Fluid Dynamics and the Human Form

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The single most import event that makes life on our beautiful planet such an extraordinary process is the presence of water. Without it life would be very different if not absent. Its presence shows itself in all life forms from the fungus and bacteria all the way through plants, reptiles, and mammals.

This essay is going to be somewhat of a journey through evolution in an attempt to highlight important aspects of the idea of fluid dynamics as a medium of communication throughout an organism beginning with a single cell up through the complexity in the human form. Most people are familiar with the story of the origins of life coming from the oceans of the planet and single cell evolutions. I find it uncanny that the internal spaces of the human body being much like the ocean in its chemical make –up in terms of minerals and general substance. Through the passing of the ages theories of mammals evolving from sea life to land life have flourished in our evolutionary libraries. This idea continues to be represented in our embryologic development in the idea that “ontogeny recapitulates phylogeny” (cell development of the embryo goes through the evolution of the species from fish to mammals). At every stage water is involved. If we’re not submersed in it we have developed a container that covets its presence.

For the human body the container that has coveted the presence of water (body fluids) is the Connective Tissue Matrix (CTM). In Dean Juhan’s *Job’s Body* the author describes the CTM as a contiguous system of structure that provides us with shape and form. Mr. Juhan goes on to say that Connective Tissue is made up of “hollow fibrils filled with Cerebral Spinal Fluid (CSF)”. *Wikipedia* describes various forms of CT:

Connective tissue can be broadly subdivided into [connective tissue proper](http://en.wikipedia.org/wiki/Connective_tissue_proper), special connective tissue, and series of other, less classifiable types of connective tissues.[[2]](http://en.wikipedia.org/wiki/Connective_tissue#cite_note-2) [Connective tissue proper](http://en.wikipedia.org/wiki/Connective_tissue_proper) consists of [loose connective tissue](http://en.wikipedia.org/wiki/Loose_connective_tissue) and [dense connective tissue](http://en.wikipedia.org/wiki/Dense_connective_tissue) (which is further subdivided into [dense regular](http://en.wikipedia.org/wiki/Dense_regular_connective_tissue) and [dense irregular](http://en.wikipedia.org/wiki/Dense_irregular_connective_tissue) connective tissues.)[[3]](http://en.wikipedia.org/wiki/Connective_tissue#cite_note-3) Special connective tissue consists of [reticular connective tissue](http://en.wikipedia.org/wiki/Reticular_connective_tissue), [adipose tissue](http://en.wikipedia.org/wiki/Adipose_tissue), [cartilage](http://en.wikipedia.org/wiki/Cartilage), [bone](http://en.wikipedia.org/wiki/Bone), and [blood](http://en.wikipedia.org/wiki/Blood).[[4]](http://en.wikipedia.org/wiki/Connective_tissue#cite_note-4) Other kinds of connective tissues include fibrous, elastic, and [lymphoid](http://en.wikipedia.org/wiki/Lymphatic_system#Lymphoid_tissue) connective tissues.[[5]](http://en.wikipedia.org/wiki/Connective_tissue#cite_note-5)

[Fibroblasts](http://en.wikipedia.org/wiki/Fibroblasts) are the cells responsible for the production of some CT.

[Type-I collagen](http://en.wikipedia.org/wiki/Type-I_collagen), is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.[[6]](http://en.wikipedia.org/wiki/Connective_tissue#cite_note-6)

It functions not only to provide structure but also plays an important role in various metabolic activities. *Wikipedia* goes on to describe numerous rolesfor CT:

* Storage of energy
* Protection of organs
* Provision of structural framework for the body
* Connection of body tissues
* Connection of epithelial tissues to muscle fibers.
* Supply of hormones all over the body
* Nutritional support to epithelium
* Site of defense reactions
* Repair of body tissues

So, we have this container we call the Human Body, “a community of cells” as stated by Bruce Lipton in “*The Biology of Perception”,* that is bathed and held in a fluid medium made up of proteins, lipids, lymph, and “earth substance”. This dynamic and hydraulic substance is the medium that enables the body to perform homeostatic functions and maintain a metabolism that affords us life. If you don’t believe in miracles at this point it’s time to re-arrange your thought field because it is this dynamic event that begins at a molecular level and reaches all the way up through our capacity to be aware and express our unique expression of consciousness that makes life so extraordinary.

This movement, from the sub-atomic to the ever fluxing tides of dynamic fluid, is crucial to health. It is a synergistic phenomenon; all cells, all systems are in communication with the whole. Each cell performs every function of the body, respiration, circulation, assimilation, digestion, excretion, and reproduction. This system is the a true expression of innate intelligence that demonstrates the plasticity of cellular evolution present in all life forms on the Earth and connects Homo Sapiens to all life on Earth.

