PROTOCOMMUNICATION

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Progress in parapsychology and the advancement of the epistemological problem, it seems to me, are dependent on solving the *modus operandi* of certain phenomena:

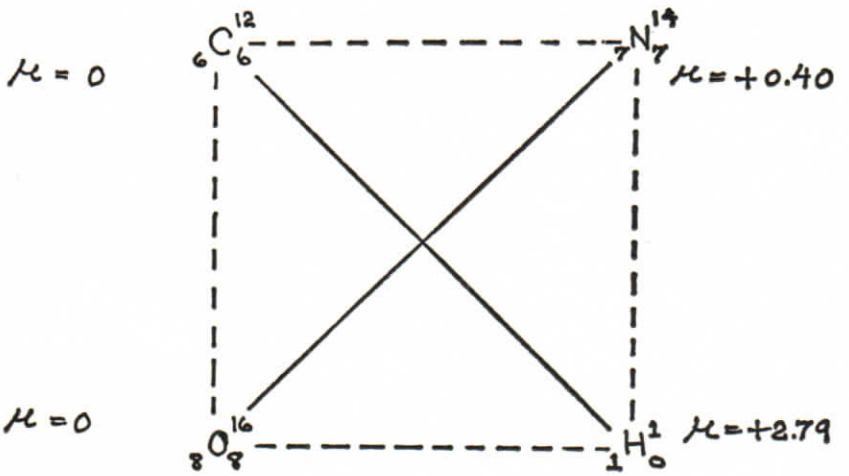
1) The Origin of Life
2) Replication in the Life process
3) Sensory Perception
4) Memory in Brain
5) Artificial Perception and Intelligence
6) Direct Brain Perception
7) Direct Brain Action
8) Memory in Nature
9) Precognition

I feel that these phenomena have a common thread the pursuit of which has been my life's work. I shall describe what I have done and what others have done to untangle this thread from nature's fabric. Although this exploration is fragmentary and presented with utmost reserve, I believe that it may serve a useful function in stimulating discussion and experimentation.

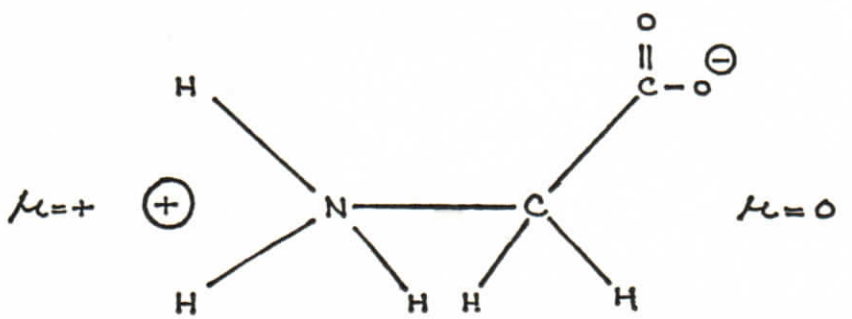
1. *Problem of the Origin of Life*

The consensus of scientific opinion [1,3] is that life originated on primitive earth from four atoms, C, O, H, and N which produced four molecules, CH_4 methane, NH_3 ammonia, H_2O water, and H_2 hydrogen. These molecules are known to exist in interstellar space.[4,5] These four molecules have also been formed into amino acids under laboratory conditions.[6-8] Twenty amino acids are the molecular foundation of all proteins. The unique feature of amino acids produced in living things is that they are all levo-rotary, i.e., they will rotate plane polarized light waves to the left. [9,10] In trying to understand this asymmetrical feature of life energies, I observed that all of the antagonistic physiological pairs of atomic elements are polarized magnetically.

Physiological pairs can be ranked by nuclear magnetic increments of 0.4 Bohr magnetons, μ. All the values for μ are ground state values.[11] From the data we can make some deductions. First, we observe that the four atomic letters of life show a set of unique magnetic moment polarizations:



We shall refer to this asymmetrical magnetic polarized group as the COHN set. The COHN set magnetic moment asymmetry within amino acids may account for the l-amino acids of life. We can briefly characterize this asymmetry with the example of glycine, one of the simplest of amino acids and the one produced in the greatest abundance in the laboratory re-creation of life origins. The chemical formula below is from Pauling.[12]



The base NH_3^+ group has a positive electric charge. The acidic COO^- group has a negative electric charge. But note that the mole-

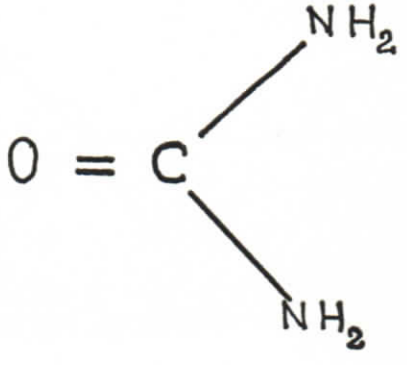
cule is also polarized magnetically with the NH_3^+ group carrying $+8.8\mu$ while the COO^- group has zero magnetic moment. In this molecule the positive electric pole, and the positive magnetic moment are on the same end of the molecule, and rotation of this group may account for the optical rotation of amino acids.

I believe that this "life" asymmetry reflects the weak violation of parity that exists in the cosmos. I further believe that this violation is related to the preponderance of hydrogen atoms in the cosmos (90% by count) [13] and preponderance of hydrogen atoms in the human body (63% by count).[14] This possibility focussed my attention on the role of the proton in life processes.

This analysis begins with the pair oxygen and hydrogen and their combination in water; and the pair carbon and nitrogen and their combination in amino acids and in nucleic acids. We shall develop the role of OH as the electron fuel cell of the organism, [15] and HOH as the proton matrix end product of fuel cell hydrosynthesis and what this means for the storage of memories originating from life experience. We shall develop the role of CN groups as building blocks of proteins and nucleotides which become the memory bank for phylogenetic and ontogenetic experience.

2. *Replication and Control in Life Processes*

Cell division has two important goals, one is to perpetuate the species, and the other is to carry on orderly growth and repair in an organism. This process is under the control of the DNA system which is made up of four nucleic acid sentences whose active components are the 2 purine bases, adenine and guanine, and the 2 pyrimidine bases cytosine and thymine.[16] It is of interest that these bases are made up of molecular building blocks that exist in interstellar space, NH_3, OH, and HCN.[17] In fact, these molecules were used by Wohler in 1828 to synthesise the first "'organic" molecule, urea:



which is a building block of all the purines.[18] The DNA molecule is a double helix in which the two nucleotide strands are held together by hydrogen bonds. The hydrogen bonds hold together the base pairs guanine: cytosine (GC); and adenine: thymine (AT). What is of interest is that this simple four letter code GC and AT, replicated in unit aggregates of molecular weight of the order of 100,000,000 contains complete instructions and operational control necessary to build a human body. Not only does this system contain an awesome stable memory capacity and accuracy in carrying out instructions, but it must also be responsive to very small signals that tell it "GO" and "NO-GO" for growth and repair.

In normal cell division the combination of the sperm and ovum triggers cell division. The start of DNA division is heralded by the appearance of a centrosome body. This latter body splits in two and the chromosomes containing DNA line up transverse to the lines connecting the two centrosomes. A classic spindle formation of microtubules occurs which is clearly visible under a microscope. At this point the hydrogen bonds holding the two strands of the DNA double helix cleave and the cell divides with a full complement of chromosomes going to each new cell.

