FGJH

An explanation with contributions from divers characters including Georges Canguilhem, Heraclitus, Douglas Hofstadter and my younger self

Georges Canguilhem: To speak of the wisdom of the body leads one to understand that the living body is in a permanent state of controlled disequilibrium, of disequilibrium which is resisted as soon as it begins, of stability maintained against disturbing influences originating without: it means, in short, that organic life is an order of precarious and threatened functions which are constantly re-established by a system of regulations.

And again: An organic regulation of a homeostasis assures first of all the return to the constant when, because of variations in its relation to the environment, the organism diverges from it. Just as need has as its centre the organism taken in its entirety, even though it manifests itself and is satisfied by means of one apparatus, so its regulation expresses the integration of parts within the whole though it operates by means of one nervous endocrine system.

This is all well and good if what we are focused on is the organism and its life. But the action of the organism will also contribute to the homeostatic regulation of the environment in which, through which and by which it guarantees its continued existence. What survival guarantees are there in the face of the albedo flip? There will be water, more water than we know what to do with. And there will be no water. There will be wars. And how can we hear the soft murmur of intelligence and of thoughtful reflection upon contesting ideas amid the feedback screech of the algorithms that filter out everything they decide on behalf of each and every one of us does not reflect our narrow preoccupations? We are in an echo chamber. Our prejudices are daily flattered by the digital flows that bathe us and bear us away on the flood, withholding all possibility of handhold or toehold on any substantial, resistant surface. We think we know what we

know and what we like and what we desire, but these viscerally felt certainties are a phantom and a straitjacket.

Canghuilhem: Every physician knows, having learned it occasionally to their embarrassment, that the immediate sensible awareness of organic life in itself constitutes neither a science of the same organism nor infallible knowledge of the localisation or date of the pathological lesions involving the human body. Here is perhaps why until now pathology has retained so little of that character which disease has for the sick person – of being really *another way of life*. Certainly pathology is correct in suspecting and rectifying the opinion of the sick person who, because they feel different, think they also know in what and how they are different. It does not follow that because the sick person is clearly mistaken on this second point, they are also mistaken on the first.

We could do worse in this situation in which we are sick and know we are sick, but remain unsure of the cause and location of the pathology, this situation of normal abnormalcy or of abnormal normalcy - we could do worse than to look again to the organs.

'The life of the living being,' Canguilhem writes in The Normal and the Pathological, 'is, for each of its elements, the immediacy of the co-presence of all.' Heraclitus, it seems, already understood this well. Plutarch writes, quoting Heraclitus, that just as we cannot step into that same river twice, we cannot lay hands twice on mortal substance in a fixed condition. *It scatters and* again *gathers*, or rather not 'again' or 'afterwards', but at the same time *it comes together and flows away*, and *approaches and departs*; therefore its becoming does not terminate in being. Given the immediacy of this co-presence of all organs, and the concomitant fact that the organism does not, therefore live in the spatial

mode, we must necessarily embark on what what Canguilhem describes as a display in extensiveness in order to gain some comprehension of what occurs.

Mark must.

Mark in order to.

The shadows of tendentiousness darken the field from the outset.

We are going to do that thing Wittgenstein calls tracing a mechanism, finding an explanation for the appearance of things that does not offer any access to aesthetic understanding.

Everything flows.

There must be an equilibrium, a balance

A balance between what goes in and what comes out, between fluid in and fluid out, in order to maintain a more or less constant proportion of fluid within the organism

Stop
This is nonsense
This is not the land of metaphor
This is not the land of language's dreamwork

This is the land of rocks and hard places, of water and ice, of air and of fire.

A body without organs is a fruitful machine, but as a living organism it is a body that cannot and will not survive

In order to maintain – no, this is not right

In the organ, in the organism, things do not happen in order to anything. The organ does not presume a goal.

They – the organs – are not sentient, they cannot foresee the future. They exist in a non-spatialised immediacy of co-presence.

And at this level the organism does not foresee the future

It is physics and chemistry

There is no must
There is no in order to
These things happen

Like the air in Leopold Bloom's breakfast-time kitchen, the art of the past century is piss-scented. Warhol knew this. It's no problem if you hand the squeegee to an assistant, but nobody can piss for you. When it comes to pissing, you have to do it yourself.

The fragrant Duchampian water fountains over all of us and falls upon everything we do. The holy Madonna cowl curve of that upended urinal rests stately above us, exemplary, rule-shattering, rule-setting.

Beauty is rendered redundant, irrelevant. As is its opposite – ugliness? repulsiveness? which is anyway the same thing:

They do not apprehend how being at variance it agrees with itself: there is a connection working in both directions, as in the bow and the lyre. Heraclitus, Fragment 51

The bow and the lyre, the Apolline machines of war and of art.

So, to begin.

Once upon a time a man told me about this, and when he did so he began by saying,

Now, this is complicated.

There are two main areas of the kidney: the outer part – the renal cortex, and the inner – the renal medulla. Nephrons, the features responsible for the production of urine, straddle these two areas.

