a whole* be compliant with the Human Rights Act. Paragraph 29 reads:

'*Health considerations and public concern can in principle be material planning considerations in determining the applications of planning permission and prior approval. Whether such matters are material in a particular case is ultimately a matter for the court. It is for the decision maker (usually the Local Planning Authority) to determine what weight to attach to such considerations in any particular case*'.

Indeed, in the case of *Yasmin Skelt v First Secretary of State and Three Rivers District Council and Orange PCS Limited* [*Crown Office/2466/2003*], the Secretary of State has recently conceded that compliance with ICNIRP must not be used as a bar to full and proper consideration of the publics health concerns, effectively negating the thrust of Para.30 of PPG8.

A4.1.2. The following extract (Paragraph 1.33) of the Final Report [**2**] of the IEGMP (the so-called 'Stewart Report') is often quoted in support of the claim that exposure to Base-station radiation is innocuousness:

'*We conclude that the balance of evidence indicates that there is no general risk to the health of people living near to base stations on the basis that exposures are expected to be small fractions of guidelines*'.

It is thus maintained that existing safety guidelines afford the public adequate protection against adverse health effects arising from exposure to the radiation emitted by GSM Base-stations. This extract omits, however, the final sentence of Paragraph 1.33, which states:

'*However, there can be indirect adverse effects on their well-being in some cases.*'

This clearly recognises that because of *indirect* adverse effects, existing guidelines do not, and cannot, afford an adequately comprehensive level of protection.

Furthermore, this summary extract fails to accurately reflect the stronger statement of Paragraph 6.44.

'*Although it seem highly unlikely that the low levels of RF radiation from base stations would have significant, direct adverse effects on health,* ***the possibility of harm from exposures insufficient to cause important heating of tissues cannot yet be ruled out with confidence****. Furthermore, the anxieties that some people feel when this uncertainty is ignored can in themselves affect well-being possibility.*' (My emphasis)

A4.1.3. Another example of selective extracting occurs in connection with the Report [**61**] prepared at the request of the Royal Society of Canada for Health Canada (Page 3, 3rd paragraph):

'*Scientific studies performed to date suggest that exposure to low intensity non-thermal RF fields do not impair the health of humans or animals*.'

The next sentence, however, which is invariably omitted, puts a rather different slant on things, for it goes on to say:

'*However, the existing scientific evidence is incomplete, and inadequate to rule out the possibility that these non-thermal biological effects could lead to adverse health effects*'.

A4.2. It is thus apparent that a less selective and more comprehensive reading of cited documents reveals a somewhat different state of affairs, and one that is consistent with the increasing number of health problems of various kinds reported by *some* people exposed to the emissions of GSM Base-stations. Indeed, at a meeting at the Royal Society on 11th November 2002, the Chairman of the IEGMP, Sir Wm Stewart, was at pains to point out [**70**] that the main conclusions of the IEGMP Report were contained in Paragraphs 1.17-1.19, and **not** solely in Paragraph 1.33, as repeatedly claimed, for example, by HM Government in its announced acceptance of the main recommendations of the IEGMP.

Para.1.17: '**The balance of evidence to date suggests that exposures to RF radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population.**'

Para.1.18: '**There is now scientific evidence, however, which suggests that there may be biological effects occurring below these guidelines**. This does not necessarily mean that that these effects lead to disease or injury, but it is potentially important information and we consider the implications below.'

Para.1.19: 'There are additional factors that need to be taken into account in assessing any possible health effects. Populations as a whole are not genetically homogeneous and people can vary in their susceptibility to environmental hazards. There are well-established examples in the literature of the genetic predisposition of some groups, which could influence sensitivity to disease. There could also be a dependence on age. **We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach**.'

Sir William went on to stress that there could be *indirect* adverse health impacts (already referred to above) on some people's well-being as much as any direct health effects, quoting Paragraph 1.31 of the Stewart Report [**2**]:

'*We are concerned at the indirect adverse impact which current planning procedures are having on those who have been, or are, subjected to the often insensitive siting of base stations. Adverse impacts on the local environment may adversely impact on the public's well-being as much as direct health effects.*'

A4.3. In connection with PPG8(Revised), two further comments are necessary:

i) PPG8(Revised) presumes that Base-stations *already* operate at the **lowest possible power**. There have, however, been instances, where, in response to complaints, the Operators have reduced the power of particular Base-stations without compromising the integrity of the network. Clearly, these installations were *not* initially operating at the presumed lowest possible power, and must thus, retrospectively, be considered to fall outside the remit of PPG8(Revised). It can thus be argued that if it can be established *ab initio* (from the submitted technical details), that a proposed Base-station is going to operate *above* the lowest possible power, then the associated Planning Application is not actually subject to PPG8(Revised).

ii) PPG8(Revised) is, in any case, only *guidance*, and *not* a mandatory requirement, as established by the Court of Appeal (17th May 2002, in the case of 3 Education Guidance Circular Appeal Cases [**71**], stating that Appeal Panels (LPAs in the present context) had to keep the guidance issued by the Secretary of State (which has, in any case, to be Convention compliant) in mind, but it was not direction, and did not lay down rules to be strictly adhered to.

A4.5. Quite understandably, the public remains sceptical of attempts by governments and industry to reassure them that all is well, particularly given the unethical way in which they often operate symbiotically so as to promote their own vested interests, usually under the brokerage of the very statutory regulatory bodies whose function it supposedly is to ensure that the security of the public is *not* compromised by electromagnetic exposure. Given the recent experience with official duplicity over *BSE/CJD* – with the initial assurances of no risk and subsequent revelations of cover-ups - the public is now understandably wary of safety assurances from 'official' governmental scientific sources in respect of electromagnetic pollution; this is particularly so when the voice of those with a view contrary to that of the prevailing officially perceived wisdom is at worst silenced, or, at best, studiously ignored.

APPENDIX B

National & International Guidelines Exposure Levels relevant *outdoor* to GSM and TETRA Signals.

Country/Body	**Exposure limit in W/m^2**		
	GSM		**TETRA**
	900MHz	1800MHz	400MHz
NRPB (UK)	33.0	100.0	26.0
ICNIRP [1]	4.5	9.0	2.0
IEEE (USA)	6	12.0	2.7
EU Countries (ICNIRP)	4.5	9.0	2.0
Exceptions:			
Belgium	1.125	2.25	0.5
Greece	3.6		1.6
Italy (< 4 hr/day)	1.0	1.0	1.0
(> 4 hr/day)	0.1	0.1	0.1
Luxembourg	0.45	0.45	?
Paris	0.01	0.1	?
Salzburg	0.001	0.001	?
Spanish Regions (*Castilla-La Mancha*)	0.1	0.1	0.1
Other countries:			
Japan (ICNIRP)	4.5	9 0	2.0
New Zealand (ICNIRP)	4.5	9.0	2.0
Russian Federation	0.1	0.1	0.1
South Africa (ICNIRP)	4.5	9.0	2.0
Switzerland (General – ICNIRP)	4.5	9.0	2.0
(Extended exposure in sensitive areas)	0.1	0.1	?

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