A New Paradigm in Cellular Biology

Gerson, Ling, Cope, Sodi-Pallares,

Damadian and the Association-Induction Hypothesis

Excerpt from "The American Revolution in Cellular Biology" by Gar Hildenbrand originally published in the Journal of the Gerson Institute and Gerson Therapy Vol. 2, No. 1, 1982.

Our cells live in an ocean of salt water (serum) that is very high in sodium and very low in potassium. The salt water passes through each cell at the rate of nearly 100 times the volume of the cell each second. Amazingly, cells themselves contain only 7% as much sodium as the serum, but they have a potassium concentration 32 times greater than that of serum. Researchers had to ask how the cell could gather so much potassium from serum which has a potassium concentration only 3% of that found in cells. To answer that question, they invented the idea of the "sodium pump" which they suggested might continually pump excess sodium out of the cell and perhaps carry potassium in.

The major articles in which the concept of the "sodium pump" were set forth occurred in 1941 (1) and 1946 (2) and by 1949 the idea was so popular as a convenient and seemingly practical answer that nobody listened to Ling when he announced that it was impossible. And even today, few scientists are interested to know that the "sodium pump" is impossible – even though a search of the scientific literature reveals that not one coherent paper has laid out the theory and interpretive value of the "sodium pump" idea. In fact, even third generation advocates of the "sodium pump" at Cambridge University admit that it is not a true scientific theory (3), and it must be kept in mind that the greatest number of Nobel Prizes given for research work based on the truth of the "sodium pump" has been won by scientists at Cambridge. It is also sobering to realize that there has never been a Nobel Prize awarded for work on the "sodium pump" itself yet many awards have been given for work which incorporates it as its flat principle. Ling has argued persuasively that the "sodium pump" is not a theory or even a hypothesis but consists of the rephrasing of observations. It has never been identified, it cannot be proved, there are no concrete facts that support its existence, and yet it stands in the way of great progress in research, diagnosis, and the practice of medicine.

In a series of articles critical of the "sodium pump", Freeman W. Cope, MD of the Biochemistry Laboratory at the Naval Air Development Center in Warminster, PA writes "In present textbooks of medicine, lengthy explanations of salt and water disturbances in disease are presented that try to explain critical measurements and why some salt and water therapies are effective and other are not. In fact, present treatments of salt and water disorders in human disease are mostly empirical. Theoretical approaches from physical chemistry have shown themselves to lack predictive value – which is not strange – since they have been based on a false model of the cell." (4)

Each time Cope authored a challenge to the "sodium pump", he detailed the theories which will replace it (4-6) explaining that in Ling's model of the cell potassium is held inside by electrostatic forces

operating somewhat like magnetism. (7) Water in cells is not free liquid but is “structured” and almost crystalline, more solid that free liquid water but less solid that ice. Cope and Damadian have confirmed the existence of this “structured water” by using Nuclear Magnetic Resonance (NMR) measurements.

There now exists two basic models of the cell. The old model is essentially a bag of water with proteins dissolved in the solution. In order to explain high cellular levels of potassium, researchers have had to rely on the idea of a pumping mechanism in the wall of the bag (the membrane). This mechanism is supposedly able to carry sodium out and potassium into the cell has been referred to in the literature as a membrane pump or, popularly, the “sodium pump”. Without it the bag of water model does not work. Ling has shown the “sodium pump” to be impossible.

In the new model, proposed by Ling and his colleagues, the cell is honeycombed by a fragile, invisible skeleton consisting of a latticework of protein and lipid (fat or fat-like) molecules. An electron current may flow through part, or all of this, “skeleton” which functions almost as one gigantic molecule and resembles a ball of steel wool or a sponge. As shown by magnetic resonance imaging, water in the pockets of this sponge-like “skeleton” is structured water; molecules nearest the skeleton are in orderly arrangement while those at a greater distance are more random. As extracellular fluid diffuses through the cell, rapid exchange of ions occurs. Ion and water concentrations are controlled by the “skeleton” which chooses potassium over sodium. The structuring of water itself controls ion concentration to some extent in much the same way that the water is purified of foreign substances as it freezes to ice.

Why the Old Idea Seems Right

The “sodium pump” was, in some ways, a logical extension of dilute solution theory (12). Researchers knew that there is a strong tendency of soluble molecules to diffuse as ions in water so that the concentration of salt in seawater for example is nearly the same in all parts of the sea. This rather fundamental observation is easily confirmed by lowering a thimble of salt crystals (sodium chloride) slowly into a glass of water not disturbing or stirring the water. It will be noticed, as time passes, that the water in the glass has a uniformly salty flavor. This is so because ions of sodium and chlorine have diffused throughout the water.

Scientists had found that fluid surrounding the cells (extracellular fluid) contains a great deal of sodium and lesser amounts of chloride and bicarbonate ions. Conversely, they found that fluid inside cells (intracellular fluid) was very high in potassium and also contained significant quantities of magnesium and phosphate ions.

They also observed that the levels of various ions in the extracellular fluid change during different phases of cell activity. In order to explain this, scientists deduced that there must be tiny pores in the cellular membrane (13) through which ions pass freely in and out of the cell.

With the movement of ions established, and with the understanding that the cell membrane was full of tiny, ion-sized holes (8 Angstroms) researchers were now faced with the question which is central to our hypothesis: Given the tendency of ions to diffuse equally into all parts of a solution and

holes in the cellular membrane through which ions may easily move, what is normally keeping 97% of the body's potassium in the cells and 93% of the sodium out?

In 1941 R.B. Dean conjectured that there may be some sort of pumping mechanism (1) which continually pumps sodium out of the cell and pumps potassium in. This "pump" could supposedly push ions against the gradient into solution with an already high concentration, like stuffing another set of clothing into an already overfilled suitcase, or perhaps like pushing a heavy rock uphill, a function that requires energy. August Krogh wrote about the "sodium pump" next in 1946 (2). After his writing the idea snowballed.

