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AN APPLICATION OF DIRECT CURRENT NEURAL SYSTEMS TO PSYCHIC PHENOMENA

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The concept of a primitive electronic communication system in all living things can be a useful tool in understanding both "normal" and "paranormal" phenomena that have lacked a rational biological explanation. Indeed, it appears that human beings are tied to the universe in a web of electromagnetic energy.

The present attitude of organized science towards psychic phenomena is that they do not exist because we know of no mechanism by which they can exist. The implication is that we know the mechanisms involved in all accepted biological phenomena. This is just not true; despite centuries of searching, we really know very little of the basic mechanisms in biology. For example, we do not know how we feel pain when injured, what makes us heal after the injury, what produces the biological cyclic patterns that all living things share, what guides migratory animals with such great precision, what is really involved in such altered states of consciousness as sleep, hypnosis and anesthesia, or where and how memory is stored and retrieved. These phenomena are accepted without question because of the universality with which they are experienced and psychic (or psi) phenomena are rejected because they are not commonly experienced. The lack of logic in this situation becomes even more apparent when one realizes that all of these phenomena, the acceptable and the non-acceptable, are related to some function of the nervous system and to varying degrees, all represent the mind-body problem. In essence, they all represent problems of control and communication within the individual, among individuals and between individuals and their physical environment. It would appear that any mechanism satisfactorily explaining any one of these functions could be applied as a frame of reference for all of the remaining functions. Such a mechanism almost surely must be a means of communication related to the nervous system, but operating in a fashion quite different from that which we presently ascribe to this system. Work begun in my laboratory some 20 years ago on the mechanisms involved in the healing of injuries has resulted in the discovery of such a system which seems to provide an adequate mechanism by which almost all psychic or paranormal phenomena can be explained.

LABORATORY DATA

When we started, the concept that all life processes must have a chemical basis was the prevailing one. Yet despite its successes in many areas, it had failed to provide adequate explanations for these basic phenomena and we decided to attack the problem by the application of two techniques new to biological research: cybernetics and solid state physics. The former deals with controlled processes from the theoretical system's point of view and the latter deals with electronic processes occurring in organized crystalline-like solids. This was not the random application of new techniques, but the result of looking at the problem of healing mechanisms without any preconceived notions of the mechanisms that should be involved. For example, the healing process reduced to its essentials, is a perfect example of a closed-loop negative feedback cybernetic system. The injury stimulates the remaining cells at the injured site into activity that results in the healing of the injury itself. As the healing progresses, the cellular activity diminishes and finally ceases when healing is complete. The schematic for the closed loop system expressing this is seen in Figure 1 in which the transducer is a mechanism that relates the extent of injury to the signal, which in turn stimulates the cells which produce the repair. As the

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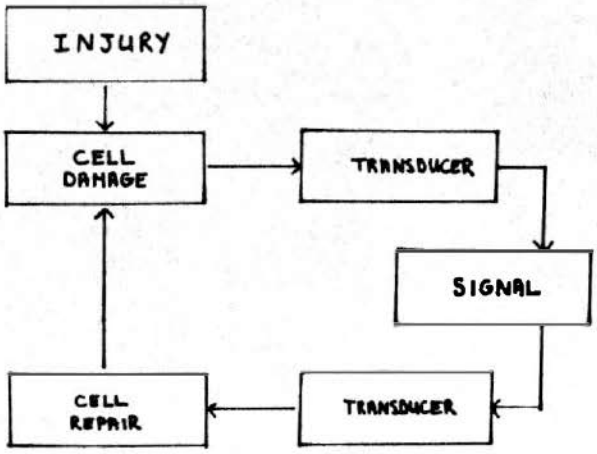


FIGURE 1.

repair proceeds, the extent of the injury is decreased, the signal decreases in proportion and the system comes to a halt when healing is complete (e.g., Becker, 1961, 1962, 1974; Becker, Bachman and Friedman, 1962; Becker, Reichmanis, Marino and Spadaro, 1976; Becker and Spadaro, 1972).

