Highlights of BEMS/EBEA 2009 (BioEM 2009) Meeting
Davos, Switzerland 14-19 June 2009

US Air Force Laboraratories Workshop

Andrei Pahkomov, formerly with the Brooks Air Force Base, and now with Old Dominion University opened the workshop The military, in conjunction with Old Dominion University in Norfolk VA, are working on very short (nanosecond), very high electric fields that can poke holes in cell membranes as well as holes in intracellular membranes (e.g., nucleus) for use as incapacitation devices similar to Tasers. Other stated purposes of this "electroporation" are to induce cell death and to allow delivery of cancer drugs inside of cells.

Rene Sase presented an animal study on the biological effects from such high power microwave exposure that he thought that the animals might explode (they didn't). The purpose was to explore the "inhibition of [organ] systems" and people "neutralization."

Summarizing his talk, he remarked that it is premature to pose a new safety standardd and warned safety standard people to carefully consider the consequences of a lower exposure safety standard because "its hard to go back" to the old standard when it was previously lowered.

He suggested we might want to limit the total Specific Absorption (SA) in joule per kg or Gray (Gy), rather than to limit the Specific Absorption Rate (SAR) in Watts per kg. Not mentioned, but implicit in such a recommendation, would be the need to keep track of the total dose (SA) over a lifetime as in done with nuclear workers.

Stephanie Miller discussed Active Denial Systems (ADS) developed by the military to force people to disperse. ADS uses a 95 GHz radiated beam aimed a people. At such high frequencies, the radiation only penetrates the skin to a depth of 1/64 inch (1/3 mm), just deep enough to reach pain nerves in the skin, causing a severe sense of pain without causing obvious tissue damage.

Plenary Session I: RF-EMF Epi & Human

Mobile Phones and Cancer – Current Epidemiological Evaluation

Anssi Auvinen, an epidemiologist with STUK-Radiation and Nuclear Safety Authority of Finland, discussed this topic. He reviewed the cellphone studies on the risk of cancer, noting that the contradictory findings of risk and "no risk." He focused on the various sources of problems in epidemiological studies as opposed to what epidemiology can accomplish, implying that epidemiological studies are not capable of resolving the issue.

He concluded his presentation with a patently false premise. Because brain tumor incidence has not been increasing, while the prevalence of cellphone use has risen to a such that a great proportion of all persons are using cellphone, there cannot be a risk of brain tumors from cellphone use. The reason this is a false premise is that brain tumor latency time (the time between first exposure and diagnosis), similar to the latency time for most cancers, is 30 years or longer, and cellphones did not exist 30 years ago.

As a professional epidemiologist Dr. Auvinen would know this is a false premise, or should have known. This leads to the conclusion that either he did know it was a false premise and thereby raises the question why he would present a knowingly false premise,

or that his lack of knowledge of basic cancer epidemiology is such that his competence is questionable.

Tutorial 2: Medical Imaging

Photoacoustic Imaging for High-Resolution Diagnostic Imaging of Cancer

Jeff Carson from the Lawson Health Research Institute of London, Ontario in Canada presented a new imaging technique using near infra-red radiation. To my surprise radiation in this frequency range is transparent to many tissues (but not to bone). This emerging imaging technique is particularly applicable to breast cancer and has the ability to measure hemoglobin and oxygen levels in the tissue (normal and malignant).

Because during the evolution of life, all organisms have been exposed to near infrared radiation (AKA heat), it is expected that this has the potential of not having adverse effects unlike other forms of radiation such as microwaves and ionizing radiation, where over the course of evolution, organisms have never been exposed.

Plenary Session II: MRI Safety (moderated by Wolfgang Kainz of the FDA)

How Safe Is Magnetic Resonance Imaging (MRI)

Sender Rajan of the Food and Drug Administration (FDA) gave this presentation. The FDA is chartered with determining the safety of MRI machines. Almost all MRI machines in use today use 1.5 Tesla (1.5T) static magnetic fields combined with intense pulsed Radio Frequency (RF) radiation. MRI technicians are regularly exposed to fringe static magnetic fields on the order of 1.0T. As the earth's static magnetic field is around 0.050T, during evolution of life on earth, living organisms have never been exposed to static magnetic fields of this intensity.

