Columbia University, College of Physicians & Surgeons

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January 10, 2006

Mr. Robert J. Pellatt,

Commission Secretary

British Columbia Utilities Commission

900 Howe Street, Box 250

Vancouver, BC V6Z 2N3 sent via Email: Commission.Secretary@bcuc.com

Dear Mr. Pellatt,

Re: **FortisBC Inc. Order No. G-114-05 / Project No. 3698407CPCN Application for Nk'Mip Substation and Transmission Line**

Mr. Hans Karow, Coalition to Reduce Electropollution (CORE), has asked me to provide testimony addressing the electromagnetic pollution issue associated with the proposed project cited above. As indicated in my CV (attached), I have spent many years studying the effects of low frequency electromagnetic fields (EMF) at both the cellular and molecular levels, and I have published extensively in peer reviewed journals.

Before addressing the main points, let me state that EMF from a 63kV power line will exceed the 3-4mG level within about 70-80 feet of the line, at typical power levels, based on the Bonneville Power Administration data. This level field will extend over an even wider range at peak power levels. Many biological systems are perturbed at relatively low EMF, but it has been shown that the risk of leukemia in children is doubled at the 3-4mG level. This field level is well within current safety limits, but the scientific basis of these limits is open to serious questions (Blank and Goodman, 2004) that challenge the capacity of these limits to be protective.

The main points I wish to emphasize are the following:

- recent epidemiological studies in the power frequency range suggest increased risk of leukemia associated with exposure to EMF

- current safety guidelines are not based on biological thresholds, and are many times above the levels that epidemiological studies have correlated with elevated risk of leukemia in children

- EMF thresholds of biological reactions are very low. Very low field strengths stimulate the stress response, the protective cellular reaction to potentially harmful stimuli

- the mechanism by which EMF cause changes in several well-documented biochemical systems involves interaction with electrons. Such a mechanism would affect many biological reactions, and possibly lead to cancer on interaction with DNA

Recent epidemiological studies indicate need for caution

Since the Wertheimer, Leeper paper of 1979, there have been many epidemiological studies of the effects of EMF in the power frequency range. Two recent meta analyses by groups of experts (Greenland et al, Epidem 2000; Ahlbom et al, Brit J Cancer 2000), of 15 and 9 major studies respectively, have shown a statistically significant doubling of the risk of childhood leukemia when exposures to low frequency EMF exceed 3-4mG. While the small number of cases of high exposure has resulted in a lack of statistical significance, the doubling of the risk of leukemia has persisted in many studies near the "significant" level. By pooling cases, it has been possible to demonstrate statistical significance. There is now quite general agreement that the epidemiological evidence indicates an association of EMF with childhood leukemia when exposures exceed 3-4mG.

Current safety guidelines are not based on biological mechanisms

In assessing the potential biological impact and risk of exposure, one would generally turn to the safety standards set by professional agencies such as ICNIRP and IEEE. However, the standards set by these agencies are unrelated to biological thresholds. They are based solely on the heating of tissue that results from the energy deposited by EMF. The energy deposition rate, the SAR, does not take into account many biological properties that change long before a change in the SAR can be detected. This fundamental flaw in the current standards makes them unreliable as a basis for safety:

- they assume that there are no biological reactions unless heating of cells occurs. The EMF thresholds discussed below, show that significant biological reactions occur in cells at very low EMF, in the absence of heating. These 'non-thermal' reactions raise an alarm regarding questions of safety.

- the standards were derived assuming that in EMF, the magnetic fields do not act directly, but only through the relatively weak electric fields they induce. This is not so. We have shown that both electric and magnetic fields can affect cells. In fact, magnetic fields penetrate cells far more effectively than electric fields at low frequency.

The SAR is a valid measure of energy deposition rate, but not of safety. It was derived at a time when all one could measure was temperature increase. Because of scientific advances, it is now possible to show many biological changes due to EMF that occur within the current safety guidelines. The current guidelines have been challenged by scientists, e.g., by an international commission that met in Catania, Italy in September 2002.