The current version (unproved) of the "sodium pump" which is prominently featured in all textbooks of medical physiology, goes like this: The pump is thought to be a carrier, possibly a chemical or an enzyme or a protein, present in the membrane cell. In order to carry the potassium into the cell, literally forcing it, the pump must have energy. This energy is thought to come from the enzyme adenosine triphosphate (ATP), which is known as "energy currency" or energy storage battery, which provides energy for most functions of the body. Because ATP is so plentiful – at least 99% of all carbohydrates utilized by the body go to the manufacture of ATP – it would be the only possible fuel for such an energy-hungry "sodium pump". (14,15)

The "sodium pump" is a very interesting idea, but has the actual mechanism been identified? No. Has the idea led to observation of fact from which to build a proper scientific theory? No. Gilbert Ling cites mathematician Charles Babbage to describe writers of "sodium pump" literature. Babbage, a 19th century scientist, defined three kinds of fraud in science writing: fabrication, trimming, and cooking. Ling thinks authors of the pump idea are primarily guilty of cooking, eg: choosing only those ingredients that will support one's hypothesis and discarding others. Damadian offers this blunt analysis: "The sciences, like a lot of other…activities where the rewards are not monetary but fame and glory, are ego-driven specialties. That's the root of the problem. The thing is that the British scientific community staked itself out on this "sodium pump" foolishness and got a bunch of Nobel Prizes and convinced the whole world that is was so when in fact it was an off-hand suggestion in one lousy paper by someone who didn't consider it very seriously". (16)

The historian Thomas Kuhn described science in terms of paradigms (17) pervasive frameworks of scientific thoughts. A poor paradigm promotes fragmentation of scientific logic while a good paradigm promotes unity. The "sodium pump" may be said to be a poor paradigm for reasons mentioned previously. Ling's theory – the Association-Induction (A-I) Hypothesis, developed in his book *In Search of the Physical Basis of Life*, is a new paradigm. Ling thinks it can easily replace the "pump" idea. He noted, "The incorrect paradigm cannot bear to look at history because it has no coherence. History, to it, is merely yesterday's newspaper. The coherent theory sees its roots in history and absolutely depends on and is part of history." Ling has found Thomas Huxley's protoplasm concept – an idea which has been extinct for fifty years – to be in full harmony with the A-I Hypothesis. Huxley used the descriptive words 'physical basis of life.' Ling explains, "That is why the title (*In Search of the Physical Basis of Life*) is another way of phrasing the A-I Hypothesis in its historic perspective and what it portends for the future. How did we become what we are? How does it happen that at the peak of our accomplishment

in the A-I Hypothesis we have practically become excommunicated? We have practically no audience at this time among the establishment." (18) The "sodium pump" was widely thought to be fueled by adenosine triphosphate (ATP) (the only possible source of energy for such a pump). In the early 50's Ling inactivated all energy systems in the cells, including ATP, by poisoning them. In spite of the resulting lack of energy in any form cells maintained high level of potassium for many hours, with ions of sodium and potassium passing freely in and out of cells. Ling calculated that a pump operating under these conditions – even a 100% efficient pump – would require from 15 to 30 times the energy available. Thus, the "sodium pump" violated a basic law of physics – the Law of the Conservation of Energy – by requiring more energy than was available in the system. (21-23)

Through slow and careful experimentation, Ling deduced the principles of his new theory and developed the Association-Induction (A-I) Hypothesis. He had created what Cope calls "an elegant model of the cell, incorporating the ideas that (a) cell water is structured (b) cell cations are associated mostly with macromolecules and (c) cation pumps do not exist." (6) Ling decided that the potassium in cells gathers at negatively charged association sites along macromolecules of proteins and lipids (fat or fat-like substances). (7,23,24) Once the potassium atoms are in place a force of attraction causes water molecules to line up their oxygen atoms facing one direction and their hydrogen atoms the other – around the protein/lipid macromolecules. This produces a layer of structured water. By "structured" it is meant that the water molecules are not free or random but exhibit an orderly arrangement as in ice crystals – although cellular structured water is much less solid than ice. (5,6)

Around the initial layer of highly structured water molecules is a second layer, which is less structures because it is farther from the attractive force of the protein/lipid macromolecules. The third layer is less structured than the second and so on. It is not known exactly how many layers of structured water molecules there are. Water molecules most distant from the macromolecules are most random and, most like free liquid water, although even this water is probably somewhat structured.

The protein/lipid macromolecules are interwoven in a latticework that extends throughout the cell to form a skeleton-like structure resembling a sponge. This skeleton itself controls ion concentrations by choosing potassium over other ions and by structuring water. Water that structured will not readily accept ions or foreign materials. Although much sodium laden extracellular serum diffuses through the cell and ions are exchanged between the cell and serum no energy is required in the form of ATP to maintain high cellular levels of potassium and other ions. In theory, the cell could hold these high concentrations forever without using energy. Only when cells are damaged by trauma or poison do they require energy from ATP. (23,24,25)

Ling solidified this model and in 1962 published the detailed book *A Physical Theory of the Living State, the Association-Induction Hypothesis*. (7) Shortly after the book was published, Cope and Damadian become involved showing with NMR (Nuclear Magnetic Resonance) measurements that cell water is not free liquid, but structured, like the ion exchange resins of a water softener. (7,23,26-33)

Ling's former college roommate and close friend, Chen Ning Yang, wrote the introduction to A Physical Theory of the Living State. Yang came to the U.S. with Ling after winning the Boxer Fellowship in

Physics the year Ling won in Biology. Yang received the Nobel Prize in Physics in 1957 and is considered one of the world's foremost authorities on cooperative phenomena. He was fascinated by Ling's A-I Hypothesis, which was accessible to him through his own work with the Ising model of magnetism. The Ising model forms the basis of modern physics theory of phase transitions (the familiar examples are condensation of steam into water and the freezing water into ice) and, more generally, of cooperative phenomena. Yang – currently (1981) the Einstein Professor of Physics Director of the Institute of Theoretical Physics of the State University of New York at Stony Brook – worked with Ling to further develop one aspect of the A-I Hypothesis, the idea of near neighbor interaction (cooperation). Together, they applied the one-dimensional Ising model to the biological polymer and, as Ling said, "We have been using that to describe quantitatively the behavior of in vitro (in glass) and in vivo (living) systems with considerable success." (34)

