Biological Terrain - Part 1

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Life and health as we know it today are changing dramatically. Never before in the history of man and womankind has the human organism had to deal with such an overwhelming degree of stress, illness, abuse, and neglect. The depletion and degradation of vital resources, the exposure to new viral and bacterial strains, pollution, petrochemicals, allergens, free radicals, excessive electromagnetic radiation, additives, and chronic environmental and mental stress are all giving rise to a vast array of new health challenges and degenerative conditions.[1] These modern-day ailments are necessitating new and expanded forms of health care assessment, evaluation, and treatment. Some practitioners are continuing to cling to the old standard forms of health care. Others are focusing their attentions and energies on becoming more and more specialized and illness-oriented. Large numbers of alternative and allopathic physicians and health care providers both in North America and abroad, however, are beginning to move beyond the old paradigms into an expanded and revolutionary approach to medicine and health care called Biological Terrain Assessment. This rapidly emerging field of science is providing them and their patients with valuable information and answers to their health care concerns. These solutions are supporting and restoring their patients' bodies and protecting them from the harmful effects of the stress and strains of modern day living.

Biological Terrain has its beginnings in Europe and is based largely on the clinical research of a noted professor named Louis Claude Vincent.[2,3] Professor Vincent discovered that the key to healing the body was not found merely in administering drugs. Rather, he believed that the key was found in the biochemistry of the body. His belief, based on a lifetime of gathering and evaluating human clinical data, was that the building blocks of life, the elements, amino acids, enzymes, molecules, and atoms found within the bodily fluids (the blood, urine, and saliva), provided vital data about the way that the body was actually functioning. By monitoring the subtle yet powerful values of pH (acidity and alkalinity), oxidation-reduction potential or redox (the electron potential and enzymatic activity), and resistivity (molecular ion movement) of these bodily fluids and making changes at a biochemical level, health and vitality could be re-established within the body that could help it to naturally combat illness and disease.[4]

Although Biological Terrain Assessment requires a thorough understanding of chemistry, biochemistry, physiology, and clinical nutrition, its philosophies and parameters are very basic. For example, in order to gain an overall working understanding of Biological Terrain, it can be very helpful to take a look at the process of growing food. Those who have lived on a farm or have had the wonderful opportunity to plant and care for a vegetable garden have probably come to deepen their respect, knowledge, and appreciation for the earth and the process of growth. They have discovered that planting a field or a garden is not just a matter of planting a seed and harvesting healthy food several months later. It involves knowledge of the chemistry of the soil, the nature of the seeds, proper control and measurement of nutrients and fertilizing materials, and assurance of adequate amounts of water and sunshine. It also requires an understanding of particular insects, molds, weeds, and fungi and what their presence indicates. When the soil is rich and filled with nutrients and minerals, the farmer or gardener can be assured that the seeds that are planted will yield food filled with vitality. He or she can also be assured that such care and awareness of the soil's vitality and ongoing monitoring of its enrichment minimizes or prevents the occurrences of molds, destructive plant microorganisms, fungi, and insect invasions. Biological Terrain Assessment, like raising a healthy garden, necessitates a thorough and comprehensive understanding of the chemistry of the human body. When the patient's body chemistry is balanced and maintained with a healthy diet and proper vitamin and mineral supplementation as well as adequate amounts of exercise and rest, the body, like the garden, can remain strong and healthy. It can also nourish a vibrant immune system that can protect and sustain it. However, if the body is fed a diet that lacks adequate vitamins, minerals, and nutrients or is processed and chemical-laden, much like the typical American diet, the body experiences illness and is unable to maintain or sustain a strong immune system. Likewise, if the body is exposed to improper amounts of rest or exercise or excessive levels of stress, the body becomes more susceptible to illness. Just as a neglected crop fails to produce healthy foods and becomes highly susceptible to elemental breakdown and destruction, so, too, the human body fails to produce vitality and wellness and becomes increasingly susceptible to illness, stress, fatigue, and chronic degeneration. In our world these inadequacies and excesses are currently altering the biochemistry of the human body to such a degree that wellness and vitality are becoming the exception rather than the rule.

