Structure and Energy

by Peter Levine

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Structural Integration is a system by which the semi-plastic tissues of the human organism are re-ordered so as to effect specific predictable changes in structure and function. It is a process by which mechanical energy is systematically introduced into myofascial connective tissue systems. One of the more striking results of this process is the structural rearrangement, towards greater alignment in the gravitational fields, of the major body segments – head, thorax, abdomen, pelvis, thighs and legs. These changes have been photographically demonstrated *ad nauseum.*

Due to growing use and possible extensive benefits of this system it is becoming imperative that we objectively document the results and learn more about the underlying physiological mechanisms, uses, misuses, etc. Recently, work has been done showing changes in blood chemistry, brain waves and electromyographic patterning. These are all interesting and important areas of research but by themselves are incomplete descriptions of the changes brought about by the methods of Structural Integration. The reason for this is that Structural Integration, by its very nature, is a system that deals with the human organism as a complete whole (in this respect it is totally different than the classical approaches to the problem of "physical therapy"). Also from the point of view of scientific investigation, the unknowns which we seek to determine are the effects of Rolfing.

Hence, we would like an overall description of changes in terms of concrete fundamental and clearly known parameters. Certainly, it is instructive to know that evoked brain potentials change in a direction which suggests a heightened vigilance or attentional capacity. However, this is something that can be measured directly without introducing brain waves, whose fundamental mode and locus of generation is still largely unknown. Recent evidence even suggests that the alpha wave (the so-called meditation pattern) is an artifact, and it has long been known that delta patterns can be recorded from a bowl of Jell-O dessert. One is reminded of the brain wave researcher's creed: "I'll see it when I believe it." To clarify then the changes initiated by Structural Integration, we must be exceedingly careful and selective in the parameters we choose.

A simple before-after photograph has long been employed as an effective representation of the gross structural changes brought about by Rolfing. This is because a picture, even though simple, static, and two-dimensional, is a least a representation of the man as a whole. Much more striking to the experienced eye is the changed movement of individuals as they are processed. What is it exactly that these observers see? Is it "objective" and can it be quantified? Does it give us a framework with which to eventually explore the physio-chemical basis of these changes?