Now we do not know what tells the DNA hydrogen bonds to divide, because the same effect can be artificially induced with electric pulses of the order of 30-40 volts.[19] The hydrogen bonds are of interest in that one of them is composed of the COHN set in the form,

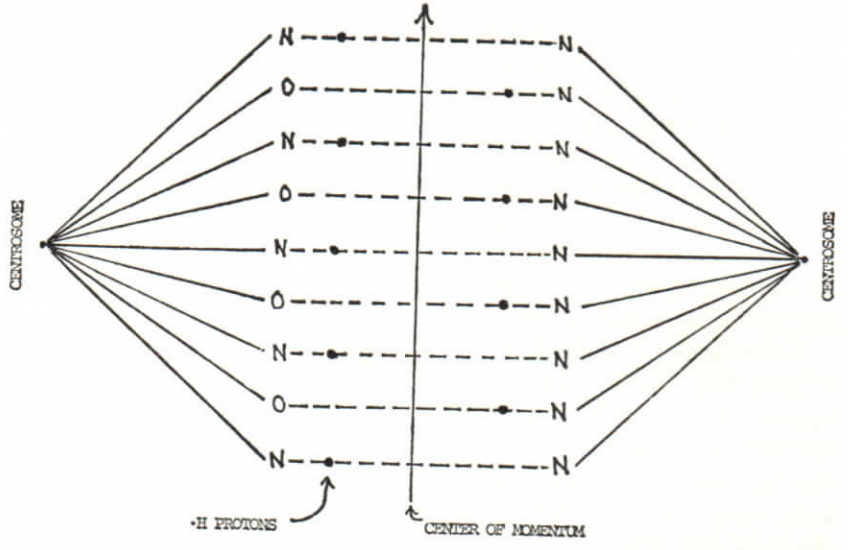
$$C = O{:}H{:}N$$

(The dots (:H:) represent electron lone pairs) and the other is composed of the NHN set in the form

$$N{:}H{:}N$$

In both bond sets the proton of the hydrogen atom is in a resonant state with the electron "lone pairs" on each side of it which gives the bond great stability. What kind of command is given which breaks this proton resonance stability in such an orderly way? The centrosome bodies behave like repulsive magnetic poles and the protons of the hydrogen bond system tend to line up in the interface repulsion region of low energy. The protons of the double helix ladder are paired in such a way that their center of momentum falls on the low energy interface where repulsive (magnetic) forces meet. This sets up a possible mechanism for super-conductivity at body temperature[20] and protons can shift like a zipper opening up the ladder of H bonds.

After the protons shift up the ladder one step and the magnetic repulsive force separates the two strands of the double helix the mechanism for super-conductivity collapses. Now in order to under-



stand this phenomena of cell division more fully let us consider what happens when we block cell division.

This can be reversibly accomplished in any system of dividing eggs by replacing about 20% to 30% of the water of the medium with deuterium oxide, D_2O.[21] While cell division is arrested as though a motion picture of the process had stopped it, the metabolic activities of the cell go on. If the D_2O is removed from the medium, cell division will resume normally. This is a phenomenon of great interest because the D_2O has counter-manded the "GO" command to divide with a reversible "NO-GO" command. Where does it act? Normal H_2O and D_2O differ only in that the hydrogen atom contains a neutron in addition to the proton. Thus the mass of the hydrogen atom is doubled; hence the term "heavy water." The essential difference between H_2O and D_2O is not chemical but nuclear. It turns out [22] that the neutron (n) has a spin opposite to that of the proton (p) where

$$n = -1.91\,\mu$$
$$p = +2.79\,\mu$$
$$\text{and, } {}_1H_1^2 = +0.85\,\mu$$

The result is that the neutron's magnetic spin tends to cancel the magnetic spin of the proton. It is my considered opinion that this

spin "shielding" effect is large enough to cancel the protonic "GO" command to divide. What we do not know is the locus and origin of the "GO" command except that it is probably protonic. But we shall pursue this question later. What is of interest is the role of water in the GO, NO-GO control mechanism.

Let us look at a situation where there is potentiation of the "GO" command in cell division and the growth and repair process. Grad [23] of McGill University has clearly shown that if a healer "treats" distilled water in glass bottles, and such treated water is used on plants, there is a significant potentiation of the growth process. Sister Justa Smith [24-26] has shown that distilled water treated by a healer's hands will significantly increase the hydrolytic action of the enzyme trypsin. The healer's "treatment" is exerted solely on the water, and the effect is most likely to be on the proton moments of the resonant hydrogen bonds of the water molecules. Further research should be directed to looking for nuclear magnetic resonant shifts either in magnetic field, or radio frequency. We shall return to the role of water in bio-control systems later. There remains the mystery of the "GO" command in egg division which I do not believe is a simple question of sperm and ovum meeting nor of electroshock stimulation of an ovum.[27] The life pattern of the Pacific salmon illustrates the larger framework of the problem.

The salmon hatches in an inland fresh water lake or pond in the spring of the year. It finds its way to the open sea by the autumn, and then moves as far as 4000 miles in the open sea from its place of birth. Five years later it begins the return voyage to its place of birth and arrives in time for optimal conditions for egg hatching. It finds a mate en route, and the two salmon ritually lay the eggs and fertilize them and then die within four to seven days. This annual event which has gone on since time immemorial has these problems for us:

What is the nature of the imprinting on the egg (at time of fertilization?) that brings the salmon back to this spot five years later? This imprinting requires a precise fix on a point on an earth that is spinning in orbital motion. The instructions require a timer for maturation, mating, and return in the right timing for optimum weather for egg hatching. The instructions require a command to go to the sea, navigate out and return in synchrony with physiological changes required for fresh to salt water adaptation. The final timing is of course the prescribed death following egg production and fertilization.

I believe that a solution of these problems should be a top priority for parapsychology because it comes close to the heart of the mystery behind the general phenomenon. I believe that the postulate of pro-

ton superconductivity is a necessary condition for such rapid and complex imprinting of the fertilized egg. The super-conductivity hypothesis is supportable for protons based on the theory of nuclear spin thermodynamics in the rotating frame.[28] This theory describes the mechanism whereby proton spin systems attain spin temperatures in the region of 1°K while the solid they are in is at room temperature (300°K).

3. *Normal Sensory Perception—Audition*

Within biological systems one of the more highly developed environmental information transfer systems is the neural network. I shall use the acoustic neural system as a model for these systems. Let us consider the perception of a 1 KHz sine wave, air-conducted tone by a human at the threshold level of sensation. The interface between the biosystem and the air is the ear drum which transmits the analog wave into the system with a displacement of $10-^{8}$ cm = 1Å (0.3Å = radius of a hydrogen atom). The 1 KHz wave is then transmitted by ossicular coupling to a fluid medium, the cochlear perilymph which transfers the wave or energy to the Basilar Membrane (B.M.). At the threshold of hearing the 1 KHz sine wave displaces the B.M. about 10^{-11} cm.[29] The radius of a nucleus—e.g., proton is 1.5×10^{-13} cm.[30]

Note: The distance from O to N in the COHN system ranges from 2.60 Å to 2.90Å.

Average = 2.72 Å in alpha helix [31]

This mechanical displacement of the B.M. is transferred to the auditory sensor—the hair cell wherein the 1 KHz sine wave undergoes transduction to produce an analog 1 KHz sine electrical signal—the cochlear microphonic signal.[32] Up to this point the information transfer process is linear. But the hair cell is now excited to generate a chemical pulse which it discharges across the synapse (Deiter) at the first order auditory neuron.[33,34] Encoding occurs, and the information (1 KHz sine wave) is now transferred along the nerve as a series of time distributed digital pulses, the classical "action potential" electrical pulses.

The actual mechanism of auditory encoding at the Deiter's synapse is not known in spite of great efforts to solve it.[35] What I present here is a highly speculative solution for which we can make certain assumptions. The first is that hair cells can resonate to one cycle per second intervals over the range of 16 Hz to 30 KHz.[36,37] The second assumption is that the higher the audio frequency the greater will be the current density flow for the constant level voltage of each action potential pulse.[38]

As the hair cells go into vibration in resonance with the 1 KHz signal, the acoustic phonon displacement of 10^{-11} cm is sufficient to strain the C=O:H:N set to open the membrane gate for the sodium pump. As the current flows (the higher the frequency, the higher the current density) it will set up a magnetic field.[39] The magnetic field will be picked up by the hydrogen proton of the C=O:H:N set and cause it to precess. The higher the magnetic field the higher the frequency of precession.