While many fields of medicine and science examine, isolate, or treat one particular part or system of the body, Biological Terrain practitioners clinically monitor the entire internal biochemical environment of the body. The goal is to gain a deeper understanding of the in-

depth elements within the patient's chemistry and prescribe the exact forms of treatment to help their patients regain and maintain a healthy internal biochemical environment. Doing so at a chemical level can then, in time, translate vitality and health to every cell, tissue, organ, and gland within the patient's body. Biological Terrain practitioners honor the principle that every human body is unique and as such, every ailment must be treated specifically. Even individuals that seem to have similar conditions such as arthritis or pre-menstrual syndrome may display biochemistries that are very different and subsequently require very different forms of treatment.

Many patients who initially undergo Biological Terrain Assessment come into their practitioner's office with reports of "normal" laboratory values and yet display illness both objectively and subjectively. After analyzing their bodily fluids for pH, redox, and resistivity, important data begin to emerge. This information helps the practitioner and the patient uncover the underlying cause of their imbalance or illness. Often very subtle yet potent influences are at work within the patient's biochemical system which can include but are not limited to parasites, viruses, fungi, pollutants, zenobiotics (environmental poisons), invasive micro-organisms, free-radicals, lack of adequate vitamins and minerals, lack of available oxygen, and the inability of the body to excrete carbon dioxide. Most standard laboratory tests are not equipped to detect or measure these elements and as a result, many patients remain sick and their doctors confused and unable to accurately ascertain their patient's clinical condition.

In order to evaluate an individual's Biological Terrain or internal biochemical environment, a practitioner analyzes urine, venous blood, and saliva.[5] In most instances, these tests are conducted in a clinical in-office assessment procedure. This test requires that a patient undergo a 12-14 hour fasting period. They are advised to avoid the use of toothpaste, mouthwashes, or lipstick that can change the chemistry of the mouth. They must also obtain and bring into the office their first morning urine. Upon the patient's arrival in the office, a small venous blood sample (0.5 ml) is drawn and a small amount of saliva (0.5 ml) is obtained.[6] The urine, blood, and saliva are then analyzed by a computerized device called a BTA S-2000. This device uses specialized multi-element microelectrodes to determine the pH, resistivity, and redox values of the fluids. The nine scientific values obtained by the BTA S-2000 are then analyzed and plotted by the instrument's computer software onto a report. This data is then assessed by the practitioner and used as a teaching guide to share with the patient. Although the testing procedure does not diagnose any specific pathology or disease states, it does serve as an analytical guide post that can be extremely helpful in the overall evaluation of the patient. Any health care provider will instantly detect the value given from this information and implement its content along with his/her standard evaluation procedures. They will also revel in its in-office status and rely on its quick and accurate values to guide them into ordering more specific and focused laboratory tests. Regardless of the type of patients that a practitioner is testing or the modalities that the practitioner chooses to implement for therapy, this scientific assessment, coupled with a deep appreciation for the underlying Biological Terrain is a worthy investment; an investment in time and commitment which is required to comprehend and appreciate a complete understanding of the biochemistry and physiology that define the revolutionary assessment of the "Biological Terrain."

pH

One of the primary values in the assessment of the Biological Terrain is pH, an analytical measurement which represents the activity and potential energetics found within the hydrogen ion.[7] All bio-chemistry texts relate the discussion and evaluation of pH with the life-sustaining fluid of water. No living species on this planet can survive without water, nor for that matter can one single living cell. The chemistry of our bodies is considered to be analogous to the chemistry of water. When it dissociates or breaks apart, water will form ions, known as hydrogen and hydroxide. This dissociation can be understood by examining the equation:[8,9,10,11]

$$H_2O \rightarrow H^+ + OH^-$$

As this equation illustrates, water will separate into its basic elemental components. This separation process is known as dissociation or the rate of dissociation. The rate in which water dissociates into its base elements is equal to 1×10^{-14} moles per litre. This occurs under specific definable parameters such as constant temperature of 22° C and constant atmospheric pressure of 1ATM. Based on mathematical representation of negative cologrithyms, the concentration of the hydrogen ions is much more easily expressed in terms of whole numbers. Therefore, pH is in fact related to the hydrogen ion concentration and can be represented by the equation:[12,13]

$$pH = \log \frac{1}{H^+ \text{ Conc.}} = -\log H^+ \text{ concentration}$$

When expressed in these terms, the concentrations of the hydrogen ion can be placed on a scale ranging from theoretical 0 to 14.14. Upon further and more comprehensive examination of the equation above, it must be noted that as the hydrogen ion concentration *increases*, the resulting pH *decreases*. This consequence creates what is termed as an acidosis. Similarly, as the hydrogen ion concentration *decreases*, the resulting pH *increases*. This consequence creates what is termed as an alkalosis.[14]