Freeman Cope, M.D., came into the study of structured water in living cells from his extensive work in solid-state physics (33). He has combined his training in medicine and physics to look into the future of medicine form the vantage point of Ling's monumental Association-Induction (A-I) Hypothesis. From the same vantage point he looked into the past, to the work of a medical pioneer from Germany, Dr. Max Gerson. (35.36) Cope's interested on the possible crossover to biological systems of solid state physics led him to read Ling's first book. (7) Shortly after reading it he contacted Ling to question him. Cope knew that biochemistry was based on the behavior of ions in dilute solution. Small molecules are known to float around in solution bumping into each other at random and sometimes reacting as they bump. However Cope reasoned things happen differently when large clumps of molecules are present because different forces are active (30,31). He was excited to see in Ling's work a logic that related some of these basic concepts. Becoming much more familiar with Ling's theoretical model of forces in cells, Cope deliberately tested the model. Using NMR measurements he verified the type of water structuring Ling had described. (21,30)

Cope continued to follow Ling's work and was eventually inspired to make a prediction of the medical applicability of some treatments suggested by that research. He predicted that large amounts of potassium could be added to a low sodium diet to the benefit of patients suffering from many diseases, and certainly heart disease (Gerson had applied this thinking in cancer and other diseases. Sodi-Pallares had done the same in heart disease. Cope was unaware of their work at the time of his prediction).

What Dr. Cope Saw – Tissue Damage Syndrome

In many degenerative processes cells are swollen with water and sodium, (38) they have lost potassium and no longer function normally. Healthy cells maintain high levels of potassium (K+) as long as they suffer no chemical or physical damage and have sufficient ATP. ATP is used to keep the cell protein in its normal configuration and in fact is part of that normal configuration. For every molecule of ATP which joins with a cell protein macromolecule, approximately 20 association sites are formed (24) which exhibit a strong preference for K+ (23,39-42). With a high concentration of K+ the cell's water is structured. Some of it (20%) is highly structured and all of it is more structured than the free liquid water. (26,27) This enables the cell to refuse sodium, which cannot dissolve in the structured water.

Writing on Physiological Chemistry and Physics, (4) Dr. Cope suggests, "When cell cation association and cell water structuring are disturbed by damage of any kind, it is probably that the production of ATP by mitochondria (tiny energy factories of the cell) will be adversely affected which will decrease ATP concentration, which will intensify the disturbances in cation association and water structuring, which will further impair mitochondrian ATP production and so on, in a cycle of destruction."

Cope calls this "cycle of destruction" the Tissue Damage Syndrome. It is capable, he says, of affecting tissues anywhere in the body. Without sufficient ATP, a damaged cell will not be able to return its proteins to the configuration and it will be unable to structure water. Cope writes "In the damaged configurational state, the cell proteins lose their preference for association with K+ rather than Na+, and the water content of the cell increases (the cell swells)" (38).

Cope has also written that the extent of the damage to the cell proteins and the length of time the mitochondria are exposed to the unfavorable salt and water environment are decisive. In the extreme the damage to the cell will be irreversible because of damage to the cell proteins is not too great, Cope predicts, "the configurational state of the proteins and also the induced charges of cation association and water structure are reversible. Medical treatment may therefore partly or completely correct the tissue damage syndrome if it is not too severe or has not existed for too long a time."

The tissue damage syndrome is something more and more physicians will come to identify in their patients in the future as the ideas of water structuring and ion-association are ushered in by the use of Damadian's MRI diagnostics (43,44). Cope postulates, "the (tissue damage) syndrome is likely to be observed in varying degrees, mild or severe, acute or chronic, and arising from any cause. Examples probably include acute myocardial infarction and chronic hypoxia of the tissues due to chronic heart failure."

By 1976, Ling's careful experimentation had given Cope the fuel he needed to make a successful medical prediction – that potassium (K+) could be given in addition to a low sodium (Na+) diet to correct the tissue damage syndrome:

"In the damaged cell the proteins lose all or part of the preference of their sites for the association with K+ rather than for Na+. Nevertheless a competition between K+ and Na+ for these sites

still exists. Therefore, if in the environment around the cell the concentration of K+ is increased compared to the Na+ the association sites are forced to accept more K+ and less Na+ because of the cooperative interactions between association sites. This tends to restore the normal configuration of the proteins. It follows that treatments to increase tissue K+ concentrations and/or to decrease tissue Na+ concentrations are a logical therapy for the tissue damage syndrome."

"Low sodium therapies are widely used and highly effective in acute and chronic heart disease. Methods of treatment include low sodium diets and diuretics to remove sodium already present in the body. Reasons are given in textbooks for the observed effectiveness of low sodium therapies is generally superficial and ambiguous. Yet in acute cardiac damage there is obvious tissue damage syndrome in the heart. In chronic heart failure, there is probably chronic hypoxia due to inadequate blood flow. There, low sodium therapy is a logical approach to both conditions in the light of modern theory." "High potassium therapy either alone or together with low sodium therapy is also a logical method for treatment for the tissue damage syndrome, but has little clinical use." Only six months after making this prediction, Cope found that the ideas had already been broadly applied successfully in the clinic by Dr. Max Gerson of New York. And within six months of that discovery, Cope found that the ideas had been successfully used in acute myocardial infarction by Dr. Demetrio Sodi-Pallares of Mexico City. (39-41)

Cope found in Max Gerson this century's pioneer in low-sodium – high potassium therapy. Gerson received his medical training in his native Germany at the turn of the century. His successful yet controversial treatment of skin, lung, and bone tuberculosis was based on a low sodium diet (48) which Dr. Gerson was later able to apply successfully to cancer. (49)

Dr. Erich Urbach, a distinguished pioneer dermatologist in the United States, wrote glowingly of Gerson's successes with tuberculosis in the 1946 test Skin Disease, Nutrition and Metabolism.