EM fields stimulate the cellular stress response

Regarding the question of safety, the most important observation is activation of stress protein synthesis in cells by EMF at both power and radio frequencies. The stress response occurs in reaction to a variety of potentially harmful influences in the environment, such as high temperature, toxic metal ions, alcohol, deviations of pH from neutrality, etc. For this reason, stimulation of the stress response by EMF can be seen as a direct answer by cells to the safety question. Cells react to EMF as a significant departure from a normal environment and as potentially harmful.

The stress proteins are the same whether stimulated by fields or by an increase in temperature, but the response to EMF requires much lower energy input. In Sciara salivary gland cells, the threshold energies of the EMF and thermal stimuli needed to evoke a stress response differ by 14 orders of magnitude, as shown in the Table below.

ENERGY to STIMULATE STRESS RESPONSE

Form of Energy	Stimulus	Energy Density (joules/m^3)
Magnetic	**8mG**	**2.6×10^{-7}**
Thermal	**5.5°C**	**$2.3 \times 10^{+7}$**

In addition to the stress response, many biological reactions, such as enzyme systems and electron transfer reactions, are affected by weak EMF. Low thresholds have been measured in several systems, and the values have been published in peer review journals. The Table below shows that the measured thresholds for changes in reaction rates of enzymes, the BZ reaction (oxidation of malonic acid), and reactions in DNA leading to biosynthesis of stress proteins, are in the range of cut-off thresholds in epidemiological studies. The table also has an entry for EMF needed to block the inhibition of breast cancer cell growth by melatonin. That study has been replicated in six labs, and it shows that a low EMF of 12mG blocks the growth-inhibiting action of melatonin on human estrogen receptor-positive, breast cancer cells, as well as the near complete blockage of the anticancer (chemotherapeutic) drug Tamoxifen. An EMF of 2mG has no effect, indicating that the threshold for an effect on these cancer cells lies between 2mG and 12mG.

Biological EM Field Thresholds (power frequency range)

Reactions:	**Na,K-ATPase**	**2-3mG**
	Cytochrome C Oxidase	**5-6mG**
	BZ (redox) reaction	**1-2mG**
DNA:	**Stress proteins (HL60 Cells)**	**<8mG**
	Stress proteins (Sciara Cells)	**<8mG**
Cells:	**Block inhibition by melatonin (Breast cancer cells)**	**2-12mG**
	Epidemiology threshold (leukemia)	**3-4mG**

Stimulation of the stress response by EMF shows that they activate DNA as the first step in protein synthesis. Several labs have shown that DNA can conduct electrons within its structure. Therefore, it appears possible for EMF to activate DNA by generating repulsive forces when interacting with electrons in DNA. We have shown that specific regions of DNA are associated with the response to EMF, and inactivating these sequences by removal or mutation eliminates the response to EMF. Inserting these DNA sequences into an artificial construct containing a gene makes the gene EMF-responsive. In brief, our understanding of mechanism has reached the point where we have identified an EMF sensitive DNA sequence, have transplanted it and have reactivated it with EMF. (We have obtained a patent for this process.) That experiment, together with the breast cancer cell study indicate that EMF can enter into health related mechanisms at very low field strengths.

Recommendation

Based on recent research on biological changes induced by EMF, it is wise and prudent to recommend minimizing exposure by all reasonable methods, especially of school age children, with the aim of being below 3-4mG at peak power levels. **ALARA** (As Low As Reasonably Achievable) has been a policy with regard to radiation safety, and the European Union has adopted a related measure, the **Precautionary Principle**, as a general approach to environmental issues. Italy and Austria have applied this approach to EMF, and I have organized a symposium on the Precautionary Principle for the next meeting of the Bioelectromagnetics Society.

On request, I am prepared to provide additional information and clarification. Please feel free to contact me via e-mail mb32@columbia.edu , or telephone provided above.