The words acidosis and alkalosis are meant to refer to the relative concentrations of either an abundance of an acid to a base or an abundance of a base to an acid. Now that we know what creates an

acid or a base we must more fully comprehend their definitions.

An acid is a molecule or ion that can function as a proton donor.

A base is a molecule or ion that can function as a proton acceptor.[15]

More definitively stated, an acid is an ion or molecule that can furnish a hydrogen ion (H^+) to a solution. This is viewed as HCL ionizes in water to form hydrogen ions (H^+) and chloride ions (CL^-) and therefore is the acid known as hydrochloric acid. The hydrochloric acid has donated a proton (the H^+ ion) to the solution. Other vital acids that function in a powerful biological capacity are carbonic acid, acetic acid, uric acid, phosphoric acid, and nitric acid.

Similarly viewed, a base is an ion or molecule that will combine with hydrogen ions (H^+) and remove them from the solution. An example of this is the bicarbonate ion (HCO_3^-) which combines with a hydrogen ion (H^+) and forms the new compound known as carbonic acid (H_2CO_3). The bicarbonate ion has accepted a proton from the solution and is therefore responding as a base. Other vital bases that function in a powerful biological capacity are sodium bicarbonate, sodium phosphate, special inter-cellular proteins, and even hemoglobin in the blood.[16]

The most important aspect concerning acid and base physiology and their relative concentrations is that they help to maintain a definitive biochemical balance within the body. Through the balance created by the concentrations of these compounds, proper and biologically compatible pH levels are sustained. These levels are very precise and must be carefully guarded and perpetuated in order that cellular function and chemical reactions within the body can occur. Without this delicate balance of pH within the body, life as we know it today would not exist. A number of vital pH measurements for the body have been accurately determined in the following chart.[17]

Tissue or Fluid	pH
Saliva	6.0-7.0
Gastric secretion	1.0-3.5
Pancreatic secretion	8.0-8.3
Bile	7.8
Small intestinal secretion	7.5-8.0
Urine	4.5-8.0
Arterial blood	7.4-7.45
Capillary blood	7.35-7.4
Venous blood	7.3-7.35

As demonstrated in the chart above, pH must fall within a very narrow band in order for proper biochemical function to occur. If the pH values fall outside the ranges described either cellular function diminishes or death to the organism will ensue. Therefore, it is critical that the body regulate and maintain all of these varying pH measurements in order to not only function effectively but more importantly, to survive. Consequently, the body has created numerous elaborate and complex systems that carefully monitor and then control any aberrant acid/alkaline deviations. The systems designed to correct these fluctuations are known as the *acid-base buffer systems.*[18]

A buffer is a solution containing two or more chemical compounds that prevent significant alterations in pH regardless of whether an acid or a base is added to the solution. The buffer systems that are the most active and therefore the most critical are the bicarbonate/carbon dioxide system, the extracellular system (which is mainly comprised of the relative concentration of phosphate), the intercellular system (which relies on the buffering integrity of the intercellular proteins and in the hemoglobin within the erythrocyte), and the bone. Although this intricate web of powerful buffers is very complex and effective, variances in the pH of many of the more significant bodily fluids do often occur. The body is constantly being bombarded by acids, both from an internal metabolic production perspective as well as from exogenous sources. It is this on-going onslaught of acids that begins to wear on the efficiency of the biological buffers as well as deplete the necessary components that allow for proper buffer functioning.[19]

