BIOEM2009 – EMBRACING A RENEWED IMPETUS FOR BIOELECTROMAGNETICS

With the pervasive presence of electromagnetic fields (EMF) in our everyday lives, BEMS recognizes that the key to addressing the health concerns, regulations and the improvement and development of current and new medical applications and therapies associated with EMF is to encourage scientific discovery. BioEM2009 (www.bioem2009.org) will focus on clinical devices, medical applications, high-throughput screening, *in vitro* and *in vivo* studies, mechanisms of interaction, theoretical and practical modeling, instrumentation and methodology, dosimetry, exposure standards, occupational exposure, epidemiology and public policy. This meeting is part of the mission of BEMS to promote research on the understanding of the interactions of electromagnetic fields with biological systems, and to broaden its technical and medical applications. The BioEM2009 Joint Meeting with EBEA brings us the ideal mix of old and new faces as well as talks that span the range of approaches from the classic to the provocative with state-of-the-art presentations by leading experts in basic and clinical science. The newly included Special Sessions and Topic in Focus Sessions will also provide considerable time to facilitate the free exchange of ideas and opinions.

The Society has come a long way from its beginnings and continues to try to adapt to present circumstances. Disseminating information (through the Annual Meeting, the Journal and the newsletter) and facilitating interactions (through scientific collaborations, personal contacts, etc.) are still key roles of the Society. Although the Society cannot be all things to everyone, it should be an inclusive society catering to all those with an interest in bioelectromagnetics and allied fields. Unfortunately, it has sometimes been tarred with favoring special interests at the expense of those who support and adhere to sound

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NEW AWARD ANNOUNCED

James C. Lin, Editor-in-Chief, Bioelectromagnetics Journal

A new award has been initiated by The Bioelectromagnetics Society, in addition to the previously announced Bioelectromagnetics Journal Best Paper Award, to recognize scientific and scholarly accomplishment in the form of a paper published in the Bioelectromagnetics journal.

Specifically, the Board of Directors of The Bioelectromagnetics Society has approved, beginning in 2009 for the 2008 year of evaluation, the awarding of a Most Influential Bioelectromagnetics Journal Paper by Citation for an article published in Bioelectromagnetics during the immediate past five years (e.g., 2003-2007 for the 2008 evaluation cycle). Provisions also have been made to award a Certificate of Runner-Up as Most Cited Bioelectromagnetics Paper, if appropriate.

The paper will be selected from among the primary research articles on recommendation of the Editorial Board of Bioelectromagnetics and approval of the Board of Directors of The Bioelectromagnetics Society, using a process which excludes self-citation from the cumulative number of citations and papers found to contain errors. The Most Influential Bioelectromagnetics Journal Paper by Citation award will consist of a certificate along with a monetary prize, presented during the Annual Business Meeting of the Society.

2009 ELECTION OF CANDIDATES

The 2009 slate of candidates has been released and the online voting (with paper ballots available for members who do not have online access) ran through May 8, 2009.

Candidates for elected office include:
President-Elect: Jeff Carson and Dariusz Leszczynski
Treasurer-Elect: Philip Chadwick and Alex Thomas
Biological and Medical Sciences: Masami Akai, Rafi Korenstein, Maria R. Scarfi, and Thomas Vernier
Engineering & Physical Sciences: Osamu Fujiwawra and Nam Kim
At Large: Vitas Anderson and Andrew Wood

Election results will be announced at the BEMS Annual Business Meeting during the upcoming joint meeting with EBEA.

RECENT RESEARCH

Editor’s note: The Bioelectromagnetics Society recently implemented a “Best Paper” award. While not directly connected with that award, we have invited all authors of recently published full research articles in the Bioelectromagnetics journal to provide a short summary of the background and context of the research documented in their articles so that Society members can from different disciplines can better understand the reported work. For copyright reasons, these summaries are different from the abstracts published in the journal. In providing additional focus on the reported research, it is our hope that communication within the society is enhanced, providing a stronger basis for assessing and selecting the best paper(s) published each year. Three authors of recent published papers have provided these summaries. We will be publishing more summaries in each issue of the newsletter on a space available basis.

GSM Base Stations: Short-Term Effects on Well-Being
Bioelectromagnetics, Volume 30, Issue 1, pp.73-80.