Martin Blank, PhD
Associate Professor of Physiology and Cellular Biophysics
Columbia University

Enclosure: Curriculum Vitae

CC: Mr. George Isherwood, Director Reg. Affairs, FortisBC George.Isherwood@fortisbc.com
Mr. Hans Karow, CORE hkarow@shaw.ca

CURRICULUM VITAE

Address	Home	157 Columbus Drive, Tenafly, N.J. 07670 (Tel: 201-567-2449; FAX: 201-567-0676; email: mbphd32@yahoo.com)
	Office	Dept. of Physiology, College of Physicians and Surgeons, Columbia University, 630 West 168th Street, New York, NY 10032 (Tel: 212-305-3644; FAX: 212-305-5775; email: mb32@columbia.edu)

Personal	Born	February 28, 1933	New York, New York
	Married	Marion Sue Hersch	July 3, 1955 (3 children)

Education	1950-1954	City College of New York, BS Magna Cum Laude (Chemistry)
	1954-1957	Columbia University, PhD (Physical Chemistry)
	1957-1959	Cambridge University, England, PhD (Colloid Science)

Academic Appointments

1954-1955	Assistant in Chemistry, Columbia University
1955-1957	Research Fellow (Chemistry), Columbia University
1957-1959	Postdoctoral Research Fellow, Cambridge University, England
1959-1964	Instructor in Physiology, Columbia University
1964-1968	Assistant Professor of Physiology, Columbia University
1968-present	Associate Professor of Physiology and Cellular Biophysics, Columbia University

Other Appointments

Summer 1956	Chemist, California Research Corp, Richmond, CA.
Summer 1957	Chemist, Esso Research and Engineering Co, Linden, NJ.
Fall 1961	Research Fellow, Cambridge University, England
Summer 1964	Chemist, Unilever Research Lab, Cheshire, England
Summer 1966	Visiting Scientist, Polymer Dept, Weizmann Institute, Israel
Summer 1967	Chemist, Unilever Research Lab, Hertfordshire, England
Summer 1968	Visiting Scholar, Bioengineering Dept, University of California, Berkeley
Summer 1969	Research Chemist, Unilever Research Lab, Vlaardingen, Netherlands
1970	Visiting Professor, Pharmacology Dept, Hebrew University, Israel
1974-1975	Physiologist, Office of Naval Research, London, England
1982 (6 mo.)	Visiting Lecturer, Biochemistry Dept, Monash University, Australia
1984-1985	Biologist, Office of Naval Research, Arlington, VA
1986-1988	Part-time IPA Biologist, Office of Naval Research, Arlington, VA
1989 (May)	Visiting Professor, Acad Sci USSR, Inst Electrochemistry, Moscow, and Dept of Biophysics, Univ of Warsaw, Poland
1992 (Nov)	Visiting Professor, Tata Institute, Bombay, India
1995 (spring)	Visiting Professor, Dept of Chemistry, University of the Negev, Beersheba, Israel Visiting Scientist, Dept of Biology, University of Victoria, BC, Canada
2005 (July)	Visiting Professor, Dept of Theoretical Physics, Kyoto University, Japan

Honors

1953	Elected to Phi Beta Kappa, City College
1956	Elected to Sigma Xi, Columbia University
1955-1957	Consumers Union Research Fellowship, Columbia University
1957-1959	Postdoctoral Research Fellowship, National Heart Institute, Cambridge University
1960-1970	Research Career Development Award (USPHS), Columbia University
1975	Certificate of Appreciation, Office of Naval Research, London
1982 (June)	Distinguished Visiting Professor, Univ Western Australia
1984	Distinguished Lecturer in Physiology, Wayne State University
1985	Certificate of Commendation, Office Naval Research, Arlington
1987	Invited Lecturer, International Biophysics Congress, Jerusalem
1988	Invited Lecturer, Univ of Bologna, 900th Anniversary Symposium
1989 (May)	Visiting Professor, Acad Sci USSR, Institute of Electrochemistry, Moscow and Dept of Biophysics, University of Warsaw, Poland
1990	Certificate of Appreciation, The Electrochemical Society
	Yasuda Award, Bioelectrical Repair and Growth Society
1992	Invited Opening Speaker, First Congress of European Bioelectromagnetics Association, Brussels, Belgium
	(Nov) Visiting Professor, Tata Institute, Bombay, India
1992-1993	Editor-in Chief, Proceedings, First World Congress on "Electricity and Magnetism in Biology and Medicine"
1993-1999	American Editor, "Bioelectrochemistry and Bioenergetics"
	Certificate of Appreciation, American Chemical Society, Environment Division
1995 (spring)	Visiting Professor, Dept of Chemistry, University of Beersheba, Israel
	Visiting Scientist, Dept of Biology, University of Victoria, BC, Canada
1997	Plenary Lecturer, Second World Congress on "Electricity and Magnetism in Biology and Medicine", Bologna, Italy
2002	Plenary Lecturer, Bioelectromagnetics Society, Quebec, Canada.
2005	Plenary Lecturer, Conference 'Biological Effects of Electromagnetic Fields', Kyoto, Japan