Acids are produced by the body as a normal function of cellular metabolism. These acids are greatly increased during times of stress as well as through factors that stimulate the sympathetic nervous system. Exercise also increases the rate and concentration of indigenous acids. Even with all of these many various forms contributing to the problem, the largest culprit in the excess acid production arena comes from the oxidation of fats, carbohydrates, and proteins.[20]

In a normal 70kg male, the metabolism and oxidation of dietary foodstuffs produces a wide array of chemical components that acutely impact the acid-base condition. When insulin is present and the tissues are adequately perfused with oxygen, cellular oxidation of carbohydrates and fats produces an excessive quantity of CO_2. This massive production of CO_2 is potentially toxic and stressful on the organism as a whole. Depending on the ability and the level of efficiency of the respiratory system, some CO_2, (although usually only a trace amount), will be vented out through the lungs. The remaining concentration of CO_2 will combine with H_2O and produce a volatile acid known as carbonic acid (H_2CO_3).

Concentrations of carbonic acid are not only difficult for the body to store, but in fact must be readily converted into their base components for immediate removal or they will be stored for later removal from the body. The body will break down the carbonic acid into a hydrogen ion and a bicarbonate ion as illustrated:[21,22,23]

$$H_2CO_3 \rightarrow H^+ + HCO_3^-$$

This breakdown allows for a higher level of efficiency to aid in the removal of this excess acid production. A portion of the newly formed hydrogen ions will be removed by the body through normal

renal physiology. However, as the kidneys are excreting the acid through the renal tubules, they are concurrently reabsorbing the bicarbonate ion. The reabsorption of the bicarbonate ion is vital, for without this compensatory mechanism the loss of this valuable ion would be similar to the addition of greater amounts of acids. Unfortunately, when the bicarbonate ion is reabsorbed, it greatly influences and thereby increases its own concentration in the plasma. This increased bicarbonate concentration can easily lead to an increase in the very stable iso-electric pH of the blood. Therefore, as the renal tubules are collecting, condensing, and ridding the body of the excess acids, they are also allowing for the continual reabsorption of the base, which will directly affect the plasma pH. When the body is saturated with acids and the kidneys are able to continue their vital role in the removal of these acids, the body prevents the occurrence of a metabolic acidosis. However, the biological systems are compensatorily creating a plasma alkalemia.[24]

If under these circumstances the body fails to produce adequate levels of insulin, or if it is functioning in a varying state of hypoxia, then oxidation of these fats and carbohydrates takes on a different outcome. When either of these two scenarios occurs, the body will produce large quantities of nonvolatile acids, namely lactic acid and beta-hydroxybutyric acid. The process in which the body manipulates and attempts to store or dispose of these nonvolatile acids is identical to the procedures utilized in exchanging acids that are produced through the oxidation and metabolism of protein.

The oxidation of amino acids forms the nonvolatile compounds of sulfuric acid, hydrochloric acid, nitric acid, and phosphoric acid. These acids are all poisonous and destructive to the body. Therefore, the body must eliminate or store the less harmful constituents of these acids as quickly as possible. Through a simple chemical reaction these acids are successfully neutralized by a family of complex mineral compounds. When these mineral compounds react with the toxic acids they produce a product that is either no longer poisonous to the body or is readily and safely stored.[25]

The family of mineral compounds that are so successful in the neutralization of these acids is known as the *carbonic salts*. These salts are often marked in chemistry texts as $X\text{-}CO_3$. The X represents any one of the four alkaline elements Na, Ca, K, or Mg. When carbonic salts meet with strong acids such as sulfuric acid, phosphoric acid, hydrochloric acid, lactic acid, or acetic acid, the alkaline minerals that are bound to the carbonate leave the salt and recombine with the acids to make a new, less detrimental salt.

