



pulses feeding into an area...The digital system works extremely fast, and it can transmit large amounts of information as digital 'bits' of data."

"[T]he first living organisms...must have had a much simpler mechanism for transmitting information. The first living organism did not have sensory organs, and it wasn't much concerned with thinking great thoughts. What it needed was a way to know when it was injured and the means to efficiently repair itself, along with the ability to relate to the important aspects of its environment and other living organisms...Since there was no requirement for quick action or for the transmission of large amounts of sophisticated information, it could make do with a much simpler system of *analog* data transmission and control."

"Before digital computers, there were analog computers. These operated in exactly the way I believe the first living organisms did. The analog computer works by means of simple DC currents, with the information coded by the strength of the current, its direction of flow, and slow, wavelike variations in its strength. While this system is slow and is incapable of transmitting large amounts of data, it is extremely precise and works well for what it is designed to do."

"If the first living organisms used an analog type of data-transmission system and if such a system is still used for injury repair [this is the major area of research interest of Becker as an orthopedic surgeon], then the entire analog system must be present...as part of our entire data-transmission and control system. The brain may thus operate as a hybrid computer, with a very important analog part that operates by means of DC electrical currents. This concept provides us with an entirely new way to look at the old brain/mind/body conundrum." (Becker, 1990a, p. 59)

"[W]e...conclude that a more primitive, analog data-transmission and control system still exists in the body, located in the perineural cells and transmitting information by means of the flow of a semiconducting DC electric current [see figure 10.1]. This system appears to have been the original data-transmission and control system present in the earliest living organisms. It senses injury and controls repair, and it may serve as the morphogenetic field itself. It controls the activity of body cells by producing specific DC electrical environments in their vicinity. It also appears to be the primary system in the brain, controlling the actions of the neurons in their generation and receipt of nerve impulses. In this fashion it regulates our level of consciousness and appears to be related to decision-making processes." (Becker, 1990a, p. 65)

## 14.1. COMPARISON OF THE ANALOG AND DIGITAL NERVOUS SYSTEMS

Figure 14.1 The comparison of the "dual" nervous systems is given below:

DIGITAL NERVOUS SYSTEM (DNS)	ANALOG NERVOUS SYSTEM (ANS)
"Central Nervous System" CNS "Peripheral Nervous System" PNS (Sensory/Motor and Autonomic)	"Perineural Nervous System" "Parallel Nervous System"
The current popular orthodox model	Becker's and others' additional system
Uses neurons as the basic structural element: Sensory, Motor and Inter-Neurons	Uses perineural cells as the basic structural elements: Glial and Ependymal cells (and possibly cerebral spinal fluid) in the CNS, and Schwann cells in the PNS
Digital encoding: nerve impulses	Analog encoding: nervous system and EM fields; sensitive to very small EM current levels
Electro-chemical/Mechanical ionic current (AC: ion interchange process). Uses EEG ElectroEncephloGram measures	Electro-magnetic/Information semi-conduction current (DC and semi-conductive process). Uses MEG: MagnetoEncephloGram measures (i.e. the SQUID: Superconducting Quantum Interferometric Device)
More recent development in evolution for more detailed, precise and swift information processing such as perception, thinking, language and other so called higher mental processes. Through language and imagery (e.g. hypnotism and visualization etc.) it can direct the Analog Nervous System to do various tasks such as healing, health enhancement, recall "unconscious" memories.	The first, more basic and 'primitive' negative feedback control system for healing and holistic, integrative, and "un-conscious" information processing; responsive to environmental rhythms and EM fields and generates and controls the biological rhythms necessary for life; provides the background and support for the Digital Nervous System so that it functions in a integrated and coordinated fashion; "preps" the DNS for performance.

"Direct evidence for the perineural DC system has been accumulating gradually for several decades. Electric currents were detected in the glial cells of rat brains as long ago as 1958, and good (though long-ignored) measurements of direct currents in the frog's brain go back to....the early 1940's." (Becker and Selden, 1985, p. 239) In support of the analog semi-conductive model, Becker says that "[e]lectron microscope work has shown that the cytoplasm of all Schwann cells is linked together through holes in the adjacent membranes, forming a syncytium that could provide the uninterrupted pathway needed by the current. The other perineural cells--the epedyma and glia-- are probably connected in the same way, for syncytial links have recently been found...Recent use of selective radiation to isolate Schwann cells has shown that they, and not the neuron fibers, supply the nerve stimulus essential to regeneration." (Becker and Selden, 1985, p. 239) (see Figures 14.2&14.3)