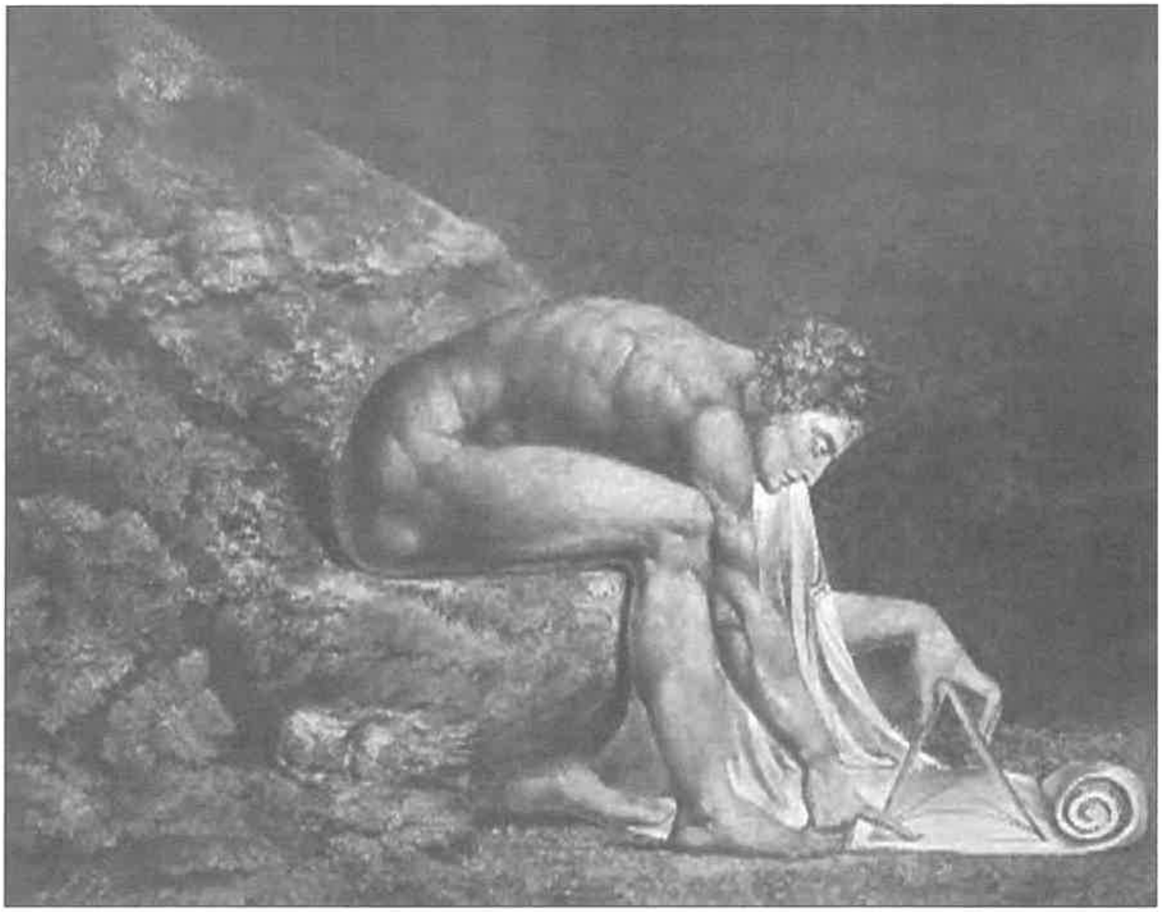
I believe that there is just such a precise objective integrating notion that can be aptly applied to this problem. It is the concept of energy. In physics long before the molecular-statistical-mechanical explanation, the gross properties of matter were described by the laws of thermodynamics. It is one of the most striking testimonies to the parsimony in nature that two simple mathematical formulations were able to describe most of the properties of matter and provide a framework with which to understand these phenomena on a molecular level. These laws, the first and second of thermodynamics, describe change (or flow) and ordering of energy, respectively. Are these not the very same concepts that one intuitively invoked to describe the process of Structural Integration; mainly that the person's structure has become more ordered and that he is more alive – that his "energy" is more flowing and that he somehow has more of it? The question now is can these intuitive perceptions be grounded in a mathematical energy formulation which will not only describe this process but point towards a unified understanding of the underlying biophysical changes.

When one thinks in terms of the energy in a biological system, what likely first comes to mind is oxygen consumption. However, when asked, *a priori,* to predict how it should be changed by processing, one is in a bit of a quandary. We might predict an increase in basal O_2 uptake reflecting the increased needs of a higher energy system (i.e. a greater requirement of previously starved "undemanding" tissue). For this reason, basal measurements are apt not to mean much without accompanying photo-thermal profiles. (Then the first law of thermodynamics states $dE = W\text{-}dq$ where dE is the change of energy in the system, W the work done, and dq the heat dissipate).

Some of these difficulties could be circumvented by also securing estimates of maximum oxygen consumption. Procedurally, this is the trivial matter of measuring the increase in heart rate to a given sub-maximal work load and extrapolating nomographically to set maximum O_2 consumption. Such a measure gives us a fair estimate of the body's capacity to utilize energy and defines an upper limit on how much work the system can do. *A priori,* there is only one direction in which this number should go as a consequence of processing, and that is up.

Let us assume for the moment that maximum O_2 capacity does increase. There are two possible reasons for this. One is simply that due to greater static alignment of the body segments with respect to gravity, energy is freed for other purposes. In addition, the total energy configuration of the myofascial system might be re-organized in a dynamic manner so as to facilitate the "flow" of energy. (A definition of flow will be deferred to a following paragraph.)