The magnitude of the current density across the membrane will determine the number of molecules of chemical transmitter such as acetylcholine that will be released at the presynaptic membrane.[40] Thus we have two parallel related events:

1) Energy release (current density) linear to audio frequency which triggers chemical transmitter molecules.

2) Proton precession triggered by the magnetic field generated by current density—and such precession frequency is linear to audio input.

The acetylcholine activating the postsynaptic membrane transfers phonons of thermal energy to the axon whose energy is equivalent to the original acoustic phonon at the hair cell. This phonon repeats the events already described. It is to be noted that each C = O:H:N set is activated serially, thus setting up the mechanism for a delay line which accounts for the slow conduction of the nerve impulse. The current density pulse besides metering out "quanta" of chemical transmitter material has another function, which is to act on perineural water shells with a hydrolysis-like action. This effect on water protons becomes, in my theory, the basis for memory. This topic will be discussed later as a brain effect when we consider more fully the subject of brain memory.

Within this model is the well-known sodium pump mechanism which maintains a DC barrier potential across the cell membrane.[41] With nerve excitation K^+ goes out of the cell, and Na^+ goes into the cell. Each of these ions has an opposing ion which acts to damp its action; K^+ is damped by Ca^{++}, and Na^+ is damped by Mg^{++}. What is not generally recognized is that K^+ has a positive (0.4) magnetic moment, and Ca^{++} has a zero moment; Na^+ has a positive (2.2) magnetic moment, and Mg^{++} has a zero magnetic moment. We would expect a short range transfer of magnetic information from the precessed proton to Na^+ and K^+ via the acetylcholine molecule.[42] This would tell the postsynaptic membrane whether it is to be excited, a process which opens the membrane to sodium ions, or to be inhibited, a process which closes the membrane to sodium ions.[43,44] This in-

formation would have to be delivered to the proton of the COHN system which acts as a gating switch on the postsynaptic membrane.

The information to be transmitted, a 1 KHz sine wave, must reach the temporal lobe cortex without distortion, and be stored in such a way that a person can vocally mimic this sound at some later time. Such storage may occur in a single nerve cell's membrane surrounding glial cells and water shells.[45] This would require domain formation (ferroelectric type) in which the proton magnetic moment poles are arranged in north pole and south pole regions.[46] Access to this memory bank requires that the action potential pulse and the proton magnetic dipole interact to perform such functions as write-in, read-out, numerical functions, store, hold, search, and erase.[47] The basic scheme of nature has the fixed hydrogen bond proton matrix scanned by travelling waves of electric pulses. The distinctive aspect of this scheme is that the protons form the storage, and hence the gestalt of the system; while input and output access is mediated by quantum electronic and photonic pulses.

We propose an extremely simple model and equivalent circuit of a unit element of the plasma membrane. The EMF source can represent any stimulus; the potential (DC) across the cathode-anode plates is determined by the polarized state of the dipoles; and its current flow by the depolarization release of potassium and sodium ions from the lattice structure of the plasma membrane. In the resting state of the nerve, the ferroelectric capacitor, C_0 is charged to a constant voltage, V, and the charge, Q, on the capacitor $= C_0V$. All linear current flow in the system is through the conducting fluids on both sides of the plasma membrane. However, the plasma membrane, on its outer surface, is covered by a coating made up of lipoid-protein layers. Conduction through this protein material is non-linear, and is represented by the C=O:H:N element as a semiconductor.

It is postulated that nerve stimulation, or depolarization will only occur by a decrease in the capacitance of the ferroelectric capacitor, and this is fundamentally dependent on the dielectric polarizibility, ϵ_a of the plasma membrane. ϵ_a, is dependent on the electronegativity of the neutral bound atoms of the plasma membrane, and can be lowered by DC biassing, by the choice of AC frequency, by pressure (strain) effects, by change in chemical composition, hydration, hydrolysis, thermal variations, etc. We will illustrate this triggering condition with the not-so-obvious case of thermal fluctuation stimulation. We assume that there is a Curie temperature, T_c, transition point, at 38°C. A temperature change above or below T_c, will decrease the capacitance and this will cause a current to flow to the load, since

current flow through the EMF source is blocked by the non-linear semi-conductor element. The capacitive discharge will in itself generate additional heat, and this represents part of the positive heat observed during the action potential phase of nerve firing. It has been observed in nerve firing that the positive heat phase is followed at times by negative heat, or absorption cooling effects. Thus the thermal cycle is completed by an increase in capacitance, causing a reverse flow of current through the load from the EMF source establishing the original charge on the capacitor. The net result is an AC output.

4. *Artificial Sense Perception*

My colleague, J. L. Lawrence, and I invented and developed an electronic system which makes it possible for a totally deaf person to hear speech sounds by Direct Brain Perception (DBP) using as stimulus to the brain an amplitude modulated alternating current carrier signal (AMAC). [48]

The AMAC signal is applied to the dry neck skin below the mastoid areas bilaterally via gold plated circular electrodes. This placement directs the AMAC signal to the brain stem region.[49] The deaf patient requires several weeks of electronic signal conditioning of such tissues with audio frequency band pure tone modulation before he can hear sounds.[50-52] One of the first measurable effects of such AMAC electronic conditioning is that a barrier potential of about 0.6 volts develops across the energized tissues. This is due to dielectric polarization of the cell membranes of all cells in the signal path.[53] Once a barrier potential is present across tissue, one can evoke the following effect: One of the AMAC energized electrodes, when it is lightly stroked over the skin, produces the sensation of hearing both in the deaf and in normals.[54] During the hearing attendant upon skin-stroking one will observe on the oscilloscope that the sine wave carrier signal injected into the head becomes half-wave rectified with the positive half-wave being clipped. What tissue mechanism detects AMAC signals?

Detection occurs when the keratin of the skin is stretched by the stroking action.[55] The coils of the alpha helix configuration of the keratin are held together by hydrogen bonds.[56]

Under the combined effect of the barrier potential forming a DC bias across the carbonyl-H-imide bond, and the stretching of the distance across the H bond, the C=O:H:N system becomes a semiconductor which rectifies the sine wave carrier.[57] Commoner has shown that stretching of such proteins in a nerve fiber also produces an electron spin resonance signal during neural conduction.[58]

The production of speech hearing capability in a deaf person by

means of direct brain electro-stimulation has revealed some significant data about information processing. Empirically we found that the deaf hear words optimally at a carrier frequency of 20 KHz with amplitude modulation of audio signals (double side band) where the half-power band pass is about 3 KHz.[59] This passes about 1.5×10^7 bits per second of information to the brain. This compares favorably to normal hearing where some 3×10^7 auditory nerve fibers with an average time constant of 5×10^{-3} sec. yields 6×10^7 bits of information per second.

Secondly, the power spectrum of the AMAC signal shows that the power pulse height of the side band curve is inversely proportional to frequency, and this accords well with the classic Fletcher-Munson curve for threshold of hearing. Thirdly, all evidence pointed to current pulses as being the signal mechanism of electrostimulation of hearing.[60]

Fourthly, actual hearing of tones in the deaf is due to a beat frequency detection effect. For example, if a 100 Hz tone is the stimulus signal, it is impressed on a 20 KHz carrier signal. Thus the head neurons see the following signal: 20 KHz + 100 Hz = 20,100 Hz: 20 KHz − 100 Hz = 19,900 Hz. The 20,100 Hz and the 19,900 Hz beat against the center frequency of 20,000 Hz and the result is that the deaf person "hears" 100 Hz. Certain proton nuclear magnetic resonant (NMR) signals in the nerve system may be of this nature where the actual perceived signal may be a side-band signal. For example, Nelson has shown that the HCH group of ethyl alcohol has a NMR at 200 MHz, but that each proton has a separate side band line 7 Hz above and below the center frequency. These side bands are due to proton-proton spin couplings.[61] Such proton-proton spin couplings may have great importance in memory induction.