"Much credit is unquestionably due Gerson, as well as Sauerbach and Hermannsdorfer for valuable contributions to the therapy of cutaneous (skin) tuberculosis in the form of diets which bear their names. Although over a hundred years ago Struwe advocated a salt-poor diet for the treatment of tuberculosis it was Gerson who really introduced dietotherapy for cutaneous (skin) tuberculosis and who methodically studied the clinical course of the disease under the salt-poor, high vitamin dietary he had planned."

"This dietary therapy for cutaneous (skin) tuberculosis has been extensively tested and approved by the majority of authors: Jesionek, Jesionek and Bernhardt Bommer, Volk, Wichmann, Judassohn, Streumke and Mohrmann, Brunsgaard, Scolari, Dudas-Grants, Stokes and others. Particularly noteworthy are the investigations which Jacobson and Brill, and Gawalowski carried out over a number of years… The Russian authors treated 124 patients who were under observation for five years, while the Czechoslovak investigator followed 127 cases. Both groups showed marked improvement."

Gerson did not add additional potassium – which Cope predicted to be valuable – until he became involved with the treatment of cancer. Gerson struggled with the question of the importance of potassium trying to reconcile his own extensive clinical observations with the available literature (49):

"In a recent article Barnell and Scribener (51) came to the conclusion that serum potassium (K) concentration can be used as an excellent guide to potassium need. My experiences in advanced cancer cases and in some chronic diseases contradict these findings. The serum is only a passage channel for support and exchange. Low K-figures may show best healing because the depleted tissues reabsorb K+ while high figures may be found in failures because the tissues lose K."

Indeed it is a simple extrapolation that suggests that cells damaged by tumor toxins might lose the ability to structure water, thereby losing potassium and absorbing sodium and water. The net effect this would have on serum would be the elevation of the serum potassium and a drop in serum sodium. This might, unfortunately, prompt the treating physician to administer sodium chloride and prohibit potassium in an effort to cause the serum readings to return to normal. The additional sodium could only make matters worse.

Gerson described the process and literature which led him to administer very large quantities of potassium (K+) to advanced cancer patients: "The decision to apply large K+ doses in a compatible composition immediately (at the beginning of treatment) was finally made after about six years of indecisive clinical experiments until I saw regularly better and more extensive clinical progress. The laboratory reports about K were fluctuating and not in conformity with the clinical picture. The literature presented a different viewpoint; there, almost all tables except the articles of Moravek (52,53) showed an undiminished K+ content in cancer tissues. He found diminished K in the beginning and later uncertain ups and downs. The situation was cleared up when Lasnitzski (54) found the ionized K41 diminished in cancers. The leading cancer specialists still rely on the laboratory work in their decision."

Gerson's treatment produced documented successes. Cope wrote (55): "The Gerson cancer therapy is an integrated set of medical treatments which has cured many advanced cases of cancer in man. Gerson developed it empirically in the course of 30 years of clinical experimentation. Essentially, he tried many variations and combinations of treatments on cancer patients, always retaining that which was successful and discarding that which was not. Gradually he evolved an integrated pattern of treatment which cured many cases of advanced cancer, 50 of which are described in clinical detail in his book."

Calling the Gerson cancer therapy a logical application of the Ling Association-Induction Hypothesis. Cope wrote:

"The high K+ low Na+ diet of the Gerson cancer therapy is a logical strategy for improving the health of the body tissues of which probably all and certainly the liver are suffering from the tissue damage syndrome. Some components of which were observed and recognized by Gerson. Treatment with the Gerson diet to increase tissue K+ concentration and to decrease tissue Na+ concentration is a logical therapy for the tissue damage syndrome in the cancer patient."

In the article entitled "The Pathology of Structured Water and Associated Cations in Cells (the Tissue Damage Syndrome) and its Medical Treatment" (4) Cope offered the following table to illustrate changes in tissue content of sodium and water when the tissue became damaged:

	State of Muscle	
	Normal	Poisoned
Potassium (mM)	105	6
Sodium (mM)	20	120
% of Normal Water Content	100%	121%

In addition, Damadian, who has catalogued many nuclear magnetic resonance measurements of cancers, suggests that the water content of a cancer cell may be even higher than that of damaged tissue, much higher. The normal cell is approximately 66% water and 34% other substances. Cancer cells which tend to be large in comparison with normal cells are as much as 90% water with greatly elevated sodium levels (16).

MRI measurements have shown that both tumors and developing tissues have a high sodium water content. Cancer cells that are low in potassium have lost their ability to structure water. They are swollen, the membranes stretched taut. Research has shown that a high potassium low sodium environment is unfavorable for tumor activity (56,49). Tumor tissue may be said to be like embryonic tissue gone wild, not subject to control. Sodium and potassium NMR readings are alike in embryos and tumors as shown first by Damadian.

Interestingly, a possible rationale for the Gerson cancer therapy comes from outside the ranks and it too, concerns itself with cellular ion concentrations. It has been suggested by William Regelson, M.D., of the College of Medicine at the Commonwealth University of Virginia in Richmond that Gerson's cancer therapy possibly achieved its clinical results as an approach that altered the mitotic regulating effect of intercellular sodium" (57). Regelson, Medical Director of the Fund for Integrative Biomedical Research based his comment on the work of Clarence Donald Cone, a physiologist who has generated substantial experimental data concerning changes in potassium and sodium levels in cancer cells.

Cone has confirmed that the elevated sodium content of cancer cells forces them to continually divide and produce tumors (56, 58-60). By altering ion levels inside and outside the cells he has experimentally stopped cancer cell division and in some cases produced swelling and rupture. Cone is now involved in extensive human trials to validate methods derived from his research with animals.

