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Three Davids, one Goliath

Scientists collaborate to tell the world why microwave guidelines are inappropriate

*Of what was believed in as the most reliable—
And therefore the fittest for renunciation*

T.S. Eliot

The Four Quartets, No. III: The Dry Salvages
1941

Three of the most prominent minds in modern science have joined forces to produce a document that reformulates how electromagnetism affects living organisms and the failure - through intent or ignorance or indifference - of science, governments and big business to protect all living things.

Their findings - three years in the formulation - explain how health and well-being are damaged / destroyed by artificial electromagnetic radiation and that the present standard of measuring radiation - the Specific Absorption Rate (SAR) which is based on acute heating effects - is totally inappropriate when considering the effects of modern microwave-based technology in everything from microwave ovens, cell phones, wi-fi and pulsed signals such as Wi-MAX and Tetra.

In effect, the three men are saying the entire edifice of monitoring electromagnetic radiation is faulty because the monitoring system is trying to measure the wrong thing.

The three scientists, Dr. Dimitris Panagopoulos, of the University of Athens, Assoc. Prof. Olle Johansson, the Karolinska Institute, Stockholm, and Dr. George Carlo, of the Institute for Healthful Adaptation in Washington, D.C., have produced documentation which strongly suggests that the safety standards governing electromagnetic frequencies are not only inadequate and misleading but ultimately destructive to life.

Panagopoulos was among the first to prove that microwaves from cell phones damage DNA. Johansson early recognized that radiation from CRT computer monitors puts pregnant women and their unborn babies at risk while Carlo, a public health scientist and

epidemiologist, first recruited to establish present standards, broke away when he learned that counter to finding that cell phones were safe, they actually caused harm.

“One of the main fortresses of those who claim that microwave radiation does not cause any adverse health effects is the erroneous measure (=SAR) introduced by them to estimate EMF bioeffects. In the present paper** (included as a pdf together with an errata list), we tear down this fortress,” said Johansson. “Our paper is a comprehensive critique and integration of the science around SAR is in conflict with the FCC, IEEE, ICNIRP, and other government safety standards, and the standard approaches used in safety studies of EMR around the world.”

Their combined findings affect everything living on the planet today due to the universal use of microwaves. Their assertions rank with Galileo who was vilified for asserting that the planets revolved around the sun. Each of the three, like Galileo, have suffered academic persecution for their efforts. It is relevant that while they personally have been subjected to everything from insults to death threats, their scientific evidence remains unassailable.

Condemned to possible oblivion through the required use of scientific jargon and government and corporate resistance, their paper, *Evaluation of Specific Absorption Rate as a Dosimetric Quantity for Electromagnetic Fields Bioeffects*¹, demolishes SAR as the standard for measuring man-made radiation and the dangers to all living things. There is also emerging evidence that this radiation affects the built environment as well.

Central to their discussion is the definition and understanding of SAR which is defined as the standard used by governments to monitor cell phone radiation. The SAR or Specific Absorption Rate of a cell phone is based on the amount of electromagnetic energy absorbed by living tissue.

SAR is a “way of measuring the quantity of radio frequency (RF) energy that is absorbed by the body,” according to the Cellular Telecommunications Industry Association (CTIA). In North America, SAR is measured in watts per kilogram (or W/kg) averaged over one gram of biological tissue while in Europe SAR is averaged over 10 grams. The FCC limit, which averages over one gram of body tissue, is much stricter than the rest of the world.

In North America, a cell phone’s SAR rating for the human head is measured between 0.0 and 1.60 with 1.60 set by the Federal Communications Commission (FCC) while in Europe SAR ratings run from 0.0 to 2.0 as adopted by the European Union Council and recommended by the International Commission on Non-Ionising Radiation Protection (ICNIRP).