5. *Memory in Brain*

We have shown in the skin-stroking effect that both the carrier potential across the C=O:H:N set and stretching the H bond length produces semiconduction, and also gates AMAC signals. Let us examine this phenomenon as it applies to awareness, anesthesia, and memory.

Becker [62] has clearly shown the relationship of body surface barrier potentials to alertness and anesthesia. During alert states there is a barrier potential (30 mV) between the neuraxis and the skin periphery, the neuraxis being positive in sign, and the skin being negative in sign. Anesthetic agents in the first stage of anesthesia lower this potential to zero and may even cause a reversal in sign. Hypnosis (if

effective for surgery, as an example) shows the same pattern of lowering of barrier potential, as shown for chemical anesthesia.

Randt and Mazzia [63] have shown that the earliest sign of stage 1 anesthesia (Plane 1) is characterized by a spontaneous dissociation of eyeball movements, so-called ocular divergence. In this condition humans can perform simple calculations, respond to questions and other stimuli, but do not retain any memory of such mental performance. Yet, at the same time it is possible for a patient to undergo major surgery during this state. Apparently, ocular divergence is a precision measure of the titer of anesthetic molecules required to uncouple perceptive-motor acts from memory imprinting. Let us analyze this important effect.

According to Pauling's [64] theory of anesthesia, anesthetic chemical agents act by forming clathrate hydrates. For example, in the case of the inert anesthetic gas xenon, the hydrate which forms around the xenon atom has been shown to be a dodecahedron of HOH molecules. Pauling states that such "water cages" produce anesthesia by a kind of plasma membrane water control rod function which damps the electrical oscillation of the neurons. All tests of this theory since Pauling first announced it in 1961 tend to confirm his concept of perineural water cage formation in anesthesia.

In addition to the Pauling concept of perineural water cages, I wish to bring up Hydén's concept of the perineural role of glia in the memory process:

"In an acute learning situation, the modulated frequencies (time patterns) set up by the neuron are also transferred to the glia. The glia are characterized by potentials of a 500 to 1000 fold *longer duration* than those recorded from nerve cells. When the neural frequency is changed a lock-in effect brings the slow frequency of the glia in synchrony (with nerve pulse frequency), the difference being a multiple. This coupling of the frequencies of the neuron and the glia forms an information system. The glial ionic equilibrium is disturbed and substrates in the form of nucleotides are transferred from the glia to the neuron to release the repressed chromosome (DNA) region, and induce the necessary enzyme synthesis for the RNA production.

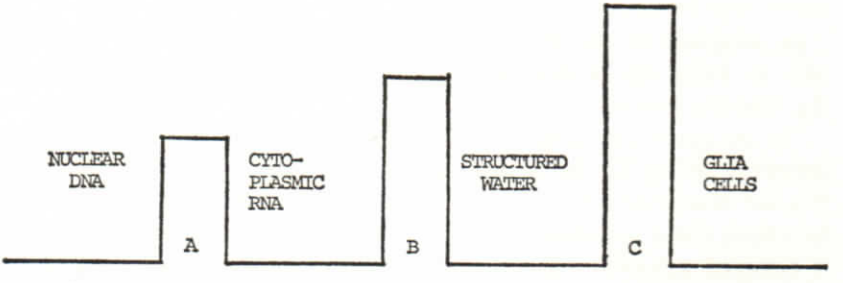
"This lock-in mechanism would, therefore, constitute the information system whereby the specific RNA was synthesized, triggered, or mediated by the glia as a regulator. As was stressed in the dicussion earlier, the glia have many features of a feedback system.

"The glia are composed of multiple, thin membranes. Such a composition is well suited for rapid processes, for example proton transfer.

"Both the glia and the neuron constitute a unit. As I see it, that is the functional unit of the nervous system.

"Modulated frequencies set up in neurons of specific areas would specify RNA and proteins. These alterations would be stable for the best part of an individual's life time. After the first chemical specification, the protein's response on the same electrical pattern that once specified the RNA would be to dissociate rapidly. A molecular fragment would be provided which will react in an activation of the transmitter substance. In view of the fast reaction, the modulated frequency could affect fluctuating charges existing between basic groups of the protein and their attached protons." [65]

Basic to our theory of memory in a brain is that the permanent spin of the proton is considered to be the seat of information. Inputs or outputs from this seat of information occur by modulating the precession frequency.[66] The macroscopic structure of the memory system is believed to be ferroelectric, as described. Ferroelectric properties have been found in RNA by Stanford and Lorey.[67] We propose the following scheme for the memory function in the central nervous system.



A) is the cell nucleus membrane barrier and is a conduction band semiconductor.

B) is the cytoplasmic plasma membrane barrier and is a tunnelling semiconductor.

C) is the structured water-glia interface in the perineural region—with proton-hopping semiconduction.[68]

When the nerve impulse fires across B, the sodium ion goes into the cell, and the magnesium ion is activated to damp the action of the sodium. The Mg^{++} and the electronic pulse tell the nuclear DNA proton to produce RNA.[69] As the electric pulse first started, the K^{+} ion went out of the cell across B, and perturbed the water proton lattice so that a proton hops into the glia to activate RNA.[70] The DNA proton and the glia RNA proton, if activated by the same en-

ergy in coincidence, come into proton-proton spin coupling at a definite precession frequency controlled by the quantum rules of current density: magnetic field described earlier. This spin coupling is transmitted through the water structure in the peri-neural area where a third proton freed by the hydrosynthesis process is also imprinted with the precession frequency of the other two protons. By this scheme the brain becomes an enormous set of interference patterns of magnetic waves generated by the proton precession frequencies.[71] It is these interference patterns which I believe humans subjectively experience as imagings, memories, and all the other mind dynamics.

The requirement of the brain for oxygen and glucose for maintenance of consciousness, memory and structure will now be considered. Let us quickly place this question in perspective. In the biological world mammals are not capable of cracking water, i.e., hydrolysis, to obtain free oxygen and hydrogen. Only algae, bacteria and plants are capable of hydrolysis—furnishing man with oxygen, the flame of his consciousness, and with hydrogen (in glucose) as the fuel of that flame. In all of man's metabolic processes the end result is the combination of 4 H with 2 O to form 2H°H and of course CO_2.[72] Thus every metabolic act of the brain, every nerve cell electrical impulse is accompanied by the formation of water, hydrosynthesis.[73] The forms that such water takes in the nerve cell, and around each nerve cell, etc. is a matter of vigorous research today.[74] The announcement of polywater by Deryagin has stirred this research to the highest level in history.[75] What is emerging is a concept first formulated by McCulloch [76] which states that mind processes are mediated by crystalline water structures, and that the nerve cell is a supporting skeletal structure for such water forms.[77]

Since consciousness is maintained only by a continuous supply of oxygen, and the integrity of brain structure (largely as water crystals) is also dependent on a continuous supply of oxygen we must consider continuous hydrosynthesis as a fundamental aspect of consciousness and mind operations. The modulation of mental states by anesthetic agents, hallucinogenic drugs, trance, hypnosis, etc. in order to influence Direct Brain Action (DBA) and Direct Brain Perception (DBP) performance can best be understood in terms of crystalline water states in the brain.

6. *Direct Brain Perception*

By direct brain perception, DBP, I mean the process of obtaining new information by a person without using the channels of sense, the memory bank or deductive logic. The perception originates from a

person at distance (telepathy), or is a vision of a scene beyond the range of sight (clairvoyance), or is the audition of a voice beyond the reach of the ears (clairaudience).

There are empirical psychological states, used over the centuries, to set the stage for the experience of DBP. Amongst these are self-induced trance—a dissociative state; release of cortical inhibitory states by the use of small amounts of alcohol, or other drugs; a state between waking consciousness and Stage 1, Plane 2 anesthesia; the REM state of sleep: cholineriag induced by drugs of the muscarinic group, e.g., *Amanita Muscaria*.[78] What is it that these various states and techniques have in common?