Although Gerson's highly innovative and controversial treatment has been listed for years by the American Cancer Society as an unproven method, (now an "alternative complementary method"), Dr. Regelson has recommended another look at the approach on the strength of Cone's evidence.

There are pockets of acceptance for Gerson's ideas and understanding of his results in cancer but nowhere is the support as unqualified as in the small group of cell biology revolutionaries, for in Gerson's work they see their historical roots. Gerson's incisive reasoning was surprisingly close to home. "Generalizations in cancer are most difficult to formulate, in my opinion, the area wherein they may be possible will be in the biological field of electrical potentials, ionization of minerals and reactivation of enzymes." (49)

Gerson's final years of clinical practice took place during Ling's first years of testing the Association-Induction Hypothesis. Gerson had been combining the literature in search of something, anything, to confirm and offer a rationale for his clinical success. He had written, "We now know that what we have inherited is not a set of chemical substances, but a pattern of dynamic energies." If he has seen Ling's work he would have recognized it immediately, but the two were destined never to meet. Perhaps, if either Gerson or Ling had been allowed uncensored publication in scientific journals that need not have been the case.

A more fortunate timeline has connected Ling with one of the most innovative cardiologists in the world. Six months after discovering the work of Gerson, Cope was surprised to find that "Sodi-Pallares and co-workers (46,47,51-65) in Mexico have for many years been using high potassium in diet and intravenous fluids together with low sodium for successful therapy of both chronic heart failure and acute myocardial infarction. Dr. Sodi-Pallares is one of the most widely respected cardiologists of Latin America". (66)

Sodi-Pallares, in his 1976 book *Ischaemic Heart Disease and Polarizing Treatment – New Metabolic and Thermodynamic Bases* (65), cites the work of Hans Selye as showing potassium salts to have a protective effect in the heart under conditions which would have otherwise produced cardiac degeneration (67, 68). His decision to use a low sodium, high potassium diet in heart disease resulted from a very personal experience as his own mother suffered from the condition. Reasoning that diuretics were intended to lower sodium in the heart patient, Sodi-Pallares set about to construct for her a very low sodium diet which proved successful. Through years of clinical observations and research, he arrived at the conclusion, "Angina pectoris and myocardial infarction are not conditions that derive from coronary disease. They originate from changes in the metabolism of myocardial fibers which begin with a thermodynamic disturbance many years before coronary arteries are affected." (65)

The "disturbances" he describes are very much in accord with Cope's description of the tissue damage syndrome. According to Sodi-Pallares "the consequences of these thermodynamic changes are immediate. They include sodium retention, potassium loss and increase of lactic acid at myocardial fiber level, concentrations of blood cholesterol and triglycerides increase (hyperlipidemias) and, later on, there is coronary damage. This explains the poor results of (standard) treatment and preventive measures in the so-called Coronary Disease." (65)

Sodi-Pallares gives a diet strikingly low in sodium to acute heart disease patients. No other practitioner surely, has come close to these phenomenally low sodium levels in any sodium-restricted diet for blood pressure or any other disease. He recommends a total daily intake of only 300-360 milligrams that is less than the patient normally excretes in the urine. He ensures adequate urine flow and sodium excretion by insisting on ample fluid intake. The diet is given in the presence of heart failure, recent myocardial infarction, severe angina pectoris, severe ventricular arrhythmia, and hypertension with diastolic figures above 110.

In less severe conditions or as patients respond the diet may be relaxed to include 500-1000 milligrams of sodium. In recovered cases this figure may be raised to the maximum of 1500 milligrams,

which is reduced with return of any symptoms. Even at the highest levels allowed his patients receive only from 2% to, at the outside, a whopping 6% of what the U.S. National Academy of Sciences estimated to be the average American's daily intake.

In severe cases, Sodi-Pallares uses what he calls "polarizing solutions", his own ideas inspired in part by work for which he has expressed gratitude to French scientist Henri Laborit (69). He writes "The Polarizing Treatment is also essentially dynamic and sufficiently flexible to allow inclusion of all the other measurements and medications which protect the myocardial fibers. The Polarizing Treatment originated with the hyposodium and hyperpotassium diets (polarizing diet), which are still its cornerstone. The polarizing solutions came later, reducing the infarction size and when prescribed correctly and with the proper diet – replacing with great advantage digitalis and diuretics… polarizing solutions with glucose, potassium, and insulin (G.K.I.)… increase ATP formation" (70,71).

Sodi-Pallares says the new treatment removes pain by correcting the underlying problem, unlike coronary bypass surgery that often relieves pain at the expense of structural damage. "It controls the contractile failure of the myocardium, improving ATP production, without driving the heart (digitalis), and without worsening an already handicapped metabolism (diuretics)." One might infer that the increased production of ATP – as seen in heart patients using the Polarizing Treatment – is due to increased potassium concentration in damaged cells correcting abnormal sodium and water content to allow water structuring, thus permitting the mitochondria to produce ATP normally. When Cope became aware of Sodi-Pallares' work he wrote him letter immediately describing the findings of Ling, Damadian, Cope, Hazlewood et at. (72) Sodi-Pallares responded enthusiastically, inviting participation in a symposium in Mexico City, which Ling attended. The newly united scientists are making up for lost time with Sodi-Pallares requesting a paper from Ling to be translated into Spanish and French. Both authors are writing new major texts each making prominent mention of the other's work.

Sod-Pallares presented results in 1969 to the New York Academy of Sciences (73) and has published widely in U.S. medical journals. His work promises a major break-through in treatment of cardiac disorders and his assertions are very optimistic: "A low sodium and high potassium diet gives electrocardiographic and clinical results which are far better than those produced by a low cholesterol diet. Sodium restriction is particularly beneficial for hypertensive patients and patients with angina or heart failure."