Obviously the key element in the system is the signal; in searching for an alternate for the elusive chemical or hormone that should be the signal, we came upon an old, previously discarded phenomenon, the current of injury. This is an electrical potential that appears at the site of injury in all living things, both plant and animal. It was first described and studied during the time of Galvani in the mid 1700s and formed the basis for the concept of "animal electricity." This concept held that electricity was the vital force distinguishing living from non-living and that actual electrical currents flowed in all living things, conveying information and controlling life functions. As science expanded over the next 100 years, support for this concept diminished and the view that chemical processes were basic to all life became dominant, actually blurring the distinction between life and non-life. Our knowledge of how living things were constructed and how electricity was generated and transmitted did not contain any mechanism that would permit actual electrical currents to flow in any organized fashion in living things. Over the past 30 years, this picture has changed. The electron microscope has revealed that in living cells and tissues there exist structures of crystal-like organization and complexity previously undreamed of. Simultaneously a veritable explosion of knowledge in solid state physics has resulted in advances in electronics, such as the transistor, that were previously held to be impossible. Thus, it became possible to consider actual electronic processes in living organisms based upon the solid state properties of the highly organized structures. It seemed, in view of this knowledge, that a re-examination of animal electricity, particularly of the relationship between the current of injury and healing, was in order and an elegantly simple experiment suggested itself.

While healing is a controlled process, animals differ in the efficiency with which they heal. Amputation of an arm in the frog results in simple scarification of the remaining stump, while in the salamander, a completely new extremity is regrown by a process called regeneration. If the current of injury was the signal in our theoretical healing control system, would it not be different in animals capable of regeneration compared with those lacking this capacity? Our experiments done in 1959 utilized these two species of amphibians. Measurements of the current of injury at the amputation site showed remarkable differences between the two during the healing process (see Figure 2).

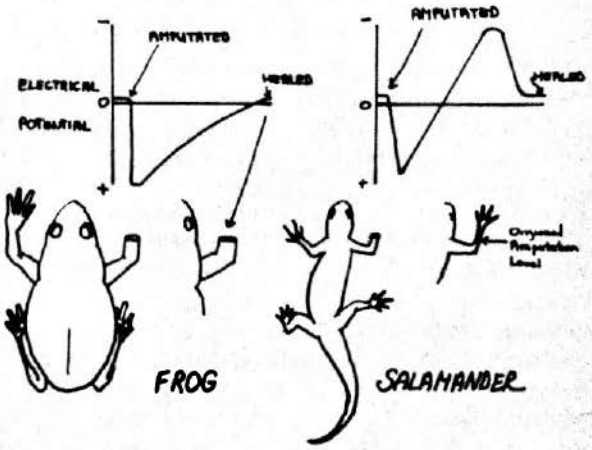


FIGURE 2.

That this electrical potential is the actual signal was shown by subsequent work which artificially duplicated the salamanders' current of injury in frogs, resulting in the complete regeneration of a new extremity. More recently, we have been able to produce partial limb regeneration in rats by a similar technique and some clinical applications are under study in human beings at this time.

While the clinical importance of this is obvious,

it seemed even more important to explore the electrical signal itself. It has no relationship to the nerve impulse, but it was related to the nerves in that denervation of the limb resulted in an almost complete disappearance of the current of injury and marked delay in the healing until the nerves regrew into the area. The injury potential is a steady state or direct current (DC) and we found that it represented a local disturbance in a total body system of a pre-existing pattern of DC potentials that closely paralled the arrangement of the central nervous system in all animals from flatworms to humans (see Figure 3).

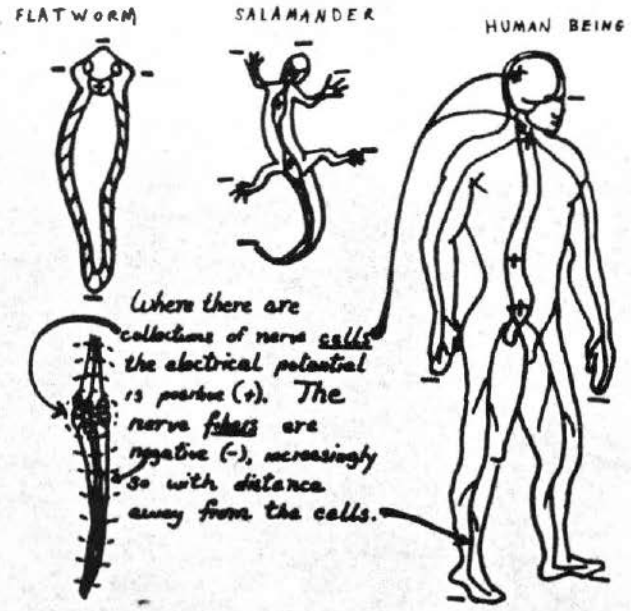


FIGURE 3.