"All the perineural cells are related and arise, embryologically, from the same basic cell line (the ectoderm) as the nerve cells and skin cells. Anatomically, the perineural cells appear to be a system of their own...[T]he perineural cells can generate electrical potentials and pass them along from one to another...[T]he perineural-cell system, extending throughout the whole body exactly as the nerves do, functions as a primitive communication system." (Becker, 1990a, p. 63) In the research on bone healing, Becker's specialty, he found that "[t]he perineural cells -- in this case, the Schwann cells -- carry the electrical signals that cause fractures to heal. The nerve has nothing to do with it." (Becker, 1990a, p 64)

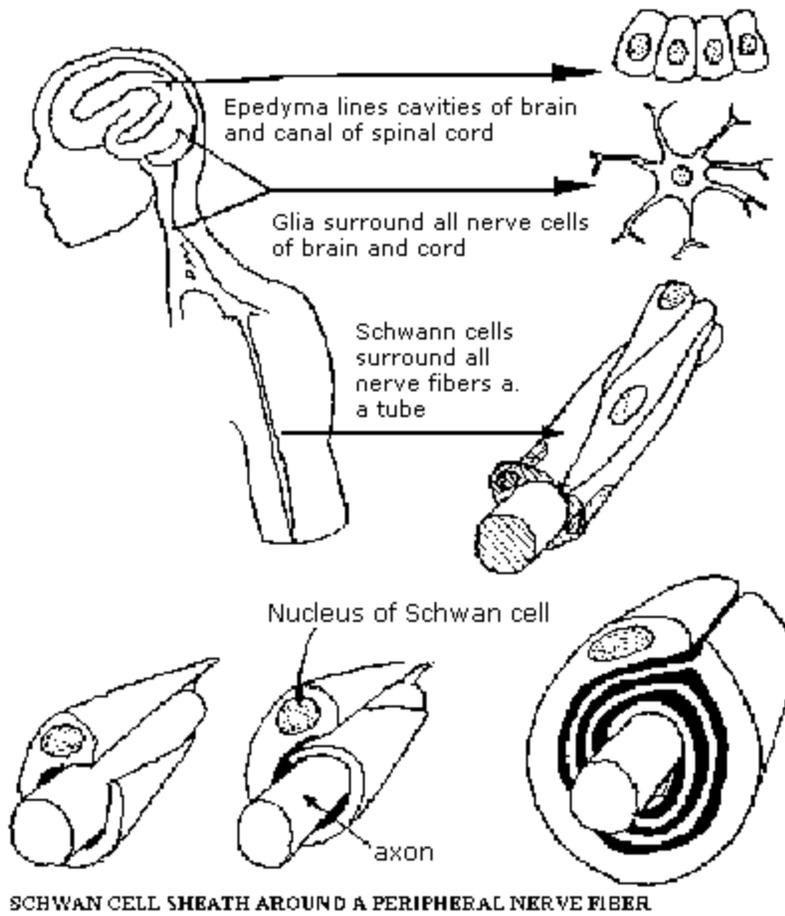
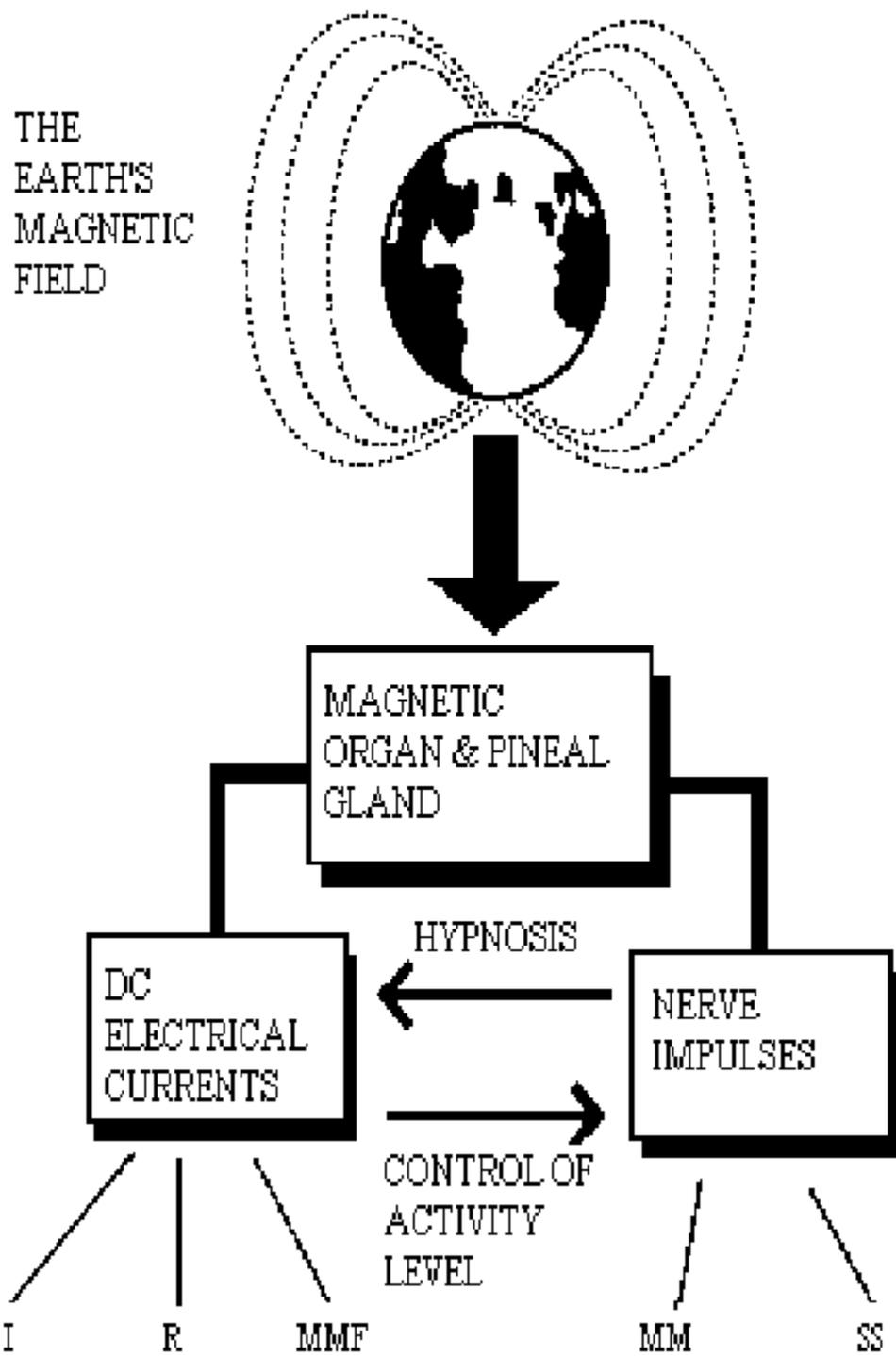