One of the keys as to how this process works can be illustrated with telepathy experiments where high scoring is controlled with negative ion inhalation, and low scoring is controlled with positive ion inhalation.[79] This effect can be rationalized by the principle of electronegativity which states that atoms have varying degrees of power to attract and hold electrons. If we saturate the respiratory air with negative ions (0_2^- and free electrons) certain atoms in the CNS* will become saturated with the maximum number of electrons they can hold. For example, the muco-polysaccharide coatings of cells will carry a high negative surface charge.[80] This will obviously create a large barrier potential. In general, we can predict that each atom will have maximum quantum orbital stability when its power of electronegativity is saturated, and this is the ground state of that atom. On a large scale this will create a condition wherein the core of each cell will be positively charged, and the cell periphery will be negatively charged.

If we induce such a state in a human subject by means of negative ion inhalation we can further stabilize these ground quantum energy level states by shielding the person from photonic and electronic perturbations within a Faraday Cage.[81] Under these conditions, namely,

a) Self-induced trance on the part of a clairvoyant,
b) Negative ion inhalation,
c) Faraday Cage shielding.

I have been able to show consistent, repeatable, statistically significant scoring in DBP tests designed as telepathy tests.[82]

It is my opinion that the quantum orbital electron stability so induced further acts by building and maintaining the proper types of water protonic structures favorable to DBP.

The techniques cited thus far all act to quench the electronic noise

* CNS = Central Nervous System

of the neuronal system. The self-imposed dissociative techniques act to shift attention to the para-neural information system—peri-neural water: glia cell system.

When the slow oscillations of this system dominate the electrical activity of the brain, the so-called alpha waves, in the frequency range from 8 to 14 Hz, the protons of the water structure are receptive to similar signals at a distance.[83] The best example of this phenomenon is the synchrony of alpha waves in identical twins by Direct Brain Action and Direct Brain Perception—or, more scientifically, proton resonance at-a-distance between two brains. The unique feature here is that protons are not to be thought of as points of energy in space, but rather as energy systems whose magnetic waves mushroom out over regions of space. We shall take up this concept in a later section.

7. *Direct Brain Action*

By Direct Brain Action, DBA, I mean the power of a person to induce a physical action-at-a-distance without the use of any known transducers, such as the muscular system. DBA is also known as psychokinesis in connection with dice tests, levitation in connection with lifting objects, poltergeists in connection with erratic movement of objects, table rapping, etc.

One of the common manifestations of DBA is in the phenomena of healing. I have already mentioned Grad's work on the induction of healing in animals, and growth induction in plants; and the transfer of healing energy from a person to water which potentiates enzyme activity. I have had occasion to study healing for a number of years in Arigó, the recently deceased Brazilian healer who did major surgery without anesthetics and without pain or shock. But the most interesting healing action I have studied was in the case of a healer, Mrs. H., who uses non-contact hand passes over a patient. This healer had previously cured a patient of a ventricular arrhythmia. The healer, Mrs. H., passed her hands over the spine of this patient, who with eyes closed, was in a prone position, covered with a white sheet. When the healer's hands passed (in the air) over the TIO to C1 vertebrae of the patient the normal asynchronous EEG waves showed an immediate high amplitude alpha wave synchrony of 9Hz. This was readily repeatable. I conclude that non-contact healer's manual passes over a patient induce a short range magnetic transmission to the hydrogen bond water protons of the brain causing them to precess in the frequency range from 7 to 14 Hz. This interpretation is compatible with the nuclear magnetic resonance frequency predicted by the Larmor equation for the parameters involved (body magnetic field of 10^{-6}

Gauss).[84-86] If the proton is in fact the universal carrier of information, per se, it would not only encode this information in quantum magnetic moments, precession frequencies, and quantum electro-dynamic resonances, but must logically do work at a distance.

Recent evidence suggests that gravity waves exist [87] with a frequency in the audio range, and detection has repeatedly occurred at 1660 Hz.[88] We have considered proton-proton spin coupling between brains at the so-called alpha frequencies. It will be recalled that protons have a not insignificant mass. We raise the very real question as to the possibility of the weak interaction between proton spin couplings, proton magnetic moment couplings and gravity waves showing in-phase locking at frequencies that are in the physiological range, i.e., from .2Hz to 30KHz, accounting for direct brain action.[89] In my experience all the DBA phenomena I have observed are very short range—a few meters at most.[90] Such short range action is compatible with the suggestion I have made.

8. *Memory in Nature*

If protons in a biological matrix are the carrier of information, per se, then protons in the cosmos as a whole would also be vehicles of proto-communication.

Hannes Alfvén has sharply reminded us that until the advent of recent space probes in peri-planetary and solar space, scientists were under the impression that deep space was a pure vacuum.[91] This impression is wrong. We now know that deep space is alive with plasmas, magnetic fields, electrostatic double layers, and currents.[92] It is estimated that about 90% of the atoms of the cosmos are made up of hydrogen atoms, and that there is on the average about one H atom per cubic cm. of space.[93] This cosmic distribution of H atoms existing as a proton matrix can be treated as a universal framework for protocommunication. Since about 63% of the human body also consists of hydrogen atoms we can look for a resonance between its protonic magnetic spin and precession systems and the protonic matrix of the cosmos as a whole. This effect would be most prominent in the perisolar region which we now know is alive with energetic protons streaming out from the sun.[94] The magneto-sheath of the earth is now also known to form a gigantic shock wave against this protonic flux from the sun. The entire picture is that of a mushroom cap facing the sun with the earth at the point of attachment of the stem to the cap and the stem reaching out as a tube far into space. In short all space is alive with protons so that any communication from proton to proton can occur through a chain-like coupling. These protons exist in

an enormous energy range from highly energetic relativistic protons to hydrogen-bond resonant quasi-static protons.

One of the curious reasons that protons in the cosmic matrix, and protons in the bio matrix can resonate is that they can in fact, under certain conditions exist at the same thermal energy level.[95] It is a fact that at temperatures of 300°K, and in the cold of deep space, proton nuclear spin systems are like dilute ideal gases in the simplicity and universality of their thermodynamics.[96]

If one applies a static magnetic field, and an RF field to a nuclear spin system at room or body temperatures one can produce within the nuclear spin system temperatures of 1°K. This is due to 3 properties of such a system: [97]

1) In a magnetic field all the protons will precess at the same frequency.

2) Because the spin moments are all polarized opposite to the magnetic field, the energy of the system has a distinct upper and lower boundary.

3) The system is subjected to a monochrome RF frequency.

We have seen that an effect similar to 1), 2), and 3) occurs in manual alpha wave induction: DBA and DBP induction of alpha waves between twins, and in transfer of a healer's power to water hydrogen bond systems. Since these effects are due to protons in elements common to planet earth, C,O,H,N, and found in interstellar space we expect to find the same information carried throughout all nature. In fact, the phenomenon of object-reading by DBP (psychometry) is one where the object carries information which may be detected by touching and by skin-stroking. I have treated this subject extensively under the title "Memory Capacity of Objects." [98] What concerns us here is the question of the basic nature of information, per se, in nature. I have treated this question in this paper, and indicated that life begins with a proton magnetic bias in nature which produces biased levorotatory molecules. I have tried to show that proton magnetic spin properties are ubiquitous in the human sensory and memory systems, and that these extend into so-called "inanimate" nature. Julian Schwinger [99,100] has recently proposed a new theory called "A Magnetic Model of Matter." While this theory is unproven, it addresses itself directly to the questions I have raised. Schwinger points out that even though the Maxwell equations call for a symmetry between electric charge and magnetic charge, the cold fact is that no magnetic counterpart to electric charge is known. Yet the unit of electric charge is unvarying in its universality. Why? He further notes that common to all nuclear particles is isotopic spin and hypercharge

which has no explanation. In addition he wonders why there exists in the universe a weak violation of charge-parity (CP) symmetry. He proposes an answer to these four disturbing questions—which are too complex to go into here. Nevertheless, he does deduce a unit of basic magnetic charge. He shows that electric charge is given by

$$e^2/hc \approx 1/137$$

and the magnetic charge becomes for ground states,

$$g^2{}_o/hc \approx 4(137)$$

His new charge unit which he calls the DYON is a fractional unit compared to the universal unit of electric charge now known, where

$$\text{DYON} = e_o = \tfrac{1}{3}\, e$$

The same type of fractional charge has been proposed for the proton and the neutron called quarks, or partons.[101]

If these theories of fractional charge, consisting of electric charge and magnetic charge are proven, we shall have a truly scientific basis for the theory of protocommunication proposed herein.