Inside the human form, in order to communicate and transport information to the whole, movement is the operative word. The different forms of movement in the body responsible for fluid dynamics are the contraction and expansion of muscles, the heartbeat, and the movement of the chest cavity when we breathe. These movements pump dynamic fluid through the body (CTM) and if there is any restriction in the CTM that stops the flow of these dynamic fluids congestion occurs then a buildup of the toxic byproducts of stress, ergo discomfort. This congestion can occur as a result of non-movement, ineffective breathing, injury, or chronic tension (hypertonicity).

Let’s start with the function of breath because in some ways I see this process as central to all the issues mentioned above. Within this idea I have to bring in tandem the relationship of the CTM to breath’s movement and the transport of fluid. When we breathe, when the diaphragm and rib cage pump, everything in the body moves with the breath. This is the most essential movement and it is readily available to us if we choose to slow down and listen.

Take a moment; lie down on the floor with your knees bent and feet flat on the floor, and listen to the movement of your breath. Take your time, breathe without expectation you will discover anything. By design all the mechanisms for the opportunity of discovery are built in to the human body and all we need to do is turn our attention away from the ceaseless chatter. While you deepen your contact with your breath the movements begin to appear; a subtle wave-like motion in the spine, the rocking of the hips, the rocking of the head, and if you listen close enough you can feel the muscles of the body contracting and expanding in different areas with each phase of inhalation and exhalation. There is nothing to do here except breathe.

After practice the sensations I speak of in this exercise will appear quickly and you will have accomplished an incredible feat for your body and being. Referring back to what the CTM performs for the body previously in this essay, these movements have delivered hormones and neurotransmitters throughout the cellular space, you have relaxed the skin and fluid has risen to the surface of the body in forms of blood, earth substance, and lymph, you have brought a new level of synergy to all the spaces and systems of your body, and, the most important of all, you have come home to your body. The body likes it when we come home.

So, whether we notice it or not, this movement is present every time we inhale and exhale. The only thing that gets in the way is the diminishment of breath due to stress. During a stress process breath gets shallow and high in the chest. In *The Thorax* by Jean-Pierre Barral he speaks of the relative levels of barometric pressure between the chest and abdominal cavity and how the internal spaces respond to this change. Think of this action much like the Blood Pressure Cuff, when you pump the bulb the cuff gets tighter. When we inhale the pressure in the chest increases, the fascial layers in the torso tighten to enable the pressure rise so more air can infuse the alveoli of the lungs with air. It’s important to consider the function of water in the lungs because the alveoli are immersed in fluid and the pressure in the lungs is measured in ml/cm H2O. Barral goes on to say that Visceral Manipulation of abdominal organs can have a positive effect on the efficiency of breathing and the movement of the chest.

The changes in pressure have an impact on distribution of fluid dynamics throughout the body. *Wikipedia* provides some interesting information on this issue when speaking to non-respiratory functions of the lungs:

In addition to their function in respiration, the lungs also:

* Alter the [pH](http://en.wikipedia.org/wiki/PH) of blood by facilitating alterations in the partial pressure of [carbon dioxide](http://en.wikipedia.org/wiki/Carbon_dioxide)
* Filter out small [blood clots](http://en.wikipedia.org/wiki/Thrombus) formed in [veins](http://en.wikipedia.org/wiki/Vein)
* Filter out gas micro-bubbles occurring in the [venous](http://en.wikipedia.org/wiki/Vein) blood stream such as those created during [decompression](http://en.wikipedia.org/wiki/Decompression_%28diving%29) after [underwater diving](http://en.wikipedia.org/wiki/Underwater_diving).[[5]](http://en.wikipedia.org/wiki/Lung#cite_note-5)
* Influence the concentration of some biologic substances and drugs used in medicine in blood
* Convert [angiotensin I](http://en.wikipedia.org/wiki/Angiotensin) to [angiotensin II](http://en.wikipedia.org/wiki/Angiotensin) by the action of [angiotensin-converting enzyme](http://en.wikipedia.org/wiki/Angiotensin-converting_enzyme)
* May serve as a layer of soft, [shock](http://en.wikipedia.org/wiki/Shock_%28mechanics%29)-absorbent protection for the [heart](http://en.wikipedia.org/wiki/Cardiac), which the lungs flank and nearly enclose.
* [Immunoglobulin](http://en.wikipedia.org/wiki/Immunoglobulin)-A is secreted in the bronchial secretion and protects against respiratory infections.
* Maintain sterility by producing [mucus](http://en.wikipedia.org/wiki/Mucus) containing antimicrobial compounds.[[6]](http://en.wikipedia.org/wiki/Lung#cite_note-6) Mucus contains [glycoproteins](http://en.wikipedia.org/wiki/Glycoprotein), e.g., [mucins](http://en.wikipedia.org/wiki/Mucin), [lactoferrin](http://en.wikipedia.org/wiki/Lactoferrin),[[7]](http://en.wikipedia.org/wiki/Lung#cite_note-7) [lysozyme](http://en.wikipedia.org/wiki/Lysozyme), [lactoperoxidase](http://en.wikipedia.org/wiki/Lactoperoxidase).[[8]](http://en.wikipedia.org/wiki/Lung#cite_note-8)[[9]](http://en.wikipedia.org/wiki/Lung#cite_note-9) We find also on the epithelium [Dual oxidase 2](http://en.wikipedia.org/wiki/Dual_oxidase_2)[[10]](http://en.wikipedia.org/wiki/Lung#cite_note-10)[[11]](http://en.wikipedia.org/wiki/Lung#cite_note-11)[[12]](http://en.wikipedia.org/wiki/Lung#cite_note-12) proteins generating hydrogen peroxide, useful for [hypothiocyanite](http://en.wikipedia.org/wiki/Hypothiocyanite%22%20%5Co%20%22Hypothiocyanite) endogenous antimicrobial synthesis. Function not in place in [cystic fibrosis](http://en.wikipedia.org/wiki/Cystic_fibrosis) patient lungs.[[13]](http://en.wikipedia.org/wiki/Lung#cite_note-13)[[14]](http://en.wikipedia.org/wiki/Lung#cite_note-14)
* Ciliary escalator action is an important defense system against air-borne infection. The dust particles and bacteria in the inhaled air are caught in the mucous layer present at the mucosal surface of respiratory passages and are moved up towards pharynx by the rhythmic upward beating action of the cilia.
* Provide airflow for the creation of vocal sounds.
* The lungs serve as a reservoir of blood in the body. The blood volume of the lungs is about **450** milliliters on average, about **9** percent of the total blood volume of the entire circulatory system. This quantity can easily fluctuate from between one-half and twice the normal volume. Loss of blood from the systemic circulation by **hemorrhage** can be partially compensated for by shunting blood from the **lungs into the systemic vessels**[[15]](http://en.wikipedia.org/wiki/Lung#cite_note-15)
* Thermoregulation via [panting](http://en.wikipedia.org/wiki/Thermoregulation#Endothermy) (observed in some animals, but not humans)added note: I believe thermoregulation is accomplished in humans via breathing through the nose. The nasal passages and sinuses condition the air going into the lungs by bringing it to body temperature.

Notice the amount of blood fluctuating on inhale and exhale. This fluctuation is expressed throughout the body as fluid volume is displaced during the breath process. This movement bathes the tissues throughout. All muscles (approximately 640) contract when we inhale. In the dynamic contraction and relaxation of muscles we can see another important function of fluid dynamics. Inside all this movement the CTM is being pumped, moving nutritive fluids throughout the space of the body.

In a perfect world the body is designed to maintain itself with built in mechanisms to accommodate for shifts in homeostatic balance. The greatest impact on how the body moves is stress, whether it is from injury, emotional trauma, or static belief systems. Take this excerpt from an essay titled Core Activation, Core Strength, and Core Intelligence:

All these muscles shorten with the movement of the inhale to maintain the body’s contact with the center. In order to stand up and move in gravity we need this contact with the center. This is, again, a function of the ANS. If we had to think about standing up to do so we would probably fall on our--well, you get the picture. After we make our first intention to stand up and walk we train ourselves through practice and calibrate the neuromuscular signals for bipedal locomotion and the patterns of movement are set by the ANS. As we develop toward adulthood we continue to train our movement via our beliefs about ourselves and the world.

During this same time period of development, via the same mechanisms we use to train our movement (the ANS), we are exposed to “stressors” in our environments that cause us to “hold our breath”, we fall to the patterns of “stress breathing” which is shallow and high in the chest also not unusual to be through the mouth. This kind of breath pattern offsets the barometric pressure in the chest and the muscles of core dynamics tighten to stabilize and the surface muscle compensate for core instability and become tense (*Visceral Manipulation, Barral & Mercier*). The formula I give to those I teach in yoga and movement is “when the core is active, the large muscles relax”.