Figure 14.2 from Becker and Selden, 1982, p. 205, Anatomy of the Perineural System



I= Injury R= Repair MMF= MEG Magnetic Field MM= Muscle Movement SS= Special Senses: Vision, Hearing, Touch, Etc.

Figure 14.3 from Becker, 1990, p. 80. Schematic outline of the dual nervous system's relation to the environment

## 14.2. EXTERNAL ELECTRO MAGNETIC FIELDS

"Any electric current automatically generates a magnetic field around itself. Hence, as perineural current conveys information in its fluctuations, it must be reflected by a magnetic field around the body, whose pulsing would reveal the same information..."

"[I]n 1971 Dr. David Cohen of MIT's Francis Bitter National Magnet Laboratory...first used the SQUID [Superconducting Quantum Interferometric Device] to measure the human head's magnetic field. Two kinds of magnetic fields have been found. Quickly reversing AC fields are produced by the back-and-forth ion currents in nerve and muscle. They're strongest in the heart, since its cells contract in synchrony. The SQUID has also confirmed the existence of the direct-current perineural system, which, especially in the brain, produces steady DC magnetic fields one billionth the strength of earth's field of about one-half gauss..."

"[T]he magnetoencephlogram (MEG) -- a recording of changes in the brain's field analogous to the EEG -- is often a more accurate reflection of mental activity than the EEG. Because the magnetic field passes right through the dura, skull bones, and scalp without being diffused, and MEG locates the current course more accurately than EEG measurements..."

