THE MACHINE BRAIN AND PROPERTIES OF THE MIND

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ABSTRACT

It is the author's contention that modern neurophysiology is based upon the operations of less than half of the brain and that the anatomical and functional existence of more than half of the cells constituting the nervous system are ignored. The author argues that the neurone doctrine, which holds that all functions of the nervous system are the result of operations of the neurons alone, is incomplete, and that a more basic and primitive information transfer system resides in these neglected cells. Theoretical considerations, prior electrophysiological evidences which were ignored, modern aspects of electrophysiology and evidence derived from the new science of bioelectromagnetics will be presented to support the theory of a "dual nervous system." This theory re-introduces some of the ancient ideas of mind functions into present day consideration of the possible operations of the mind/brain system.

Keywords: **Mind, brain, electrophysiology, bioelectromagnetics, neuronal, glial**

INTRODUCTION

If a way were devised to dissolve all of the nerves in the brain and throughout the body, it would appear to the naked eye that nothing was missing. The brain and spinal cord and all of the peripheral nerves would appear intact down to their smallest terminations. This is because the central nervous system (CNS) is composed of two separate types of cells; the nerve cells, or "neurons", and the "perineural cells." There are far more perineural cells in the CNS than there are neurones. The brain is totally pervaded by glial cells of various types and every peripheral nerve is completely encased in Schwann cells from its exit from the brain or spinal cord down to its finest termination. Every nerve cell body and its projections of axons or dendrites is covered with perineural cells of one type or another. Despite their ubiquitous presence these cells have been dismissed as "supportive" or "nutritive" (the general term "neuroglia" means "nerve glue"). It is my thesis that collectively the perineural cells constitute an information transmission system, more primitive in nature but capable of exerting a controlling influence on the basic

EDITOR'S NOTE

With this article we are starting a new section of the journal — Perspectives. The energetic and informational interactions we study are not well understood. We can not at this time, for instance, objectively quantify much concerning the mechanisms responsible for the phenomena we observe. As a result there is uncertainty in the minds of many as to even which line of inquiry to pursue. In contrast to the formal refereed papers in the Clinical, Theoretical, or Experimental Sections, Perspectives are designed to point towards directions worth pursuing, even when there may not be enough research to fully justify or explain the insights presented. Perspectives are invitational, will appear irregularly, are not refereed, and represent the unmodified and singular view of authors selected from our community for the quality and originality of past work. Publication of each Perspective is in two parts. Part One proposes a basic model, or insight. Documentation through citations, or original research, is not essential. Part Two references the works the authors feel support their theses. During the months that separate the publication of these two parts readers will have time for thought and are encouraged to directly correspond or talk with the authors, in the process providing additional support for the Perspective, or raising objections and providing the authors with research supporting the correspondent's contentions. Authors are asked to incorporate the fruits of these exchanges in their Part Two publication. Perspective is, itself, an experiment. If successful it will provide a forum for the synthesis of intellect and intuition which lies at the core of creative breakthroughs. SAS

functions of the neurons. As such, the two systems, the perineural and the neural, function as a unit — a dual nervous system, (DNS) with properties and capabilities greater that those of each part. Further, I propose that the operating system of the perineural cells is such that its sensory inputs fall outside of the five recognized senses and into the area of "subtle energies." The capabilities of the DNS are therefore greater than those of the CNS and include functions prohibited by the operating system of the neurones.

I propose to develop this thesis by first briefly reviewing the historical development of the concepts of mind and brain to show how the presently restrictive "neuron doctrine" became dominant. Next I shall review the theoretical reasons why there is a real requirement for a more basic operating system in the brain. This will be followed by a brief presentation of the modern electrophysiological and functional data that support the thesis of the DNS.

HISTORICAL

From the beginnings of human civilization, we have been intent on explaining the workings of our mind. We are aware of our existence, are capable of emotions, thought, creativity and remembrance, we receive information from our environment and are able to move and manipulate our environment. The very possession of a mind led us to question our beginnings and our place in Nature. Initially, these questions were answered by the various primitive religions and the concept a "vital spirit" or "soul", with powers and capabilities beyond those of the body, became widespread but integrated with the concept of the mind as something that set us apart from the non-living, the properties of the spirit. This simultaneously made us a part of the rest of the natural world and gave us access to a portion of the natural world undetected by our senses - the other reality.

With the beginnings of science in ancient Greece the mind began to be associated with the body. While Aristotle, the founder of logical, objective analysis, believed the the soul and mind resided in the heart, Erisistratos and Herophilus, his contemporaries, correctly identified the brain and nerves as associated with sensation and movement but made little mention of the other capabilities of the mind.[1] To Plato, mind and soul were the same and the other reality actually existed as his "forms."