We speculate that on a cosmic scale protons are imbedded in a magnetic field matrix which gives them spatial orientation. The cosmic gravitational field determines the lattice spacing of such protons. These two fields determine the gestalt of the proton lattice, and input and output of "information" is mediated by quantum boson, pion, electronic, and photonic pulses. This concept of a brain applies equally to the bio-domain, or the cosmic domain.

It now remains to illustrate features of protocommunication and the nature of protons which can only come from observations of precognition.

9) *Precognition*

Nineteen years ago (August 1952) this month I conducted an experiment with Eileen Garrett.[102] The target she was seeking clairvoyantly was created by big cosmic ray pulses incident upon a coincidence counter housed 0.3 miles away from her. This target source gave a purely random distribution of events. Her direct hits in calling the time of arrival of the cosmic rays were at a P level of 10^{-6}. This gave me confidence that the experimental design and procedure were valid.

One of the striking findings of this study was the precognition hits made by Mrs. Garrett, not only for their statistical significance ($P = 10^{-3}$), but for the verbal description of the "coming" event. I must state that the counter was so set that only the big cosmic (C.R.) ray events triggered the detectors. In this way during the course of the experiment the average C.R. pulse interval was about 6 minutes

with a range of 1 to 30 minutes. By clairvoyant knowledge alone, Mrs. Garrett was able to see and describe the components and function of the C.R. detector. In this way we knew unambiguously when she "saw" the pen recording device, the amplifier circuits, the coincidence counter tube, the Faraday Cage in which this apparatus was housed, or the arrival of the cosmic ray showers. She was able to sense and describe the coming of a cosmic ray as long as 116 seconds before it hit the detector circuit, and then to call, within a second or two, the final movement of the pen that recorded the C.R. event. Here is a description by Mrs. Garrett of one such event starting 33 seconds before the pen recorded the event:

"I see little particles coming down. A formation of particles. The particles look like mercurial globules assembling. They have a fluid, magnetic quality. The particles gather together, they pile up in the *tube* (Note by author: The coincidence counter *tube*). The particles strike and make a sound as they hit—it has a shrill quality. The sound is transmitted into a light. NOW! The pen moves!" The Target Pen recorded the cosmic ray event at 23′05″ of the experiment. Mrs. Garrett said "NOW" at 23′06″ of the experiment. This is clearly both a brilliant precognition hit, and a hit synchronous in time.

I, and all my colleagues (seven of them) present at the experiments were impressed with this power of description of an event 3×10^{10} meters out in space, or about half the diameter of the sun. I personally am convinced that her mind locked onto those protons in space which were headed on a collision course for a point on a rotating planet. If all this be true how do we account for it? Let us examine some of the facts.

Interstellar space is filled with a plasma made up of magnetic fields of the order of 10^{-6} gauss, and atoms and ions such as protons making what Hannes Alfvén [103,104] has called a viscous medium. Protons moving at relativistic velocities are profoundly influenced by the magnetic field while their rest mass is not significantly altered, their total energy, particularly the magnetic component, is increased. It is my opinion that the quantum concept of a point proton is not valid under these conditions. Rather we should think of a spread out, a mushroom-shaped proton, if you will. If we accept this point of view the proton now has a frame of reference which (depending on its energy) may have a wave length that is equal to the radius of the solar system. Thus we do not have to be concerned with Einstein's limiting velocity of light, c, nor with Feinberg's velocities that exceed c. We need only be concerned with spin temperatures and plasma temperatures which determine resonant conditions between protons in

the clairvoyant's brain, and those in space. Protons in interstellar space can have temperatures ranging from 1°K to 10,000°K. It would seem that the two protons in question must be at the lower end of this scale in order to be at thermal equilibrium. If this condition can be met and it is within the physiological range, I see no difficulty in bringing the bioproton and the cosmoproton sets into resonance.[105-111] It requires an extraordinary quality of perception on the part of a clairvoyant to come into resonance with such an elusive target.[112-116] Now what can we say about more long range precognition? Does the proton plasma in which all planets and life are immersed act as a giant brain?

Concluding Remarks

Let me briefly review the essential points that I want to make as a concluding statement.

In order to find some place in the greater order of nature for our personal experience of the brain as mind-qualities, I have been led by my biophysical and parapsychological researches to examine the most common unit in the universe—the proton.

I find that a magnetic basis for matter, as proposed by Schwinger, is required in order to explain l-amino acid molecular asymmetry of life processes operating through proton magnetic asymmetry.

I find that the DNA hydrogen bond system is a suitable matrix for proton superconductivity which may account for basic bio-control mechanisms that must operate in cell division, cell growth and repair, and abnormalities such as cancer.

I find that the C=O:H:N set is a good molecular basis for semiconduction, ferroelectricity, and proton precession effects with which to build a sensory apparatus.

Biological memory finds a rational basis in the simple concept of modulated proton spin states. The same concept applied to a paraneural domain of water-glia is a possible basis for direct brain perception (DBP). However, this latter mechanism is intimately linked to the concept of a cosmic protonic plasma brain built into all of nature.

I feel that no man should put forth a serious theory without suggesting experiments that will test its validity. I want to propose, very briefly, a number of such experiments.

I believe that if the proton-proton spin coupling exists in DBP it should be possible to shield a sender from a receiver in a telepathy experiment. This may be done by placing one of the participants in an enclosure of D_2O. I predict this will stop, or attenuate DBP. A control for this experiment would place the subject in a charged

Faraday Cage Enclosure whose walls could be emptied, or filled with D_2O without perturbing the subject.

Long range precognition and detection of protons, as was described for Mrs. Garrett, can best be done by astronauts in a satellite in space. On earth we would have a clairvoyant. In space, an astronaut with a helmet that would detect when an energetic proton went through his brain. The clairvoyant would try to guess when the astronaut's brain is activated by a proton. The experiment could be reversed with the astronaut trying to guess when a person on earth had a cosmic ray event pass through his brain. This experiment would be highly important in determining proton energy levels, spin temperatures, and the role of the earth's magneto-sheath in direct brain perception.

Another experiment would involve driving two brains in synchrony using the techniques of nuclear magnetic resonance. It would be desirable to have the two brains at matching thermal equilibria, and at driving frequencies such as the alpha frequency. We would look for either increased or decreased DBP transmission between the two subjects.

The most important study would be a long term study of the life cycle of the salmon. I believe that this study could yield more basic information about geo-cosmic information imprinting than any other study of which I can conceive. The most important phase for study would be the ritual egg laying and egg fertilization.