An example of this type of reaction would be:[26]

$$X\text{-}CO_3 + H_2SO_4 \rightarrow X\text{-}SO_4 + H_2O + CO_2.$$

In this example, the toxic, highly dissociated sulfuric acid combines with the carbonic salt to form a less poisonous sulfuric salt, water, and an additional molecule of carbon dioxide. The new product, the carbonic salt, can more readily be excreted through the kidneys than its earlier predecessor. While this process is effective, the entire premise is predicated on two key factors. First, that there are adequate numbers of readily available organic minerals to provide the initial creation of the carbonic salt. Secondly, that the production of additional levels of carbon dioxide can be eliminated by the body through the already overburdened respiratory system. Unfortunately, both of these assumptions are not always the case. Often times organic mineral concentrations are depleted from the body and the respiratory system is virtually incapable of ridding the system of greater concentrations of CO_2. Either of these scenarios will force the renal tubules to once again collect, condense, and rid the body of this excess acid production and once again cause the reabsorption of the critical bicarbonate ion. This reabsorption of the bicarbonate ion has the great potential of adversely affecting the delicate balance of the plasma pH. When the kidneys are overstressed in their attempt to stay relatively current with the increased acid load, the blood is also stressed attempting to maintain homeostasis with respect to pH. The stress placed upon the blood will often create a shifting of the pH values further into the alkaline range. These stressors playing out continually over many months and years can create far-reaching distortions within the entire physiological climate.[27]

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metal electrode and is arranged in a solution containing a reversible oxidation-reduction system. The primary focus of the electrode is to detect the system's ability to gain or lose electrons until it has reached a state of equilibrium. A heterogeneous complex that will donate electrons is considered to be a reducing system while a heterogeneous complex that will accept electrons is considered to be an oxidizing system. In living tissue, oxidation-reduction systems can be divided into two separate types : [33,34,35,36]

1) Those in which the oxidized and reduced forms differ solely in the number of electrons, e.g., in which a change in valence of an element has occurred and

2) Those in which "hydrogen transfer" occurs.

These two reaction possibilities can either occur simultaneously or consecutively.[37]

When a metal electrode is placed into a solution containing a reversible oxidation-reduction system, the electrode will analytically measure the oxidation-reduction potential or the ORP.[38] The ORP is a relative measurement which determines the tendency for a reaction to occur. It is measured in the electrical value of millivolts (mV) and is most often represented by the letter E.[39]

Reduced substance → Oxidized substance + electron = E

If E is +, the reaction has a greater tendency to occur in the direction that the arrow is drawn and hence favors the oxidized state. If, however, E is -, the reaction has a greater tendency to occur in the direction opposite to the way the arrow is drawn and hence will favor the reduced state. Examples of this would include:

$Na \rightarrow Na^+ + e^-$ $\quad E = +2.71$ mV

$Ag \rightarrow Ag^+ + e^-$ $\quad E = -.80$ mV

In the first reaction, E is a positive number. The reaction, therefore, will favor the products which are in the oxidized state.

In the second reaction, E is a negative number. The reaction will favor the reactants which are in the reduced state.

The entire purpose for oxidation and reduction to occur is found in two very simple but extremely powerful premises:

1) To create high cellular energy in the form of ATP

2) To oxidize or burn up invading pollutants, xenobiotics, and some species of microorganisms[40,41]

These two premises are so significant that without them our life as we know it would cease to exist. ATP energy is the high cellular energy that runs each and every cell of our body. Without the adequate production of ATP, our bodies would rapidly run out of the fuel that enables them to work. When our cells stop functioning, so do our bodies. Many forms of diseases as well as many conditions that manifest themselves by creating fatigue in the host are inhibitors or depleters of ATP.[42] The ability of our cells to oxidize invading pollutants, xenobiotics, and some species of microorganisms is paramount to survival in the contaminated, polluted world that we live in. If the oxidation-reduction reaction were not able to burn up these contaminants then with the first exposure of our bodies to these factors, cellular integrity would most certainly be compromised. This would ultimately lead to death. It therefore becomes increasingly obvious to understand not only whether or not an oxidation-reduction reaction is occurring or will occur, but to fully appreciate the significance of the relative concentration of electrons.