We were able to show that these DC potentials were produced by actual electrical currents flowing in a circuit pattern and that these currents were semiconducting in nature. The system appeared to be capable of communicating information as an analog system. The direct currents could do this by changing their magnitude or polarity or by displaying slow rhythmic fluctuations. This is in sharp distinction to the nerve impulse which is produced by the movement of ions across the nerve cell membrane in a traveling wave fashion, conveying information as digital "bits." While the nerve impulse can be measured electrically, it does not involve movement of an electrical current lengthwise along the nerve (see Figure 4).

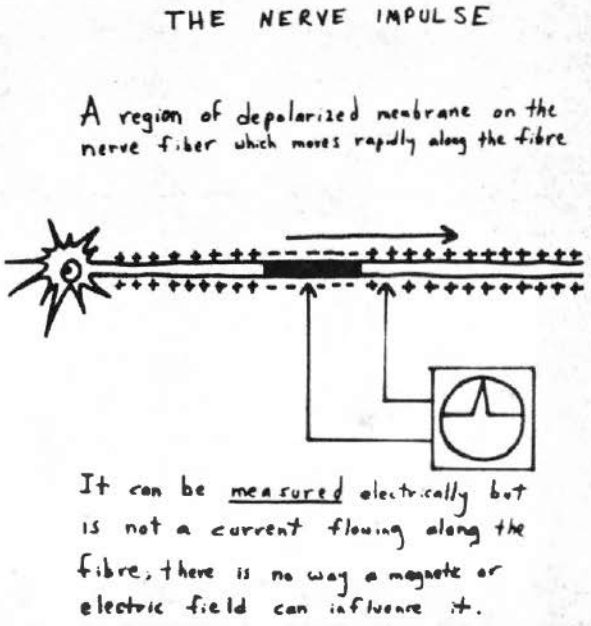


FIGURE 4.

In the classical view, the nervous system functions exclusively by means of the nerve impulse, generated by nerve cells and transmitted by the nerve fibers. The nerve cells are found in the brain and spinal cord areas and the fibers make up the peripheal nerves and the connecting tracts within the spinal cord and brain. A simplified view is shown in Figure 5.

This system functions where large volumes of information must be transmitted at high speed and it is directly involved in our special senses (i.e., vision, hearing, touch, etc.) and in controlling our rapid, coordinated muscle movements. It is not involved in any of the functions we addressed ourselves to; these seemed to be the result of control by the DC or analog type systems. In a cybernetic sense, the analog type of computer is more primitive than the digital type. Its data capacity is limited and its speed is slow; nevertheless, it is capable of transmitting signals with greater accuracy and integrating them with greater ease than the digital system. The mechanism involved in the generation and transmission of the nerve impulse is very sophisticated and it is for this reason, as well as others, that we postulated that the DC or analog system appeared long before the nerve impulse system, perhaps even furnishing the substratum upon which it was constructed. It

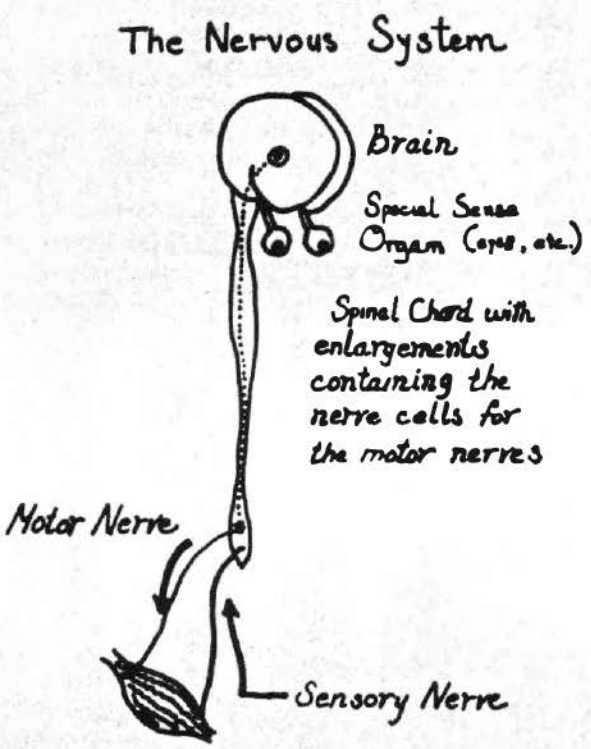


FIGURE 5.