REFERENCES

1. Bar-Nun, A.; Bar-Nun, N.; Bauer, S. H.; and Sagan, Carl: "Shock Synthesis of Amino Acids in Simulated Primitive Environments," *Science* **168** (1970): 470–473.
2. Miller, S. L.: "The Formation of Organic Compounds on the Primitive Earth," *Ann. N.Y. Acad. Sci.* **69** (1957): 260.
3. Fox, Sidney, W.: "Synthesis of Amino Acids by the Heating of Formaldehyde and Ammonia," *Science* **170** (1970): 984–86.
4. Donn, Bertram: "Interstellar Molecules and Chemistry," *Science* **170** (1970): 1116–17.
5. Wick, Gerald L.: "Interstellar Molecules: Chemicals in the Sky," *Science* **170** (1970): 149–50.
6. Miller, S. L.: *Op. cit.*, ref. 2.
7. Fox, Sidney, W.: *Op. cit.*, ref. 3.
8. Bar-Nun, A.; Bar-Nun, N.; Bauer, S. H.; and Sagan, Carl: *Op. cit.*, ref. 1.
9. Pauling, Linus: *Nature of the Chemical Bond* (Ithaca, N.Y.: Cornell University Press, 1948).
10. Corrigan, John, J.: "D-Amino Acids in Animals," *Science* **164** (1969): 142–49.
11. Condon, E. W., (Ed.), and Odishaw, Hugh: *Handbook of Physics*, Table 3.1. Nuclear Moment Values; section 9–93 (New York: McGraw-Hill, 1967, 2nd. ed.).
12. Pauling, Linus, and Hayward, Roger: *The Architecture of Molecules* (San Francisco: W. H. Freeman, 1964), Plate 45.

13. DONN, BERTRAM: *Op. cit.*, ref. 4.
14. ANDREWS, DONALD HATCH: *The Symphony of Life* (Lee's Summit, Mo.: Unity Books, 1966), p. 200.
15. YEAGER, ERNEST: "Fuel Cells," *Science* **134** (1961): 1178–1186.
16. CRICK, F. H. C.: "On the Genetic Code," *Science* **139** (1963): 461–64.
17. WICK, GERALD L.: *Op. cit.*, ref. 5.
18. ORÓ, J., and KIMBALL, A. P.: "Synthesis of Purines under Possible Primitive Earth Conditions. I. Adenine from Hydrogen Cyanide," *Arch. Biochem. Biophys.* **94** (1961): 217–27.
19. TARKOWSKI, A. K.: "Spermless Egg Activation Is Achieved in the Mouse," *Dateline in Science* **5** (1970): 1.
20. LITTLE, W. A.: "Superconductivity at Room Temperature," *Scientific American* **212** (1965). 21–27.
21. GROSS, PAUL R., and SPINDEL, WILLIAM: "Heavy Water Inhibition of Cell Division: An Approach to Mechanism," *Ann. N.Y. Acad. Sci.* **90** (1960): 345–613.
22. CONDON, E. U. (ed.), and ODISHAW, Hugh: *Op. cit.*, ref. 11.
23. SMITH, JUSTA: "Are These Healing Hands?" *Response* (publication of Rosary Hill College, Buffalo, N.Y. **11**, Spring 1968, p. 18.
24. ———: "Effect of A Homogeneous Magnetic Field on Enzymes," in *Third International Biomagnetic Symposium* (Chicago, Ill.: University of Illinois, 1967), pp. 22–25.
25. ———: "Considerations Regarding the Mechanism of the Action of Magnetic Fields of Enzymes," in *Third International Biomagnetic* Symposium (Chicago, Ill.: University of Illinois, 1967), pp. 26–27.
26. ———: *Op. cit.*, ref. 23.
27. TARKOWSKI, A. K.: *Op. cit.*, ref. 19.
28. REDFIELD, ALFRED G.: "Nuclear Spin Thermodynamics in the Rotating Frame," *Science* **164** (1969): 1015–23.
29. FLANAGAN, JAMES: "Computer Simulation of Basilar Membrane Motion and Electronic Artificial Larynx," 1965 IEEE International Convention Record, Part 12, p. 40.
30. WEISSKOPF, VICTOR F.: "The Three Spectroscopies," *Sci. Amer.* **218** (1968): 15–29.
31. HAMILTON, WALTER C., and IBERS, JAMES A.: *Hydrogen Bonding in Solids* (New York, N.Y.: W. A. Benjamin, 1968), p. 87.
32. CRICK, F. H. C.: *Op. cit.*, ref. 16.
33. LUMMIS, R. C.: "The Secret Code of Hearing," Bell Laboratories Record, September 1968, pp 261–66.
34. KANEKO, Y., and DALY, J. F.: "Activity of Acetylcholinesterase on the Endolymphatic Surface of Outer Hair Cells," *Acta Otolaryng.* **67** (1969): 602–10.
35. LUMMIS, R. C.: *Op. cit.*, ref. 33.
36. PUHARICH, H. K., and LAWRENCE, J. L.: "Means for Aiding Hearing." U.S. Patent No. 2.995.633, August, 1961.
37. ———: "Alternating Current Energy Used to Simulate Audition in Deaf Humans." Paper presented at the 35th Annual Convention Aerospace Medical Association, Miami, Florida, May 13, 1964.
38. ———: "Hearing Rehabilitation by Means of Transdermal Electrotherapy in Human Loss of Sensorineural Origin (I)," *Acta Otolaryng.* **67** (1969): 69–83.
39. REDFIELD, ALFRED G.: *Op. cit.*, ref. 28.
40. ECCLES, SIR JOHN: "The Synape," *Sci. Amer.* (Jan. 1965): 56+.
41. BAKER, PETER F.: "The Nerve Axon," *Sci. Amer.* (March 1966): 74+.
42. MAURO, ALEXANDER: "Space Charge Regions in Fixed Charge Membranes and the Associated Property of Capacitance," *Biophys. J.* **2** (1962): 179–98.
43. ECCLES, SIR JOHN: *Op. cit.*, ref. 40.
44. PAULING, LINUS: *Op. cit.*, ref. 9.

45. HYDÉN, HOLGAR: "Activation of Nuclear RNA of Neurons and GLIA in Learning," in *The Anatomy of Memory* edited by Daniel P. Kimble (Palo Alto, Calif.: Science and Behavior Books, 1965): p. 231.
46. VON HIPPEL, ARTHUR R.: "Molecular Designing of Materials," *Science* **138** (1962): 91–108.
47. BOBECK, ANDREW H., and SCOVIL, H. E. D.: "Magnetic Bubbles," *Sci. Amer.* (June 1971); 78–90.
48. PUHARICH, H. K., and LAWRENCE, J. L.: *Op. cit.*, ref. 36.
49. PARISI, MARIO; RIVAS, EMILIO; and DE ROBERTIS, E.: "Conductance Changes Produced by Acetylcholine in Lipidic Membranes Containing a Proteolipid from Electrophorus," *Science* **172** (1971): 56–57.
50. PUHARICH, H. K., and LAWRENCE, J. L.: *Op. cit.*, ref. 38.
51. MANFREDI, A., and BOMBELLI, U.: "Radioacoustic Treatment of Deafness," *Atti della Fondazione Giorgio Ronchi* **18** (1963): 603–16; and *Publicazioni dell'Istituto Nazionale di Ottica, Arcetri Firenze, Serie IV*, No. 408.
52. ———: "Explanatory Notes on Radioacoustic Treatment of Deafness." Paper presented at the Seventh Congress of the International Society of Audiology, Copenhagen, August 24, 1964.
53. PUHARICH, H. K., and LAWRENCE, J. L.: "Hearing Rehabilitation by Means of Transdermal Electrotherapy in Human Hearing Loss of Sensorineural Origin (II)." Excerpta Medica International Congress Series No. 189 containing abstracts of papers read at the Ninth International Congress of Oto-Rhino-Laryngology.
54. INGALLS, CLYDE, E., E.E.: "Sensation of Hearing in Electromagnetic Fields," *New York J. Med.* **67** (1967): 2992–97.
55. GIBSON, T.; STARK, H.; and EVANS, J. H.: "Directional Variation in Extensibility of Human Skin in Vivo," *J. of Biomechanics* **2** (1969): 201–4.
56. PUHARICH, H. K.; LAWRENCE, J. L.; and DUGOT, R. S.: "Transdermal Electrostimulation of Hearing." Paper presented at the Thirteenth Annual Scientific Meeting Committe for Research in Otolaryngology, American Academy of Ophthalmology and Otolaryngology, Chicago, Ill., October 11, 1969.
57. PUHARICH, H. K., and LAWRENCE, J. L.: *Op. cit.*, ref. 53.
58. COMMONER, BARRY; WOOLUM, JOHN C.; and LARSSON, ERNST: "Electron Spin Resonance Signals in Injured Nerve," *Science* **165** (1969): 703–4.
59. PUHARICH, H. K., and LAWRENCE, J. L.: "Electrostimulation Techniques of Hearing." Technical Documentary Report, Defense Documentation Center, Virginia, December, 1964.
60. *Ibid.*
61. NELSON, F. A., and WEAVER, H. E.: "Nuclear Magnetic Resonance Spectroscopy in Superconducting Magnetic Fields," *Science* **146** (1964): 223–32.
62. BECKER, ROBERT O.: "Some Observations Indicating the Possibility of Longitudinal Charge Carrier Flow in the Peripheral Nerves." Paper presented at the Second Annual Bionics Symposium, Ithaca, N.Y., August 31, 1961.
63. RANDT, CLARK T., and MAZZIA, VALENTINO D. B.: "Recent Memory Fixation in Man." Reprint from Transactions of the American Neurological Association, 1965, pp. 141–44.
64. PAULING, LINUS: "A Molecular Theory of General Anesthesia," *Science* **134** (1961): 15–21.
65. HYDÉN, HOLGAR: *Op. cit.*, ref. 45.
66. REDFIELD, ALFRED G.: *Op. cit.*, ref. 28.
67. STANFORD, A. L., JR., and LOREY, R. A.: "RNA's Function in Memory: Lingering Polar Alignment?" *Dateline in Science* **3** (1968): 1.
68. SHAH, DINESH O., and HAMLIN, ROY M., JR.: "Structure of Water in Microemulsions: Electrical, Birefringence, and Nuclear Magnetic Resonance Studies," *Science* **171** (1971): 483–485.