When a life-sustaining fluid like blood is loaded with electrons and therefore has a negative E value, the potential for potent life-giving chemical reactions to occur is very great. However, when the blood becomes depleted of these essential life-providing electrons and the E value becomes more positive, the potential energetics of the fluid have been spent. To more completely comprehend what the change in the E value has on the energy of the fluid or cell, one must begin to think in terms of potential and kinetic energy. A fluid that has a positive E value has just spent all of its kinetic energy and accordingly is void of all potential energy. The fluid or cells that make up this entity are incapable on their own to create a chemical reaction. Conversely, a fluid that has a negative E value has a warehouse of available kinetic energy and therefore a very high potential energy. This fluid is able to donate its electrons and prime the system to create a chemical reaction.[43]

Understanding the value of E can easily provide tangible analytical evidence of the potential energetics and life-sustaining properties of a fluid. However, in a true biological system, E is replaced by a factor called rH_2. rH_2 is considered to represent the partial pressure of hydrogen that is exerted on the cathode. It is calculated from the Nernst equation:[44]

$$E = E^\circ + 2.3 \frac{RT}{F} \log \frac{(\text{oxidants})}{(\text{reductants})}$$

E = oxidation-reduction potential in millivolts

E° = the standard potential occurring when all activities are equal

R = the gas constant

T = temperature in degrees Kelvin

F = Faradays constant or the number of electrons reacting

In a biological system the new equation becomes:

$$E = E^\circ + 2.3 \frac{RT}{F} \log \frac{(H+)}{rH_2}$$

If you solve the equation for rH_2 and factor in the concentration of the hydrogen ion (pH), the resultant is an oxidation-reduction potential calculated in respect for a true biological system. Since rH_2 is a relative factor representing partial pressure, it is denoted in the terms of bar. The scale for rH_2 ranges from 0 - 42, where 0 corresponds to the maximal hydrogen partial pressure of 1 bar and 42 corresponds to the minimal hydrogen

Biological Terrain - Part 2

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In the final analysis, the typical American adult consumes more than 150 mEq/day of both volatile and non-volatile acids. This large and excessive dietary acid consumption coupled with diminishing tissue stores of alkaline minerals, complicated by excessive simple sugar intake and compounded by an inability to adequately saturate the tissue with oxygen, all spells excess overburdening of the surrounding interstitial cells with acids. When the body reaches a point where its ability to remove the excess acids is overcome by the acids both produced and consumed, the body must resort to storing the acids within. In its initial stages, the body will always store the acids in a region that represents the least amount of biological threat to the species. This area is the interstitial cells or the matrix. When this area becomes saturated, the body will begin to store these acids anywhere it can.[28] Unfortunately, the other storage places are not nearly as benign. As the intercellular space becomes loaded with acids, the cellular metabolism, respiration, and ultimately cellular integrity are all greatly compromised. When all of these changes occur on a cellular level, the cell has become diseased and pathology is most certain to follow.

When the pH of a cell is altered, the normal enzymes utilized by or produced from the cell are also affected. Science has documented that enzyme kinetics is greatly dependent upon pH and temperature to maintain enzymatic integrity.[29] When the pH is altered even slightly, the overall enzyme function of many associated systems will also be detrimentally effected. The far-reaching influence of the pH alterations can be felt in the digestive system, the immune system, and even in the lymphatic system. With this abbreviated approach to the understanding of the biochemistry and physiology reactions, it becomes increasingly apparent that a simple but accurate assessment of the varying fluid pH levels can give valuable information. This information can include endogenous and exogenous acid and alkaline production, physiological stress placed on varying organs and systems of the body, compensatory accomplishments and ultimately, enzyme kinetics.

Food Source	Acid Produced	Quantity (mEq/day)
Carbohydrates & Fats	Volatile Acids	20 mEq/day
Amino Acids:		
a. Sulfur-containing	H_2SO_4	
b. Cationic	HCL	100mEq/day
c. Anionic	HCO_3	
Phosphate	H_2PO_4	30 mEq/day
	TotalAcidsConsumed:	150mEq/day

Tab. 1: Metabolic Production Of Nonvolatile And Volatile Acids From The Diet

Oxidation-Reduction/Redox

During the 1920's, biological medicine scientists and chemists began to discover that the monitoring and assessment of the movement of electrons or electron potential of bodily fluids was as critical in the biochemical equation of Biological Terrain as pH.[30] Therefore, the second factor in the assessment of the Biological Terrain is called the *oxidation-reduction potential*. This analysis is predicated on the understanding that all chemical reactions are dependent upon the ability of electrons to attract or repel one another.[31] Before one can fully understand the dynamic role that these electrons play in the chemical reactions of molecules, an in-depth look at the basic structure and function of molecules and atoms would be prudent.