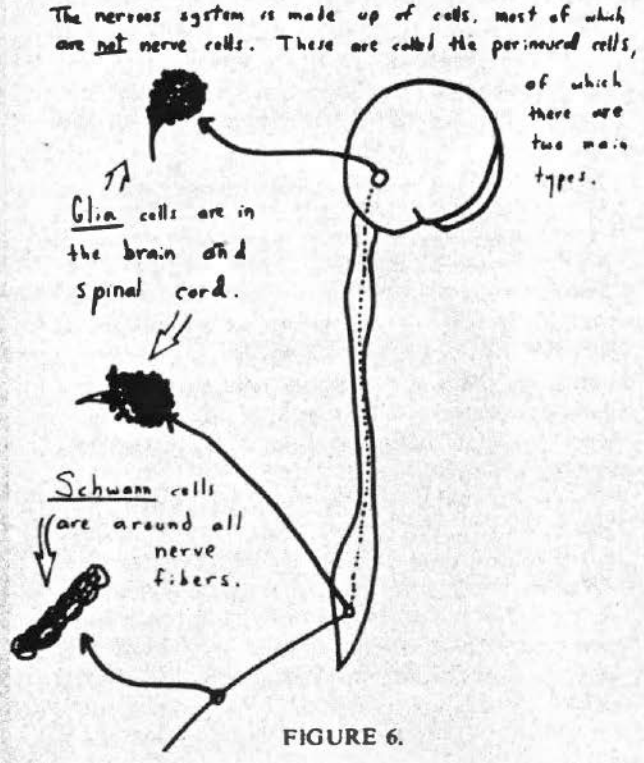


FIGURE 6.

therefore seemed unlikely that the nerves themselves contained both systems of data transmission. We immediately directed our attention to another type of cell present in the nervous system, the perineural cells. Actually, there are far more perineural cells than nerve cells in the nervous system, and they pervade it completely, surrounding all of the nerve cells proper and ensheathing all of the nerve fibers (see Figure 6).

Within the past few years, we have been able to identify the location of the DC system as being in these cells. The perineural cells are all in contact with each other and viewed as a whole, appear to provide a complete net-like system of great complexity based upon a simple design. The Schwann cells provide channels of input information and output controls, while the Glia cells of the brain and spinal cord provide various levels of integration centers for information processing and possibly storage (see Figure 7).

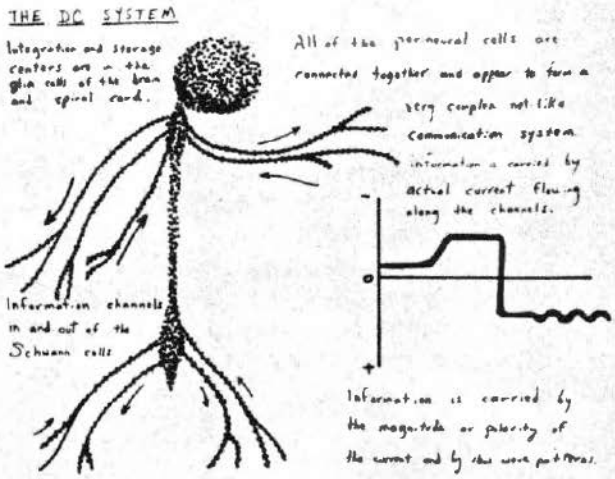


FIGURE 7.

The system is concerned with the injury-healing phenomenon through the current of injury; the expansion of our original control system schematic is shown in Figure 8.

We have now identified all of the elements in this system and are presently postulating that the input DC signal is at least a part of the pain sensation. This furnishes a logical base for explaining the ability of locally applied electrical currents to abolish pain sensations. The system further provides an excellent frame of reference for the phenomenon of acupuncture. The insertion of metal needles into specific "points" and "meridians"