Dr. Rajan stated there were 40 million MRI scans in the last year and such scans are "considered safe for repeated procedures."

Some 3.0T machines are now being introduced with 7T and 9T machines in development. The FDA is performing initial studies to determine if there are adverse effects in humans. They will be using between 17 to 25 subjects for these adverse effects studies.

During the question and answer period Lloyd Morgan noted that using from 17 to 25 subjects would not allow sufficient statistical power to determine any adverse effects. Dr. Rajan, replied, "Good point" noting that he was not the one who determines the number of subjects.

Mr. Morgan also asked if there had ever been any studies to determine if there were any long-term follow up of the millions of people who have been exposed to MRI machines' intense fields. Dr. Rajan replied that such studies were being planned. Mr. Morgan noted, with the introduction of MRI machines around 25 years previous, that it was "unconscionable" that the FDA, charted with determining the safety of such machines, had never done such a study.

Topic In Focus 2: RF-EMF AND BBB (moderated by Dariusz Leszcynski)

Increased Blood-Brain Barrier Permeability As a Marker of Brain Damage After Exposure to Mobile Telephone-Type Radiofrequency Fields.

John Finnie[1] of the Veterinary Services Division and Hanson Institute Centre for Neurological Diseases in Adelaide, Australia gave this presentation.

Dr. Finnie noted at the beginning of his talk that if there were leakage of the Blood-Brain Barrier (BBB) as a result of cellphone usage there would be a "profound impact even if {it were a] small problem." He showed a Motorola system designed for providing an accurate dose to animals that did not allow the animals to move. He then noted that such restraint would cause stress in the animals and such "stress may cause BBB leakage."

Lloyd Morgan asked if there had been any studies showing that animal stress resulted in leakage of the BBB. Dr. Finnie said there had been no such studies. Mr. Morgan rhetorical asked why he had made such a statement, noting that the effect was to cast doubt on studies that show BBB leakage in animals, without evidence any evidence of such an effect.

Non-Thermal Electromagnetic Fields From Mobile Phones and Base Stations Do Have Effects Upon Mammalian Brain

Leif Salford, a neurosurgeon from Lund University in Sweden, gave this presentation. He began by noting that microwave radiation, never existing during the evolution of living organisms, has increased by a factor of 10^{12} to 10^{18} over the last 60 years. His results, with more than 2,000 combined rats in many studies, show that cellphone radiation causes BBB leakage with the result that albumin, toxic to neurons, enters the brain resulting in the death of neurons.

Of considerable alarm, these results show that Specific Absorption Rates (SAR) of 1 Watt of power deposited per kilogram of tissue results in significant increased leakage of albumin across the BBB, and the highest leakage occurs at levels 100 times smaller levels (0.010 Watts per kilogram).

To place the SAR values that Dr. Salford reports that result in BBB leakage, into context, the 10 highest SAR cellphones range from 1.6 to 1.47 W/kg and the 10 lowest SAR cellphones range from 0.43 to 0.22 W/kg.

He notes that the lowest 0.010 W/kg exposure resulting in the maximum BBB leakage are exposures that can be expected when you are a meter (~3 feet) from a person using a cellphone, or 200 meters (~660 feet) from a cellphone base station (AKA, cell tower, or mast).

Session 6: Epidemiology

Residence Near Power Lines and Mortality From Neurodegenerative Diseases: Longitudinal Study Of The Swiss Population

Anke Huss from the Institute of Social and Preventive Medicine, University of Bern in Switzerland gave this presentation. The study examined all people living within 50m of 220/380 kilo Volt transmission lines in Switzerland using a Graphical Information

[1] Dr. Finnie has received a grant from the Australian Centre for Radiofrequency Bioeffects Research (ACRBR), an Australian Cellphone Industry trade association and presented at the ACRBR annual conference in 2007.