All life is composed of *molecules*. Molecules are made up of tiny particles known as *atoms*. An atom consists of a positively charged nucleus that is surrounded by one or more negatively charged particles called *electrons*. The positive charges must equal the negative charges so that the atom can maintain electrical neutrality. The majority of the atom's mass is found in the nucleus. The mass of an electron, in comparison, is only 1/1836 the mass of the smallest and lightest of all the nuclei. The nucleus of an atom contains both *protons* and *neutrons*. Protons and neutrons have masses that are almost equal but they differ in charges. A neutron lacks a charge while a proton has a positive charge that exactly balances the negative charge of a single attached electron.

When two atoms are close enough to combine and react chemically and form chemical bonds, it is the electron that determines or "sees" the incoming reagent and determines the chemical compatibility. The electrons in the outermost shell of one atom analyze the electrons in the outermost shell of the other atom and an instantaneous determination is made in accordance to binding congruity. It is therefore the electron that is the key to the reactability and chemical behavior of all atoms. Neither the neutron or the proton can rival the significance of this tiny negatively charged particle.[32]

In order to determine the chemical cohesiveness of an atomic or molecular compound, a monitoring device can be placed within the reaction confines of a solution. This device is often times a

pressure of 1 x 10^{-41} bar. The balance point of the rH_2 scale where the concentration of reductants is equal to the concentration of oxidants is 28. Any rH_2 value determined below 28 represents a reduced state while any rH_2 value above 28 represents an oxidized state. [45,46]

The measurable and definable scale of rH_2 allows the astute practitioner immediate access to the electron potential of the three major fluids of the body. In this easy and straightforward test, high versus low potential energy can be determined. This provides a window into the full biochemical make-up of the patient. In today's world where harmful oxidative stress comes from so many varying sources, the ability to quickly and precisely determine the extent of the damage created from the stress is a tool that each and every practitioner should have at their immediate disposal. Through the assessment of the rH_2, the underlying cause of the bio-chemical imbalance becomes even more readily available and assessable.

Resistivity

The third and final parameter that defines the Biological Terrain is *resistivity*. Of all of the three values, resistivity, which is represented by the small letter *r*, is perhaps the easiest to understand and integrate. Resistivity is a simple measurement of the fluid's ability to conduct an electrical current.[47] In actuality, resistivity is inversely proportional to the more common electrical testing parameter of conductivity. By first understanding the value of conductivity and then applying this understanding to the relationship between itself and resistivity, the ability to comprehend its full and diverse possibilities is immediately brought to light. Electrically speaking, conductivity is the ability of an electrical current to pass through a given medium. If the electrical current can easily and readily flow through the solution, in this case, one of the fluids of the body, then the conductivity is considered to be very high. However, if an electrical current has a great difficulty in passing through a solution, then the solution is said to have very poor electrical conductivity. The factor that dictates whether or not a solution is electrically conductive or not is dependent upon the relative concentration of electrically conductive biological ions. In the body, these ions are present in the form of mineral salts. Mineral salts are very electrically conductive and when their presence is substantial, the ability of an electrical current to flow through the solution is tangible. As the relative concentration of mineral salts increases, the ability to conduct an electrical current also increases and therefore the conductivity is elevated. Conversely, as the relative concentration of mineral salts decreases, the ability to conduct an electrical current also decreases and therefore, the conductivity is diminished.

Recall that the relationship between electrical conductivity and electrical resistivity is inversely proportional. Therefore, as the mineral content increases, the conductivity increases and the resistivity decreases. Conversely, as the mineral content decreases, the conductivity decreases and the resistivity increases. Resistivity is a simple and relative measurement of the concentration of electrically conductive ions in solution. It is referred to and stated in the electrical scale in terms of *ohms cm*. The simplicity in comprehending and testing for this last parameter is by no means a suitable representation of its relative significance. Resistivity values of the three biological fluids are a definitive analytical evaluation that imparts a great deal of information.[48]

