Author's Reply

Ronold W. P. King

The entire series of comments by Lapin and Guy deals with the specific absorption rate (SAR). That is, their comments are concerned with the temperature increase in the body due to microwave irradiation. Neither of the above papers[1][2] makes any claim that the microwave electric fields to which radio amateur operators are exposed have any significant thermal effect. The discussion in Section I of the above paper[2] shows that its concern was directed to the possible effect of microwave radiation on the replication of cells. Lapin and Guy should study the first two references in the above paper[2] (repeated here as [1], [2]). After they have studied them, they may not be quite so sure that "there is absolutely no basis for the conclusion that amateur radio operators are at any health risk." The effect of a microwave electric field on cells is quite different from thermal effects in the body.

REFERENCES

[1] E. Pennisi, "Trigger for centrosome replication found," *Science*, vol. 283, pp. 770–771, Feb. 1999.
[2] E. H. Hinchcliffe, C. Li, E. A. Thompson, J. L. Maller, and G. Sluder, "Requirement of Cdk2-cyclin E activity for repeated centrosome reproduction in *Xenopus* egg extracts," *Science*, vol. 283, pp. 851–854, Feb. 1999.

Comments on "Electric Current and Electric Field Induced in a Human Body When Exposed to an Incident Electric Field Near the Resonant Frequency"

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In the above paper,[1] King calculates the induced current density and electric field at the surface of a right circular cylinder modeling a human being in size and composition, when illuminated by a vertical dipole source 10-m distant with a power of 1 kW at 60 MHz. To quote from the abstract of the above paper: "Since this frequency range includes an important amateur radio band of 50–60 MHz and exposure to electric fields at this frequency has been shown to be hazardous, the study has a specific motivation." In his analysis, he derives a resonance curve for his model human that peaks at 53 MHz. At the conclusion of his paper, he gives the values of current density and electric field at the body for his assumed parameters and states: "These values are significant and provide a quantitative basis for the statistically observed increases in malignancies in amateur radio operators." This latter statement refers to a study by Milham [1] of mortality in a population consisting of men in California and Washington states that were listed by the Federal Communications Commission (FCC), Washington, DC, as possessing amateur radio licenses.

I will leave it to others to comment in detail on the merits of King's model and the actual biological effects of the current densities and electric fields he calculates with this model. However, I will make the following two observations on this matter: When using their transmitters, the great majority of radio amateurs will be seated at a desk typically covered with metal boxes. Whether such a seated person is well modeled as a right circular cylinder seems questionable to me. The second observation is that King cites only microwave studies on mice to show that electromagnetic radiation causes malignancies. Also, these studies themselves are widely disputed. He then uses simple dimensional scaling to show that 2.45 GHz for a mouse scales to 100 MHz for a man. Such a scaling law may be useful in calculating the "resonant frequency" for a human subject versus a mouse when treated as antennas, but such scaling is meaningless when the physics of a hypothetical carcinogenic process are unknown. Would 100 MHz be as effective as 2.45 GHz in causing cancer in a cell by this unknown process? In fact, there is no unequivocal evidence that radiation at either frequency causes cancer. Due to the variation of loss tangent with frequency, 2.45 GHz is much more effective in *cooking* tissue than 100 MHz so that this *known* process does not scale as King proposes.

However, my main objection to King's conclusions, quoted above in this paper's opening paragraph, is in the connection of his analysis to [1]. First, let us look at the Milham study. Milham obtained the names of 67 829 amateur radio license holders in the states of Washington and California from the FCC files whose licenses were in force from January 1, 1979 to June 16, 1984. The death records in these two states were then searched to obtain 2485 names matching those in the FCC file. The deaths were sorted into many standardized *International Classification of Diseases* (ICD-8) categories. A striking result of the study