Authors: Christoph Augner, Matthias Florian, Gernot Pauser, Gerd Oberfeld, and Gerhard W. Hacker

The growing presence of cellular phone base stations in inhabited areas has raised concerns about possible health effects caused by emitted RF-EMF (radiofrequency electromagnetic fields). The World Health Organization (WHO) had recommended investigating the effects of RF-EMFs emitted by cellular phone base stations in its research agenda [WHO]. Although there is an emerging number of studies in this area of research, we have little evidence about possible effects on well-being [Hutter et

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al., 2006]. In an attempt to obtain further information, we utilized a standardized psychological questionnaire including three categories of subjective well-being (good mood, alertness, calmness). To additionally address the problem of ecological validity, we tested the 57 participants of our study under “real-life” exposure conditions. In a field laboratory, three different exposure levels were created by use of shielding devices that could be installed or removed during the breaks of the four consecutive 50-min experimental sessions such that double-blinded conditions prevailed. The overall median power flux densities were 5.2 µW/m² during “low”, 153.6 µW/m² during “medium”, and 2126.8 µW/m² during “high” exposure sessions. Predominant was a GSM-900 downlink signal emitted by an operating antenna mounted on the façade of the building. Participants were randomly assigned to one of three different exposure scenarios (HM, MH, and LL). For scenarios HM and MH, the first and third sessions were “low” exposure. The second session was “high” and the fourth was “medium” in scenario HM; and vice versa for scenario MH. Scenario LL had four successive “low” exposure sessions constituting the reference condition. Analysis of psychological well-being data revealed that participants in scenarios HM and MH (high and medium exposure) were significantly calmer during those sessions than participants in scenario LL (low exposure throughout) (p=0.042). Other well-being categories showed no significant differences. These results show that short-term exposure to GSM base station signal may increase calmness, which is consistent with evidence from EEG studies that revealed a slight hypnotic effect [Mann and Röschke, 1996; Borbély et al., 1999; Huber et al., 2000; Lebedeva et al., 2000, 2001]. In this context, further research should be done to find out whether any effects on concentration or work performance could be detected.

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References:


Effect of Long Term Exposure to 0.5 T Static Magnetic Fields on Growth and Size of GH3 Cells

Authors: Arthur D. Rosen and Erin E Chastney, Department of Biological Sciences, Purdue University, W. Lafayette, IN

There has been an ongoing interest in the effects of static magnetic fields (SMF) on biological systems for several decades. Virtually all of the reported effects attributed to moderate intensity SMFs have employed brief exposures and were of relatively short duration. This study was carried out in an attempt to expand our knowledge of the effects of SMFs on cellular systems by examining the effects of prolonged exposures to moderate intensity SMFs on such basic cellular functions as growth and size.

We observed that prolonged exposure to a 0.5 T SMF was associated with a significant decrease in cellular proliferation and an increase in cell size. A statistically significant decrease in cell growth was noted following a two week exposure, with return to baseline after two weeks following removal from the field. With a four week exposure, a greater decrease in cell growth was noted with return to...
baseline only after three weeks. When cell size was examined, we found that there was a statistically significant increase in diameter during the third and fourth week of exposure which persisted for one week post exposure.

These findings may be explained by changes in the cellular actin cytoskeleton. This structure is involved in a process of continuous dynamic reorganization modulated by intracellular Ca²⁺++. This process, though slow, is cumulative and is eventually reflected both in plasma membrane structure and in cytokinesis. It is the disruption of cytokinesis that explains not only the decreased rate of cellular growth but also the increase in cell size.

This study describes, for the first time, the effects of prolonged exposure to SMFs on cellular function. The explanation for this phenomenon is derived from several diverse disciplines and emphasizes the dynamic processes involved in cellular growth. It also offers an excellent model for the further study of the long term effects of SMFs.

Mobile phone use and location of glioma

Authors: Hanna Hartikka, Sirpa Heinavaara, Riitta Mantyla, Veikko Kahara, Paivi Kurttio, and Anssi Auvinen, STUK – Radiation and Nuclear Safety Authority, Helsinki, Finland.

Why is this particular research area important to Bioelectromagnetics?
Cancer risk from radiofrequency fields is a key scientific controversy at the moment with major public health importance due to the ubiquitous exposure.

What was already known about this topic prior to this research?
A large number of case-control studies have already been published about the relation between mobile phone use and brain tumor risk. The results are inconsistent, with some indicating increased risks either overall or some sub-groups such as those with long duration of use or ipsilateral tumors occurring on the same side where the phone was generally held. The major uncertainty is the crude exposure information with substantial uncertainty due to self-reported retrospective usage data.

What did this work contribute to the subject?
This new approach to the analysis has the potential to avoid both major shortcomings of earlier studies. Accurate localisation of the tumor allows more detailed exposure assessment in terms of field strength. Using distance between phone and tumor as the key exposure indicator instead of call-time avoids recall bias (lack of comparability of reported exposure between tumor cases and controls with potential distortion of the results.)

IN MEMORIAM: V V LEDNEV
Valery Vasilyevich Lednev, outstanding scientist-biophysicist, professor, Dr. Sc. Biol. passed away February 27, 2009 of a thrombotic stroke.

