

MODERN BIOELECTRICITY

edited by

Andrew A. Marino

Louisiana State University
School of Medicine
Shreveport, Louisiana

Preface

It has been almost 25 years since I was introduced to bioelectricity by my teacher, Robert Becker. The subject was then in its infancy and had no natural constituency because it did not fit easily within any of the orthodox scientific pigeon-holes. In physiology, electricity usually meant action potentials, within engineering it related to microwave heating, in physics and medicine it was associated with X-rays and radiotherapy treatment of cancer, and in chemistry it was linked to electrode reactions. Against this backdrop, two important themes emerged. What is the nature of the system or process that controls the living organism? Some might hold it to be the finger of God, and declare its inherent mechanics to be unknowable. The other extreme involves focusing on molecular minutiae in the belief that life can be defined at that that level. Modern bioelectricity is a middle-of-the-road approach which began with a crystallizing perception that electrical interactions are more fundamental than biochemical reactions, and hence that they perhaps have a greater probability of explaining the physical basis of life and the processes that control and express it. Bioelectricity's other major theme—environmental electromagnetic pollution—became important beginning in the early 1970's.

Much has happened during the past two decades, and this book is a monument to that work. As with all new initiatives, many questions have been raised, and previously unrecognized problems have become manifest. But it is the business of science to uncover and solve these problems, and it is precisely this effort, which is taking place on a broad scale across many traditional scientific disciplines, that constitutes the chief development in bioelectricity during the past 20 years. To build a new science there must be a group of scientists that are equal to the task, as well as a need for the approach that it embodies. The reader can judge whether the authors of this book meet that test.

As Machiavelli observed more than 400 years ago, any new idea is inherently born in struggle because it has preexisting opponents who are the adherents of the old idea, whereas the idea's potential proponents are still inchoate. If bioelectricity is to become a science and serve as a tool for solving mankind's problems, then the public-health issue of environmental electromagnetic fields must be faced and solved. This issue, which ironically was one of the seminal rationales for bioelectricity, has now come to serve as an incubus on progress because the lion's share of research funding of bioelectrical studies comes from organizations that create the electromagnetic fields whose risk-causing propensity is at issue. This is not a good or even acceptable pattern of funding if our true interest is the unbridled search for truth.

Perhaps the reader is interested in the men who, at least in my view, are responsible for pioneering bioelectrical research. Robert Becker's contributions to bioelectricity span its entire domain—more so than any other investigator. He is a bold innovator and thinker of new thoughts, an indomitable spirit and a great influence on this field. C. Andrew Bassett introduced bioelectricity into the scientific mainstream. The magnetic-field device he developed for clinical use was made available to a wide range of investigators, leading to many reports in the scientific

and medical literature. Such reports were rare when Bassett began his studies in the 1960's; now they are commonplace. Zachary Friedenber and Carl Brighton have a long involvement with bioelectrical studies, and their career-long commitment has done much to regularize bioelectricity as a science and to underscore its usefulness. As successive chairmen of a clinical department of a prestigious medical school, they have been instrumental in establishing the credibility of the new science. Their attention to methodology, quantitation, and detail has earned them widespread respect. Allan Frey was for many years a solitary witness to the scientific fact that electromagnetic fields are physiologically significant. The effects do not exist, he was told, or if they do they are trivial, and if not, they are classical and hence are no threat to the status quo. Hindsight shows us that Frey was correct, and his tenaciousness has enriched this field. Perhaps least known of the pioneers is Milton Zaret, a soft-spoken man who saw what he saw through his bimicroscope, wrote about it, and continued to write even though some found his reports displeasurible. It is the duty of the scientist to report on nature, and the duty of the citizen to contribute to the collective judgment of how the scientific facts are to be incorporated into the fabric of society. Perhaps the well-being of our society demands that we accept a specific prevalence of microwave-induced cataracts as the price for living in an affluent and militarily strong society. That is, however, an entirely different issue from whether microwave radiation causes cataracts.

Bioelectrical research in the Soviet Union antedates that done in the West but language and other difficulties have hindered widespread appreciation of the Soviet studies. Nevertheless, the work of Yu. Kholodov and A.S. Presman must be mentioned. Presman's book was one of the earliest systematic treatments of bioelectricity, and it had a profound influence on me and many others. Although I have never met the, I feel that they must have the same indomitable spirit as their American counterparts.

I have organized the chapters according to the general framework of bioelectricity. Chapters dealing with the biological significance of natural electrical signals are grouped following the introductory chapter. Part III deals with measurements and computations of electrical properties and characteristics of tissue. Laboratory studies of biological changes induced in living organisms are described in Part IV. The rationale for bioelectricity is what it tells us about life, health, and disease, and these topics are covered in the last two parts.

The King of Hearts advised "begin at the beginning, and go on till you come to the end: then stop." Practical considerations, alas, have necessitated a relatively arbitrary end to this book, and I cannot offer the reader a guarantee of completeness. But I can guarantee that it is an authoritative exposition of the major threads of modern bioelectricity.