According to the CTIA website: “From time to time, some researchers report that a study shows a possible connection between radio frequency fields and a health problem. These reports are sometimes the subject of dramatic stories in the broadcast media and sensational material on some websites. Of course, responsible expert authorities do not base their conclusions on just the latest study – they evaluate all of the relevant studies.”²

¹ Panagopoulos, D., Johansson, O., Carlo, G. *Evaluation of Specific Absorption Rate as a Dosimetric Quantity for Electromagnetic Fields Bioeffects*. PLOSOne. <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0062663>

² http://www.ctia.org/consumer_info/index.cfm/AID/10371

Thus, industry is in a position to sideline criticism or fuel confusion. This is done most often by scientific reports commissioned by industry through Technology Transfer Offices at any of a number of universities or through the League of European Research Universities. While independent researchers are sidelined and deprived of funds, paid for research invariably returns evidence favourable to the industry that paid for it. Nowhere has this been more obvious than the success of Mike Repacholi, industry consultant former coordinator of the World Health Organization's Radiation and Environmental Health Unit in Geneva until 2006 and Karolinska Institute Prof. Anders Ahlbom who was accused of conflict of interest at the International Agency for Research in Cancer (IARC). It was Swedish writer Mona Nilsson who discovered that Ahlbom was co-founder of "Gunnar Ahlbom AB" a Brussels-based lobby firm aiming to assist the telecom industry on EU regulations, public affairs and corporate communications.

The SAR standard is further compromised by the fact that it was first formulated by the IEEE in 1982. As outlined by Mason, Murphy and Petersen³, safety standards were established by engineers - not doctors or physicists or biologists - but by technical people. Effects at the cellular, atomic or sub-atomic level were not taken into consideration because there was no way of measuring them and it suits industry to keep it that way.

The argument about the safety of microwave communications is further complicated because people can not feel the effect of microwaves passing through their bodies or see the signals accounting for the general lack of concern and popularity of cell phones. The Panagopoulos/ Johansson / Carlo paper compensates for the overall indifference of the ordinary cell phone user by looking at the mathematics behind the physics - complete with physics equations - and the behaviour of living tissue at the molecular level.

The scientists readily show that SAR can not be realistically measured below the Thermal Effect, when the basic defense of CTIA as well as the entire microwave communications industry in both the media and the witness box is that there are no biological / health effects other than thermal. The three scientists first prove through a series of equations that disturbances or oscillations within cells induced by environmentally accounted microwave fields disturbances or oscillations do not cause heating, and secondly, that heating is not at all necessary to cause damage. This assertion alone has a profound implication for public investigations in both Canada and the United States.

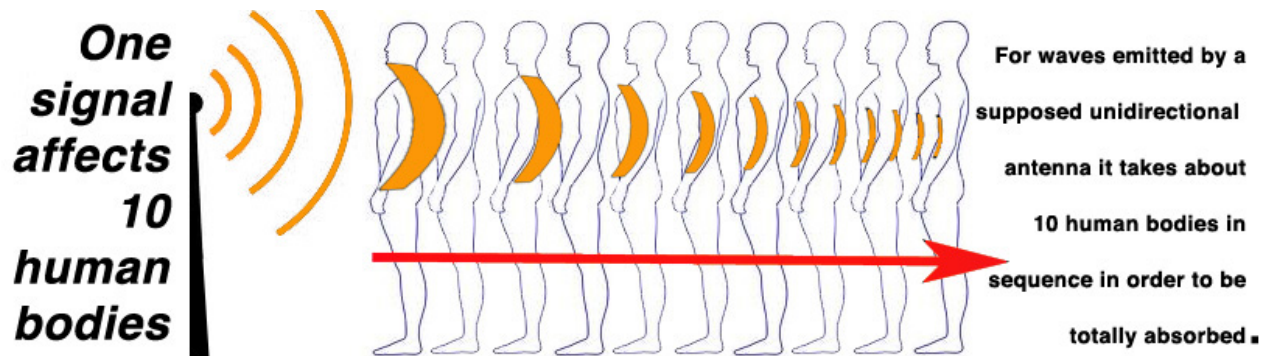
Even though some scientists still express skepticism regarding the existence of non-thermal effects, there is already a large and constantly increasing number of studies indicating that environmental man-made EMFs can produce severe biological alterations such as DNA damage without heating the biological tissue. This can take place through non-thermal mechanisms that involve direct changes in intracellular ionic concentrations or changes in enzymatic activity. DNA damage may lead to cancer, neurodegenerative diseases, reproductive declines, or even heritable mutations. Brain tumors, decrease in reproductive capacity, or symptoms reported as "microwave syndrome" (headaches, memory loss, fatigue, etc), are observed among people exposed to mobile telephony radiation during recent years. Recently the International Agency for Research on Cancer (IARC) has classified RF/microwave EMFs as "possibly carcinogenic to humans"