V.V. Lednev was born on December 30, 1939 in Bakharden, Turkmen Republic of the former USSR, in the family of a military man. Having graduated from secondary school in 1957 in Moscow, V.V. Lednev entered the physical faculty of Moscow State University, from which he graduated in 1963 at the Department of Biophysics with the specialty of “physicist-experimentalist”. The field of his scientific interests developed during his study at the Moscow State University and biophysics became a dominant direction. Since 1968 V.V. Lednev was an employee of the Institute of Biological Physics, Academy of Science of USSR. His previous research was at the Institute of Crystallography, coupled with three years of training in the Royal College of the London University in the laboratory of professor J. Hanson where he learned X-ray scattering techniques, defined a direction of scientific activity for V.V. Lednev that led to studies on the contraction of muscles. His studies on actin chains performed in England provided a basis for him to develop a mechanism for muscle contraction. V.V. Lednev defended this mechanism in his PhD thesis. The following studies of Dr. Lednev on myosin chains are known worldwide. As the head of the laboratory of Biophysics of Muscular Contraction, Dr. Lednev has involved in his study a galaxy of young employees owning various modern biophysical, biochemical, and physiological.
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cal methods. The most significant result of his studies was finding of two structural states of the actomyosin complexes and of the existence of myosin head conformers. These studies have received wide international response and became a subject of a series of the PhD theses supervised by V.V. Lednev.

Since 1988, a new subject of scientific interest of V.V. Lednev was the biological effects of weak magnetic fields. This problem is especially important in connection with technological progress and possible health risks imposed by anthropogenic electromagnetic fields. Effects of magnetic fields with different physical characteristics on biosystems have been studied in many laboratories over the world. However, exact mechanisms of these effects are unknown. V.V. Lednev formulated an original theory of parametric magnetic resonance in biological systems. This theory describes effects of the combined magnetic fields on the velocity of some calcium-dependent biochemical reactions. The theory of magnetic parametric resonance developed by V.V. Lednev is of great theoretical and practical significance. This theory has been proved during subsequent experimental studies with the test-systems of various levels of biological organization, from a molecular one to the level of whole organisms. Among them are the rates of ferment reactions in solutions, the rate of regeneration of planaria, development of the gravitropic reactions in stalks of plants, the rate of generation of active oxygen species in neutrophils.

For the latest several years, the scientific interests of V.V. Lednev focused on the solution of the problem of the effects of extremely-weak magnetic fields on biosystems. He proposed a model for such effects that has allowed the identification of primary targets: magnetic moments of hydrogen nuclear spins and diamagnetic electron currents in molecules. The predicted responses were then proven experimentally with various test-systems.

One of the brightest examples of the embodiment of V.V. Lednev ideas has become a study of extremely-weak magnetic field effects on physiological functions of the human organism. The study performed in collaboration with the All-Russian Scientific Research Institute of Physical Training in the chamber specially designed by V.V. Lednev revealed effects of extremely-weak magnetic fields on variability of the heart rhythm. The interest of the medical biophysics community in his findings is exemplified by his cooperative works with the Regenerative Center of Childhood Orthopedics and Traumatology, St.-Petersburg, Russia, and the Scientific Research Institute of Pediatrics. In these studies V.V. Lednev developed new methods for medical treatment by means of weak magnetic fields.

V.V. Lednev participated actively in a pedagogical, scientific, and public life. He was a member of Academic Councils of the several scientific organizations. He took part in numerous scientific congresses and conferences of different levels. He is an author of more than 100 publications and has supervised more than 10 dissertations.

Valery Vasilyevich Lednev belonged to that galaxy of scientists whose bright talent and selfless passion for the science attracted to him many colleagues and pupils. He possessed enormous inquisitiveness, improbable persistence on searches of necessary materials, methods and solutions for experimental problems. The surprising skills to communicate allowed him to find collaborators and colleagues in the various interdisciplinary fields of research. V.V. Lednev was able to resolve the complicated issues in the simplest way and to extract everything new, most important and interesting from seminars and conferences. Enormous working capacity and surprisingly bright imagination supported by his significant scientific knowledge in the area of fundamental and applied biophysics allowed him to find precisely and easily the most interesting problems, to evaluate them and to suggest uncommon solutions during creative discussions with colleagues.

He was a passionate person and all of us who got a chance to communicate with him and enjoined his friendship, will miss him. The bright memory of him will be always with us. We believe that the scientific world will for long time turn to his scientific heritage, develop creative ideas of V.V. Lednev, analyze results of his studies and think about his theoretical hypotheses. Valery Lednev is survived by his wife, Tamara V. Ledneva, and his son, Mikhail V. Lednev.

Written by: Prof. Ivanitsky G.R., Prof. Maevsky E.I., Dr. Belova N.A., Dr. Srebnitskaya L.K., Dr. Rajdestvenskaya Z.Ye., Prof. Chemeris N.K., Prof. Gapetyev A.B., Prof. Breus T.K., Prof. Gurfinkel Yu.I., Prof. Binhi V.N., Prof. Belyaev I.Ya., Beylina S.I., Teplov V.A., Ermakov A.M., Dr. Matveeva N.B., Znobishcheba A.V., Dr. Karnauhov V.N., Dr. Karnauhov A.V., Ermakov A.M., Prof. Dudin M.G., Dr. Arsen’ev A.V., Dr. Ivanov A.V., Dr. Droz dov A.V.

