

LETTER TO THE EDITOR SPECULATIONS ABOUT BYSTANDER AND BIOPHOTONS

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□ Mothersill and many others during the last hundred years have shown that cells and now whole animals may communicate with each other by electromagnetic waves called biophotons. This would explain the source of the bystander phenomena. These ultra-weak photons are coherent, appear to originate and concentrate in DNA of the cell nucleus and rapidly carry large amounts of data to each cell and to the trillions of other cells in the human body. The implications of such a possibility can be wonderfully important.

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An intriguing and fascinating series of publications has appeared in *Dose-Response* published by Dr. Carmel Mothersill and colleagues at McMasters University in Hamilton, Ontario, Canada (Woenckhaus 1930; Daev 2007; Ahmad *et al.* 2013; Mothersill *et al.* 2013). She has found *in vitro* and *in vivo* evidence for bystander ‘information’ transmission from irradiated to unirradiated cells/tissues/ animals. In one study, the right brain hemisphere of rats were given a single dose of 35 Gy or 350 Gy. An unirradiated naive rat was placed in the same cage with an irradiated rat for 48 hours. A clonogenic mammalian cell assay was performed. Signals were transmitted to the unirradiated cage mate causing similar or even greater effects in the cage mates than in the irradiated rats (Mothersill *et al.* 2013); in this study, she demonstrated *in vivo* signaling between two whole animals. An associated paper suggests that the signal may be photons of light (Ahmad *et al.* 2013). Similar adverse bystander-like effects have also been observed in naive cage mate animals placed with mates receiving a high dose of radiation (Woenckhaus 1930; Daev 2007). In these and other publications during the last decade Mothersill suggests that an organism may transmit information to other organisms by a weak electromagnetic field and not by chemical signals.

Ultra-weak signals of light are possible candidates for bystander signaling. Alexander Gavrilovich Gurwitsch, a famous Russian embryologist, physician and professor of histology in the 1920s discovered ultra-weak UV photon emissions from living tissue (Belousov 1997). He named these photon emissions “mitogenetic rays” because they stimulated an increase in cell division for nearby unexposed cells. He suggested that

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weak photons may control cell growth and differentiation. In an age of biochemistry and molecular biology Gurwitsch's studies were largely forgotten.

Vlail Kaznachejev is Director of the Institute for Clinical and Experimental Medicine in Novosibirsk. Guided by Gurwitsch's work, he carried out thousands of experiments over a twenty year period in the Soviet Union which were published in a book in 1981 (Kaznachejev and Mikhailova 1981). The experiments indicated that cellular information can be transmitted electromagnetically and induced in target cells absorbing photon radiation. In the basic experiment, two sealed quartz containers containing the same cell cultures were separated by a thin optical quartz window. One sample was equally divided and placed in each of the two halves of the apparatus with only a thin optical window visible between them. Thus, the two containers were completely environmentally shielded except for optical coupling. The cells in one sample were subjected to ionizing radiation. UV photons from irradiated cells absorbed by cells in the unirradiated culture were thought to have caused their death within 12 hours. Several presentations at a recent conference in the Czech Republic on ultra-weak photon emission by cells using immortalized mouse fibroblasts and adult human microvascular endothelial cells, caco-2 cell line cultures, and unicellular green alga *Chlamydomonas reinhardtii*, all demonstrated similar optical biocommunication as was observed by Kaznachejev (Kaznachejev and Mikhailova 1981; Conference 2013).

Fritz-Albert Popp (1938-), German biophysicist and cancer radiotherapist, discovered a wider spectrum of ultra-weak photon emissions ($\sim 10^{-3}$ eV) from 200 to 800 nm emitted from living cells. He coined the term 'biophoton' for them (Bischof 2003). According to Popp *et al.* 1984, a biophoton is a photon of non-thermal origin in the visible and ultraviolet spectrum emitted from a biological system. A comprehensive review of the field of biophotons has been provided by Ted Nissen (Nissen 2006). Popp found that biophotons were coherent and suggested that they may regulate all life processes of an organism (Popp *et al.* 1988). Biophotonic signaling may be used in the reception, transmission, and processing of electromagnetic data perhaps with some of the same transmission features of fiber optics. Popp believed that biophotons may represent a wide variety of frequencies which seem to originate from DNA and be concentrated in DNA of the cell nucleus; accordingly light can be stored in DNA and released over time (Popp *et al.* 1984). He concluded that biophotons appear to communicate with all the cells of the body instantaneously in a synchronous wave of informational energy (Popp *et al.* 1988). Overall, there is a relatively large amount of literature about DNA and its ability to create photons in a coherent state (Laager 2008; Conference 2013).

Biophotons may represent a complex cell-to-cell communication that relies upon speed of light transmission. The physics of light seems to fit the biological observations. Light is the most efficient and fastest mediator of information in the world. The coherent property of biophotons may have a profound effect on their ability to influence information transfer. Frequency coding gives light a capability of encoding information from DNA in biophotons. An optical resonator is required to store light within a very small confined space. The ability to trap photons and slow the propagation of light plays a significant role in quantum optics (Tanabe *et al.* 2007). Light beam twisting can form a propagated helical shape that possibly could scan and encode parts of DNA and transmit an enormous amount of data (Feldman 2013). Of course, much of this is speculation awaiting the widely dispersed dots of science inquiry to be connected. Even so, Mothersill has demonstrated possible photon signaling among animals as Gurwitsch and Kaznacheyev have both done *in vitro*. The ramifications of these observations are enormous.

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