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EDITORIAL

Fluidity of the body

All is flux, nothing stays still

Heraclitus of Ephesus (circa 5 century B.C.)

Flux, fluid and fluidity are derived from L. *fluere* to flow and Gk. *phluein* to flow abundantly, or to overflow. Everything is flowing all the time, all the ways. Restlessness rules. In a manner of speaking, a fluid's mind is flow-id. "The melancholy view of Heraclitus as to the changing and fleeting character of life led to his being known as 'the weeping philosopher'. The constant flux, according to Heraclitus, of atoms, molecules and what have you, created unity-in-opposites, to create an illusion of steadiness or static-ness.

At the atomic level, the electrons spin in their own orbit at about 800 miles a second and the protons and neutrons, in the nucleus, waltz around each other at 40,000 miles a second. The seemingly lifeless matter is throbbing with dynamism of its own kind. All flux, you see.

The kinetic theory – kinetic meaning a state of flux, fluidity, or movement – holds that "the particles of matter in all stages of aggregation (gaseous, liquid, solid) are in a violent state of agitation, the vibratory motions becoming more energetic with an increase of temperature. Evidence of molecular agitation is provided by diffusion and Brownian movement." Conversely, with a decrease in temperature, the particulate movement becomes progressively less, until absolute zero (i.e. 0°K, -273.15°C, -459.67°F), when the thermal energy of random motion of particles is also zero, obviating all movements to create a state, albeit theoretical, of absolute static-ness.

What avails at the micro level asserts at the macro level. The nervous system is an excellent example of fluidity in function. The neuraxis – brain and spinal cord – is 96% water that with the addition of a modicum of 4% of salts, proteins and lipids assumes a seemingly solid state that is suspended, cell by cell, in neuraqua.[1] Neuraqua (so-called cerebrospinal fluid [CSF]), isodense with the neuraxis, is constantly moving in and out of the neuraxis and in and out of the vascular system. The constant influx and efflux of this neuraqua serves to nourish the neuraxis, to serve as its lymphatic system as it were and to render the central nervous system weightless due to it having the same specific gravity as the neuraqua.

Electrical activity of every neuron and the whole neuraxis is never a flat line, with the activity shooting up to high levels in deep sleep. That was the first intellectual shock that Adrian, had had in 1930's when he recorded the electroencephalography of a cat put to sleep after a milk-feed. The brain seems to work overtime when it is expected to be still. Your neuraxis is on an overdrive exactly when you are fast/dead asleep. "If we took a piece of brain the size of a match head alone, there could be up to a billion (interneuronal) connections on the surface." (Susan Greenfield). Each of the billion connections is bursting with electrical energy. Adrian's co-Nobelist Sir Charles Sherrington's poesy, his reverence for the brain, merits a mention here: "A dense constellation of some thousands of nodal points bursts out every few seconds into a short phase of rhythmical flashing. At first a few lights, then more, increasing in rate and number with a deliberate crescendo to a climax, then to decline and die away. After due pause the efflorescence is repeated. With each such rhythmic outburst goes a discharge of trains of travelling lights along the stalk and out of it altogether into a number of nerve branches. What is this doing? It manages the taking of our breath the while we sleep."

What is true for every neurone, holds true for every sensory receptor and every muscle cell.[2] Flux – ceaseless – is the be-all and end-all of circuitocytic function. A circuitocyte is a sensory receptor, a neurone, or a muscle cell whose sole characteristic is establishing a circuit to be a part of the same.

Animal life, Portmann aphorized, is configured time. Every cell, plant, microbe, animal is configured water. As is a cell so is the whole body, made largely of water. The body water, through its ceaseless input and output, is in a state of constant fluidity or flux. Water moves in turns intervascular, then extracellular, intracellular, the direction reversing. The kidneys, in an average human, produce a filtrate of 150 L in a day and return 148.5 L to the body and let out 1.5 L or more as urine. Each exocrine gland is pouring out fluid all the time to let the water out and the ducts flushed. The billions of sweat glands are like rivers returning their waters to the ocean of water in the milieu exterior. The 5 L of blood has ceaseless flow between two heartbeats, its first and its last. The heart owes its contractility to the dilatation (diastole) forced upon the ventricles by the incoming blood – so-called venous return to the heart. Within physiologic limits, greater the venous return, greater the ejaculatory force of the ventricles.