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IN MEMORY OF PROFESSOR VALERY LEDNEV

Editor’s note: The recent death of Valery Lednev prompted remembrances of his work from many of his colleagues. Those responses also give important perspectives on how the development of complex interaction models has influenced research in bioelectromagnetics over the past two decades:

From Abe Liboff, Professor Emeritus, Department of Physics, Oakland University, Rochester, Michigan and Research Professor, Center for Molecular Biology and Biotechnology, Florida Atlantic University, Boca Raton, Florida:

Valery Lednev was a good friend and colleague. We often took lunch together at the BEMS annual meetings, where we dissected the latest reports and laughed a lot.

I cannot stress enough how important his work was to the science underlying weak, low frequency magnetic interactions with living things. Where the rest of us working in the resonance area were initially focused on frequency dependences, Valery added another dimension, that dealing with variations due to magnetic intensity. Not only did this open a new avenue for possibly cracking the mystery of ion resonance-like interactions, but this description based on intensity gave engineers and epidemiologists the opportunity to try to relate their needs to a new theoretical framework.

Although many saw him as a theoretician, he told me his real interests, originally in muscle physiology, were in finding good experimental models to illuminate the parametric theory. Although most of us are familiar with his work on myosin, less are aware of later work, first connected to planaria regeneration, and subsequently to gravitropism in plants.

Apart from annual BEMS get-togethers I recall two very extended conversations with Valery. One was the lively, rough and tumble debate at a private meeting on Margarita Island, just off the coast of Venezuela. The subject, low frequency magnetic resonance biointeractions, was discussed in depth, sometimes into the wee hours. Involved were just a few invited participants, including Valery and me, Janie [Page] Blanchard, Carl Blackman, Charles Polk, and Frank Prato, and perhaps less than ten others. Everyone agreed that we learned much (more than we wanted to know) about Bessel functions. Great heat was generated over a factor of two in the Bessel argument that Blanchard and Blackman had discovered, and some of their striking experimental results. But what really impressed me was the resolute manner in which Valery stood his ground, day after day, to defend his point of view. It was a bravura performance, the sort that is only possible by a scientist supremely secure and confident in himself and his work.

The other meeting was more subdued, just Valery and me, sitting in the sun, on the steps of the Cell Biophysics Institute in Pushchina. Our conversation ranged all over the place. I especially remember how much we shared—a deep love of science, coupled to an impatience with those who failed to recognize that our resonance studies were opening up a new branch of biology. What many did not know is how much thought he gave to the deeper philosophical basis of what we were doing. In this regard, I cannot think of anyone else in the bioelectromagnetics field with whom such thoughts could be intelligently shared.

I regret not having the chance to pursue the meaning of Zhadin’s work with Valery. There is such a beautiful path of investigation starting with Blackman being interested in how the static GMF might affect biomagnetic interactions leading all the way to Zhadin asking how ICR magnetic field combinations might affect complex ions in solution, with neither Carl nor Mikhail having any reason to expect a fruitful result, other than scientific curiosity.

Valery’s work was an integral part of that beautiful path. He will be greatly missed, both for his science as well as his good humor.

A Personal View by Carl Blackman on the Impact of Valery Lednev on One Aspect of Bioelectromagnetics:

When a scientist dies, it is a time for reflection and remembrances. I would like to comment on the circumstances of my first meeting with Valery Lednev and subsequent interactions.

First, the prologue. In July of 1984 at the BEMS meeting, our research group reported that the strength of the earth’s static magnetic field could determine which frequency of ELF fields would cause changes in the calcium efflux from brain tissue in vitro (Slesin 1984; Blackman et al., 1985). We suggested either a cyclotron resonance-like or a magnetic resonance-like phenomenon might be involved. Abe Liboff was immediately interested and he, along with Bruce McLeod, developed the ion cyclotron resonance (ICR) model, which described AC frequency and DC intensity conditions that would be ‘tuned’ to the charge to mass ratios of common ions in biological systems (McLeod & Liboff, 1986). The model was supported by biological responses these authors were able to test in several biological systems over ensuing years (e.g., Smith et al., 1987; Liboff et al., 1989). What was missing from

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the ICR model was a way to predict the intensity of the AC field that would be effective for causing biological responses. This was the situation when Valery Lednev came upon the scene.

In late 1989, when I was BEMS president-elect and thus Chair of the Technical Program Committee, Charles Polk recommended that I consider inviting a Soviet biophysicist he had recently met at a scientific meeting in Eastern Europe. The Soviet scientist was Valery Lednev, who had developed a theoretical model, ‘Parametric Resonance’, for a process that contained the Ion Cyclotron Resonance-like formality, but contained additional constructs that framed the AC field intensity into the predictions of multiple intensity windows. Because of Charles’ enthusiasm for Lednev’s advances and because of the accumulating experimental evidence that the static magnetic field was an essential feature of some non-thermal effects, I invited Valery to present at one of the symposia at the 1990 BEMS meeting in San Antonio. He subsequently published his theory (Lednev, 1991) and supportive data (Shuvalova et al., 1991).