Two thousand years later, as scientific knowledge was increasing, Descarte proposed a bipartite system consisting of the brain and body which functioned as a sensory - motor machine with the "soul," separately located in the pineal gland and given the responsibility of controlling the machine.[2] In addition to acting as the central control, Descarte assigned to the pineal the additional capacity for consciousness, thought and emotion. In his view, animals lacked a "soul" and while they possessed a brain and pineal gland, they were simply machines.

One hundred years later, Galvani introduced electricity into biology[3] and in 1849 du Bois-Reymond identified the method of information transmission in the nerves, the "nerve impulse" as being electrical in nature.[4] He believed it represented the flow of actual "electrical particles" along the nerve fiber, however, one year later, von Helmholtz measured the speed of transmission of the nerve impulse and proved it to be many times slower than that of the passage of an electrical current along a wire.[5] Therefore, while one could detect and measure the nerve signal electrically, it could not be the actual flow of electricity along the nerve.

In 1868, Bernstein solved this conundrum with his famous hypothesis of the polarization of the nerve membrane.[6] He proposed that an electrical potential existed across the nerve membrane with the outside being electrically positive and the inside being negatively charged. Bernstein postulated that this polarization was the result of an active process in the membrane that separated ions of different polarity. The nerve impulse was simply the breakdown, or depolarization, of this potential in a small area of the nerve fiber which then propagated itself along the fiber by the continuous movement of charged ions. Final proof of Bernstein's hypothesis came only in 1939 when Hodgkin and Huxley actually measured the membrane polarization using microelectrodes inserted into the giant axon of the squid.[7] Today, the controls for sensory and motor function are well understood within this paradigm. Throughout this development, little attention was directed towards the perineural cells. Despite their ubiquitous nature, and the fact that embryologically their origin was identical to that of the neurons proper, they were still considered to be the equivalent of styrofoam packing material.

Neuronal electrophysiology was so successful that, by now the view that this is all there is to the CNS has become dominant and known as the "neuron doctrine," which holds that all mental, sensory and motor activity are the province of the nerve cells alone. Anatomically, the architecture of the brain consists of uncounted num-

bers of neurones organized into relatively specific structures or areas each subserving a specific function with massive interconnection within and between structures. The nerve impulse sets very restrictive limits on the possible functions of the brain and, by implication, rules out any property inexplicable by its mechanism. The neuron doctrine envisions the brain to be akin to a massively interconnected, parallel processing digital computer. This has led to the fashionable idea of "artificial intelligence", the probability that man will ultimately build an inorganic based computer of this type which will mimic all functions of the human mind and bring into question the uniqueness of life. Today we have arrived at a "machine brain" that totally excludes the spirit properties.

There are a number of difficulties with this point of view. First of all, it is based upon the electrophysiology of the sensory and motor systems alone. The electrophysiology of cogitation, creativity and emotion are assumed to be similar but in actuality they still elude us. Secondly, it permits of no other operational system within the brain and it requires that all functions related to the brain must be generated or performed by nerve action potentials or their derivatives. For example, the brain functions encompassed by parapsychology are declared non - existent because they cannot be explained by this paradigm.

It is my belief that this paradigm is inadequately based and overly restrictive, it ignores certain aspects of neurophysiology and neuroanatomy that "do not fit" and which indicate that both the structure and functions of the brain and nervous system are much more complex than envisioned. Further, in a more general fashion, it provides a major problem for theoretical biology which has not been adequately addressed. The neglected aspects of neuroanatomy and neurophysiology will be briefly described and discussed at length in subsequent papers. The remainder of this paper will deal with the theoretical problems posed by this restrictive paradigm governing biological information transfer and integration.

THE THEORETICAL PROBLEM

The nerve action potential is a highly complex, sophisticated mechanism transmitting information via a digital system (the "all or none" concept) based upon a traveling wave of breakdown in polarization of the nerve membrane. Even without consideration of the immediate requirement for a network, or "circuit diagram" for

such an information system to work, it would appear highly unlikely that this was a system present in the earliest living organisms. Nevertheless, in order to have been successful (as they obviously were or we would not be here), these organisms must have had some sort of information transfer system in order to perform a few basic controlled functions within their structure and they must have related to their environment in some fashion.

Obviously, any attempt to describe the form and function of the earliest living organisms is simply an exercise in imagination. Nevertheless, since Darwin there have been many such attempts. All have been colored by the fashion of science at the time. At present, with the current emphasis on genetic manipulation, the favored scenario is "First there was DNA," (or RNA if you prefer). Both DNA and RNA are very complex methods of coding information and subject to the same critique as the action potential. I would rather propose to strip life down to its essentials in a single living organism. All presently living organisms have two basic functions without which life, apparently, would be impossible.The first is the ability of self repair - to heal injuries. The second is the possession of a cyclic alternation of rest and activity, tied to the geophysical cycles resulting from the Earth's rotation. Both of these functions can be accomplished by a quasicrystalline, semiconducting matrix with the transmission of information by a simple analog system of direct electrical currents (DC). One requirement is a sensitivity of the matrix, or portions thereof, to the Earth's magnetic field. As will be discussed at length in a latter portion of this paper, present scientific evidence indicates that many living organisms contain organized microcrystalline deposits of magnetite mineral in close association with the nervous system. These appear to be responsible for the sensitivity to the Earth's natural magnetic field which is now known to be possessed by most organisms. If the earliest living organisms were constructed of a semiconducting matrix built about a microcrystalline deposit of magnititie, the functions of such a structure could have provided the basis for the more complex information transfer system of latter organisms.

