

Present state of research on genotoxic effects of mobile phone radiation

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It took quite a while after the close of the REFLEX project*, which provided evidence of DNA damaging effects of mobile phone radiation, until the German Commission on Radiological Protection (SSK) of the Federal Office for Radio Protection (BfS) issued on 5/6 December 2006 a statement concerning the genotoxic effects of radiofrequency (RF) electromagnetic fields that reads as follows¹: “Based on an evaluation of scientific literature, the SSK has concluded that even considering the recently published results until October 2006: There is no scientifically based suspicion that RF fields have a genotoxic effect, and there is no scientifically based suspicion that RF fields have an influence on gene regulation. The results of available studies give no indication that there is an adverse health effect on the genome by radiofrequency electromagnetic fields questioning existing exposure restrictions.”

For the current chairman of the Committee Non-ionizing Radiation in the SSK, the biologist Prof. Alexander Lerchl from the private Jacobs University Bremen, the existence of genotoxic effects of radiofrequency radiation as shown at the Medical University of Vienna (MUV) within the frame of the REFLEX project, would – if true - indeed be alarming. He states²: “Should they be confirmed would this be not only an alarm but the beginning of the end of mobile communication, as DNA damages are a first step towards cancer.”

As Prof. Lerchl is convinced that genotoxic effects of mobile phone radiation do not exist, he assumes that the research findings at the MUV have been faked. To get rid of them, he started a campaign against the REFLEX project and its follow-up study in 2008, which in the meantime looks quite bizarre but nevertheless continues. His accusations are currently under investigation by the newly established Austrian Agency for Scientific Integrity.

Meanwhile, the results of the research work at the MUV have been confirmed and expanded in several scientific papers. As the DNA damaging potential of mobile phone radiation has been proven in different isolated cell systems using various methodological approaches, the results cannot be questioned anymore. Two papers even describe DNA damages in the brain cells of experimental animals that were exposed to radiofrequency electromagnetic fields below the valid safety limits. Thus, we are confronted with the question whether or not the same deleterious alterations may also occur in the brains of regular mobile phone users. According to Prof. Lerchl there is no evidence that mobile phone radiation brings along a high health risk, and he cites the World Health Organisation (WHO), the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), and the BfS that all agree on this. Strong hints that this assumption could be unfounded are ignored by him.

In the following, the relevant scientific papers published since the end of 2009 are briefly described:

- Franzellitti et al.³ published in *Mutation Research* in October 2009 a paper in which they provide evidence that in isolated human trophoblasts DNA strand breaks significantly increased during a 16- respectively 24-hours GSM exposure - just as observed in Vienna. No increase in DNA strand breaks was found when cells were exposed only to the carrier frequency of the GSM radiation.
- Xu et al.⁴ followed a few days later with a paper in *Brain Research* in which they demonstrate the genotoxic potential of mobile phone radiation while applying another detection method for genotoxicity. They report that the DNA adduct rate caused by oxygen radicals in the mitochondria of primary cultured neurons (nerve cells) is significantly increased after a 24-hours GSM exposure.
- Campisi et al.⁵ published a paper in *Neuroscience Letters* in early 2010 in which they describe an increase of oxygen radicals accompanied by an increase in DNA strand breaks in primary rat glia

* REFLEX - Risk evaluation of potential environmental hazards from low energy electromagnetic field exposure using sensitive in vitro methods (QLK4-CT-1999-01574). Funded within the 5th Framework Programme of the European Union.

cells after exposure to a high-frequency field (900 MHz, GSM-like modulated). To achieve this effect an exposure time of 20 minutes at an electric field strength of 10 V/m (safety limit: 41 V/m) was sufficient. Again, no genotoxic effects were detected during exposure to the unmodulated carrier frequency of 900 MHz.