If we were to rearrange these muscles to demonstrate their interactivity it would look like this:

 Levatores (Thoracic)

Stabilizes and opens chest cavity

Scalenes (Cervical)

 Trapezius

It begins in the center of the body and extends in both directions, up and down.

Psoas

 Thoracolumbar Diaphragm

Stabilizes mid torso

 Quadratus Lumborum

 Latissimus Dorsi

 Rotatores (Lumbar)

Pelvic Floor

 Biceps Femoris

Stabilizes lower body

 Semimembranosus

 Adductors

 Popliteus

 Inner Sleeve (Calf)

 Plantar Fascia

The list is much bigger and the muscles I mention are the one palpable from the surface of the body. The deeper musculature inside the chest wall, the posterior/anterior intercostalis, the longus coli, and the intercostals, act as mediators for the relationship between the inside and outside of the body therefore can be mentioned as an expression of Core Dynamics. It is interesting to me, as a student of the Eastern movement arts of Yoga, Tai Chi, and Chi Kung, the claim is made that all movement begins in the center of the body.

So, here we have this cellular space, transporting and communicating the ever pulsing movement of fluid, responding to information each cell interprets from the environment it lives within. I’m reminded of this experiment I’ve seen mentioned over and over again in numerous texts addressing cellular behavior. Put a cell in a medium and add a nutritive substance and the cell moves toward the substance; introduce a noxious substance and the cell does everything it can to move away and distance itself from the noxious substance. I like what Bruce Lipton says in his DVD presentation *The Biology of Perception* “we are not individuals, we are a community of cells”.

The cellular community relies on movement and nutritive factors. The different types of movement are accomplished through our day to day activities, exercise (informed movement), and the movement created by breathing and the heartbeat. Let’s say something about how “stress” impacts all these types of movement.

First let’s make a distinction between “stress” that is useful for the body and “stress” that diminishes the body. The body needs stressors in order to get stronger and healthier. Regular exercise, though perceived by the body as stress, helps build muscle mass and strengthens the cardiovascular system. The “stress” that diminishes the body is rooted in outdated and ineffective belief systems about ourselves and the world around us. These beliefs are created during a time in our lives when we didn’t have the cognitive capacity to really understand what was going on around us. In these cases we were left with a feeling of incapability and fear. When this happened we held our breath and went into hiding. Consequently, as we moved forward into life, we didn’t develop the capacity to respond to the variety of situations we would be presented with. The pattern that developed was the sense of incapacity and fear. This state suppresses the immune system and routes blood away from the organs to the muscles, elevates blood sugars, increases the heart rate, elevates blood pressure, and creates a state of acidity in the blood.

If only this would turn off but it doesn’t because we hold onto this belief and it functions as a background program that filters our interaction with the environment. As a result, it continues to deplete the body and is the ground for homeostatic dysfunction. The human organism is designed to assess the situation, deal with it in the best way it can, and let go. There is no way to avoid “stress”, it is a given. All we can do is meet it, respond, and let go. It’s the letting go that is important.

Stress is a function of the ANS and is influenced by our beliefs. Beliefs are the foundation of our perception and have a dramatic influence on the ANS. This has been shown over and over in the work with Post Traumatic Stress Disorder. The trauma locks the pattern of response in our perception of an event and the response gets triggered over and over again by sometimes completely unrelated stimuli. The trick becomes teaching the person how to recognize the response and defuse the pattern.

When our breath is mitigated by stress the dynamic flow of fluid throughout the structure is diminished. If this happens habitually the muscles exhibit tension. Tension further interferes with the circulation of fluids and the body develops patterns of tension and consequently weakens muscle and makes the muscle unresponsive to voluntary action. The results are a vulnerability to injury. Chronic low back pain, neck pain, knee issues can all be linked to ineffectual breathing. Tense and ineffectively used muscles adhere to each other and further atrophy occurs.

In Kundalini Yoga’s *Guide to Sadhana* published by the 3HO Foundation it is stated that the key to health and longevity is flexibility of the spine. I would go further to say that, along with “flexibility of the spine”, effective, conscious, breathing, and thorough, intent-full movement are important aspects to keeping the form open, healthy, and strong.

I don’t particularly believe to know how to take care of the body is rocket science. Our culture does not support this knowing and turns it over to doctors who are not trained in the synergistic nature of the human form, let alone proper bio-mechanics. The choice is up to each individual to learn how to take care of and maintenance the body. When we come home to our body it is ready and waiting to take our guidance and repair and strengthen. This can happen at any age.