"...[T]he MEG research so far seems to be establishing that every electrical evoked potential is accompanied by a magnetic evoked potential. This would mean that the evoked potentials and the EEG of which they're a part reflect true electrical activity, not some artifact of nerve impulses being discharged in unison, as was earlier theorized. Some of the MEG's components *could* come from such additive nerve impulses, but other aspects of it clearly indicated direct currents in the brain, particularly the central front-to-back flow. The MEG doesn't show the EEG's higher-frequency components, however, suggesting that some parts of the two arise from different sources." (Becker, 1985, pp. 239-241)

Some of the most dramatic examples of the external electromagnetic field is in research on "External Qi Gong" (or Chi Gong) and the development of the "Qi Gong Information Machine" and the "Infratonic Qi Gong Machine" (China Healthways Institute). "To explore the relationship between electromagnetism and the Chi Gong phenomenon, doctors at the Huazhong Normal University in Wuhan, China, used NMR [Nuclear Magnetic Resonance] in an attempt to determine whether Chi Gong Masters give off any electromagnetic radiation. They studied the effects of Chi Gong 'treatment' on the complex, bioactive, organic, phosphorus-containing chemical o-n-propyl-o-allylthiophosphoramidate ...chosen because it produced a well-characterized NMR spectrum in its normal state. However, if exposed to a low-strength electromagnetic field, the chemical would absorb the energy, and certain atomic 'bonds' in its structure would be altered. This change would result in a specific recordable change in the NMR spectrum. The extent of the change in the NMR spectrum indicated the amount and the site of structural change in the chemical molecule..."

"In the experiments, the chemical substance was enclosed in a sealed glass container, and Chi Gong masters were asked to 'treat' it, holding their hands a certain distance away from the container. The NMR spectrum was recorded before the treatment and found to be normal. Following the treatment, the NMR spectrum changed significantly; the extent of the alternation in the NMR spectrum could be increased by repeating the Chi Gong exposure...[see Figure 14.4, Figure 4-2 from Becker, 1990a, p. 113)]

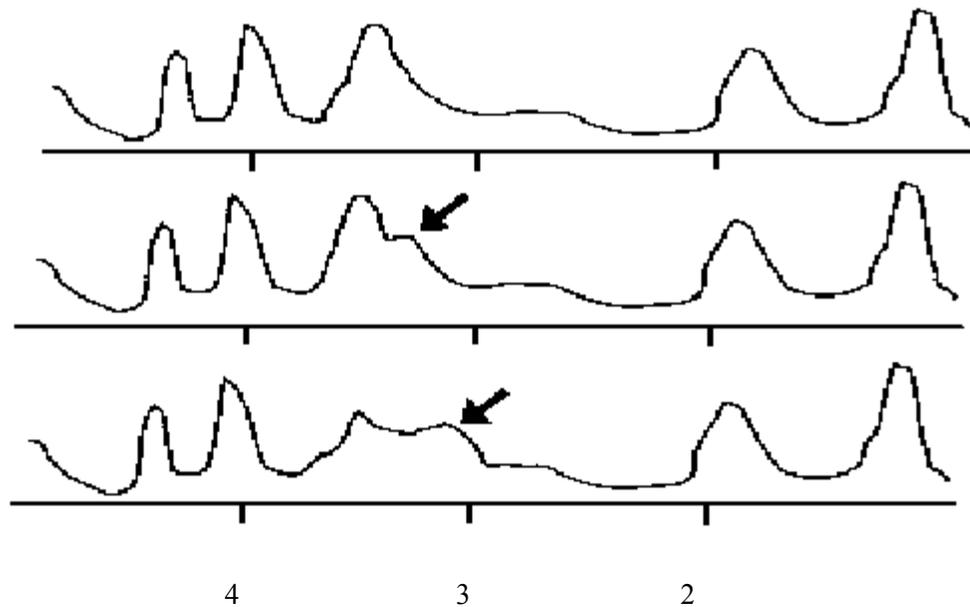


Figure 14.4 from Becker, 1990a, p. 113

NMR scans of the chemical. *Top*, natural-state NMR; *Middle*, after first Chi Gong treatment; *Bottom*, after second Chi Gong treatment. The resonance that had peaked at 2.5 before treatment broadened and showed a new peak (arrow) closer to 3 following the first treatment. The second treatment resulted in a decline in the original 2.5 peak, and the second peak increased in size and moved closer to 3. These NMR changes could be related to an increasing alternation in a specific part of the structure of the chemical molecule.