Lednev’s theoretical construct, describing a predictive role for the AC intensity, as well as the AC Frequency and the DC intensity that was previously provided by the ICR model, became the predictive model to test using other biological test systems and possible ionic components. The predictions of the Lednev model fit experimental results he obtained in Russia, as well as results reported by Frank Prato and his colleagues in Canada. However, our laboratory efforts produced experimental results that were not fully accounted for by the predictions of the AC intensity response in the Lednev model but, following revisions by Blanchard et al. (1994) the revised model, ‘Ion Parametric Resonance’, fit our data (Blackman et al., 1994) and predicted the response when we obtained new data (Blackman et al., 1995). Subsequent biological tests in Sweden (by Baureus Koch et al., 2003 and independently by Sarimov et al., 2005 each using different biological systems) obtained results that were more consistent with the Blanchard model, and symmetrically, additional reports from Russia supported the Lednev model. In this sense, it appears that both models have heuristic aspects, which allow them to fit and predict subsets of the experimental results.

Valery stayed on the scene debating all who thought his model was not developed using sound, fundamental first principles of physics. At times he would be annoyed with results we published because our data did not fit his theoretical model, and at other times he complemented me on our experimental results, particularly Trillo et al. (1996) demonstrating hydrogen resonance and Blackman et al. (1999) defining the bandwidth of the hydrogen resonance response.

Lednev continued his research into the effects of combined weak static and alternating magnetic fields, extending them to effects on morphine-induced rat EEGs, on plant gravitropic responses, and most recently (Lednev et al., 2008) on the modulation of cardiac rhythms in humans, which was published within months of his death. Valery was always engaged and focused on scientific problems, and he has left us in bioelectromagnetics with a substantial legacy of both discoveries and uncertainties.

It is apparent that additional research is needed, as exemplified by reports from teams led by Binhi et al. (2002; 2006; 2007), Del Giudice et al. (2002), Comisso et al. (2006), Eberhardt (e.g., Baureus Koch et al., 2003), Zhadin (1998; 2001), Belyaev (Sarimov et al. (2005), and Novikov and Fesenko (2009), to establish a rigorous model that may have adjustable, fundamental parameters to fit both types of results, and to extend to more complex wave forms that are now being used. Embedded within this research effort will most likely be the pioneering work of Valery Lednev.

Valery Lednev was a highly respected and accomplished Soviet scientist who initially worked in the more restricted Soviet environment but was in the forefront to eagerly seek out and engage wider audiences for his work and establish new colleagues as collaborators to contribute to scientific explorations on the international stage. He was a worthy colleague and competitor, who will be missed for the scientific ingenuity and perception exhibited in his publications.

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See Valery Lednev, continued on page 8
From Oleg Kolomytkin, LSU Health Sciences Center:

Professor Valery Lednev worked at the Institute of Theoretical and Experimental Biophysics, Russian Academy of Sciences. His initial scientific studies involved the biophysics of muscle proteins. In the 1990s he changed his interests dramatically and moved into new area for him – bioelectromagnetics. Prof. Lednev was the first scientist to apply the principles of quantum mechanics to explain biological effects of weak magnetic fields. Amazingly, his theory predicted effects that were later confirmed experimentally. His success inspired many others to follow his approach and develop quantum mechanical theories to overcome the main problems, especially the problem of thermal noise. But Prof. Lednev was much more than just the founder of a new direction in bioelectromagnetics. He was an inspirational person who always brought a fresh insight and an upbeat attitude to the scientific problems on which he worked. He helped many young scientists, and had many friends around the world.

From Arthur Pilla, Mount Sinai Medical Center:

It really all started with a paper published in 1984 in Science (Liboff et al.) which quite conclusively demonstrated that magnetic fields, per se, could affect the rate of division of living cells. Up to that revelation, all of us working on the biological and clinical effects of electromagnetic fields (EMF) were convinced that the message was carried to the cell by the induced electric field. The magnetic field in, e.g., bone growth stimulator devices, was merely there to induce the electric field.

Although it is clear that most clinical EMF devices operate via the induced electric field, it is also clear that weak static (DC), and combinations of weak DC and low frequency AC magnetic fields, for which there is no question that the induced electric field is well below detectability, can indeed have profound biological and clinical effects.

To rationalize these findings, Abe Liboff proposed the Ion Cyclotron Resonance (ICR) model which predicted certain combinations of very weak AC/DC magnetic fields would have peak effects at resonances based upon the charge to mass ratio of the suspected target ion. Notwithstanding that the ICR model has theoretical problems, ICR predictions were confirmed more often than not experimentally. In fact, a very effective bone growth stimulator, designed to help heal recalcitrant bone fractures, was developed using ICR predictions. It is in use today.