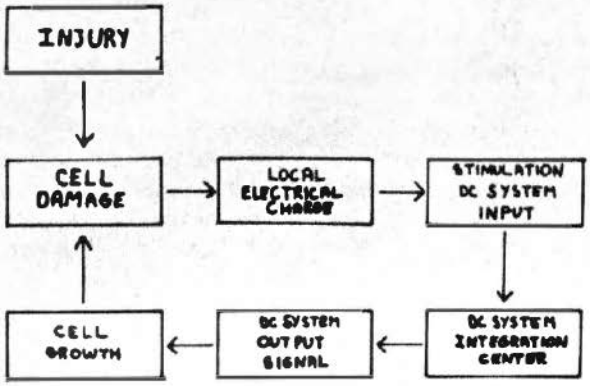


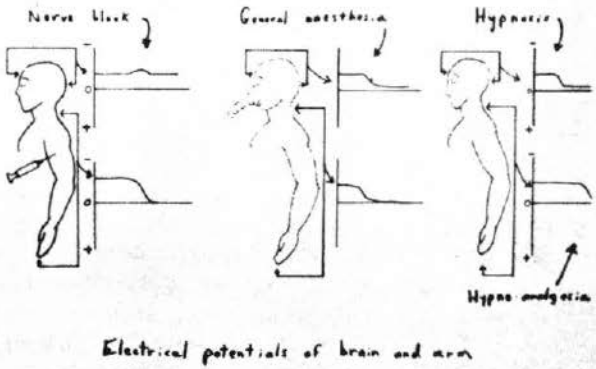
FIGURE 8.

produces a local electrical alteration which then diminishes the ability of the system to transmit the electrical currents we associate with the pain sensation. It is interesting to note that recent advances in clinical acupuncture have involved the injection of additional, battery generated, electrical current to potentiate the analgesic effect.

IMPLICATIONS OF BODY SYSTEMS

There are several indications that the operational level of the nerves proper, that is, their ability to generate and transmit the nerve impulse, is under the control of the perineural system. Changes in the local DC potentials in the glia network produce either a depression or enhancement of function of the nerve cells in the brain. Appropriate application of either electrical currents or field (both electrical and magnetic) can bring about profound changes in the electroencephalogram and levels of consciousness. In this light, we can view the entire communications system as a hybrid type computer with the analog DC system using the nerve impulse digital system as a tool for rapid data transmission, but exercising control over its level of operation. Thus, much of what we consider to be basic brain functions may be primary to the perineural system and related to the nerve impulse system only as a data processing apparatus.

So far we have shown how the DC electrical system in the perineural cells is concerned with pain and the healing of injuries and how it may be related to basic mental mechanisms. We have also been able to show that it is the primary system that regulates one's state of consciousness. Sleep, anesthesia, and hypnosis all show common changes in the DC electrical potentials in the brain and similar alterations of consciousness can be produced by applying the appropriate amount of electrical current, in the right direction, across the brain; this being the basis for clinical electroanesthesia. We found that in hypnosis, individuals had the power to alter the DC potentials of the system themselves. Hypnoanalgesia, for example, is produced by the lowering of the DC potentials to the area concerned in exactly the same way as a chemical block of the local nerve supply (see Figure 9).



Electrical potentials of brain and nerve

FIGURE 9.

It thus appears quite reasonable to postulate that other similar states of consciousness may be associated with voluntary access to the operations of the perineural system itself. In this fashion the individual could control pain sensation and influence growth processes within his or her own body by altering the DC potentials in the appropriate direction. The relationship between this and such phenomena as voluntary pain control, the production of stigmata, and the "miraculous" cure of pathological states by supposed "divine intervention" should be evident. In this way the same electrical system that regulates pain and the healing of injury may also be used to explain psychic phenomena that occur within the individual.

Semiconducting electronic systems have several interesting properties which relate to the other areas of psychic phenomena, communication between individuals and communication with the physical environment. There is always an interaction between an electrical current and a magnetic field, but in the case of semiconducting currents, this interaction is thousands of times greater than it is with currents flowing in a wire. Furthermore, one can construct specific semiconducting devices,

on the microscopic scale, that will enhance this sensitivity thousands of times. In general, such semiconducting currents will be altered in magnitude as the environmental magnetic field varies in magnitude; thus cyclic fluctuations in the external magnetic field may produce similar fluctuations in the internal currents flowing in the DC system. Such alterations may be reflected subsequently in changes in the general level of neural activity.

