

## **BACKGROUND INFORMATION TO CALL FOR PROPOSALS IN THE MOBILE TELE COMMUNICATIONS AND HEALTH RESEARCH PROGRAMME**

### **Summary and Conclusions of the Scientific Evidence of the Independent Expert Group on Mobile Phones**

The summary of recommendation for research was as follows:

- Effects on brain function
- Consequences of exposure to pulsed signals
- Improvements in dosimetry
- Sub cellular and cellular changes induced by RF radiation and their possible impact on health
- Psychological and sociological studies related to the use of mobile phones
- Epidemiological and human volunteer studies including the study of individuals who might be more susceptible to RF radiation

The report also gave more detailed guidance in some specific areas as follows (in no particular order of priority):

#### **Pulse modulation & resonance effects<sup>1</sup>**

There is very little information available on how telecommunication fields with different pulse or amplitude modulation affect the human health. Questions have been raised whether RF fields modulated at EEG frequencies or at other natural body frequencies would influence CNS responses. There is a particular need to investigate pulse modulation effects.

In discussion of the theoretical work of Hyland who suggested that the mechanism proposed in the model of Frohlich of the coherent state in biological systems, could lead to biological effects at mobile phone frequencies. The Expert Group discuss work that suggested DNA polymers and elements of fibre structures (cytoskeletons), such as microtubules and actin filaments could have modes in this range; they note no resonant absorption was found from DNA in solution although this might not rule out the possibility that it occurs under the conditions under which DNA exists in tissues. They suggest the work in DNA should be repeated under conditions more closely matched to those in tissues and similar measurements should be made on microtubules and actin filaments.

#### **Base Stations**

In discussion of biological effects of base stations they conclude there is little evidence to support resonant behaviour, but further work to investigate this proposed mechanism could be worthwhile.

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<sup>1</sup> The indents are further clarification points agreed by the Programme Management Committee at its first meeting on 9<sup>th</sup> February 2001.

### **Physical basis of non-thermal effects:<sup>1</sup>**

The Independent Expert Group considered possible interaction between RF radiation and biological systems that might apply at field strengths too low to cause significant thermal effects such as the fields to which the public are exposed from base stations.

These include polarisation of cells, rectification, protein unfolding and resonant interactions. Theoretical work suggests that DNA polymers and cytoskeletal elements could have resonant modes in the RF range but no evidence for resonant absorption has been found for DNA in solutions. Such work might be pursued under conditions more closely matched to those in tissues.

### **Exposure conditions**

In considering experimental studies more generally the group comment that a considerable problem in the interpretation of experimental is that many of them have given insufficient detail concerning exposure conditions. Moreover, in the case of pulsed fields when SAR values are quoted it is often unclear whether these refer to the average SAR or to the peak SAR during pulses. It is very important to make this distinction, since the peak SAR can be 1000 or more times the average value. They conclude full details should be provided of experimental conditions including maximum SAR per pulse for pulsed radiation.

### **Neurotransmitters**

The group say most of the work on neurotransmitter systems has used high power densities and has probably revealed thermo-regulatory or other responses to temperature change. However, in view of the essential role of neurotransmitters in brain function and the involvement of specific transmitter systems in the regulation of emotion, memory, sleep etc this area deserves further investigation, including the assessment of these functions in human subjects.

### **Learning and Memory**

The Group say increases in core temperature of 1 degree C or more certainly lead to changes in the performance of well learned tasks and other simple behaviours. However, there is no consistent experimental evidence that exposures to low level RF fields affects learning and memory in animal. The studies of Lai and co-workers challenges these conclusions and suggest that spatial learning can be disturbed at average SAR below 1 W/kg. However the peak-pulse energy was much higher than that associated with mobile phones, the effects reported were statistically weak and they have not been reproduced by Sienkiewicz et al (2000) using 900 MHz fields. D'Andrea (1999) has speculated that some cognitive tasks may show particular sensitivity to RF exposure, and effects on these behaviours may occur at SARs below those required to disrupt simple, well learned tasks. Few studies have yet explored this possibility The hippocampal slice preparation shows great potential for the study of RF field effects; more research is indicated. However, studies on human subjects

are needed to assess whether fields associated with mobile phones have any effect on learning or memory.

### **Gene Expression**

While there is currently little evidence that exposure to mobile phone radiation causes a stress response in mammalian cells, judged by elevated gene expression, the results on nematode worms are indicative of a non-thermal influence on gene expression. This model and similar model systems, using cultured mammalian cells carrying reporter transgenes linked to important genes, could be valuable in defining genetic responses to radiation.

### **Cell growth survival or proliferation**

Experiments on DNA synthesis do not demonstrate convincing, consistent changes in cell proliferation under conditions that mimic emissions from mobile phones or base stations. However work on the effects of RF fields on nucleic acid synthesis deserve further study.

### **DNA damage: in vivo studies**

This area deserves further research, but the evidence of Sarkar et al (1994) and Lai and Singh (1995,1996) for DNA damage in rats is contradicted by a number of other studies in vivo and is not supported by in vitro work.

### **Epigenetic effects- interaction with genotoxic agents**

The report says that although thermal effects may account for the positive reports that RF radiation enhances the actions of genotoxic agents, the evidence for epigenetic effects must be taken seriously. Further research is needed in this area to clarify the position.

### **Reproduction and Development**

There is no convincing evidence from studies of rodents that exposure to RF fields at levels associated with mobile telecommunications poses any risk for the fetus or for male fertility. While there are good reasons to doubt whether the decline in female fertility described by Magras and Xenos (1997) was actually due to the very low level exposure. It is important to repeat this study under better controlled conditions.

### **Heart and Blood Pressure studies**

There is, on the basis of published evidence, no basis for concern about effects of mobile phone use on the heart and circulation. However, this is a subject that merits more experimental work on human volunteers. In particular the group advise that a study similar to that of Braune et al (1998a) is carried out with a larger number of subjects and appropriate control conditions.

## **Epidemiology**

The group makes clear recommendations for epidemiological studies. They propose:

Large case controlled studies of brain cancer, acoustic neuroma, salivary gland cancer, and leukaemia.

That in addition to already on going cohort studies, a large cohort study of long term mobile phone users be undertaken in the UK, which focuses particularly on people who started use in the 1980s and that, given the considerable design difficulties and potential costs entailed, a pilot study should be undertaken before a full scale investigation.

Double blind trials be undertaken to assess the relation of mobile phone use to symptoms such as headache that have been reported by users, and that a cross sectional survey of symptoms be conducted in relation to mobile phone use in the UK.

They propose that further epidemiological studies should be undertaken to clarify the relation of mobile phone use to the risk of motor vehicle accidents, and in particular whether the risk differs between hand held and hands free phones, and whether the risk of hands free use exceeds that of other forms of driver distraction, notably conversation with passengers.

Finally, they say there is a need for a significant research programme to be initiated so that the impact of mobile phone technologies on well being in its broadest sense is properly addressed and understood through epidemiological or other approaches.