In the world of the earliest organisms, magnetic fields played the dominant sensory role. It is feasible to postulate that the ability to detect the Earth's field and derive timing information from it evolved into a means for the detection of other organism and (to stretch the analogy to its limits) inter-organism communication via the magnetic field generated by each individual. Surprisingly, some evidence exists for the retention of this ability in modern organisms including humans. With evolutionary

development and particularly the acquisition of multi-cellularity, one can conceptualize the sequestering of the analog system into specialized cells, the precursors of the present perineural cells. These would continue to convey DC information via tight junctions or an actual syncytial network.

However, for further evolutionary progress additional abilities were required including effective motor function and greater use of sensory cues furnished by the environment. This required expanding the information transfer abilities beyond that of the simple analog system. In what may be too great a conceptual leap for some, I would propose that the analog system gave rise to another cell type — the primitive neuron capable of digital information transfer. However, the analog system utilized this cell type as a "tool" for the sensing of such high information content sources as light reflected from the environment. It is necessary for the theory to hold that the functioning of the digital cells be controlled and integrated by the more primitive analog system.

The concept of the earliest information system functioning on an analog basis is supported, to a modest extent, by the historical development of computer technology in which analog computers antedated digital. The analog system offers a number of advantages and disadvantages when compared with the digital. The analog system is incapable of transmitting large amounts of data at high speed, the hallmark of the digital systems. However, when the requirements are for the precise control of single functions, analog systems perform exceedingly well and are electronically simple requiring few components.

The present concepts of the functional anatomy of the brain tend to follow the vogue of reductionism - breaking down a complex system into discrete functional parts. The problem with this is that the brain, par excellence, functions as an integrated whole. It is presently assumed that integration is accomplished by massive neuronal interconnectedness, this however, poses a number of problems when such functions as consciousness are considered. Consciousness appears to be "de-localized", a function of the total brain rather than a single area of "consciousness." It would appear likely that some, as yet undisclosed, system is functioning to relate all brain functions together in the fashion that we actually experience. The modern theory of Gestalt psychology, while based initially on visual perception, postulated the existence of brain "fields", large areas of integration not necessarily related to a single functional sensory area. The Gestalt theorists postulated some

overall integrating system but lacked the neurophysiological evidence for its existence. The presence of an underlying, more primitive, analog system provides a physiological basis for such integration throughout the entire brain. Some recent evidence indicates that, extra-neuronal, extra low frequency waves are present during sensory integration in various portions of the brain. The relationship of these observations to the dual system theory will also be discussed in a later section.

Good electrophysiological evidence for the existence of a dual system was obtained between the 1920's and 1940's but was ignored in favor of the more attractive and exciting neuronal electrophysiology. Presently expanding knowledge in such areas as electrophysiology and bioelectromagnetics have since lent major support to the basic thesis. These evidences will be discussed in detail in later papers.

In short, if we perform the "gedanken experiment" of postulating the information transfer system of the earliest living organisms we arrive at a tenable conclusion that excludes the neuron doctrine but still permits organismal function and integrity at the most basic level. In outline, this system was analog in nature, transmitting information via DC currents within a semiconducting matrix. An integral, and essential, element was the presence of magnetite mineral providing a "magnetic sense" which related the organism to the cyclical variations in the Earth's geomagnetic field for the detection of a timing signal. With evolutionary development and the acquisition of multi-cellularity the system became concentrated in a specific cell system which was the precursor of the present perineural cell system. Organisms at this level would have been capable of limited inter-organism communication via further development of the magnetic sense. It cannot be said if what we call consciousness was acquired initially or during this phase of the informational system development. The limitations of this life form were surmounted by the development of cells capable of digital information transfer, the precursors of modern neurons. Such cells, however, functioned to provide the basic analog system with greater informational capacity and as such they were basically tools controlled by the underlying system.

This theory hold that the present day information system, complex as it is, is basically a dual system, with the original analog system still present and operating to provide the "wholeness" that characterizes the human brain. This view expands the capabilities of the human mind far beyond the confines of the digital "machine brain"

to include such functions as magnetic field sensing and expands the physiological base for such properties as consciousness and our concepts of reality. At any rate, it would appear desirable that, before we rush to build the "brain computer" (at not inconsiderable expense) we re-evaluate both the old and new evidences for "something more" operating within our brain. Possibly we can re-introduce a more scientific version of the ancient "properties of the spirit" and probably find more mysteries as well.

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