This assertion could have an impact on the outcome of the public consultation of the Royal Society of Canada in Ottawa in early July when the RSC's Expert Panel reviews Canadian Safety Code 6. It was Dr. Magda Havas of Trent University, Peterborough who

³ Mason, Murphy and Petersen. IEEE EMF Health & Safety Standards, Radio Frequency Radiation Branch Brooks Air Force Base, Texas, 78235

prised the admission from Health Canada scientist, James McNamee, that the Safety Code 6 guideline for microwave radiation (which includes radiation from most devices using microwave technology such as cell phones, cell phone base stations, cordless phones (DECT), Wi-Fi, wireless toys and baby monitors, smart meters etc.) is based only on the heating effect where previously Health Canada claimed that Code 6 relates to both Thermal and non-Thermal effects. The discovery stirred even more controversy when it was learned that even the Thermal Effect was narrowed to specific frequencies.

One of the problems of SAR is that it is based on conductivity of living tissue while the



available conductivity measurements have been taken from dead animals. The variations in conductivity which are very large even within a single cell are not taken into account and increase dramatically in live animals and even these conditions change with the age of the creature. This leads to the universally accepted assertion that children are more vulnerable to microwave radiation than adults, According to their paper, the relative “permittivity” of an adult human brain is calculated to be around 40 while the corresponding value for a young child’s brain is between 60 and 80 resulting in almost double the radiation absorption and SAR. Permittivity is a physical quantity to describe the “ability” of an electric field to propagate within a medium. Children, they claim, are as much as doubly vulnerable as adults to the bio-effects of electromagnetic fields.

Given the innumerable frequencies in the environment and the innumerable conductivity variations within the human body which vary from individual to individual, the attempt to realistically estimate the SAR from conductivity measurements becomes fruitless. Thus SAR can only be realistically estimated by temperature increases which do not occur at environmentally accounted EMF intensities. “Man-made electromagnetic fields at environmental levels do not normally cause thermal effects (measurable temperature increases within exposed biological matter)”, say the scientists, adding, “and this is in agreement both with experimental studies and plausible proposed mechanisms for the action of EMFs on cells. Thereby, it follows that, SAR is not a proper measure to describe the *biological* activity of man-made electromagnetic fields at environmental levels..”

The difficulty of establishing a SAR value is exacerbated by the actual measuring technique. There are three ways to calculate SAR:

- insertion of micro-antennae in tissue
- insertion of thermal probes into tissue
- numerical modeling

The use of micro-antennae, perhaps easy to administer, is limited due to the complexity of the tissue being measured. While the use of thermal probes gives a better result because

temperature is more evenly distributed but the insertion of probes disturbs surrounding tissue and can result in unpredictable outcomes.

While the third method of establishing a SAR value, numerical computer modeling, is considered the best alternative of the three, it, too, has limitations. Just as a digital photograph is composed of digital components called pixels, tissue can be broken down into miniscule cells called voxels. Values are assigned on how well the voxel conducts electricity, its resistance to an electrical charge, and density. But the human body with its widely varying components - skeleton, organs and tissues and fluids and chemicals - is vastly complex leading the scientists to conclude: "all methods of simulation, no matter how much improved, are and will always be, highly simplified compared to living tissue, since they can never take into account the countless variations in the physical parameters of living matter especially at cellular level."