Andrew A. Marino
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Contributors

- E. AARHOLT, Department of Electronic and Electrical Engineering, University of Salford, Salford, M5 4WT, United Kingdom
- ROBERT O. BECKER , Erie Canal Road, Star Route, Lowville, New York 13367
- HERMANN BERG, Academy of Sciences of the GDR, Central Institute of Microbiology and Experimental Therapy, Department of Biophysical Chemistry, DDR-69 Jena, German Democratic Republic.
- I.S. BEZDOL'NAYA, Marzeev Scientific Research Institute of General and Communal Hygiene, 50 Popudrenko Str., Kiev-94, 252660, USSR
- MARIAN BIELEC, Department of Biological Effects of Nonionizing Radiation, Center for Radiobiology and Radiation Safety, Warsaw, Poland
- NANCY A. BLAKEMORE, Department of Microbiology, University of New Hampshire, Durham, New Hampshire 03824
- RICHARD P. BLAKEMORE, Department of Microbiology, University of New Hampshire, Durham, New Hampshire 03824
- MARTIN BLANK, Department of Physiology and Cellular Biophysics, Columbia University, 630 West 168th Street, New York, New York 10032
- RUGGERO CADOSSO, Center for Experimental Haematology, Department of Internal Medicine II, University of Modena , Policlinics Via del Pozzo 71, I41100 Modena, Italy
- GIOVANNI CECCHERELLI, Center for Experimental Haematology, Department of Internal Medicine II, University of Modena , Policlinics Via del Pozzo 71, I41100 Modena, Italy
- A. DAL MONTE , Department of Pediatric Orthopedics, Istituto Ortopedico Rizzoli, Bologna , Italy
- Yu D. DUMANSKIY, Marzeev Scientific Research Institute of General and Communal Hygiene, 50 Popudrenko Str., Kiev-94, 252660, USSR
- GIOVANNI EMILIA, Center for Experimental Haematology, Department of Internal Medicine II, University of Modena , Policlinics Via del Pozzo 71 , I41100 Modena, Italy
- G. FONTANESI, Department of Orthopaedics and Traumatology, Arcispedale S. Maria Nuova, Reggio Emilia, Italy
- RICHARD B. FRANKEL, Francis Bitter National Magnet Laboratory, M.I.T., Cambridge, Massachusetts 02139
- ALLAN H. FREY, Randomline, Inc., County Line and Mann Roads, Huntingdon Valley, Pennsylvania 19006
- WILLIAM GENSLER , Department of Electrical Engineering, Building 20, University of Arizona, Tucson, Arizona 85721
- F. GIANCECCHI , Department of Orthopaedics and Traumatology, Arcispedale S. Maria Nuova, Reggio Emilia, Italy
- EUGENE M. GOODMAN, Biomedical Research Institute, University of Wisconsin - Parkside, Kenosha, Wisconsin 53141
- BEN GREENEBAUM, Biomedical Research Institute, University of Wisconsin - Parkside, Kenosha, Wisconsin 53141
- FRANCIS X. HART, Department of Physics, The University of the South, Sewanee, Tennessee 37375
- M. JABERANSARI, Department of Electronic and Electrical Engineering, University of Salford, Salford, M5 4WT, United Kingdom

A.H. JAFARY-ASL, Department of Physiology, Medical School, Shiraz University, Shiraz, Iran

SIDNEY B. LANG, Department of Chemical Engineering, Ben-Gurion University of the Negev, P.O. Box 653, Beer Sheva 84105, Israel

SLAWOMIR LIPSKI, Department of Biological Effects of Nonionizing Radiation, Center for Radiobiology and Radiation Safety, Warsaw, Poland

ANDREW A. MARINO, Department of Orthopaedic Surgery, LSU School of Medicine in Shreveport, P.O. Box 33932, Shreveport, Louisiana 71113

MICHAEL T. MARRON, Office of Naval Research, Arlington, Virginia

P.N. MARSH, Department of Electronic and Electrical Engineering, University of Salford, Salford, M5 4WT, United Kingdom

ROCHELLE MEDICI, Analytical Services, 2220 El Molino Place, San Marino, California 91108

MICHAEL A. PERSINGER, Behavioral Neuroscience Laboratory, Department of Psychology, Laurentian University, Sudbury, Ontario, P3E 2C6, Canada

RONALD PETHIG, Institute of Molecular and Biomolecular Electronics, University College of North Wales, Dean Street, Bangor, Gwynedd LL57 1UT, United Kingdom

ARTHUR A. PILLA, Bioelectrochemistry Laboratory, Department of Orthopedics, Mount Sinai School of Medicine, One Gustave L. Levy Place, New York, New York 10029

G. POLI, Department of Pediatric Medicine, Istituto Ortopedico Rizzoli, Bologna, Italy

MARIA REICHMANIS, 1951 Bolin Road, North Augusta, South Carolina 29841

M.G. SHANDALA, Marzeev Scientific Research Institute of General and Communal Hygiene, 50 Popudrenko Str., Kiev-94, 252660, USSR

BETTY F. SISKEN, Department of Anatomy, University of Kentucky, Lexington, Kentucky 40506

C.W. SMITH, Department of Electronic and Electrical Engineering, University of Salford, Salford, M5 4WT, United Kingdom

STEPHEN D. SMITH, Department of Anatomy, University of Kentucky, Albert B. Chandler Medical Center, Lexington, Kentucky 40506

GRAZYNA SOKOLSKA, Department of Biological Effects of Nonionizing Radiation, Center for Radiobiology and Radiation Safety, Warsaw, Poland

WILLIAM E. SOUTHERN, Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois 60115

J.A. SPADARO, Department of Orthopedic Surgery, State University of New York, Health Sciences Center, 750 East Adams Street, Syracuse, New York 13210

STANISLAW SZMIGIELSKI, Department of Biological Effects of Nonionizing Radiation, Center for Radiobiology and Radiation Safety, Warsaw, Poland

H. TI TIEN, Membrane Biophysics Laboratory, Department of Physiology, Michigan State University, East Lansing, Michigan 48824

GUISEPPE TORELLI, Center for Experimental Haematology, Department of Internal Medicine II, University of Modena, Policlinics Via del Pozzo 71, I41100 Modena, Italy

MILTON M. ZARET, 1230 Post Road, Scarsdale, New York 10583-2030

JOZEF R. ZON, Department of Physiology, Michigan State University, East Lansing, Michigan 48824

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