System (GIS) to determine locations. The study found that an increased risk of Alzheimer's disease, but not MS or ALS, in people living in proximity to the transmission lines. The risk was higher, the closer the person lived to the transmission line, and was higher, the longer the person lived in proximity to the transmission line.

Exposure to Contact Currents And Magnetic Fields And The Risk of Childhood Leukemia

Robert Kavet from the Electric Power Research Institute (EPRI) gave a presentation on the risk of childhood leukemia from exposure to contact currents,[2] magnetic fields and wire codes.[3] The study had 514 subjects including 245 children diagnosed with leukemia. For contact currents the voltage was measure between a bathtub faucet and the bathtub drain pipe with the resultant current calculated using the estimated resistance of a child touching the faucet. Dr. Kavet noted, because so many drainpipes are now plastic, that few homes had a voltage between the faucet and drain resulting in lowered statistical power for detection of a contact current effect on childhood leukemia. Magnetic fields were measured in each room of the house and the average magnetic field of all rooms was used in the study. Wire codes were determined by the method defined in the Wertheimer & Leeper paper.

He found no risk from contact currents, no risk from magnetic field exposure, and a near significant risk for childhood leukemia from the OHCC (ordinary high current configuration) wire code.

Because a child predictably spends the most time in the bedroom, in its bed, Lloyd Morgan asked why the magnetic field had not been measured at the child's bed. Dr. Kavet's, a non-sequitur, answer was, "Because this was a study of contact current."

Case-Control Study on Childhood Leukemia and Radio Frequency Electromagnetic Fields in the Vicinity of Television and Radio Broadcast Transmitters

Hiltrud Mezernich from the Institute of Medical Biostatistics, Epidemiology and Informatics in Germany presented this study. There were 16 AM radio broadcast transmitters and 8 FM/TV broadcast transmitters in the study. Rather than distance from the transmitter, the electric fields calculated by a field strength prediction program were used. The study found no risk of childhood leukemia in proximity to broadcast transmitter.

The study was funded by the German Mobile Telecommunication Research Programme which received €8.5 million from the cellphone industry.

Plenary Session III: New Directions

Hyperthermia Using Functional Magnetite Nanoparticles

Dr. A. Ito gave this presentation. He is from Kyushu University in Japan. Magnetite (Fe_3O_4) nanoparticles (10 nm) go to cancer cells but not normal cells. A 100-500 kHz magnetic field is applied causing heating of the tumor cells. When the tumors are eliminated the stress gene, HSP70 is expressed resulting in an immune response. In one

[2] A voltage between a water pipe (e.g. a bathtub faucet) creates contact currents and a conducting drainpipe). This voltage is created in homes with incorrectly wired electrical wiring.

[3] Wertheimer & Leeper showed a risk of childhood leukemia used wire codes as a surrogate for magnetic field in their seminal 1979 paper. They used a series of "wire codes" such as VHCC (very high current configuration) and VLCC (very low current configuration) in their study.

experiment, 2 tumors were implanted in an animal distant from each other. One tumor received the nanoparticles. When the magnetic field was applied this tumor disappeared. An hsp70 protein with an antigen peptide, the result of treating the implanted tumor, went to the untreated tumor, resulting in the elimination of the second tumor.

Session 8: Medical applications

Pulse Electromagnetic Fields Increase Angiogenesis In A Rat Myocardial Ischemia Model

Art Pilla, from the Albert Einstein College of Medicine in New York showed that rats with a myocardia ishemia (a heart attack resulting in damaged heart muscle from lack of oxygen) could grow blood vessels to supply the damage heart as a result of application of pulsed electromagnetic fields (PEMF). Art, a pioneer in the use of non-thermal PEMF for bone fracture healing continues to expand therapeutic PEMF applications. This is no accident. He, and his team, developed the specific properties of a PEMF from knowledge of how cells behave electrically. In this example the PEMF uses a 27.12 MHz "carrier" because the FCC allows frequencies in this band to be used for all forms of medical applications. Yet, it is not the carrier that has the required characteristics but the pulse itself. The pulse, a rapid rise to a given voltage level remains a this level for a set period of time, then falls just as rapidly. The pulses are repeated for a set number of times and the result, known from a detailed knowledge of how particular cell types behave, provides the desired therapeutic result.