Areas of Research

General Experimental and Theoretical Areas:

Electromagnetic field effects on cells (stress response, enzyme reactions, DNA)
Membrane biophysics and transport mechanisms (active, passive, excitation mechanisms)
Biopolymers (surface and electrical properties of proteins, DNA)

Theoretical Models of Processes in Membranes and Biopolymers:

Electric and magnetic field effects on electron transfer reactions, enzymes, DNA
Ion fluxes in excitable membranes and ion gating in channels
Cooperative reactions in membranes, hemoglobin

Specific Biological Systems:

Electron transfer reactions: Belousov-Zhabotinski (oxidation of malonic acid), cytochrome oxidase
Enzymes: Na,K-ATPase, cytochrome oxidase, F_0F_1ATPase (effects of ions and EM fields)
Proteins: hemoglobin, red cell membrane, lung surfactant, Sciara salivary gland proteomics
Cells: red blood cells, sperm cells, HL60, Sciara salivary gland, E. coli
Membranes: red blood cells, sperm cells, membrane enzymes

Interfaces, Monolayers (proteins, lipids, ions), Bilayers:

Permeability (to water, gases, ions) and Rheology (elasticity, yield stress, flow)
Electrical effects: Adsorption, Electrode Noise, Surface Potential

Teaching

Faculty of Medicine - College of Physicians and Surgeons, Columbia University
- Medical Physiology - from 1961 to 1991
  - Lectures- physical biochemistry, membranes, transport.
  - Demonstrations- membrane properties, lung surfactant, analog computer.
  - Laboratory teaching including mammalian experiments.
- Course Director, 1989-1990
  - Computerized syllabus and administration (30 faculty, 310 students)
  - Introduced lab reports and new lab exercise
- Summer Science Teachers Program, 1995, 2000, 2004

Faculty of Pure Science - Graduate School of Arts and Sciences, Columbia University
- Basic Principles in Membrane Biophysics - Physical biochemistry (1970 - present)
  - membranes, electrical properties, ion transport
- Membrane Biophysics - Surfaces, membranes, channels, model systems.
- Graduate Seminar - Basic papers on membranes and transport.
- Control Mechanisms in Physiology - Lectures and lab on analog computer.
- Principles of Physiology - Lectures on biophysics (membranes, biopolymers)

Ettore Majorana Center, Erice, Italy-International School of Biophysics (Co-Director of 4 courses)
- 1981 Bioelectrochemistry I: Redox Processes
- 1984 Bioelectrochemistry II: Membrane Phenomena
- 1988 Bioelectrochemistry III: Charge Separation Across Biomembranes
- 1991 Bioelectrochemistry IV: Nerve-Muscle Function

National Medical School Review
- Lectures on Membranes, Nerve, Muscle

City University of New York (Graduate School)
- Surface Chemistry - Lectures on Surface Chemistry in Biology

Tata Institute, Bombay, India
- Course in Bioelectrochemistry

University of Beersheba (Department of Chemistry), Israel
- Course in Biophysics

Faculty Committees

Admissions, Faculty Council (and Executive Committee of the Faculty Council), By-Laws (Formulation of Stated Rules), First Year Faculty, Divisional Elections Commission, ad hoc tenure and department review committees.