Then came Valery Lednev whose presentations in the early 1990’s at BEMS and other meetings, and whose publications in Bioelectromagnetics revealed his Ion Parametric Resonance (IPR) model, which also predicted resonances based upon charge to ion mass ratio for weak AC/DC magnetic fields. Many of our colleagues have added, and continue to add, refinement to the IPR model.

Valery chose Ca2+-calmodulin (CaM) dependent myosin light chain phosphorylation to illustrate his model....a powerful choice because the principle difference between IPR and ICR related to an AC/DC effect on an already bound ion, rather than on the ion trajectory to the binding site. I remember very specifically that Valery was already convinced that the Ca/CaM target would be involved in all EMF bioeffects when he first spoke to us in the early 1990’s.

I was not convinced about Ca/CaM as the ubiquitous EMF target, and even less convinced about IPR. Then, by chance, Marko Markov came to work in my laboratory. I asked him to try to reproduce Lednev’s results on myosin light chain phosphorylation. Marko proceeded, and the next thing I knew he was showing me results which suggested that very weak static magnetic fields alone could accelerate phosphorylation. I asked him to repeat many times then show me again. He did, and there was a very clear weak DC magnetic field effect on the rate of myosin light chain phosphorylation. [In addition] there was a dose curve which showed saturation in the 2-5 G range. Marko also showed clear weak AC/DC magnetic field resonance effects in this system [that were dependent] upon Ca2+ binding.

Now things were getting more complex. Up to then, neither the ICR or IPR models predicted a weak DC magnetic field effect on either the ion trajectory or the already bound ion. None of us expected the weak static magnetic field effect on a system which involved Ca2+ binding. Are these models fundamentally wrong, despite the abundant experimental evidence....or is it just fine tuning that is needed? My group has, up to this day, been trying to explain weak DC and AC/DC magnetic field effects by looking at a Lorentz force model on the already bound ion......all because of Valery Lednev.

... These days it is reasonably well accepted that the Ca/CaM/NO (nitric oxide) cascade is essential for EMF therapeutic applications. The reason we are all looking at such Ca/CaM dependent mechanisms is fundamentally due to [the work of Valery Lednev].

From Shoogo Ueno, past president of BEMS:

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Professor Lednev contributed greatly to the early development of bioelectromagnetics, in particular, to the understanding of possible mechanisms for the effect of weak magnetic fields on biological systems. Professor Lednev was a pioneer of theoretical study of bioelectromagnetics, and many young researchers in this field have been inspired by his rich insight. I first met Professor Lednev at an international symposium on biological effects of magnetic and electromagnetic fields at Pleven, Bulgaria when Professor Marko Markov organized the interesting meeting in 1989. I was not able to understand Professor Lednev’s difficult theory with difficult equations well, but his passion and earnest attitude toward the science reached into my heart.

From colleague and BEMS member Marko Markov:

I first met Prof. Lednev in association with a meeting of the East European countries I attended in 1987 in Puschino on biological effects of EMF. Actually, at that time Lednev was not interested in EMF and my visit was a short official meeting with him as the Deputy Director of the Institute of Biophysics.

To my surprise, in October 1989, Valery Lednev came to Bulgaria for the Second International School on “EMF and biomembranes” that I organized. During the first two days I realized that Valery had something interesting to say and rearranged the program to give him a lecture spot. It was (to the best of my knowledge) the first presentation of his theory of parametric resonance.

The following year, in June 1990, his theory was presented for the first time at the large Bioelectromagnetics meeting in San Antonio. In July 1990, he and I attended the Gordon conference where Valery was treated as a movie star. There he presented a poster on the first experiment designed to confirm his model using myosin phosphorylation. I was impressed by the idea, despite the small number of experimental repetitions shown.

When I joined Art Pilla at the Mount Sinai Medical Center in January 1991, we decided to try to replicate the experiment on myosin phosphorylation. I remember as if it was yesterday how Valery was very kind to send me the manuscript he had submitted for publication in Dokladi AN USSR. Following his protocol, I was able to adjust the experiment and replace gel electrophoresis with Cherenkov emission as a read-out for the experiment. With the easy guidance of Valery, I was able to develop a biophysical dosimeter (100 uL volume) which allows to investigate the effect of various magnetic field and obtain a real time biological response to the applied magnetic fields.

During the years I was pleased to meet him several times in the USA and Canada. When I organized the IV international workshop on Biological effects of EMF, October 2006 in Crete, Valery was among the participants of the meeting. I did not expect that this would be our last meeting and wish I had more communication with him.