"The conclusion that may be reached from the Chinese studies is that the healer phenomenon has a basis in physical reality, and that some form of electromagnetic energy is unquestionably involved. The results indicate that the healer gives off electromagnetic energy from his hands during the treatment process." (Becker, 1990a, pp. 112-114) Both the "Qi Gong Information Machine" and the "Infratonic Qi Gong Machine" are based on this type of research. They measured the emissions from 20 Qi Gong masters, recorded them, took some type of average, transferred this to electronic circuitry on a "chip", put it into a machine which duplicates the emissions and you have your very own set of Qi Gong masters in a box!! (see Figure 14.5, a picture of the "Infratonic Qi Gong Machine"

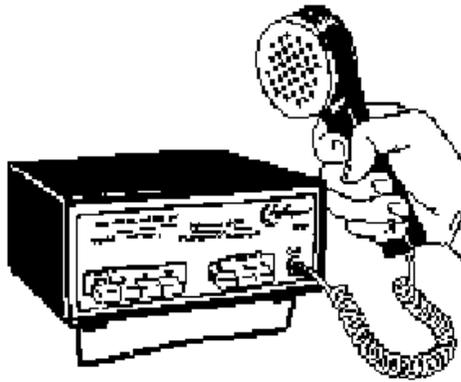


Figure 14.5 The Infratonic QGM (Qi Gong Machine) from China Healthways Institute, 115 N. El Camino Real, San Clemente, CA 92672. Email: <chi@exo.com>. Websites: <http://www.chinahealthways.com> and <http://www.soundvitality.com/>

### 14.3. INTERNAL ELECTRO MAGNETIC FIELDS

"Since every reaction and thought seem to produce an evoked potential, the DC system seems directly involved in every phase of mental activity. At the very least, the electric sheath acts as a bias control, a sort of background stabilizer that keeps the nerve impulses flowing in the proper direction and regulates their speed and frequency. But the analog structure probably plays a more active role in the life of the mind. Variations in the current from one place to another in the perineural system apparently form part of every decision, every interpretation, every command, every vacillation, every feeling, and every word of interior monologue, conscious or unconscious, that we conduct in our heads." (Becker and Selden, 1985, pp. 239-241)

"...[W]hen a human subject is told to make a certain muscular movement after being given a signal, there is an increase in negative DC after the signal, but... this occurs almost a half-second *before* the muscular action is performed. It appears that the DC is somehow involved in getting the neurons ready to fire the command to move the muscles. This...'readiness potential,' seems to imply that the DC system *commands* the nerve-impulse system...[I]t seems clear that the DC-potential system in the brain is activated prior to the nerve-impulse system, and that the latter may depend upon the former's being in a particular electronic state. The DC system thus appears to be, in fact, the place where the actual command decision is made." (Becker, 1990a, p. 65)

Becker has researched the phenomenon of the Hypnotic Trance related to DC brain fields with interesting results. This is part of the whole research on the relationship between these DC brain fields and states and levels of consciousness.

"We found that we could reliably determine whether a subject was truly hypnotized or was simply trying to please...In true hypnosis, the DC potential from the front to the back of the head (which is actually a measure of the brain's midline DC current) undergoes a drop in strength similar to the drop that occurs during very deep sleep. If the subject was only trying to please us, he or she was mentally active, and the DC potential went *up* in strength. We therefore concluded that hypnosis is real, that it has a measurable electrical correlate, and that it represents some change in the subject's level of consciousness." (Becker, 1990a, p. 90) (see Figure 14.6)