Possibly the most far-reaching reaction to correct treatment of salt water disorders – and possibly the greatest resistance – will be seen in the world's pharmaceutical manufacturing industry. Sodi-Pallares has written "The doctor must also refrain from prescribing medications with ecotopic or depolarizing effects except in well-defined circumstances and even here he must try to avoid the depolarizing and ectopic effects of these medications (75,76)…The majority of the medicines we use in cardiology are capable of producing undesirable side effects and may depolarize the myocardium and it is for this reason that we have removed from our armamentarium many of them such as: diuretics (77,78)… digitalis (77-78)… antiarrhythmics (64)…"

These drugs are big business items and there can be no doubt that pharmaceutical industries would feel deeply any substantial reduction in their use by physicians who wrote 23 million prescriptions for digitalis in 1980 in the U.S. alone, one brand of which, Lanoxin, is the number 7 best-selling drug in the U.S. (84).

These cardiac preparations may represent only the ground floor of the skyscraper according to Gerson, a keen observer of vast clinical experience, who raised three key points concerning administration of drugs to patients receiving the low sodium diet he constructed. Writing in his 1934 book *Diattherapie der Lungentuberkulose (Diet Therapy for Lung Tuberculosis*) he suggested 1) minute doses of drugs may be effective, 2) at the same time even tiny doses of drugs might be harmful, and 3) drugs which have not previously worked may be useful in this context.

Gerson wrote "It very quickly became evident that the inability of the patient to tolerate drugs increases with the length of time on the diet therapy. So that, in many cases 1/5 and perhaps even smaller fractions of the usual recommended doses of these treatments can be damaging, regardless of whether they are ultraviolet, X-ray, gold, tuberculin, morphine derivatives, or salicylic acid (aspirin). This side effect of the diet therapy promises the future likelihood of promoting healing with very minute quantities of even drugs which, when prescribed with a normal diet and in high doses do not obtain results. On these grounds, this book cannot overemphasize and must warn that at the present time our experiences are such that ever-so-small doses of medications or other therapies may not be so harmless. Attempts to combine drugs and other modalities with the Gerson Diet can have very negative results."(48)

Gerson's observations are echoed by Sodi-Pallares, "We rarely prescribe diuretics nowadays since the diet has shown that they are unnecessary in the great majority of cases. The same can be said of beta-blockers, steroids and other drugs; the low sodium and high potassium diet considerably reduces the doses of these medications while maintaining their efficiency and avoiding complications of their administration." (65)

While he avoids their use in most patients, Sodi-Pallares has found that doses of defibrillating drugs – reduced in the fashion of Gerson – are effective. He writes, "If a patient requires digitalis to control his heart or a fast ventricular rhythm produced by atrial fibrillation, the polarizing diet reduces he effective dose of digitalis to one third or one fourth of the dose needed without the diet – even though the diet was not specifically indicated for his condition." (65)

It may likely be of extraordinary significance to the manufacturers of diuretics – very popular drugs – that so simple an approach is as effective as those drugs and without side effects. The most frequently treated disease in the U.S. is hypertension, commonly treated with diuretics which Sodi-Pallares feels are harmful: "After a long period of observing the effect that the diet has in maintaining equilibrium in very advanced cardiovascular conditions – particularly on the size of the heart – we were convinced that the progress of the disease and the ever-increasing cardiac enlargement are mainly due to the iatrogenic effect of the medicines used. These alter the patients' metabolic-thermodynamic condition perhaps even more than the disease itself."

Raymond Damadian, inventor of MRI scanning technology and the president of FONAR Corporation, which manufactured the first MRI scanner, was working in the lab of A.K. Solomon who is widely cited for work and writings on the "sodium pump" and related theories (14,15). Damadian became aware through a series of events that the "pump" idea was not going to work out (85-87). He began to look in directions that led him to Ling, who's A-I Hypothesis immediately made sense. Damadian visited Ling in Philadelphia to learn more of this new and compelling theory of ion-association and water structuring. Subsequently – working independently and having been greatly influenced by Ling-Damadian developed his own model of the cell as an ion-exchange resin granule, a concept which Ling had considered but discarded (85,86,87). In Damadian's Ion-Exchange Resin Theory, cellular ions are accumulated and selected much the way they are in an ion exchange resin bead. By attachment of the ions to fixed charges of opposite sign anchored to the matrix of the bend. Water selects one ion over another, contractile proteins (29) within the cell fueled by metabolism control cellular water content.

Damadian worked with Cope to confirm cell water structuring by NMR and did additional experiments independently (88,90,91) satisfying himself that water structuring occurred. He also gathered significant data concerning differences in water structuring from one type of tissue to another. Then he made a conceptual leap that would make him famous. He reasoned that malignant cells because of known differences from normal cells would have water structuring distinguishable from normal cells and their NMR reading would be different. And he proved it. (43)

Other researchers have followed his lead (92-99) and have confirmed the detectability of cancers with MRI. While not all researchers have the frame of reference shared by Ling, Cope, Hazlewood, and Damadian, it is commonly accepted that the water in cancer cells is considerably less structured than in normal cells. It is now accepted that these cells contain abnormally high levels of water and sodium.

Damadian moved swiftly to develop and patent the magnetic resonance imaging whole body diagnostic technique that he calls FONAR (100-101).

FONAR and other MRI diagnostic machines in the works are able to measure the cell's ability to structure water, and in so doing are able to see things that the CAT scanner misses. MRI, which uses no harmful x-rays, was reported by a four institution team to have detected nearly 700% more multiple sclerosis lesions than the CAT scanner (103) which uses x-rays to measure tissue density. MRI has also detected tumors so small they were missed by radionuclide scan. It is more sensitive than either radionuclides scan or ultrasound in identifying cirrhosis of the liver (103).

It has been predicted that the MRI scanners will replace CAT scanners (103) which have not shown that they are useful enough to routinely expose patients to the cost and the risk (106). While the CAT scanner can show tissue abnormalities, it cannot see changes in the chemistry of those tissues. Luis Todd of the University of Nuevo Leon in Monterrey, Mexico, has reported that the FONAR machine he uses has demonstrated a chemistry analysis capability to differentiate between manic-depressive patients and those with similar symptoms but different illnesses (107).