From Joseph Bowman, National Institute for Occupational Safety Health:

With the passing of Valery Lednev, I recall his pivotal role in the continuing debates over the mechanisms by which low level magnetic fields might produce biological effects. Lednev’s 1991 Bioelectromagnetics paper on his ion parametric resonance model first suggested a convincing answer to the puzzles of biological effects from combined AC and DC fields that is still valid today. Lednev’s brilliant insights and supporting experimental work also started me on a fascinating effort to apply quantum theory to epidemiology.

In 1991, I had finishing assessing EMF exposures for the Los Angeles study of childhood leukemia, and was analyzing the results. When we were formulating our epidemiologic hypotheses, Carl Blackman had published calcium efflux experiments that showed changes only with particular combinations of AC and DC fields, suggesting a resonance mechanism. To explain Blackman’s findings, Abe Liboff had proposed his cyclotron resonance theory and confirmed it with several experiments. To test this hot new theory, I was able to convince epidemiologist John Peters and the EPRI sponsors to measure DC magnetic field in the child’s bedroom in addition to assessing wire codes and measuring ELF electric and magnetic fields.

To everyone’s dismay, the initial results of the Los Angeles study [London et al., 1991] were significant associations with the Wertheimer-Leeper codes but not with the ELF measurements. To explain this “wire code paradox,” the epidemiologists then let me examine the childhood leukemia data for any sign of magnetic resonance. By then, theoreticians had shown that cyclotron resonance would require ion orbits far too large to fit in biological tissue, so Liboff’s theories were now an untenable basis for the epidemiologic analysis. However, I was able to formulate a semi-empirical ion resonance hypothesis from Carl Blackman’s calcium efflux results [Bowman et al., 1995].

Amazingly, children exposures to these resonance combinations of AC and DC magnetic fields showed significant risks. When I varied parameters like...
The minimum exposure duration whose values the epidemiologists had set arbitrarily, the relative risks shot up to 10 or greater -- values typical of cigarette smoking and asbestos. At that point, the epidemiologists barred me from further risk analyses and found some inconsistencies in the results. We eventually published a more sober report entitled “Hypothesis: The risk of childhood leukemia may be related to combinations of power-frequency and static magnetic fields” [Bowman et al., 1995].

Throughout this investigation, many remarked on the futility of testing mechanistic hypotheses with epidemiologic studies. I did learn that testing for magnetic resonance in epidemiologic studies would require much better measurements that capture a person’s exposure to the AC and DC vectors simultaneously. Also, my semi-empirical resonance hypothesis made little contribution to scientific knowledge.

The ion parametric resonance model proposed by Lednev in 1991 was therefore a major breakthrough for me -- a theory rooted in basic physical principles that predicted “windowed” biological responses which were then observed in the laboratory and could be tested rigorously in an epidemiologic study. Unfortunately, the quantum chemistry that I had studied in graduate school was barely adequate to understanding parametric resonance. I could see one thing clearly -- Lednev’s one-dimensional formulation of parametric resonance did not apply to environmental exposures which occur in three dimensions. If ion parametric resonance were to be tested in epidemiologic studies, a three-dimensional model of ion resonance would be needed. I could not persuade Lednev to help me when we met at the 1992 EMF World Congress in Orlando, FL.

Ion resonance, however, could only be a hobby for me at my new job at the National Institute for Occupational Safety and Health (NIOSH). While I worked on practical occupational EMF problems, I have made slow progress on testing ion resonance by epidemiology. Stefan Engstrom showed how to extend the Lednev theory to three dimensions [Engstrom and Bowman, 2004] so that personal exposures to ion resonances can be measured. With the now-defunct Electric Research and Management, I developed a personal AC/DC waveform capture monitor [McDevitt et al, 2002] and software that calculates magnetic resonance metrics [Bowman et al., 2009]. Now with exposure measurements on electric utility workers in my computer, the capstone to my hobby will be testing the resonance hypothesis on a cohort of electric utility workers before I retire.

The amazing part of this story has been the creativity and durability of Lednev’s original insights that allowed their testing on my slow track. Parametric resonance is a little known phenomenon that is seldom encountered outside of graduate physics courses and atomic spectroscopy. Most theorists see little likelihood for quantum phenomena in biology. Nonetheless, Lednev saw this mechanism’s potential to explain the biological data and committed himself to its development. In his first publications, the theory was suited for subtle spectroscopy experiments, which are highly implausible in biological tissues. Under repeated theoretical criticisms from Robert Adair and others (myself included), Lednev refined his model so that it applied to an ion in a biological cage. Recently, Vladimir Binhi has improved on Lednev and kept ion resonance viable. Experimental studies occasionally report biological effects from ion resonance conditions although replications are still rare.

I cannot foresee the end of the ELF bioelectromagnetics saga, but I bet Valery Lednev will be part of its final history.

References:

Bowman JD, Miller CK, Krieg EF, Song R [2009]. Software for analyzing digital vector waveforms of 0-3000 Hz magnetic fields. Submitted to Bioelectromagnetics.