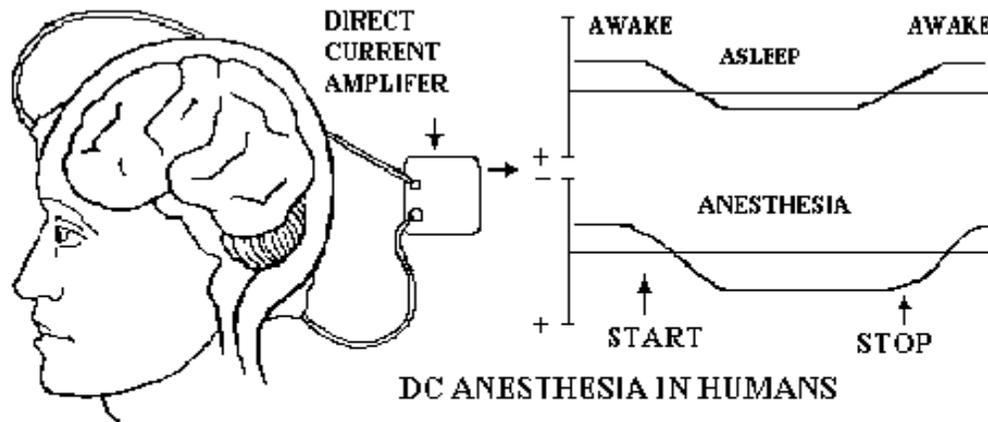


Figure 14.6. from Becker and Selden, 1985,. p. 116. DC Anesthesia In Humans

"We found the same DC system pattern in the human being as in the salamander...We found the same relationship between the level of consciousness and the strength of these DC currents. Sleep produced a modest drop, and deep general anesthesia resulted in a drop in the potentials to zero in the same sequence, starting with the brain." (Becker, 1990a, pp. 87-88) It is interesting that the techniques of Electro Sleep and Electro Anesthesia are not at all used in North America (unlike the more "backward" science of the old U.S.S.R. where this approach has been researched and applied). North American medicine prefers the role of drug pushers with all their potentially harmful "side effects" for sleep and anesthesia.

"One of the most interesting aspects of hypnosis is its ability to produce anesthesia...[G]eneral anesthesia in human patients is produced by a fall in the normal DC electrical current across the brain, which then seems to produce similar declines in the DC potentials in the remainder of the body. We had also shown that local anesthesia, produced by blocking the nerve to a single part of the body, results in a drop of the DC current to zero in that area alone. We concluded that the perception of pain is directly controlled by the status of the DC currents, either in the entire body or in any local area..."

"[I]f the local anesthesia produced by hypnosis is real, it should be accompanied by a similar drop in the DC current in the anesthetized area. [We found that t]he decline in the DC potentials along the [hypnotically] anesthetized...arm was exactly the same as that seen during standard chemical nerve block."

*"Under hypnosis, humans may be given verbal commands to the conscious digital-system portions of the brain, which can then effectively control the operations of the DC analog system. Since the primitive analog system controls growth and healing, it is possible that under certain circumstances, conscious thought can cause healing."* (Becker, 1990a pp. 90-91)

"These discoveries [of the intricate and multilayered self-regulating feedback arrangement of the perineural system] give us a testable physical basis for the placebo effect and the importance of the doctor-patient bond. They also may give us the key to understanding the 'miracle' cures of shamans, faith healers, and saints, as well as the spontaneous healing reported by means of visions, prayer, yoga, or battlefield terror...A combination of biofeedback, recording electrodes, and the SQUID magnetometer would seem to be the ideal setup for the next level of inquiry into the mind's healing powers."

"Moreover, since the analog system, like the impulse network, appears to work on both conscious and subconscious levels simultaneously, it's a likely missing link in several other poorly understood integrative functions that also cross from one realm to the other. It may lead us at last to fathom... memory and emotion. It may even help us understand what happens when a new synthesis of creative thought, a.k.a. inspiration, bursts forth like a mushroom from strands of mycelia that have been quietly gathering their subterranean forces. Then science for the first time will begin to comprehend the artistic essence that makes its rational side productive." (Becker and Selden, 1985, p. 242)

#### 14.4. THE NEGATIVE FEEDBACK CONTROL PROCESS

"This [mind/brain interface] part of the analog system's job is much less well understood, however, than its integrative function throughout the rest of the body. Perineural cells accompany every part of the nervous system. The perineural structures are thus just as well distributed to integrate bodily processes as the nerves themselves. They reach into each area of the body to create a normal electrical environment around each cell, or a stimulatory one when healing growth is needed. Likewise they enable an organism to sense the type and extent of damage anywhere in the body by transmitting the current of injury, with its by-product of pain, to the CNS..."

"Thus our bodies have an intricate and multilayered self-regulating feedback arrangement. We know, on the psychological level, that a person's emotions affect the efficiency of healing and the level of pain, and there's every reason to believe that emotions, on the physiological level, have their effect by modulating the current that directly controls pain and healing." (Becker and Selden, 1985, pp. 241-242)

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## 14.5. AN ANNEX ON MODERN THINKING AND RESEARCH ON GLIA CELLS

### 14.5.1. INTRODUCTORY COMMENTS

The following recent (2005) article comments on the neglected functions of glial cells. It's interesting that mainstream bio-science typically underestimates the sophistication of organisms (see the work of M-W. Ho, C.W. Smith, R.O. Becker, J.L. Oschman, K. Korotkov and R. Gerber for examples of bio-scientists who are researching this incredible sophistication.) The work of R.O. Becker described in sections 14.1-14.4. above has been, and still is, unacknowledged. The article reprinted below makes absolutely no mention or acknowledgement of Becker's pioneering work begun in the 1950s!! The fact that, after a gap of over 30 years, mainstream bio-science is "discovering" these various functions of the glial cells illustrates how the politics of science (scientism and the plague of the CSICOPian mentality) inhibits the progress of science.