Department of Physiology: Director of Seminar Program 1973-1984, Graduate Committee, Undergraduate Committee

Society Memberships

American Association for the Advancement of Science
Bioelectromagnetics Society
Bioelectrochemical Society
American Chemical Society (Colloid and Surface Chemistry Division)
Biophysical Society
Electrochemical Society (Organic and Biological Division)

Professional Activities

Editorial Boards

Bioelectrochemistry and Bioenergetics - Editorial Board, 1978 -1998;
Co-Editor, 1981 - 1987; North American Editor, 1993 - 1998
Journal of Electrochemical Society - Divisional Editor (Biology), 1978 -1991
Journal of Colloid and Interface Science - Advisory Board, 1978 -1981
Colloids and Surfaces (founded 1979) - Editorial Board, 1979 -1986

Bioelectrochemical (BES) Society

Founding Member, March 1979; Vice President, 1979 - 1988; President, 1988 - 1992.
Co-organizer, 4th International Symposium, Woods Hole, MA, 1977.
Plenary Lecturer, Weimar, DDR, 1979.
Organizing Committee, Topical Lecturer, Jerusalem, 1981.
Scientific Committee, Invited Lecturer, Stuttgart, Germany, 1983; Bologna, Italy, 1985.
Liaison to Bioelectromagnetics Society Board, 1984-1996.
Organizing Committee, Invited Lecturer, Szeged, Hungary, 1987.
Honorary Committee, Invited Lecturer, Pont-a-Mousson, France, 1989; Bielefeld, Germany, 1992; Seville, Spain, 1994; Israel, 1996.
Organizer, Symposium on Biological Effects of Environmental EM Fields, Israel, 1996.
International Scientific Committee, Invited Lecturer, Denmark, 1998; Bratislava, Slovakia, 2001; Florence, Italy, 2003.

Bioelectromagnetics (BEMS) Society

Invited Lecturer, BEMS meetings, San Francisco, CA, 1985; Madison, WI, 1986; Stamford, CT, 1988; Quebec, Canada, 2002
Invited Speaker, BEMS Workshop on Cooperative Phenomena, Bethesda MD, 1988
Invited Speaker, BEMS Gene Workshop, Los Angeles, CA, 1993
Board of Directors, 1989-1992; liaison from BES 1985-1996.
President Elect, 1996; President, 1997-1998; Past President, 1998-1999
(Nominating Comm, Journal Comm, Public Affairs Comm)
Plenary Lecturer, Quebec, Canada, 2002
Symposium Organizer (Bioelectromagnetic Mechanisms), Washington, DC, 2004
Symposium Organizer (Precautionary Principle), Cancun, Mexico, 2006

World Congress on Electricity and Magnetism in Biology and Medicine

1992-3 Executive Committee, Site Selection Committee, Program Committee.
1992-3 Editor-in-Chief of Proceedings Volume, First World Congress
1994-7 Vice President, Executive Committee for Second World Congress
Chairman, Technical Program Committee, Second World Congress

International School of Biophysics, Erice, Italy; Co-Director and Lecturer in following:

Bioelectrochemistry I: Biological Redox Reactions and Energetics, 1981.
Bioelectrochemistry II: Membrane Phenomena, 1984.
Bioelectrochemistry III: Charge Separation Across Biomembranes, 1988.
Bioelectrochemistry IV: Nerve-Muscle Function, 1991.

Division of Colloid and Surface Chemistry, American Chemical Society

Symposium Chairman, "Surface Chemistry of Biological Systems", 1966; 1969.
VK LaMer Award Committee, 1971-1976, Chairman 1975-1976
Symposium Chairman, "Bioelectrochemistry", Miami, 1978; Cleveland, 1981; Washington, 1983;

Denver, 1987.
Program Committee, Biology and Medicine, Chairman, 1979-1983.
Invited Lecturer, Colloid and Surface Science Symposium, Ann Arbor, 1987.
Invited Lecturer, Biological Interfacial Reactions Symposium, Atlanta, 1991.

Division of Organic and Biological Electrochemistry (Electrochemical Soc)
Symposium Chairman, "Electrochemical Processes at Biological Membranes", Seattle, 1978
Officer: Secy-Treas 1979-1981; Vice Chair 1981-1983; Chair 1983-1985.
Board of Directors, Electrochemical Society, 1983-1985.
Symposium Chairman, "Electrical Double Layers in Biology", Toronto, 1985.
Invited Speaker, "Ion Transfer Across Interfaces", Boston, 1986.
Member, Interdivisional Committee on Chemical Sensors, 1984-1987.
Invited Speaker, "Redox and Interfacial Properties", Washington, 1991.