Here, the scientific trio edge into Einstein's Theory of Relativity and the intricacies of physics and the interaction between living beings and any number of microwave signals and frequencies. With countless variations within living matter and consistently increasing and varying microwave frequencies, SAR estimation for non-thermal radiation levels verges on Chaos Theory.

The question arises of how can you correlate two interacting elements which are both changing dynamically while being measured. This, the scientists identify as the "non-linearity between electromagnetic exposure and biological effect". In the same way that laws have been enacted to set a limit for alcohol consumption while driving, the amount of alcohol consumed by a driver results in measurable blood alcohol levels which can be related directly to physical functioning behind the wheel of a car. This is dosimetry, the dose or amount of alcohol which results in an altered state of consciousness that renders a driver unfit to drive. The present SAR dosimetry of microwaves does not work.

The scientists note, "The biological/health effects from man-made EMFs/non-ionizing radiation, do not follow a linear dose-response (or cause-effect) relationship according to the experimental evidence." They explain that there are inconsistencies. "Experiments have shown that, the absorption of a larger amount of energy by the same mass of a given tissue and within the same time-interval, does not necessarily induce a larger biological effect. In other words, a more intense field or larger SAR does not necessarily relate to a larger biological response or consequent health effect."

This is what the scientists refer to as the "non-linear relationship" between exposure and biological effects. It is particularly relevant at the lower end of the non-ionising spectrum "where the largest effects do not correspond to the largest SAR or intensity values". This is a non-linear relationship or what Edward Lorenz identified as the "Butterfly Effect" in his paper of the same name delivered in 1972 to the American Association for the Advancement of Science in Washington, D.C. It is here the entire SAR standard crumbles.

The paper cites several studies where results of tests do not match expected outcomes, particularly a 2008 study by J. L. Eberhardt, B.R.R. Persson, A.E. Brun, L.G. Salford and L.O.G. Malmgren of the Department of Medical Radiation Physics, Lund University Hospital, in Sweden. They recorded damage to the blood-brain barrier in rats while other studies revealed no effect on the blood-brain barrier but the strongest effects were prompted by the weakest radiation intensity. This is chaos, indeed, and could well account for the absence of replication studies, a fact government and industry are quick to point out. It is also possible that when there is such divergence between cause and predicted effect, the SAR standard could further complicate matters, making things even worse.

A further complication is the presence of what the scientists term “windows” where biological effects are more pronounced regardless of the intensity or frequency of the radiation. In particular they cite two different studies in which Panagopoulos was lead author. Both reported DNA damage was more pronounced at 10 $\mu\text{W}/\text{cm}^2$ than at 250 $\mu\text{W}/\text{cm}^2$. “If the corresponding biological effect increased proportionally, there would be no ‘windows’ or other non-linear effects in regards to intensity or SAR. Nevertheless such effects exist and they are repeatedly recorded since the mid-seventies.”

In the absence of an absolute or linear relationship between exposure and biological effect, the scientists conclude that neither SAR nor radiation rate is proportional to the biological effect. That does not indicate that there is no relationship. On the contrary, they assert that there is a relationship and that it is “intimately associated with living matter” and recommend a method of measurement standard which is much easier to quantify - the amount of radiation reaching the skin. “We should at least use a measure that can be known more precisely,” they claim. “Such a more precise quantity is the radiation/field intensity on the surface of the biological object as measured by any qualified and calibrated radiation/field meter - plus the additional physical parameters of the field/radiation which can also be accurately known, such as pulse and/or carrier frequency, waveform, modulation etc.”

In discussion, the scientists restate the disparity between the SAR which is actually based on the heating of tissue and the absence of consistent temperature increases. Living tissue is in constant activity and biomolecules oscillate with microwave stimulation.