### 14.5.2. "THE FORGOTTEN BRAIN EMERGES"

C. Krebs, K. Hüttmann and C. Steinhauser

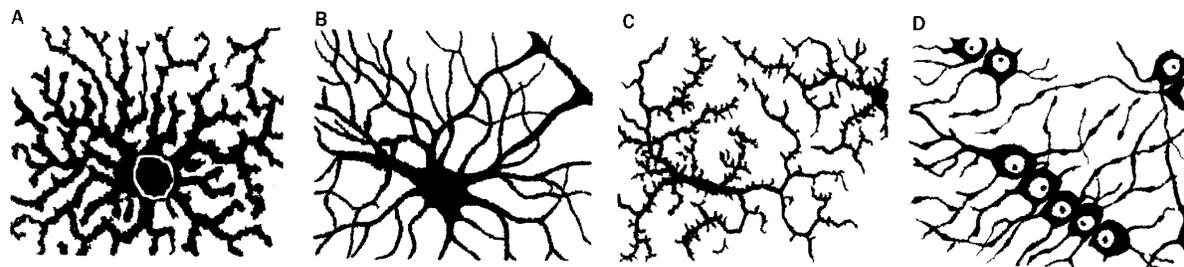
Krebs and Hüttmann are researchers in the experimental neurobiology department at the University of Bonn's Clinic for Neurosurgery. Steinhauser is professor of neurobiology at the university."Krebs, C., K. Hüttmann and C. Steinhauser (2004) "The forgotten brain emerges," Scientific American - Mind, v. 14, #5, pp. 40-43

"The brain consists mainly of neurons, right: Wrong. there are nine times as many glial cells in our gray matter as there are neurons. For 50 years, neuroscientists have maintained that glia merely provide support services to neurons: warding off pathogens, maintaining a healthy ion balance around the neurons and insulating them from electrical interference."

"But recent work indicates that glia are intimately involved in all aspects of our brain's information processing. Not only do glia talk with neurons, they communicate among themselves, aiding and abetting how our brains react, learn and remember. Understanding more about how glia function may greatly alter our model of how the brain and mind work."

#### 14.5.2.1. Always Talking

"Glial cells are of three different types. [see figure 14.7. below] Microglia [Figure 14.7. C] in the brain act like immune system cells elsewhere in the body by protecting neurons from intruders. Oligodendrocytes [Figure 14.7. D] form insulating myelin sheaths around the outstretched axons that carry a neuron's signals to neighbouring neurons. Astrocytes [Figure 14.7. A and B] surround neurons, especially at the synaptic gap where signalling molecules cross the tiny gulf between the end of one neuron's axon and the next neuron's dendrite. The latest research demonstrates that astrocytes -- the most numerous of all glia -- perform many different functions."



The basic classification of glial cells in the brain—protoplasmic astrocytes (a), fibrous astrocytes (b), microglial cells (c) and oligodendrocytes (d)—traces back

to Spanish anatomist Pío del Río Hortega. Hortega made these drawings in 1920 with the help of a microscope's camera lucida.

Figure 14.7. Basic classification of glial cells [from *Scientific American Mind*, 2005, January, v. 14, #5, p. 43]

“Among other supportive jobs, astrocytes supply neurons with nutrients from blood vessels, they absorb neurotransmitters when needed to help shut’ down the neurons that are sending them, and they ensure that ion concentrations remain constant in intracellular spaces in the brain. But it has become increasingly clear that astrocytes also listen in on the signals passing from neuron to neuron and communicate with those neurons. Astrocytes talk with one another, too, along networks that parallel neural networks, using the same neurotransmitters that neurons use. Clearly, glia affect how neurons communicate—in other words, how we think and how our brains perform.”