Gordon Research Conferences
Speaker, "Chemistry at Interfaces", 1963.
Speaker, "Sensory Transduction in Microorganisms", 1978.
Day Chairman and speaker, "Chemistry at Interfaces", 1974.
Organizing Chairman, First Conference "Bioelectrochemistry", 1980.
Day Chairman and speaker, "Bioelectrochemistry", 1982.
Speaker, "Bioelectrochemistry", 1984, 1986, 1988.
Speaker, "Protons and Membrane Reactions", 1985.
Speaker, "Physicochemical Aspects, Transport in Microvasculature", 1985.
Discussion Leader, "Bioelectrochemistry", 1990, 1992, 1994, 1996, 1998, 2000 (Oxford), 2002.
Speaker, "Bioelectrochemistry", 2004.

Invitations to Miscellaneous Meetings, Workshops, Panels (Departmental Seminars not listed)
Chairman and Lecturer, "Physical Chemistry of Interfacial Transport: Biological Interfaces - Flows and Exchanges" NY Heart Assoc, 1968
Chairman and Lecturer, "Transport and Rheology of Interfacial Layers", Internat Conf on Surface and Colloid Science, Jerusalem, Israel, 1981
Lecturer, "Structure and Function in Excitable Cells", Biophysical Congress Satellite Conf, Woods Hole, MA 1981
Lecturer, "Biophysics of Cell Surface", Arendsee, DDR, 1981
Guest Speaker, CIBA Foundation, Biological Effects of Electromagnetic Fields, London, 1984
Lecturer, "Electrochemical Growth Stimulation", International Society of Electrochemistry, Berkeley, CA, 1984
Lecturer, "Biophysics of Cell Surface", Heringsdorf, DDR, 1985
Lecturer, Bioelectrical Repair & Growth Soc, Utrecht, Netherlands, 1986
Lecturer, IEEE/Engineering in Biology and Medicine Soc, Fort Worth, TX, 1986
Lecturer, International Biophysics Congress, Jerusalem, Israel, 1987
Session Organizer, IEEE/Engineering in Biology and Medicine Soc, Boston, MA, 1987
Lecturer, Bioelectrical Repair & Growth Soc, Washington, DC, 1988
Lecturer, "Chemistry Physics of Electrified Interfaces", Bologna, Italy, 1988 Symposium Organizer, "Bioelectrochemistry", AIChE, Washington, DC, 1988
Speaker, BEMS Workshop on Cooperative Phenomena, Bethesda MD,1988
Speaker, National Research Council, "Health Effects of EM Fields", Washington, DC, 1989
Lecturer, "Electrobiology Today", Bologna, Italy, 1989
Speaker, California Department of Health Service Workshop on "ELF Field Exposure and Possible Health Effects", Berkeley, CA 1991

