ACUPUNCTURE & ELECTRO-THERAPEUTICS RES., INT. J., Vol. 12, pp. 75-79, 1987

0360-1293/87 $3.00 + .00

ELECTROMAGNETISM AND THE REVOLUTION IN MEDICINE

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Around the turn of the century biology settled into its "final paradigm", all functions of living things, from the production of energy to the processing of information in the nervous system, could be reduced to chemical reactions. The great surge of scientific understanding that began in 1600 and culminated in the final years of the 1800's effectively excluded from biology and medicine such vitalistic concepts as "life force" as well as any effects of electricity or magnetic fields except for shock or heat. While this emphasis on scientific verification has led to obvious advances in the practice of medicine and in the understanding of life, over the past few decades it has become evident that this paradigm was not without defects. In the area of basic biology we seemed no closer to understanding the nature of life or even such "simple" processes as the mechanisms that controlled growth processes. In clinical medicine our treatments became ever more complex and expensive and while we had to a large extent solved the problem of infectious diseases, they were replaced by other conditions inherent in the living organism over which we had little effective control.

As these concepts gained credance, some biomedical scientists began a re- evaluation of the earlier, now discarded, paradigm which centered about such vitalistic concepts as "life force" and "the whole is greater than the sum of its parts". The re-evaluation was scientifically justified on the basis that the original reasons for discarding these concepts were based upon inadequate understanding of the physical sciences. In 1900, for example, semiconduction was an obscure oddity. By 1960 it had

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This paper was presented during the 2nd International Symposium on Acupuncture & Electro-Therapeutics, held at the School of International Affairs, Columbia University, during October 16-19, 1986.

grown to the most important advance in the understanding of electricity in the past few centuries. While the original scientific evidence for the exclusion of electromagnetism from biology seemed amply justifiable at the time, it was based upon such fragmentary understanding that its foundation was questionable. The basic question that was re-opened was, " Could the concepts of life force and the like be equated to hitherto undiscovered actions of electromagnetic forces within and upon the organism?".

The primary driving force behind this re-evaluation came from the Nobel Laureate, Albert Szent-Gyorgii whose perceptive and prophetic Koranyi Lecture delivered in Budapest in 1940 suggested the application of the new principles of physics to the defects in the chemical paradigm. He was followed by many others who demonstrated over and over that living organisms exhibited phenomena that could only be explained by exquisite sensitivity of living organisms to the subtle force of electromagnetism. Change comes slower in the biomedical sciences than in the physical sciences and it has taken the better part of the last two decades for these new ideas to gain a foothold. However, once such a change begins, it grows at an exponential rate, slowly at first then with ever increasing speed. We are now at the point in this curve where the growth of both knowledge and acceptance of this new paradigm is becoming explosive. This development will bring about a revolution not only in biological concepts but in medical practice.

It has been my privilege to play a small part in this process. What follows is a brief review of where we are at the present time, how we got there and my predictions for the future.

Starting in the 1940's Dr. Harold Burr produced an enormous

amount of evidence indicating that minute electrical forces played a role *within* the living organism, and Dr. Frank Brown demonstrated many times that the *external* magnetic field of the Earth influenced biological cyclic patterns of behavior. Later, Dr. William Keeton showed that this field also provided a compass sense to migratory animals. While these observations were accurate and credible, they simply were not accepted. According to the chemical paradigm the intrinsic strength in such fields simply was insufficient to influence chemical reactions or to produce a force upon the molecules of living material greater than the thermal agitation normally present. My own contributions, beginning in 1960, rested upon the observations of these predecessors. I was able however, to use instrumentation of far greater sensitivity than that available to Burr, for example, and not only confirm but extend his observations. There no longer was any question that minute electrical phenomena, best understood on a semiconduction basis, accompanied,and more importantly,appeared to direct growth processes. By 1963 I was able to produce the first firm evidence for effects of external magnetic fields on the function of the central nervous system, and by the mid 1970's I was able to propose that the central nervous system was composed of two distinct but related systems. One, the more primitive, operating in a semiconducting fashion and utilizing actual electrical currents for the transmission of information, was related to the ancient acupuncture system. The other, the more evolutionarily recent, operated in the accepted fashion as a digital data transmission system that dealt mainly with such sophisticated processes as the special senses and motor integration.

Science has always seemed to feel that its own products and machines were somehow superior to living systems. This has meant that living things could never have properties greater

than the most advanced machine or instrument available to science at the time. Hence, true advancement in science has always depended upon advancement in technology, and this has been true in this present revolution as well. One device, the superconducting, quantum interference detecting magnetometer has proven to be the key to final acceptance. This device, commonly called the SQUID has proven the existence of true electrical current flowing in the central nervous system by virtue of its detecting the magnetic field so produced. This field, now called the magnetoencephalogram, is detectable in space surrounding the head and demonstrates many of the complexities of the well known electroencephalogram. The SQUID also has enable scientists of various types to detect and identify deposits of magnetic material, composed of the mineral magnetite, within all living organisms thus far examined. This mineral is present in the form of unit cell crystals, linked together in a specific fashion and always associated with abundant neural connections. Most recently, this material, now termed, the *magnetic organ*, has been shown capable of detecting the strength, polarity and direction of the Earth's magnetic field with great precision. Its presence in such life forms as bacteria and the human indicates its importance. At this time it is considered to be the organ responsible for migratory and homing behavior, however, our knowledge of this organ is still in its infancy and in all probability it will be found to have additional functions. More recently, an even more significant discovery has been made. The pineal gland, formerly thought to be a relatively insignificant remnant of the third eye has been found to be the true "master gland" of the body. It regulates, via the production of many neurochemical agents, the function of the pituitary, thyroid and adrenal glands, as well as via its production of melatonin, the level of activity of the entire central nervous system. In this latter fashion, it is the prime mover for the phenomena of

biological cycles. While the pineal does have connections to the retina and is influenced by the daily light-dark cycle in sunlight, it has been found to be exquisitely sensitive to the Earth's magnetic field which also demonstrates a similar cycle in strength. Therefore, the integration of all body activities in a cyclical fashion is regulated basically by the cycles of change in the Earth's magnetic field. It is now evident that the small strength magnetic field of the Earth is a non trivial factor in our environment and a physical force from which we derive information of great importance to the functioning of our bodies.

This re-introduction of subtle physical forces into biology as sources of information has great significance for clinical medicine. Organisms *must* be related to their environment if they are to succeed evolutionarily. Information flows from the environment that ensures that the functions of living organisms are in harmony with that environment. It is apparent that our prior concepts of this information flow were superficial and simplistic. We are just beginning to understand the subtleties this relationship between the biota and the Earth's geomagnetic field, as we are also just beginning to understand the electrical and magnetic forces that are intrinsic to the body itself, that act upon the information thus provided. It is my belief that electromagnetic fields of a variety of types will be increasingly employed by medical science to effect processes within the body that are presently beyo nd our control by chemical means. In addition, this new paradigm strongly suggests that therapies previously discarded as ineffective and unscientific, must be re-evaluated in its light.