Session 7: In Vitro Studies I

Induction Of Adaptive Response In Human Lymphocytes Exposed To Radiofrequency Radiation

Maria Scarfi, from the Institute for Electromagnetic Sensing of Environment in Naples, Italy presented results showing when human blood lymphocytes are first exposed to 900 MHz RF radiation at 10W/kg for 20 hours, then challenged with mitomycin, a genotoxic agent known to cause micronuclei (a precursor to cancer), the number of micronuclei are significantly reduced in 4 out of 5 human blood donors. This suggests that RF can protect cells from a known genotoxic agent in some, but not in all persons.

Session 9: Dosimetry IV

ELF and LF Magnetic Field Exposure In Hybrid And Electric Cars

Dr. G. Schmid from the Austria Research Centers made magnetic field measurement from 0 to 100 kHz in 3 hybrid cars (Honda Civic, Toyota Prius, and Lexus GS 450H), 2 electric cars (Panda Electric and Doblo Electric), and 2 conventional cars (VW Passant and Audi A4 Kombi). These measurements filtered out the magnetic fields from magnetized tires. Interestingly, the hybrid and electric cars had lower fields than the conventional cars because the hybrid and electric cars used return wires in close proximity to the load wires while the conventional cars used the chassis as the return current path.

Topic In Focus 3: EM Cancer Therapy

Treatment Of Cancer With Non-Thermal Electromagnetic Fields: Past, Present And Future

This was the single most impressive presentation of the meeting. Boris Pasche from the Department of Medicine at the University of Alabama presented the history of electromagnetic fields in clinical medicine. The current research in this field has found that certain precise (e.g., 1873.477 Hz) frequencies can be used to treat specific cancer types. He concluded, Cancer-related frequencies appear to be tumor-specific and treatment with tumor-specific frequencies is feasible, well tolerated and may have biological efficacy in patients with advanced cancer.

Session 16: Animal Studies

Alterations Of Antiproliferative Response To Amylase In Mammary Epithelial Cells From Fisher 344 And Lewis Rats Exposed To ELF Magnetic Fields

This was yet another presentation of the work of Maren Fedrowitz from the lab of Wolfgang Löscher in Hannover, Germany. For many years now they have shown how exposures to 50Hz magnetic field induce breast cancer in rats. Industry has challenged their work through non-replication, replication experiment that were unsuccessful in inducing breast cancer in rats. They have in turn, shown that the non-replication, replications were caused by the use of different rat strains.

This year Dr. Fedrowitz showed, using 2 rat strains, Fisher 344 and Lewis rats, that amylase act to inhibit breast cancer cell growth with a stronger effect in Lewis rats than in Fisher 344 rats.

Though I admit to substantial ignorance in biology, it appears that they are homing in on the mechanism of how magnetic fields can induce breast cancer.

Session 17: Epidemiology

Increased Trends In Brain Cancer Under Age 40 In The US SEER Program, 1975-2005

Dr. Devra Davis from the University of Pittsburgh presented age-specific brain tumor data. She began by showing the dangers of using age adjusted brain tumor incidence. Because brain tumor incidence increases with age, the effect of the aging of the US population (average age in 1970 was 25.5 and in 2000 the average age was 35.3 years) distorts changes in younger age groups.

She used a technique, "joint point analysis," that uses weighted least squares regression to fit multiple line segments, with unspecified join points, to the data on a log scale resulting in the determination of the optimal number of join points, their locations, and the estimated annual percent change (EAPC) within the time interval associated with each line segment. The result was to show that age specific brain tumor incidence trends shift sharply during the years from 1975 to 2005. For example, malignant brain tumors, ages 0 to 39, increased at an annual rate of 2.2% from 1975 until the mid-90s, then decrease at an annual rate of –1.2% through 2005. This shift in incidence trends become even more dramatic when examined for 10 year age groups in the 0-9 year and 10-19 age ranges. However, for the 20-29 year and 30-39 year age ranges, there has been from 1975 to 2005, a continuous annual incidence increase of 1.2% and 0.7% respectively.