Speaker, FASEB Symposium on "Cancer, EM Fields and Biological Systems", Atlanta, GA 1991
Panelist, EPA- NYC Dept of Health Panel on Health Effects of EM Fields, New York, NY, 1991
Panelist, BEMS Workshop, Research Agenda, Health Effects of EM Fields, Milwaukee, WI, 1991
Opening Speaker, First Congress of European Bioelectromagnetics Association, Brussels, 1992
Speaker, EPRI Workshop on Neurobiology, Asilomar, CA, 1992
Speaker, FASEB Symposium, Biological Effects of Electromagnetic Fields, Anaheim, CA, 1992
Panelist, Molecular Electronics Symposium, First World Congress on Electricity and Magnetism in Biology & Medicine, Orlando, FL, 1992
Lectures (4) on Bioelectrochemistry of Proteins and Membranes, Tata Inst, Bombay, India, 1992
Plenary Lecture, Bioelectrochemical Society of India, Bombay, 1992
Speaker, Biophysical Society Public Policy Symposium on Biological Effects of Electromagnetic Fields, Washington, DC, 1993
Organizer, ACS Symp, Biological Effects of Environmental EM Fields, Denver, CO, 1993
Speaker, Helen Hayes Hospital, Haverstraw, NY, 1993
Speaker, Bell Labs (Series on EMF), Murray Hill, NJ 1993
Speaker, International Society of Molecular Electronics & Biocomputers, Gaithersberg, MD, 1993
Speaker, International Society of Toxicology, New Orleans, 1993
Speaker, ACS Conference on Chemical Health and Safety, Garden City, 1993
Panelist, Deadline Club, "Tension over High Tension", New York, 1993
Organizer and Speaker, Biophysical Society Workshop on Biological Effects of Environmental Electromagnetic Fields, New Orleans, LA, 1994
Speaker, ACS Conference on Environment, Hofstra University, NY, 1994
Lecturer, Hackensack Meadowlands Environment Center, Lyndhurst, NJ, 1994
Plenary Lecture, International Society of Electrochemistry, Portugal, 1994
Seminar Lecturer, Weizmann Institute, Rehovoth, Israel, 1995
Seminar Lecturer, Hebrew University-Hadassah Medical School, Jerusalem, Israel, 1995
Distinguished Lecturer, Wayne State University Medical School, Detroit, MI, 1995
Lecturer, Centre for Environmental Health, Victoria, BC, 1995
Lecturer, Victoria Cancer Clinic, Royal Jubilee Hospital, Victoria, BC, 1995
Speaker, First World Congress in Magnetotherapy, London, UK, 1996
Speaker, Applied Physics Division, CSIRO, Sydney, Australia, 1996
Speaker, Complementary Healing Conference, Baltimore, MD, 1996
Speaker, Vermont Law School Conference "Unplugged", Killington, VT, 1996
Speaker, 9th International Congress on Stress, Montreux, Switzerland, 1997
Speaker, Internat'l Comm Non-Ionizing Radiation Protection/ World Health Org (ICNIRP/WHO) Seminar, Bologna, Italy, 1997
Plenary Lecturer, Second World Congress on "Electricity and Magnetism in Biology and Medicine", Bologna, Italy, 1997
Speaker, EMF - Scientific and Legal Issues , Catania, Italy, 2002
Speaker, Chemistry and Biochemistry Departments, CUNY. 1998
Speaker, 10th International Congress on Stress, Montreux, Switzerland, 1999
Speaker, Electromed99, Norfolk, VA, 1999
Speaker, Tutorial on Magnetic Fields, Procter & Gamble, Cincinnati, 1999
Speaker, Potential Therapeutic Applications of Magnetic Fields, Vanderbilt Univ, 1999
Speaker, North American Academy of Magnetic Therapy, Los Angeles, 2000
Speaker, 3rd International Conference on Bioelectromagnetism, Slovenia, 2000
Speaker, Electromed2001, Portsmouth, VA, 2001
Speaker, EBEA Conference on EMF. Helsinki, 2001
Plenary Lecturer, Bioelectromagnetics Society, Quebec, Canada, 2002
Speaker, XXVII URSI General Assembly, Maastricht, Netherlands, 2002

Speaker, EMF - Scientific and Legal Issues , Catania, Italy, 2002
Speaker, Physics Colloquium, University of South Florida, 2003
Speaker, RIFE Conference. Topic: Electromagnetic Fields and Living Cells. Seattle, 2004
Plenary Lecturer, Conference ‘Biological Effects of Electromagnetic Fields’, Kyoto, Japan, 2005

Grant Review Consultant

Office of Naval Research, Department of Defense
IPA Biologist, Manager of Membrane Electrochemistry ARI, 1986-1988
Chairman, Panel on Biological Sciences Div, August 1986
Member, Panel on Interdisciplinary Research, April 1979
Electric Power Research Institute, Palo Alto, CA
Member, Basic Sciences Advisory Committee, 1987-1991
National Institutes of Health
Radiation Study Section, 1991
(several ad hoc Study Sections and site visit committees)
National Science Foundation
US Army Research Office
US-Israel Binational Science Foundation
Petroleum Research Fund
Medical Research Council - Canada
Australian Research Grants Committee
Research Corporation (Providence, Rhode Island)
University and Polytechnic Grants Committee, Hong Kong
International Science Foundation (for Former Soviet Union), Washington, DC
Breast Cancer Research Program, University of California
US Army Medical Research and Materiel Command, Neurotoxin Exposure Program, AIBS
US Army Radiofrequency Radiation Research Program, AIBS

Consultant to various environmental groups on biological effects of electromagnetic fields (power frequency and radiofrequency)