Electromagnetic (EM) field effects upon living organisms have been postulated from the time of Mesmer, but never substantiated until the past decade. We now know that the biological cycles of sleep-wakefulness, evident in all living things, are the result of the same cycle of rhythmic fluctuations in the earth's EM field. The migration of many animals is guided by the earth's EM field; in fact, the navigational ability of the homing pigeon is based upon a magnetic compass far more sensitive that the best instrument we can manufacture. In the geologic past, the magnetic field reversed itself on many occasions; these were associated with "great dyings" during which entire species of animals were eliminated to be replaced by simpler forms which then evolved differently. All life, therefore, is tied irretrievably to great tides in the electromagnetic field. Alterations in the normal ebb and flow are produced occasionally by storms on the sun which result in magnetic storms on the earth. We have found these to be statistically related to the incidence of mental disturbances in the human population.

We really are just beginning to understand the multitude of factors that are involved in the production of the earth's EM field; however, there appears little doubt that it constitutes a subtle, but important aspect of the living environment. In this light, the "natural" EM environment is difficult to describe. Our best estimate in this regard is that it contains magnetic fields generally of one gauss in strength and electrical fields from several 100's to several 1000's of volts per foot and that both of these contain frequency components in the extra low frequency (ELF) range, i.e., from 0.1 to 100 cycles per second,† and that the entire field pattern fluctuates with the lunar daily (around 24 hours) and the lunar monthly (28 day) periods. Longer periodicities are imposed by solar cycles, i.e., 11 years.

From the beginning of this century, humans have been altering this natural electromagnetic environment through the use of electrical power and communication devices. The electromagnetic environment of all industrialized nations is now far from that which pre-existed. While the thought that this may have biological effects was often expressed in the past, it has been discounted until relatively recently. At this time there is a growing awareness that this technological advancement may have been a mixed blessing. The concept that the EM factors, may be productive of human disease, in the urban environment in particular, is not lightly dismissed. For example, we know that magnetic fields as low as one gauss in intensity, fluctuating at frequencies close to that of our power lines, can produce changes in human reaction times and other measurements of overall neural functioning as well as major alterations in blood lipids, which can be associated with arteriosclerotic disease. Electrical fields of a few thousand volts in strength, fluctuating at power frequency of 60 cycles, are known to produce marked stress responses in animal populations chronically exposed to them. The human being, while not apparently possessing the highly developed magnetic compass of the homing pigeon, nonetheless shares with all living things the ability to perceive and be influenced by small changes in the EM fields of his or her environment.

This brings us finally to another property of such semiconducting electronic systems. They are not only sensitive to the external EM fields, but they generate their own external EM field. The flow of internal current generates an external EM field in the space around all organisms which follows the variations of the internal system. While such fields are exceedingly small in magnitude, those surrounding the human body, generated by the electrical activity of the brain and heart, have been detected and recorded.‡ We now know that surrounding every living thing is a particular EM field which reflects the operations of its internal DC systems. Since the internal system reflects the operational level of the entire brain, then this external field is capable of containing such information. We do not know at this time how to

† The major frequency range coincides with that found in the electroencephalogram (EEG), with ten cycles per second as the primary frequency. The EEG shows many similar patterns in widely diverse animals including man. Its exact origin is not known and we now postulate that at least in part, the DC analog system is involved in its production.

‡ These magnetoencephalograms and magnetocardiograms were obtained by using a particular type of semiconducting device known as the Josephson junction, developed only within the past few years.

"read" the information contained in either electroancephalograms or magnetoencephalograms; however, it is well known that they indicate subtlties of brain functioning greater than general levels of consciousness. Since we know that living things are capable of sensing extremely low magnitude EM fields and also that each living thing generates such fields, the possibility of communication between individuals using this modality is obvious.

Several problems, however, present themselves. The extremely low strength of the field generated by living things is far below that of the earth's normal field and even farther below that of the interfering fields we artificially produce by power and communication devices. This problem, the detection of a low amplitude signal imbedded in a high amplitude "noise," is common in science at this time and is overcome rather simply by several techniques. The commonest is for the "receiver" and "sender" to be frequency locked—both operating at only a certain frequency and unable to detect any other frequency. While our pollution of the EM environment may be productive of pathology, it does not necessarily preclude communication in the biologically significant region of the ELF spectrum.

Another problem is the reported independence of distance in ESP. We are all familiar with the dependence of radio signals on distance; how can these extremely weak biologically generated fields be propagated over many miles and still be "received?" Again, a specific property of the ELF spectrum may be an answer. The frequencies in this portion of the EM spectrum are capable of world-wide transmission even at relatively low strength, due to their interaction between the earth's surface and the ionosphere.† It should be noted that solid state technology continues to advance; the Josephson junction, which permitted the detection of the human being's self-generated EM field, was discovered only a few years ago. Devices still to be discovered may include ones capable of interception of such life-generated fields on a frequency selective basis and may provide a clue for the mechanisms used by the living systems themselves. At this time we do not know whether or not the technique of Kirlian photography reveals any of this field. We do know, however, that injured portions of living organisms show an increased Kirlian effect, presumably due to the increased electrical activity at that site.