That a body becomes more ordered in a gravitational field as a consequence of processing is indisputable. The Inertial Centers of the body segments can be derived from considerations of Newtonian mechanics, and the total unbalanced force (torque energy) calculated. This energy can then be compared to the increased maximum O_2 consumption. If they are equal we need look



Newton

by William Blake

no further. If, however, the increased maximum O_2 is greater than predicted from the postural argument, we must look deeper to considerations of energy flow.

Let us consider the body to be made up of an ensemble of energy-generating organs, the vector sum of which we shall call the body energy (this is a paraphrase of a statement made by Dr. Rolf.) As a simplifying approximation, let us first consider only organs directly involved in locomotory behavior – i.e. the bones, muscles and connective tissue. Specifically, we have a mechanical system of joints (articulations), energy sources (the muscles, their blood supply and innervations), springs (the elastic components of the muscle and fascia) and viscous, damping focus (the inelastic components of muscle and fascial tissue). Action at a joint is then represented by a lever powered by an energy source (a motor) driving a spring and dashpot (damping force) connected in parallel. These various "module organs" would be interconnected by networks of parallel combinations of elastic and damping components.

Considering first action at a single joint, we see that if the viscous elements greatly outweigh the elastic ones, motion will be impeded and energy wastefully dissipated. The problem is compounded when one realizes that all of the individual energy sources are interrelated through their myofascial investments.

If we examine a simple act such as walking, in the light of this model it is apparent that for maximal efficiency these various energy sources must operate in precise synchronous, often reciprocal, patterns. If the interconnecting networks are overly viscous then no one joint can be moved without dissipating energy throughout the entire system. If by some process the viscous elements could be changed into more elastic ones, what would the model predict? Clearly, an increased capacity for energy flow between joints is to be expected. NO! That this by itself will effect an overall change towards more rhythmic efficient energy flow is not true. If the individual elements are still unbalanced with respect to each other, then the increased capacity for energy transfer may be of little use or may even give the appearance of less synchronicity. This is so because all of the modules have their own intrinsic frequencies of oscillation; and if they are in wrong phase relationships with each other, their energies may tend to "collide" or interfere with one another. What, then, is the resolution of this problem? The various energy sources must then be modified so as to bring the system, as a whole, as near to a *resonance* condition as possible.

Returning briefly to the world of Structural Integration: the first few sessions (mainly the first) are devoted to reworking the superficial fascia. (To the practitioner, these early sessions change the resiliency of the body tissue to his touch.) In the later sessions muscle groups at increasingly deeper layers are manipulated (unstuck, loosened, repositioned, etc.) The end result of this process is an individual no longer torn by the force of gravity and moving with an ease of mobility he did not have before.

Let us now look at this process in terms of the model. Could not the reworking of the superficial fascia correspond to reducing the viscosity of the damping elements which interconnect the arrays of energy modules? If the multitudes of energy sources were themselves operating in proper timing sequences, then this initial operation should bring the system into ordered functioning. This is clearly not the case with individuals being processed, and the model suggests that the individual energy sources, one by one, must be then "adjusted" so that the total complex action of these aggregates is brought into resonance (a practitioner might choose the word harmony or relationship). The word resonance in the model is a precise mathematical formulation, which states that there will be sets of unique relationships between the periodicities, elasticities, and viscosities of the energy modules such that an optimum exchange or flow of energy results if certain conditions are met.

If this is so it can be tested in a very simple way. Before-after motion picture photographs can be taken of subjects with markers painted at various joints as they walk. The relative motion of the joints can be analyzed by a Fourier power spectrum representation, each joint bar being considered as an energy oscillator. All of these joint pairs are inter-coupled to each other with energy necessarily flowing between. If they are properly linked (as a function of the relative frequencies and damping of the other components) then a minimum of energy will be dissipated in the process. The body will be then in a maximal energy configuration. Might not this correspond to what the practitioner and processor describes as being "connected" and "no longer dragging?"

These measurements, along with the static torque ones, can now be compared with the oxygen update and thermal data. From this we should be able to make a descriptive framework towards understanding the process that begins after mechanical energy is introduced into the tissues by the practitioner.