From Frank Prato, Lawson Health Research Institute:

Valery Lednev was a great inspiration to the Bioelectromagnetics group at the Lawson Research Institute here in London Ontario. During the formative years of this group, Valery visited London and I visited Valery in Puchino Russia. Valery convinced the London, Canada group to attempt experiments using exposures defined by his Parametric Resonance Model. Up to that time the London, Canada group could only increaseSee Valery Lednev, continued on page 11
sensitivity to pain. Using Lednev’s model, the London group was able to induce analgesia for the first time in their nociceptive animal behavioral work.

Our world wide bioelectromagnetics discipline has lost a true pioneer. Valery was able to do both sophisticated theory in the biophysical detection of ELF fields and novel experimental approaches to confirm predictions of his theoretical work. It is truly astounding that he was able to achieve much of this during the research funding crises that accompanied the fall of the Soviet Union. During my visit to his research facility, parts of the research building had to be cannibalized to keep other parts in operation. For example the fluorescent lighting had to be taken from the halls and non-research rooms to be placed into the research labs as lighting in the research labs failed. I often wonder how much greater Valery Lednev’s impact and productivity would have been if he had reliable funding during the last two decades of his life.

From Ben Greenebaum, past president of BEMS and former editor of the Bioelectromagnetics journal:

As a reviewer and editor for Bioelectromagnetics, I not only saw his manuscripts, but also his obvious and significant influence on the work of others. I met him a couple of times at meetings and found him more than willing to discuss his ideas and, in spite of the language barrier, someone whom I’d have probably enjoyed knowing better.

Valery V. Lednev exerted a significant influence on bioelectromagnetics through his theoretical interpretation of resonance-like field effects, first presented in 1991 (Lednev, 1991), and his related experimental data. A number of people, including Carl Blackman, Abe Liboff, and Lednev himself, had previously published a great deal of data showing that for combined AC and DC magnetic fields, including the earth’s steady field, some frequency and intensity combinations caused changes in biological systems and others, though similar, did not. Liboff (1985) had noticed that the pattern in many instances fit that of ordinary cyclotron resonance. If taken literally, however, his idea had a number of difficulties. Lednev’s 1991 proposal, based on quantum mechanical ideas associated with Zeeman splitting of spins, though also having difficulties, pointed out that there were other theoretical routes to explaining the observed pattern of effects. Lednev’s specific idea has not found wide acceptance, but by showing that alternative approaches could also produce better theories or to do experiments that tested the apparent patterns further or distinguish between the various theories.

For that, if for nothing else, he deserves to be remembered with gratitude by the bioelectromagnetics community. In addition, a quick PubMed search has confirmed my impression that he had a long string of contributions in biophysics, both before and after the 1991 paper, ranging from studies of muscle structure and cytoskeletons through the more recent work with electromagnetic fields, some associated with the resonance ideas and some in other areas, including millimeter waves.

V. V. Lednev. 1991 Possible mechanism for the influence of weak magnetic fields on biological systems. Bioelectromagnetics 12: 71-75


NOTE TO CONTRIBUTORS

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CALENDAR

Third International Conference of Applied Electromagnetism
CNEA 2009: “Potentialities of Electromagnetism in Medicine,
Agriculture, Industry, and Environment”
Date: 18-21 May 2009
Location: Santiago de Cuba, Cuba
Email: eventoscnea@yahoo.com

Eighth International Symposium on EMF
Date: 26-29 May 2009
Location: Modvdi, Italy
Information: http://www.aumontefiore.org/emf2009/

Cigré International Colloquium: “Power Frequency
Electromagnetic Fields - ELF EMF”
Date: 3-4 June 2009
Location: Sarajevo, Bosnia and Herzegovina
Information: http://www.bhkcigre.ba/english/ebhkcigre.htm

WHO IAC (International EMF Project) 2008
Date: 10-11 June 2009
Location: Geneva, Switzerland
Details: See September/October 2008 BEMS Newsletter

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BIOEM2009: Joint Meeting of BEMS and EBEA
Date: 14-19 June 2009
Location: Davos, Switzerland
Technical Program Co-Chairs: Guglielmo D’Inzeo and Dariusz
Leszcynski
Contact: Gloria Parsley, Tel: +1 301 663 4252; Fax: +1 301
694 4948; Email: bemsoffice@aol.com.

Progress in Electromagnetics Research Symposium (PIERS)
Date: 18-21 August 2009
Location: Moscow, Russia
Information: http://piers.mit.edu/piers2k9Moscow/

Occupational Exposure to Electromagnetic Fields: Paving the
Way for a Future EU Initiative
Date: 6-9 October 2009
Pre-registration Due: May 30, 2009
Contact: kjell.hansson.mild@radfys.umu.se
Conference web site: www.av.se/occupEMF

Sixth International Workshop on EMF
Location: Bodrum, Turkey
Dates: 11-16 October 2010
Contact/Information:
tunaya@istanbul.edu.tr or msmarkov@aol.com