APPLICATION TO THE STUDY OF PSI

If such a mechanism as I postulate exists, why then is not psi a more common (and accepted) phenomenon? The answer to this can only be speculative at the present time. It is possible that certain individuals have a more sensitive detective mechanism (similar to the pigeons' magnetic compass), by virtue of genetic or developmental accident. It is also possible that the evolutionary development of the special senses and their associated nerve impulse system provide us with so much data that, in effect in most of us, the operation of our hybrid computer brain is swamped with this type of information. Some support for this thesis lies in the commonly reported requirement for some type of "trance" state or altered sensory input for the operation of many psychic phenomena. Perhaps the world is too much with us! In any event, this concept leads to much further interesting speculation, as for example, the possible actual existence of de Chardin's noosphere.‡

The capacity of the internal DC field to generate external EM fields leads us to one final and more speculative observation. All matter, living and non-living, is ultimately an EM phenomenon. The ultimate composition of all material things is the atomic structure held together by electromagnetic forces. If it is practical to predict that certain individuals have enhanced capacities for detecting the EM fields generated by other living things, is it not practical to theorize that they may also have the capacity to control and enhance their own EM field? Since we do know that the cellular functions of our bodies are controlled by our own internal DC field, can it not be that the "healer" can generate "supportive" electrical currents and voltages which he or she conveys to the patient to bring about resolution of the pathological state? Much of what has been reported about this phenomenon is in accord with this concept. More speculatively, interactions of such biologically generated fields with material objects in the environment becomes a possibility and the relationship between

† The U.S. Navy intends to take advantage of this property with their proposed communication system—Project Sanguine. This will operate at 70 cycles per second and from one station be capable of communication with submarines, even when submerged, around the world.

‡ Teilhard de Chardin (1969) postulated in addition to the biosphere, a noosphere, a world field of thoughts and perceptions of all living things.

this concept and the phenomenon of psychokinesis would appear worth investigating. At a less spectacular level, but perhaps more importantly, can the projection of such "thoughts" by individuals onto non-living objects so change the EM characteristics of these objects that they can in turn be sensed by other individuals? In this area, we must leave the ground of present scientific fact and enter the realm of pure speculation. However, this may be the commonest of the paranormal phenomena to be experienced and its explanation should be in accord with that for the other phenomena.

To summarize, the concept of a primitive electronic communication system in all living things has proven to be a powerful tool in understanding many "normal" and "paranormal" biological phenomena that previously were without a rational explanation. The human being is part of the living universe, which is tied together in a web of electromagnetic energy, interrelating all things. The identification of electronic solid state communication systems of great antiquity in all living things has provided us with a powerful tool to understand many of the basic functions of life itself. It is my belief that the further development of human beings will rest upon increased understanding of and access to these systems. In this way, humans will ultimately come to be able to control the workings of their own bodies, to communicate with all living things, and to understand their relationship to the universe.

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A Comment

ARTHUR C. HASTINGS

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The work by Becker and his colleagues on the direct current nervous system makes pioneer contributions to an understanding of acupuncture, pain, and psychophysiological self-regulation. Now Becker suggests the DC system could be a communication channel for extrasensory perception (ESP) and an action mode for psychokinesis (PK).

Other researchers (Persinger, 1975; Kogan, 1968; Puthoff and Targ, 1976) have discussed the possibility that extremely low frequency (ELF) electromagnetic waves are involved in paranormal information transfer such as biocommunication or ESP. If this is so, the direct current system described by Becker could be considered the "sense organ" for this communication. This leaves open the question whether there is a "sending and receiving" pattern or whether the two systems "tune in" to each other and thus share a common field of information.

That the DC system can respond to ELF waves appears plausible on the basis of Becker's work, and the implications of this alone are likely to be consequential. Whether ELF waves can carry ESP information it is not yet possible to answer. One problem is channel capacity. Free response studies, such as those conducted on remote viewing by Puthoff and Targ (1976), require much higher information capacity than is possible according to