- Kesari et al.⁶ published a paper in the *International Journal of Radiation Biology* in April 2010 providing evidence that high-frequency electromagnetic fields (2.45 GHz, 50 Hz modulated) exert their genotoxic effects also in living organisms. In brain cells of rats they observed a significant increase in DNA strand breaks after a 2-hours exposure a day for 35 days with a whole-body specific absorption rate (SAR) of about 0.11 W/kg.
- Guler et al.⁷ present data in their paper published in *General Physiology and Biophysics* in March 2010 which demonstrate that also New Zealand white rabbits react with lipid and DNA damage after exposure (15 minutes a day during 7 days) to GSM-like 1800 MHz signals (electric field strength: 14 V/m; safety limit: 58 V/m). This gives further proof that modulated high-frequency electromagnetic fields may cause genotoxic alterations in the brain of whole-body exposed experimental animals.
- Most recent findings that again point to a DNA damage of the GSM 1800 MHz signals were presented at the International Meeting of the Bioelectromagnetics Society (BEMS) in Seoul, South Korea, in June 2010 by Xu et al.⁸. In two of four different cell lines – Chinese hamster lung cells and human fibroblasts – a significant increase in DNA double strand breaks was just as in Vienna observed after a 24-hours intermittent exposure (5 minutes on/10 minutes off) at an average SAR of 3 W/kg. Human amnion epithelial cells showed a similar tendency, however, the increase was statistically not significant. Human lens epithelial cells did not show any effects. These findings speak for a cell-type dependent effect of the GSM radiation.

We have to wait and see how these new findings, which show how absurd the campaign against the results of the Vienna team is, will be dealt with. In the long run truth in science – about which the initiator of the campaign against the REFLEX results enjoys to talk so frequently – cannot be suppressed.

¹ Statement by the German Commission on Radiological Protection (2006) Effects of Radiofrequency Fields on the Genome: Genotoxicity and Gene Regulation. Adopted at the 213th session of the Commission on Radiological Protection on 5/6 December, 2006: page 6. <http://www.ssk.de/en/werke/2006/volltext/ssk0620e.pdf>

² Lerchl A (2008) Fälscher im Labor und ihre Helfer: Die Wiener Mobilfunk-Studien – Einzelfall oder Symptom? Books on Demand GmbH (ISBN-13: 9783837063417): page 43.

³ Franzellitti S, Valbonesi P, Ciancagli N, Biondi C, Contin A, Bersani F, Fabbri E (2009) Transient DNA damage induced by high frequency electromagnetic fields (GSM 1.8 GHz) in the human trophoblast HTR-8/SVneo cell line evaluated with the alkaline Comet assay. *Mutat Res* 682(1-2):35-42.

⁴ Xu S, Zhou Z, Zhang L, Yu Z, Zhang W, Wang Y, Wang X, Li M, Chen Y, Chen C, He M, Zhang G, Zhong M (2009) Exposure to 1800 MHz radiofrequency radiation induced oxidative damage to mitochondrial DNA in primary cultured neurons. *Brain Res* 1311:189-96.

⁵ Campisi A, Gulino M, Acquaviva R, Bellia P, Raciti G, Grasso R, Musumeci F, Vanella A, Triglia A (2010) Reactive oxygen species levels and DNA fragmentation on astrocytes in primary culture after acute exposure to low intensity microwave electromagnetic field. *Neurosci Lett* 473(1):52-5.

⁶ Kesari KK, Behari J, Kumar S (2010) Mutagenic response of 2.45 GHz radiation exposure on rat brain. *Int J Radiat Biol* 86(4):224-43.

⁷ Guler G, Tomruk A, Ozgur E, Seyhan N (2010) The effect of radiofrequency radiation on DNA and lipid damage in non-pregnant rabbits and their newborns. *Gen Physiol Biophys* 29(1):59-66.

⁸ Xu S, Zeng Q, Zhang D, Chiang H, Leszczynski D, Xu Z (2010) The effect of 1800 MHz GSM mobile phone radiation on cellular DNA stability. *Bioelectromagnetics Society Annual Meeting*; June 14-18, 2010; Seoul. Abstract Collection: 9-3. http://www.bioelectromagnetics.org/bems2010/supp_data/9-3.pdf