69. De Robertis, Eduardo: "Molecular Biology of Synaptic Receptors," *Science* **171** (1971): 963–71.
70. Runnels, L. K.: "Ice," *Sci. Amer.* (December 1966): 118–26.
71. Kastler, Alfred: "Optical Methods for Studying Hertzian Resonances." *Science* **158** (1967): 214–21.
72. Walker, J. L., Jr.: "Unified Account of the Variable Effects of Carbon Dioxide on Nerve Cells," *Science* **167** (1970): 1502–4.
73. Rosenberg, Barnett, and Postow, Elliot: "Semi Conduction in Proteins and Lipids—Its Possible Biologic Import," *Ann. N.Y. Acad. Sci.* **158** (1969): 1+
74. Rabideau, S. W., and Florin, A. E.: "Anomalous Water: Characterization by Physical Methods," *Science* **169** (1970): 48–52.
75. Frank, Henry S.: "The Structure of Ordinary Water," *Science* **169** (1970): 635–41.
76. McCulloch, Warren S.: "The Biological Sciences in the Great Ideas Today," Encyclopaedia Britannica, Chicago, 1966, pp. 288, 334.
77. Teorell, Torsten: "Electrokinetic Considerations of Mechanoelectrical Transduction," *Ann. N.Y. Acad. Sci.* **137** (1966): 403–1048.
78. Puharich, H. K. (Andrija): *Beyond Telepathy* (New York, N.Y.: Doubleday & Co., 1962).
79. ———: *Sacred Mushroom* (New York, N.Y.: Doubleday & Co., 1959).
80. Lippman, Muriel: "A Proposed Role for Mucopolysaccharides in the Initiation and Control of Cell Division," *Transactions of the New York Academy of Sciences* **27** (1965): 342–60.
81. Puharich, H. K. (Andrija): *Op. cit.*, ref. 78.
82. Puharich, H. K.: "Electric Field Reinforcement of ESP," *Int. J. Neuropsychiat.* **2** (1966): 474–86.
83. Puharich, H. K.; Smith, J.; and Kitselman, A.: "Computers, Chance and Cholinergia," *Darshana* (India) **1** (1961): 41–43.
84. Rocard, Y.: "Actions of a Very Weak Magnetic Gradient: The Reflex of the Dowser," *La Nature* (1963), No. 3343: 468–72.
85. Walsh, W. M., Jr.: "Magnetic Resonances and Waves in Simple Metals," *Science* **171** (1971): 36–42.
86. Wigner, Eugene P.: "Events, Laws of Nature and Invariance Principles," *Science* **145** (1964): 995–1006.
87. Weber, Joseph: "Evidence of Gravity Waves Reported," *New York Times,* June 15, 1961, p. 1.
88. Witteborn, Fred C.: "Data Confirm Faint Gravity Pulls Free Electrons in Magnetic Field," *Dateline in Science,* January 20, 1967, p. 1.
89. *Ibid.*
90. Puharich, H. K. (Andrija): *Op. cit.*, ref. 78.
91. Alfvén, Hannes: "Antimatter and Cosmology," *Sci. Amer.* (April 1967): 106.
92. Alfvén, Hannes, and Elvius, Aina: "Antimatter Quasi-stellar Objects, and the Evolution of Galaxies," *Science* **164** (1969): 911–17.
93. Alfvén, Hannes: *Op. cit.*, ref. 91.
94. Ness, Norman F.: "Earth's Magnetic Field: A New Look," *Science* **151** (1966): 1041–52.
95. Porter, William S.: "Hydrogen Energy Levels: Perturbation Caused by Proton Structure," *Science* **143** (1964): 1324–25.
96. Redfield, Alfred G.: *Op. cit.*, ref. 28.
97. *Ibid.*
98. Puharich, H. K. (Andrija): *Op. cit.*, ref. 78.
99. Schwinger, Julian: "Relativistic Quantum Field Theory," *Science* **153** (1966): 949–53.
100. ———: "A Magnetic Model of Matter," *Science* **165** (1969): 757–61.
101. Kendall, Henry W., and Panofsky, Wolfgang K. H.: "The Structure of the Proton and the Neutron," *Sci. Amer.* (June 1971): 61–77.

102. PUHARICH, H. K.: *Op. cit.*, ref. 82.
103. ALFVÉN, HANNES: *Op. cit.*, ref. 91.
104. ———: *Op. cit.*, ref. 92.
105. REDFIELD, ALFRED G.: *Op. cit.*, ref. 28.
106. CRANE, H. R.: "The g Factor of the Electron," *Sci. Amer.* (Jan. 1968): 76–85.
107. JENSEN, L. H., and SUNDARALINGAM, M.: "Hydrogen Atom Thermal Parameters," *Science* **145** (1964): 1185–87.
108. JOHNSON, CHARLES Y.; YOUNG, J. M.; and HOLMES, J. C.: "Magnetoglow: A New Geophysical Resource," *Science* **171** (1971): 379–81.
109. PORTER, WILLIAM S.: Op. *cit., ref.* 95.
110. REINES, FREDERICK, and SELLSCHOP, J. P. F.: "Neutrinos from the Atmosphere and Beyond," *Sci. Amer.* (Febr. 1966): 40+.
111. ROMIG, MARY F., and LAMOR, DONALD L.: "Anomalous Sounds and Electromagnetic Effects Associated with Fireball Entry." Memorandum RM-3724-ARPA, July 1963, The Rand Corp., Santa Monica, Calif.
112. VAOLENTINUZZI, MAXIMO: "Theory of Magnetophosphenes," *Amer. J. Med. Electronics* (April-June 1962): 112–21.
113. VOLKERS, W.: "Detection and Analysis of High Frequency Signals from Muscular Tissues with Ultra-Low Noise Amplifiers." Technical Report No. TR 76, Millival Division of COHU Electronics, Schenectady, N.Y.
114. WEI, LING Y.: "Role of Surface Dipoles on Axon Membrane," *Science* **163** (1969): 280–82.
115. WITTEBORN, FRED C.: *Op. cit.*, ref. 88.
116. WIENER, N.: *Cybernetics* (New York, N.Y.: John Wiley & Sons, 1948), p. 166.