“And yet neurons and glia differ markedly in how they conduct information. Neurons send rapid electrical impulses, known as action potentials. Astrocytes use chemical messages, which are controlled by rising and falling concentrations of calcium ions. An increased concentration spreads throughout the cell like a human wave propagating through the stands at a baseball game—and often spills over to neighbouring astrocytes through channels between the cells. Although they are dissimilar, the two types of cells sometimes use the same types of messenger molecules. Recently our neurobiology group in Bonn, working with Andrea Volterra of the University of Lausanne in Switzerland, demonstrated that astrocytes, when activated by the chemical messenger glutamate, release the same neurotransmitters that neurons release, using a similar molecular mechanism.”

“By affecting how neurotransmitters carry signals across synaptic gaps among neurons and by releasing the same neurotransmitters to neurons and to one another, glia directly influence information transfer in the brain. Astrocytes affect the signalling between adjacent neurons along a chain and, using their own network, also affect how neurons are triggered in distant parts of the brain. Researchers now think astrocytes coordinate the activity of nerve cells in various brain regions at the same time, through the propagation of calcium ion waves.”

#### 14.5.2..2.Clues from Epilepsy

“One way to examine how glia communicate is to analyze what happens during epileptic seizures. This condition manifests itself as occasional sudden disturbances of consciousness or uncontrollable convulsions or spasms. In these episodes, neurons in one region of the brain fire suddenly and in complete synchrony. In some cases, only a few cells misfire. In others, the

discharge spreads to large areas of the cerebral cortex. The firing can be very intense. These electrical storms temporarily bring the affected brain region to a standstill. But how?"

"To look for an answer, we studied tissue from the hippocampus of epileptic patients. The hippocampus is heavily involved in the onset and spread of seizures, and in patients who have severe epilepsy it can be surgically removed as a treatment of last resort. By experimenting on thin sections of removed hippocampus, we were able to track ion streams flowing through the cell membranes of individual astrocytes and thus measure the activity of individual ion channels and neurotransmitter receptors."

In a non-epileptic brain there are normally two different types of astrocytes: gluT cells and gluR cells. But we have found that in one widespread form of temporal lobe epilepsy, called sclerosis of the hippocampus, gluT cells are completely lacking in the hippocampus. In healthy brains these astrocytes absorb glutamate released by neurons and thereby inhibit prolonged stimulation of the neurons. The gluT cells also have potassium channels in their cell membrane that can remove potassium ions from the intracellular space, again shutting down neurons so they do not run wild."

"It turns out that gluT astrocytes are connected together in long networks comprising hundreds of gap junctions—a particular type of regulated channel between cells. Functioning collectively as a large network, gluT cells can remove molecules and ions from many neurons simultaneously by shunting them to blood vessels where they are carried away, shutting down overactive transmission in a brain region. The loss of gluT cells in the hippocampus, however, prevents the rapid removal of messenger molecules and ions. Instead the substances collect around neurons, over stimulating them for too long and raising the probability of excessive firing."

"A further consequence of gluT cell loss is that the neurons become energy-depleted. In healthy tissue, astrocytes absorb glucose from the blood and transform it into lactic acid, which the neurons use to generate energy. A lack of gluT astrocytes in patients with sclerosis of the hippocampus appears to considerably impair the supply of nutrients to neurons in that region. So it may be that vast complexes of neurons over stimulate at the onset of a seizure, then stop en masse, exhausted."

"For their part, gluR astrocytes possess specialized receptors for a variety of messenger substances, including glutamate. The precise function of these cells is still largely unclear, however. Although they, like gluT astrocytes, have potassium channels in their membranes, they are not connected in a network and so cannot remove those ions. Patients with sclerosis of the hippocampus have gluR cells, but the density of the potassium channels in their cell membranes is significantly lower than in a healthy brain. In addition, the glutamate receptors in these cells operate more slowly. That fact may allow neurons to fire more easily, further increasing the risk of an epileptic seizure."

#### **14.5.2.3. A New Pathology**

"Although we must pin down more details, our work on seizures thus far indicates a clear correlation between unusual astrocytes density and electrical storms in the brain. What we still do not know is whether the deficiency or changes in glial cells actually cause this form of epilepsy or are a consequence of it. Either way, we can conclude that glia and neurons cooperate closely."

"Future research on pathological problems in the brain will have to consider not just neuronal

activity, as has been the practice to date, but glial activity, too. To actually pinpoint the mechanisms underlying certain brain diseases and conditions, researchers must develop a new understanding of how glia-particularly astrocytes-contribute to information processing. Only then can effective treatments be developed.”

#### **14.5.2.4. Further Reading**

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