With regard to the A-I Hypothesis, which is fully supported by the technology behind MRI, Ling knows he is correct. “This polarized water is not a fantasy. We can actually create a condition and make this water, and with the components which are present in all cells.” (34) His case is airtight. MRI is only one of a number of approaches that can be used to verify the cellular structure Ling has so carefully labored to understand. Dr. Ling is forgiving in nature. He explains that there is no real villain “they are all nice people.” Perhaps Copernicus understood opposition to the sun-centered universe in somewhat the same way.

References

1. R.B. Dean: Biol. Symp. Vol. 3, 331 (1941).
2. A. Krogh: Proc. Royal Soc., London, Ser. 3, V. 133, 140 (1946).
3. I.M. Gwynn, Karlish: Ann. Rev. Physiol. Cambridge (1975).
4. F.W. Cope: Physiol. Chem. Phys. 9, 6, 547 (1977).
5. ------: Physiol. Chem. Phys. 8, 5, 479 (1976).
6. ------: Physiol. Chem. Phys. 8, 6, 569 (1976).
7. G.N. Ling: A Physical Theory of the Living State (Blaisdell, N.Y. 1955).
8. F.W. Cope: Proc. Nat. Acad. Sci. 54, 225 (1965).
9. ------: J. Gen. Physiol. 50, 1353 (1967)
10. ------: Biophys. J. 10, 843 (1970).
11. G.B. Kolata: Science 192, 1221 (1976).
12. C.F. Hazlewood: Science 177, 815 (1972).
13. A.K. Solomon: Sci. Amer. 203, 6, 146 (1960).
14. ------: Sci. Amer. 207, 2, 100 (1962).
15. R.L. Post, C.R. Merritt, C.R. Kinsolving, C.D. Albright: J. Biol. Chem. 235, 1796 (1960).
16. R. Damadian: Pers.Comm. (2/4/1982).
17. T. Kuhn: The Structure of Scientific Revolutions (U. of Chicago Press, 1962).
18. G.N. Ling: Am.J.Phys.Med. 34,89 (1955)
19. W.D. McElroy, B. Glass, Eds.: Phosphorus Metabolism (Johns Hopkins Press, Baltimore, 1952).
20. G.N. Ling: Am.J.Phys.Med. 34,89 (1955)
21. ------: C.L. Walton: Physiol.Chem.Phys. 7,50 (1975).
22. ------: Am. J. Phys.Med. 4,89 (1955).
23. ------: Int.Rev.Cytol. 26,1 (1969)
24. J. Gulati, M.M. Occhsenfeld, G.N. Ling: Biophys.J. 11,1973 (1971).
25. L. Minkoff, R. Damadian: Bipophys.J. 13,167 (1973)
26. C.F. Hazlewood, B.L. Nichols, N.F. Chamberlain: Nature, 222,747 (1969).
27. F.W. Cope: Biophys.J. 9,303 (1969).
28. R. Damadian, F.W. Cope: Physiol.Chem.Phys. 8,349 (1976).
29. L. Minkoff, R. Damadian: Physiol.Chem.Phys. 8,349 (1976).
30. F.W. Cope: Bull.Math.Biophys. 27,99 (1965).
31. ------: Bull.Math.Biophys. 29,691 (1967).
32. ------: Adv.Biol.Med.Phys. 13,1 (1970).
33. ------: J.Biol.Phys. 3,1 (1970).
34. G.N. Ling: Pers.Comm. (2/4/1982).
35. M. Gerson: Physiol.Chem.Phys. 10,449 (1978)
36. F.W. Cope: Physiol.Chem.Phys. 10, 465 (1978).

37. C.F. Hazlewood, D.C. Chang, B.L. Nichols, D.E. Woessner: Biophys.J. 14, 583 (1974).
38. G.N. Ling, M.M. Ochsenfelf: Physiol.Chem.Phys. 8,389 (1976).
39. ------: J.Gen.Physiol. 49,819 (1966).
40. ------: G. Bohr: Biophys.J. 10,519 (1970).
41. I.L. Reisin, J.Gulati: Science, 176,1137 (1972).
42. J. Gulati, I.L. Reisin: Science, 176,1139 (1972).
43. R. Damadian: Science, 171,1151 (1971).
44. ------: K. Zaner, D. Hor, T. DiMaio: Proc.Natl.Acad.Sci., USA, 71,1471 (1974).
45. E.T. Angelakos, B.D. Polis, R.Riley: Circulation 49-50, Suppl. III (1947).
46. D. Sodi-Pallares, A. Bisteni, B.A. Medrano, M.R. Testrelli, A. DeMicheli: dis.Chest. 43,424 (1963).
47. ------: Ann.N.Y.Acad.Sci 156,603 (1969).
48. M. Gerson: Diattherapie der Lungentuberkulose (Leipzig und Wien, Franz Deuticke 1934).
49. ------: A Cancer Therapy – Results of Fifty Cases, 3rd Ed. (Totality Books, Del Mar, CA. 1979)
50. E. Urbach: Skin Disease, Nutrition and Metabolism (Grune & Stratton, N.Y., 1946)
51. Barnell, Scribener: J.Am.Med.Assn. 164,9,959 (J 29, 1957).
52. V. Moravek: Acta.Radiol, et Canc, Boh.Slov. 2,70 (1939).
53. ------: Zeitschr.F.Krebsforschung, 35,492,509 (1952).
54. Lasnitzki, L.K. Brewer: Can.Res. 2,494 (1942).
55. F.W. Cope: Physiol.Chem.Phys. 10,465 (1978).
56. C.D. Cone: N.Y. Acad.Sci. Ser.II, V.31, N.4, 404-427 (Apr 1969).
57. W. Regelson: J.Am.Med.Assn. 243,4,338 (Jan. 26, 1980).
58. C.D. Cone: J.Theor.Biol. 30,151 (1971).
59. ------: J.Theor.Biol. 30,183 (1971).
60. ------: J.Cell.Physiol. 82,3 (Dec. 1973)
61. E. Calva, A. Mujica, R. Nunez, K. Aoki, A. Bisteni, D. Sodi-Pallares: AmJ.Physiol. 211,71 (1966).
62. D. Sodi-Pallares: Am.J.Cardiol. 24,607 (1969)
63. D. Aviza-Herrara, D. Sodi-Pallares, L. Saenz-Arroyo, F. Cisneros, A. Bisteni, J. Vasquez del Mercado: Stroke, 3,76 (1971).
64. D. Sodi-Pallares, A. Bisteni, J. Ponce de Leon, D. Aviza, m. Gonzalez Ahumada G.A. Medrano: Agressologie, 13,391 (1972).
65. D. Sodi-Pallares, J. Ponce de Leon: Ischaemic Heart Disease and Polarizing Treatment (Tampa Tracings, Box 1245, Tarpon Springs, Florida, 1976).
66. F.W. Cope: Physiol.Chem.Phys. 11,93 (1979).
67. H. Selye: Experimental Cardiovascular Diseases (Springer Verlag, N.Y. & Heidelberg & Berlin, 1970)
68. ------: Ann.N.Y.Acad.Sci. V. 156, I. 195-206 (1969).
69. Sodi-Pallares, et al: Electrocardiografia Polimetrica Ediciones del Inst.Nal.de.Cardiol.demexico. Mexico, D.F. (1971).
70. E. Calva, A. Mujica, A. Bisteni, D. Sodi-Pallares: Am.J.Physiol. 209,371 (Aug.1965).
71. H. Laroti: Agressologie 15,11 (1974).
72. F.W. Cope: Pers.comm. (2/2/1982).
73. D. Sodi-Pallares: Ann.N.Y.Acad.Sci. 156,603 (1969).
74. Select Committee on Nutrition and Human Needs of the United States Senate: Dietary Goals for the United States (U.S. Gov't Printing Office, Washington, 1977 Stock no. 050-070-03913-2, Catalog No. Y 4. N95: D 63/3).
75. S. Gubjarnason: Cardiol. 57, 35-46 (1972).
76. D. Sodi-Pallares, J. Ponce de Leon, F. Cisneros, A. Bisteni, G.A. Medrano: Geriatrics, 21, 138 (1966).