The eyeball comprises water filled balls one within another where the contained water is forever in a flux. The water gives it the rounded shape and serves as the refractory medium. The fluidity of air underlies the CINE rhythm – Cyclic Inspiration N Expiration, from the lungs to the tissues and back, sans any pause. All gaseous flux.

Fluids play a major role in the locomotor system. The bones bear and transmit weight not through the hard, fragile, unbendable bony lamellae, but by and through the contained

fat and marrow that are liquid at body temperature. The sole and the palm of man are capillary hemangiomas that take all the impact, helped toward this by the water in the sweat glands and the liquid-like plantar and palmar fat. The synovial fluid does not merely lubricate a joint but serves in the relay of weight transmission. When you stand or jump the fluids of the foot take the impact, pass it on to the synovial fluid of the joints, from synovial fluid to the blood and fat of the marrow right up to the scalp. That's how Ussain Bolt of Jamaica manages to finish 100 m within <10 s.

Heraclitus is right. The whole animal body is in a state of ceaseless flux, of one form or other. Flux is life. No flux is death.

All translatory weight-bearing must be on a fluid cushion. The felines have their soft adipohemal paws. The equines have a hydrated hoof overlaid by a mass of fat and a lake of blood. The elephant has a huge circular plane of hydrated keratin supported by fat and blood vessels. Even the snail –gastropod- slides on a film of blood over its so called gastropod.

All fast moving vehicles ride on the fluidity of air. Ships sail through the fluidity of water. The prime requirement is that the interface of the weight carrier (limb or tyre) and the weight-bearing surface must have the faculty of accommodation to the ever changing interface. Flux and fluidity has the ready deformability and reform ability which a solid weight-bearer misses. The pillars can be solid but the paws and hoofs must exhibit fluidity.

The fluidity of air plays a vital role on either side of the diaphragm. Above it, the air inflates the lungs to broaden the chest for giving wide anchorage to the muscles of the upper limb and to ferry oxygen and carbon dioxide. Underneath the diaphragm, the dome of the gastric fundus houses a ball of gas that gets established within 2 h after birth and stays until death. It's a cushion of air on which the heart dances, air-cushioned as it is by the lungs on either side, in front and in the rear. It's possible that the gastric air, like the air in the swim-bladder of the fish is an active secretion by the fundic mucosa to subserve cardiac action.

One entity that is a largely viscous fluid gel is mucoid connective tissue (MCT). A non-fibrillar colloid material essentially acellular, forms the vitreous of the eye, the dental pulp and the nucleus pulposus of the intervertebral discs.[3] With a fluid's ability to be "infinitely incompressible," the MCT in the pulp at the root of the tooth takes all the impact of mastication and that of the discs gives mobility to the spine and the capacity to take impacts. MCT also forms the main substance of the umbilical cord.

The versatility, the infinite incompressibility, the ready accommodativeness of fluids – air, water, synovial fluid, fat, CSF, blood, lacrimal fluid – needs wider appreciation. A 7 microns thick (or thin) film of tear separates the eyeball from the eyelids allowing the latter to roll over the ball thousands of times a day for 100 years, the 7 microns comprising 4 of water and 3 of lipid. At a Ripley's believe it or not, in USA granite ball of 14,000 pounds could be rolled over by a single person on account of a film of water 1/254 inch, separating the ball from the trough. According to the British neurosurgeon Rowbotham, it will need 10,000 tons of pressure to reduce the brain to half its size. Fluidity is a divine gift.

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