Biologically Closed Electric Circuits

CLINICAL, EXPERIMENTAL AND THEORETICAL EVIDENCE FOR AN ADDITIONAL CIRCULATORY SYSTEM

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by

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To contribute a preface to this work of Björn Nordenström is an honour for a French-speaking colleague, but above all it is a great responsibility with respect to the international scientific community, because the opinions expressed in this preface have the potential of influencing the speed of diffusion, study, and acceptance of the extraordinarily original and fruitful ideas of this work. “Biologically Closed Electric Circuits” marks no less than a major point in the evolution of our understanding of biologic science.

Nordenström’s theory offers important implications throughout the entire range of normal and pathologic physiology. With profound conviction, I dare assert that no vital process can be fully understood without considering this new electrophysiologic theory. A vast field of multidisciplinary research is opening before us. Numerous concepts which today are confused, including even chemotaxis, are here clarified.

Consider a collection of tissues, organs, interstitial fluid, blood vessels, lymphatic channels and excretory canals. Such tissues, e.g., vessels, were found to function as insulated electric “cables”. Their contents of blood plasma conduct current effectively inside these vessels, but not necessarily between vessels. Conductivity of blood capillaries is further enhanced when insulating vessel walls join the conducting interstitial tissue fluid over the blood capillaries. Differences of electric potential (no matter whether created normally, pathologically or artificially) will create electric fields throughout the body. Current will flow preferentially in conducting pathways, inducing ionic and electroosmotic transports over both short and long distances. These transports will produce diverse biologic effects.

This idea, so simple and logical, is supported by numerous experiments in this work. As the course of experimentation progressed, Björn Nordenström found himself led beyond the concept of the biologically closed electric circuit to predict the existence in organisms of an electrical circulatory system—a system not only as complex as the circulation of the blood but also one which intervenes in all physiologic activities.

To the reader of this book I offer specific advice: begin by reading not only the summary Chapter I but also on pages 327–328 the 27 lines of Section G (“Physiological capacity of BCEC systems”), which will immediately stimulate one’s interest in this new theory and incite a wish to deepen one’s knowledge of it.

This work is very clear. I feel little need for lengthy considerations of its scientific merit, but I cannot resist emphasizing the fascinating and broad medical scope of this book, i.e., a new view on carcinogenesis and a therapeutic mode against cancer which theoretically offers possibilities against diverse inflammatory states, fractures, atheromas and neurologic complications of various diseases (e.g., hepatic coma). Moreover, this book offers new scientific bases which will reorient future research on a wide range of hitherto poorly understood processes, e.g., acupuncture, oral galvanism, meteorologic influences on human beings, types of adipose tissue, diverse secretory mechanisms, diurnal rhythms and embryogenesis. This list of disparate functions leaves unmentioned many other applications. In particular, extrapolation of the theory at the intracellular level offers many possible consequences.

The coming years will see a wealth of experimentation derive from this new approach to electrophysiology. Its full importance is today impossible to appreciate. For example, disparities of findings noted hitherto between in vitro and in vivo work can now be assessed anew. The implications of Nordenström’s theory appear far-reaching even beyond today’s most enlightened suspicions.

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Biopotentials have fascinated me for many years, and when I found that small positive potentials existed on skin carcinomas relative to normal tissue I searched for an explanation, feeling that it was of fundamental importance.

It was my search for more information that led me to Björn Nordenström. The vast amount of material he had collected in searching for an explanation of the corona structures around a variety of pulmonary plasmas and inflammatory lesions, surprised me.

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This book is an account of his research and, as so often happens, it touches on fields beyond the original observations. The potentials, although small, which he measured in many tumours seemed to be a major factor in water transport, cell movement, etc. Reproducing these electrical conditions in vitro as well as in vivo produced histological evidence of cellular transformations, migration of cells and ions and transport of tissue water, indicating that electrical forces must be of fundamental importance to maintain, e.g., homeostasis.

The way in which the morphology of breast adipose tissue changes under the influence of small D.C. currents and, in particular, how the histology is so different according to the position of the tissue in the potential gradient, is convincing evidence of cellular changes brought about by electricity.

The extracellular fluid and its regulation we know is fundamental to controlling cell division. Ionic differences lead to potential differences in the body between cells and between one organ and another. Currents of the order of microamperes flow across the edge of wounds, and limb regeneration, even finger tip regeneration in children, has been reported to be connected to these currents.

The new concept of energy conversion in tissue over biologically closed electric circuits (BCEC) described in this book offers a unified theory even for such diverse phenomena as acupuncture and the effect of electromagnetic fields on man and increases our understanding of the mechanism of tumour growth.

The test of a good theory is if it indicates further experiments. The treatment of lung tumours by direct current was such an experiment which has produced positive results in those patients treated so far. This encouraging application alone justifies the concept of BCEC and should encourage us to seek further applications of this theory.

I once heard a Professor say that writing a book was like giving birth to a baby. This book took my friend many hours of toil, not only in its conception but in meticulous measurement and experimentation. The time, in my opinion, is ripe for a new look at the importance of electricity in biology and therefore I am sure that this is a book not "born prematurely".

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Progress in Natural Science, including Medicine, depends on the interaction between ideas and techniques. In this book both aspects are amply represented. I may venture that the superb X-ray technique of Nordenström revealed to him new structures around tumours in the lung and the breast which he calls the corona structures. In the search for their origin he made use of various techniques, which led to, e.g., a mapping of the electric potential distribution across tumours and normal tissues in vivo and in tissue models. This started a new train of ideas.

All the evidence pointed to the existence of local electric current flow on a macroscopic scale in living tissue. His overall conclusion is that the blood vessels, not excluding even the large ones, are current carrying cables which, in combination with other conducting tissue media as, e.g., interstitial tissue fluid, allow closed electric circuits to operate over large distances (Nordenström's nomenclature: BCEC, Biologically Closed Electric Circuits). One specific circuit particularly considered in this book is called VICC (Vascular-Interstitial Closed Circuit). The activation of such a circuit must lead to various physiological effects and possibly structural modifications.

Nordenström's new views may appear startling to most physiologists, who are familiar with the old ideas of local nerve circuits, injury potentials, electrotonus, etc., which appear in the traditional textbooks. An important distinction, however, is the question of dimensions and location. While the nerve events take place in domains with the magnitude of millimetres, Nordenström's BCEC represent electrogenic systems for long range selective transports of material and distant functional effects in the entire body beyond centimetric even to the metric range, i.e., between organs.

I will now comment particularly on two physiologic aspects related to Nordenström's concept of BCEC:

1. The electric current as a driving force for water movement, i.e., electroosmosis,
2. The energetics of the current flow.

For more than a century electric potentials and currents have been discussed as driving forces for ions in the body fluids, mostly relating to nerve and muscles. The fact that theoretically, electrical forces are involved in the transport of the universal solvent, water, has by and large been neglected. The enormous
Many important discoveries have been made through further investigations of seemingly trivial features that may well have been generally observed, but neglected. Pulmonary radiography has undoubtedly been one of the most widely performed radiographic examinations over the years. When Björn Nordenström’s curiosity led him to look into the mechanism behind the corona that can be radiographically demonstrated around pulmonary lesions, he encountered a hitherto unknown biological system.

The further evidence the author presents in favour of his concept of Biologically Closed Electric Circuits