77. ------: Gaceta Medica de Mexico, 104,407 (1972).
78. H.D. Ariza, M. Ahumada Gonzalez, J. Figueroa, D. Sodi-Pallares, A. Bisteni, F. Cisneros: Memorias deol VIII Congreso Nacional de Cardiologia, p.2 (1973) Mexico.
79. J. Ponce de Leon, H.J.A. Gonzalez, E. Comoglio, C.H. Linares, D. Sodi-Pallares: Memorias dol VI Congreso Nacional de Cardiologia, p. 80 (1969) Mexico.
80. J. Ponce de Leon, M. Gonzalez-Ahumada, D. Sodi-Pallares: II Congreso Medico Estatal de Baja California, Tijuana, B.C. (June, 1971).
81. J.Ponce de Leon, A. Bisteni, G.A. Medrano, D. Ariza, J. Ribeiro Nogueira, D. Sodi-Pallares: Resumenes del IV Congreso Nacional de Cardiologia, p. 36 (1965) Monterrey, Mexico.
82. P.R. Maroko, E. Braunwald: Ann.Int.Med. 79,720 (1973).
83. Y. Shinohara: Jap.Circ.J. 32,1269 (1968).
84. Associated Press, San Diego Union (3/25/1982).
85. R. Damadian: Biophys.J. 11,773 (1971).
86. ------: Ann.N.Y.Acad.Sci. 204,211 (1973).
87. ------: C.R.C. Crit.Rev.Microbiol. 377 (March 1973).
88. F. W. Cope, R. Damadian: Physiol.Chem.Phys. 6,17 (1974).
89. L. Minkhoff, R. Damadian: J.Bacteriol 125,353 (1976).
90. F.W. Cope, R. Damadian: Nature, 228,76 (1970).
91. R. Damadian, F.W. Cope: Physiol.Chem.Phys. 5,511 (1973).
92. ------: K. Zaner, D. Hor, T. DiMaio: Physiol.Chem.Phys. 5,381 (1973).
93. C.F. Hazlewood: J.Natl.Cancer Inst. 52,625 (1974).
94. ------: G. Cleveland, D. Medina, J.Natl Cancer Inst. 52, 1849 (1974).
95. D.C. Chang, C.F. Hazlewood: J. Magn.Reson. 18,550 (1975).
96. P.T. Beall, C.F. Hazlewood, P.N. Rao: Science 192,904 (1976).
97. P.C. Lauterbur: Nature 242, 190 (1973).
98. P. Manfield, A.A. Maudsley: Br.J.Radiol. 50, 188 (1977).
99. W.S. Hinshaw: J.Appl.Phys. 47,3709 (1976).
100. R. Damadian, L. Minkhoff, M. Goldsmith, M. Stanford, Koutcher: Physiol.Chem.Phys. 8,61 (1976).
101. ------: “Apparatus and method for detecting cancer in tissue”, U.S. Patent 3,789,832, filed Marche 17, 1972.
102. E.R. Shell: Tech.Rev. 27 (July 1981).
103. P. Gunby: J.Am.Med.Assn. 247,2 (1/8/1982)
104. J.L. Marx: Science 213, 24 (July 1981).
105. R. Tellalian, FONAR Corp.: Pers.Comm. (3/25/1982).
106. E.R. Shell: Tech.Rev. 23 (July 1981).
107. United Press International: “New Body Scan Process Shown, Called Potentially More Useful, Safer than X-Rays” (11/20/1981).
108. C.F. Hazlewood: Cardiovasc.Dis.Bull.Tex.Heart.Inst. 2,83 (1975).R. Damadian, G.N. Ling, C.F. Hazlewood, F.W. Cope: Science 193,532 (8/13/1976).
109. F. Capra: The Turning Point (Simon & Schuster, 1982).