PUBLICATIONS - Books, Reviews, Chapters

1. Blank M (1957) The Transfer of Monolayers through Surface Channels. **PhD Dissertation**, Chemistry Department, Columbia University, 54pp.
2. Blank M (1959) The Permeability of Monolayers to Carbon Dioxide and Oxygen. **PhD Dissertation**, Department of Colloid Science, Cambridge University, England, 105pp.
3. Blank M (1967) Editor, Symposium "Surface Chemistry of Biological Systems". **Journal of Colloid and Interface Science** 24:1-127.
4. Blank M and Britten JS (1970) Physical Principles in Monolayer and Membrane Permeation. in **"Physical Principles of Biological Membranes"**, edited by F Snell et al; Gordon & Breach, New York, pp 143-163.
5. Blank M (1970) Editor, **"Surface Chemistry of Biological Systems"**. Volume 7, "Advances in Experimental Medicine and Biology", Plenum Press, New York, 340pp.
6. Blank M (1972) The Measurement of Monolayer Permeability, in **"Techniques of Surface Chemistry and Physics"**, Volume I. Good, Stromberg, Patrick (eds); Marcel Dekker Inc., New York, pp 41-88
7. Blank M (1979) Monolayer Permeability. **Progress in Surface & Membrane Science** 13:87-139.
8. Blank M (1979) Surface Pharmacology: Drug Binding Equilibria and Ion Transport in Membrane Structures. **Pharmacology and Therapeutics** 7:313-328.
9. Blank M (1980) Editor, **"Bioelectrochemistry: Ions, Surfaces and Membranes"**, Advances in Chemistry, Volume 188, American Chem Soc, Washington, DC, 527pp.
10. Blank M (1981) Surface Pharmacology: Drug Binding Equilibria and Ion Transport in Membrane Structures, in **International Encyclopedia of Pharmacology and Therapeutics**, Inhibitors of Mitochondrial Functions, M Erecinska, DF Wilson (eds). Pergamon, New York, pp 19-34.
11. Milazzo G and Blank M (1983) Editors, **"Bioelectrochemistry I: Biological Redox Reactions"**, School of Biophysics, Erice, Italy. Plenum, New York, 348pp.
12. Blank M (1983) Transmembrane Potentials and Redox Reactions from the Physiological Point of View. in **"Bioelectrochemistry I: Biological Redox Reactions"**, G Milazzo, M Blank (eds), Plenum, New York, pp 227-247.
13. Blank M (1983) The Effects of Surface Compartments of Ion Transport Across Membranes. in **"Structure and Function in Excitable Cells"**, DC Chang, I Tasaki, WJ Adelman, HR Leuchtag (eds); Plenum, New York, pp. 435-449.
14. Blank M (1986) Editor, **"Electrical Double Layers in Biology"**, Plenum, NewYork, 319pp
15. Blank M (1987) The Surface Compartment Model: A Theory of Ion Transport Focused on Ionic Processes in the Electrical Double Layers at Membrane Protein Surfaces. **Biochimica et Biophysica Acta - Reviews on Biomembranes** 906:277-294.
16. Blank M and Findl E (1987) Editors, **"Mechanistic Approaches to the Interaction of Electric and Electromagnetic Fields with Living Systems"**, Plenum, New York, 439pp.
17. Milazzo G and Blank M (1987) Editors, **"Bioelectrochemistry II: Membrane Phenomena"**, International School of Biophysics, Erice, Italy. Plenum, New York, 543pp.
18. Blank M (1987) An Electrochemical Perspective on Excitable Membranes, Channels and Gating. in **"Bioelectrochemistry II: Membrane Phenomena"**, G Milazzo, M Blank (eds); Plenum, New York, pp. 431-456.
19. Blank M (1988) Recent Developments in the Theory of Ion Flow Across Membranes Under Imposed Electric Fields. In **"Modern Bioelectricity"**, AA Marino (ed); Dekker, New York, pp 345-364.
20. Markov M and Blank M (1988) Editors, **"Electromagnetic Fields and Biomembranes"**, Plenum, New York, 309pp.

Blank M (1990) Editor, **Syllabus for Human Physiology Course**, 13th Edition, Physiology Department, Columbia University, New York, 704pp.

22. Milazzo G and Blank M (1990) Editors, **"Bioelectrochemistry III: Charge Separation across**

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