As is found in any biological system, a balance or homeostasis must be maintained in order that maximum function is perpetuated. A set concentration of conductive ions, e.g., mineral salts, is essential to allow the body the ability to carry out its many complex and diverse chemical reactions. If the concentration of these mineral salts deviates from a normal and acceptable range then the underlying bio-chemical function is greatly affected. Mineral salts are designed to exist in relatively small and balanced concentrations in both the saliva and blood. Conversely, the mineral salts are ideally designed to flow freely through the excretable urine. This process assures that the kidneys are adequately removing excess minerals from the body and that the influx of essential conductive ions remains competent and stable. If the body loses too many minerals through the urine, then the biological function of all of the remaining systems of the body will be greatly affected. Conversely, if the body does not remove the mineral salts in sufficient enough concentrations, then the body will also become toxic and the underlying function will suffer. Osmotic gradients, cellular integrity, chemical reactivity, and proper neurological function are all dependent on proper balance and elimination/retention of mineral salts.

A plethora of material has been written on the relative importance of minerals and the dynamic roles that they serve in the integrity and function of the body. [49, 50, 51] Through this last parameter of resistivity, indications of blood purification, kidney excretion, enzymatic concentration, dietary factors, and alkaline reserve potential can all easily be inferred. Therefore, the overall value and significance of the assessment of the parameter defined as resistivity is not only crucial in determining many valuable biological functions, but must be considered on equal ground with the factors of pH and rH_2.

Summary

There exists a strong inter-relationship of the values of pH, rH_2 and resistivity. One of these factors alone is not adequate, two factors together are more valuable, but only the three parameters of pH, rH_2 and r can successfully and completely define the Biological Terrain. In a world of at least three dimensions, finding a point in space cannot be defined by only one component. In fact, in such a model, three direction or mapping points must be labeled. Most often these three points are referred to as the X, Y, and Z coordinates. In a three-dimensional human body one should not expect the laws of physics to apply any differently. Therefore, in order to clinically monitor and evaluate the overall big-chemical function and plot the Biological Terrain, the three independent values must be utilized. Valuable infor-

mation can be ascertained with one or two values, but all three parameters are necessary to obtain an in-depth comprehensive assessment of the terrain. The three analytical scientific factors not only provide the practitioner with invaluable information separately, but when all three factors are mathematically joined together the database multiplies exponentially.

Strong and highly emphasized words of guidance need to be imparted in relationship to the assessment of the three factors that define the Biological Terrain. While the information they impart can aid in the ascertainment of many valuable biological and chemical occurrences within the body, they DO NOT diagnose any specific pathology or disease states. They are 100% analytical guide posts or road signs that tremendously aid in the overall evaluation of the patient. They allow the practitioner to document a starting point or reference point to determine if the methodology chosen for therapeutic purposes is appropriate. They also give the practitioner a teaching guide to share with the patient, thus allowing the patient to take an active role in his or her health care. Finally, they provide the practitioner with immediate, easily ascertained in-office information that is irreplaceable in helping to determine the need for additional specific laboratory assays.

As any practitioner begins to work with and evaluate the Biological Terrain, he or she will understand that never before in the history of medicine has one simple test provided such a strong base of active and tangible information. The assessment of the Biological Terrain is a tool that can be easily and effectively implemented into any type of practice. The foundation for all of the factors is straight-forward basic biology and chemistry and will stand up to the highest levels of scrutiny and inspection.

Our way of life and our level of health are changing rapidly and dramatically. It is vitally important that today's health care providers take quantum leaps in their understanding, appreciation, and treatment of these new health challenges. It is also extremely important that they are prepared and equipped to provide their patients with the information and strategies to deal with these expanding and at times, overwhelming health concerns. The study and practice of Biological Terrain is the medicine of the future and the field of science that is now fully equipped to meet these needs and address these clinical challenges. It is an extremely valuable field of science that necessitates strong degrees of knowledge, respect, and appreciation for not only the chemistry of the body but more importantly, for the underlying forces of nature that control and dictate the body's internal environment. It is also a field of science and study that can enable both the allopathic and the alternative health care professions to not only clinically validate and monitor these subtle yet powerful forces of nature, but even more importantly, verify the effectiveness of their therapeutic protocols. Welcome to the fascinating and expansive world of Biological Terrain.

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