Such trends do not indicate cause, but there are many potential causes including: profligate use of CT scans, aspartame, cellphone use, poor ascertainment of incidence, changes in brain tumor definitions, and microwave induced blood-brain barrier leakage.

Plenary IV: Hot Topic, "When Do We Know Enough To Stop Research on the Safety of Wireless Communications?"

The panelist for this topic were: Joe Morrissey, formerly with Motorola, representing the Mobile Manufacturers Forum (MMF), Chris Portier, Director, Office of Risk Assessment Research, National Institute for Environmental Health Sciences (NIEHS), Darius Leszczynski, and Neils Kuster serving as moderator.

Joe emphasized the industry mantra that the only biological effect from non-ionizing radio frequency fields is heating. He commented that the various studies, epidemiological, in vivo, and in vitro have found contradictory results. For example, he showed a slide presenting epidemiological studies that showed 12 studies had found a risk of brain tumors while 14 studies has not found a risk of brain tumor, and another re long-term animal studies, the "gold standard" for showing an effect, by and large don't show an effect. He finished with a comment about the need for "precaution."

Darius said that the most important studies are epidemiological studies though exposure assessment is problematical because "operators are unwilling to provide records." He commented that there is "sufficient data, but insufficient quality." The majority of studies are in vitro studies but results concerning genotoxicity are contradictory. He finished his remarks by stating what is needed are human studies that show biomarker changes.

Chris began by responding to the question posed in the title of the topic, "When Do We Know Enough To Stop Research on the Safety of Wireless Communications?" He remarked that the question is not to stop funding, but rather, given the myriad other health issues confronting society should we also be concerned about EMF health issues? In order to stop funding we have to believe it is safe. He then went into the myriad testing criteria required to show drugs and chemicals are safe, noting the EMFs have no such testing criteria. He stated that if cellphones were treated like a chemical they would not be approved. He finished his remarks by noting that precaution should be encouraged.

Lloyd Morgan directed questions to Joe, Darius, and Chris. He began telling Joe that the notion that the only biological effect from non-ionizing radiation was heating "is a lie." There is voluminous literature showing the contrary, but he need only look at bone fraction healing to see that his statement is a lie, and suggested he should talk to Art Pilla. Surprisingly, Joe appeared to be ignorant of the bone fracture healing literature through the application of PEMF. Mr. Morgan challenged Joe's 14 epidemiological studies that showed no risk of brain tumors from cellphone use because these Interphone studies have been shown to result in a statistically significant protection from brain tumor by use of a cellphone. This is the result of 11 design flaws in the Interphone protocol, 8 of which underestimate the risk of brain tumor. Mr. Morgan noted that Joe's former colleague at Motorola, CK Chou had published a long-term study of rats in 1992, a full 10 years after completion of the study, showing excess cancers in the rats. Finally, Mr. Morgan said the there was a simple, no-cost precautionary principle action that could reduced cellphone

radiation to the brain by many orders of magnitude: remove the speaker that places the cellphone to the ear and replace it with a wired, not a Bluetooth, headset.

Mr Morgan said to Darius that in the US, people could obtain their billing records from cellphone operators, which was also done in the Interphone validation studies. Darius reiterated that this was not possible in Europe.

Finally, Mr. Morgan asked Chris Portier why shouldn't cellphones be required to follow the same approval rules as chemicals. Chris responded by saying if it were up to him, this should be done.

There was one poster that I would like to add to my highlights. Poster 165, Electromagnetic Field Effects On Malignant Cell Proliferation Are Dependent Upon Temporal Patterns.

This poster was by Carly Buckner from Sudbury Regional Hospital in Ontario Canada. She showed that a particular waveform, a "Thomas" FM modulated pattern from 25 Hz to 6 Hz designed for pain relief inhibited proliferation of malignant cells but had no effect on non-malignant cells. Other waveforms, including a mirror image Thomas waveform (6 Hz to 25 Hz) had no effect.