The difficulty with the SAR standard is that it does not and cannot account for the increased bio-effects of pulsed / modulated microwave signals. “SAR offers no information at all with respect to frequency, waveform, or modulation of the EMF/radiation although these parameters are directly related in the literature to biological (and consequent health) effects,” explain the scientists. And this is exacerbated by the fact that - and studies have proven it - “that fields of the same SAR but of different carrier or modulation frequencies produced different biological effects on the same biological sample.”

The final two paragraphs of the document are telling. The scientists agree that due to the non-linearity in findings on electromagnetic frequencies and that neither SAR nor radiation field intensity are precise enough to track biological effects, another way must be found to account for the effects of EMFs on living things.

They conclude that SAR should not be held up as the “dosimetric quantity to describe non-thermal effects” and that it should only be used in tandem with measurements of intensity with the variation in measured SAR values included in any results. They assert that the measurement of EMFs could be achieved quite readily in laboratories around the world by properly trained technicians using accurate intensity meters already available in the market place and not be based on complicated, time-consuming and largely inaccurate methods of SAR estimation that cannot be readily performed.

The need is becoming more urgent, they claim, “As increasing evidence is being accumulated for intense biological activity of man-made EMFs with consequent adverse effects on the human health and the natural environment, the need for fast and reliable measurement/dosimetry of such fields is becoming demanding.”

Panagopoulos, citing his chapter of the book, *Electromagnetic Fields: Principles, Engineer-*

*ing Applications and Biophysical Effects*⁴ says, “just one sentence since the abstract describes everything,” adding, ‘The electromagnetic nature of living matter makes the possibility of *no effect* from man-made electromagnetic fields sound naive and absurd’.”

Commenting on the significance of the joint paper, Dr. Carlo said, “our paper has a much more profound message: When the SAR is used as an exposure metric in research studies, the imprecision means that studies which show 'no effect' are likely 'false negatives' and studies that show an effect are likely under-reporting the true risk. This imprecision is a fatal flaw -- derived from a systematic bias toward the null -- that calls in to question the validity of a large percentage of the scientific database that everyone relies upon in assessing risk, danger and modes for protecting the public. It shakes the foundation of the science that we are using to sort out the full range of non-ionizing radiation health effects.”

Assoc. Prof. Johansson, too, agrees with Carlo in the influence industry has had in the recognition of potential biohazards in the environment and the proposed movement to a system of biomarkers in the establishment of safety standards for microwave radiation. “Our paper,” he said, “is a comprehensive critique and integration of the science around SAR, and it is in conflict with the FCC, IEEE, ICNIRP, and other government safety standards, and the standard approaches used in safety studies of EMR around the world.

Essentially, Johansson claims, the paper concerning the short-comings SAR is an important step away from what he calls “plastic doll-based research” and towards biologically-based safety recommendations with genuine relevance for living organisms.

“In our minds,” he said, “this is the only way to approach these issues, especially since children may be at great risk. To continue to use SAR as a safety recommendation after our paper now has been published will only demonstrate total ignorance of and disrespect to the actual facts in the matter. We therefore choose not to wait but to act.”

This willingness to act in the face of vast financial resources and global power is indicative of the beliefs of the three scientists that they are protecting humanity. The importance of their paper was anticipated by poet T.S. Eliot⁵, author of *The Wasteland*, considered by many to be the most influential poetic work of the 20th Century, and contemporary of electricity pioneer Nikola Tesla, who wrote about electricity in anticipation, perhaps, of Dr. Panagopoulos, Prof. Johansson and Dr. Carlo. Said Eliot:

*Right action is freedom
From past and future also.
For most of us, this is the aim
Never here to be realised;
Who are only undefeated
Because we have gone on trying...*

- John Weigel

⁵ Like the three scientists, Eliot, too, rejects the concept of linearity.