MICRO WAVE NEWS
A Report on Non-Ionizing Radiation

Science Gets It Wrong on DNA Breaks

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Making sweeping statements about scientific knowledge is always challenging, especially when writing about an unfamiliar field of research. Take, for example, this opening sentence from an article, "Fraud Charges Cast Doubt on Claims of DNA Damage from Cell Phone Fields" by Gretchen Vogel in this week's *Science* magazine:

> "The only two peer-reviewed scientific papers showing that electromagnetic fields (EMFs) from cell phones can cause DNA breakage are at the center of a misconduct controversy at the Medical University of Vienna."

Sweeping ... and wrong.

Not counting the two papers from Hugo Rüdiger's lab in Vienna, here are 11 papers that point to changes in DNA breaks following exposures to cell phone radiation:

- R.J. Aitken et al., "Impact of Radiofrequency Electromagnetic Radiation on DNA Integrity in the Male Germline," *International Journal of Andrology, 28,* pp.171-179, 2005 (Australia);
- W. Baohong et al., "Studying the Synergistic Damage Effects Induced by 1.8 GHz Radiofrequency Field Radiation (RFR) with Four Chemical Mutagens on Human Lymphocyte DNA Using Comet Assay *in Vitro*," *Mutation Research, 578,* pp.149-157, 2005 (China);
- W. Baohong et al., "Evaluating the Combinative Effects on Human Lymphocyte DNA Damage Induced by Ultraviolet Ray C Plus 1.8 GHz Microwaves Using Comet Assay *in Vitro*," *Toxicology, 232,* pp.311-316, 2007 (China);
- G. Gandhi and Anita, "Genetic Damage in Mobile Phone Users: Some Preliminary Findings," *Indian Journal of Human Genetics, 11,* pp.99-104, 2005 (India);
- J. Kim et al., *"In Vitro* Assessment of Clastogenicity of Mobile-Phone Radiation (835 MHz) Using the Alkaline Comet Assay and Chromosomal Aberration Test," *Environmental Toxicology, 23,* pp.319-327, 2008 (Korea).
- S. Lixia et al., "Effects of 1.8GHz Radiofrequency Field on

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DNA Damage and Expression of Heat Shock Protein 70 in Human Lens Epithelial Cells," *Mutation Research, 602,* pp.135-142, 2006 (China);
• J. Phillips et al., "DNA Damage in Molt-4 T-Lymphoblastoid Cells Exposed to Cellular Telephone Radiofrequency Fields *in Vitro*," *Bioelectrochemistry and Bioenergetics, 45,* pp.103-110, 1998 (U.S.);
• T. Nikolova et al., "Electromagnetic Fields Affect Transcript Levels of Apoptosis-Related Genes in Embryonic Stem Cell-Derived Neural Progenitor Cells," *The FASEB Journal, 156,* pp.495-502, 2001 (Germany);
• K. Yao et al., "Effect of Superposed Electromagnetic Noise on DNA Damage of Lens Epithelial Cells Induced by Microwave Radiation," *Investigative Ophthalmology & Visual Science, 49,* pp.2009-2015, 2008 (China).
• K. Yao et al., "Electromagnetic Noise Inhibits Radiofrequency Radiation-Induced DNA Damage and Reactive Oxygen Species Increase in Human Lens Epithelial Cells," *Molecular Vision, 14,* pp.964-969, 2008 (China).
• D. Zhang et al., "Effects of GSM 1800 MHz Radiofrequency Electromagnetic Fields on DNA Damage in Chinese Hamster Lung Cells," *Chinese Journal of Preventive Medicine, 40,* pp.149-152, 2006 (China, in Chinese).

Some of these experiments investigated the effects of cell phone radiation alone while others looked at synergistic action with other agents. Some found large effects, while others saw small ones. Most found increased DNA breaks, while Jerry Phillips measured both increases and decreases. Nevertheless, they all reported DNA changes with cell phone radiation.

In addition, others have shown chromosomal changes following exposure to cell phone radiation. For instance:

• L. Manti et al., "Effects of Modulated Microwave Radiation at Cellular Telephone Frequency (1.95 GHz) on X-Ray-Induced Chromosome Aberrations in Human Lymphocytes *in Vitro," Radiation Research, 169,* pp.575-583, 2008 (Italy);
• M. Mashevich et al., "Exposure of Human Peripheral Blood Lymphocytes to Electromagnetic Fields Associated with Cellular Phones Leads to Chromosomal Instability," *Bioelectromagnetics, 24,* pp.82-90, 2003 (Israel);
• P. Sykes et al., "Effect of Exposure to 900 MHz Radiofrequency Radiation on Intrachromosomal Recombination in pKZ1 Mice," *Radiation Research, 156,* pp.495-502, 2001 (Australia).

And finally, a number of researchers have documented DNA changes at other, similar microwave frequencies but which are not used in mobile phone networks. For instance:

• H. Lai and N.P. Singh, "Acute Low-Intensity Microwave Exposure Increases DNA Single-Strand Breaks in Rat Brain Cells," *Bioelectromagnetics, 16,* pp.207-210, 1995 (U.S.);
• H. Lai and N.P. Singh, "Single- and Double-Strand DNA Breaks in Rat Brain Cells After Acute Exposure to Radiofrequency Electromagnetic Radiation," *International Journal of Radiation Biology, 69,* pp.513-521, 1996 (U.S.);
• R. Paulraj and J. Behari, "Single-Strand DNA Breaks in

Rat Brain Cells Exposed to Microwave Radiation," *Mutation Research, 596,* pp.76-80, 2006 (India);
• S. Sarkar et al., "Effect of Low-Power Microwave on the Mouse Genome: A Direct DNA Analysis," *Mutation Research, 320,* pp.141-147, 1994 (India);
• M. Zhang et al., "Study of Low-Intensity 2450 MHz Microwave Exposure Enhancing the Genotoxic Effects of Mitomycin C Using Micronucleus Test and Comet Assay *in Vitro," Biomedical and Environmental Sciences, 15,* pp.283-290, 2002 (China);
• M. Zhang et al., "Effects of 2450 MHz Microwave on DNA Damage Induced by Three Chemical Mutagens *in Vitro," Chinese Journal of Industrial Hygiene and Occupational Diseases, 21,* pp.266-269, 2003 (China, in Chinese).

Sources tell us that there are more papers now in the publication pipeline.

None of this should be interpreted as indicating that the cell phone–DNA issue is closed. Others have failed to see such genetic effects and the jury is still out. But, clearly, to state that only two papers have shown DNA breaks is grossly misleading —no, simply wrong.

We have been closely following the University of Vienna story for some months and we will be reporting on it in detail sometime soon. The *Science* story reveals but a glimpse of some of the maneuvering going on behind the scenes; in this case, manipulating the media to influence public opinion. At the moment, we are still trying to sort out who is doing what.

Science, Gretchen Vogel, DNA breaks, Hugo Rüdiger,

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