The blood vessels that feed the renal cortex lead, after many bifurcations, to small, tangled knots called glomeruli. Wrapped around each glomerulus is the beginning of a tubule which proceeds from there, away through the cortex. The walls of the blood vessel forming the glomerulus and of the tubule are permeable in the same way as we find in very many cell walls throughout the body. Water molecules can pass freely from blood vessel to tubule, as can some solutes – things carried in the blood – such as sodium, potassium, calcium and chloride ions. These are all small in size. Glucose can also pass, along with, say, alcohol or the residue of recreational, performance-enhancing or therapeutic drugs, but larger molecules – such as, for example, proteins, which comprise chains of amino acids – cannot, and remain in the blood. One important solute that can pass is urea, a molecule comprising two amide (NH_2) groups joined by a carboxyl group. Urea is formed in the liver through the combination of two ammonia molecules with a carbon dioxide molecule. Excretion of urea removes excess nitrogen from the body.

The concentration of solutes in the blood, the interstitium and the tubule is in equilibrium at this point, having an osmolality in the region of 300 mOsmol/kg.
But free movement of this kind is passive, and would therefore not normally occur given this state of equilibrium. Something has to give the water molecules, ions and other solutes a push. There needs to be a gradient down which they can flow. In this case it is a pressure gradient provided by the capillary entanglement of the glomerulus. The pressure in the blood vessel is higher than in the surrounding interstitium and tubule so serum – water and the mixture of small molecules and ions it contains – is forced out of the glomerular capillary and into the tubule.

The path of the tubule in its journey away from the glomerulus through the cortex is, like the line stipulated in the instructions for some of Sol LeWitt's drawings, not short and not straight. In light of this, and because it is the region of the nephron closest to the glomerulus, it is referred to as the proximal convoluted tubule. Along its length the walls of the proximal convoluted tubule are freely permeable to both water and solutes, but when at the end of this section of the nephron it turns to pass down into the renal medulla the situation changes. What happens here is that the tubule passes straight down into the medulla, turns through 180 degrees and runs straight back up to the cortex, where it once again traces a convoluted path. This last section, for the sake of topological clarity, is called the distal convoluted tubule. The part between the two cortical convolutions that descends deep into the medulla, turns sharply, ascends and re-enters the cortex is known as the Loop of Henle, named after the man who first identified the feature, Friedrich Gustav Jakob Henle. It is what goes on in and around the loop of Henle through the operation of a countercurrent multiplier that allows a more concentrated solution of urea to be generated. The action of the loop creates a gradient of increasing concentration, increasing osmolality, in the renal medulla, from 300 mOsmol/kg at the boundary with the cortex, to 1200 mOsmol/kg at the foot of the loop.

How is this gradient achieved?

Close by and parallel to the arms of the loop are capillary blood vessels, the vasa recta. Blood flow in the vasa recta runs in the opposite, counter, direction to that of the fluid in the loop of Henle – arterial blood passing down into the medulla adjacent to the ascending arm of the loop, and venous blood passing up into the cortex alongside the descending arm of the loop.

The ascending arm of the loop is impermeable to water. Its lower, thin, portion is permeable to ions and in its upper, thick, section ions are moved out of the tubule into the interstitium. The descriptive terms 'thin' and 'thick' refer not to the lumen – the diameter of the tubule forming the loop, but to the epithelial, the walls of the tubule. Along the upper, thick portion of the ascending arm ions are actively transported across

this epithelial out of the tubule into the medullary interstitium by means of a dephosphorylating enzyme, an ATPase. As I am sure you know, such enzymes, common throughout the body, catalyse the breakdown of Adenosine Triphosphate into Adenosine Diphosphate and a phosphate ion, thereby releasing energy that is put to use in the cell. In this case the ATPase is a Sodium – Potassium – Chloride Cotransporter. Energy is needed for this process because the ions are being moved against the concentration gradient. The effect is to increase the concentration of ions in the interstitium, and to decrease the concentration of ions in the fluid passing up the ascending arm of the loop. The action of the ATPase in the ascending loop drives up the concentration of ions in the interstitium, but the osmolality gradient is only maintained because the vasa recta is taking blood down into the medulla. Its walls are freely permeable, so ions moved out of the ascending arm of the loop of Henle into the interstitium can pass freely into the vasa recta where they are taken back down further into the medulla. Because the osmolality of the interstitium increases in the direction of blood flow, ions will continue to flow into the vasa recta maintaining equilibrium between interstitial osmolality and blood osmolality at all points. This is the system of countercurrent multiplication that generates and maintains the steep medullary osmolality gradient.

In contrast to the ascending arm of the loop, the walls of the descending arm are freely permeable to water, but are impermeable to solutes. As the loop descends into the medulla, because of the osmolality gradient water is drawn out of the tubule into the interstitium. The effect of this movement of water out of the tubule is to concentrate the remaining fluid, bringing it to an osmolality of 1200 mOsmol/kg in equilibrium with the surrounding interstitium deep in the medulla by the time it reaches the bottom of the loop. Running alongside the descending arm of the loop of Henle is the ascending, venous vasa recta – the distinction between arterial and venous simply indicates a vessel that is carrying blood away from the heart, and one that is returning blood to the heart. The blood in this capillary has been taken down into the medulla and as a consequence of free permeability of the capillary walls is in equilibrium with the high interstitial osmolality around the turn of the loop of Henle. As it travels back up in the venous vasa recta water passes from the interstitium into the capillary such that when it reaches the renal cortex blood osmolality has returned to 300 mOsmol/kg.

Whereas at the turn of the loop the concentration of solutes in the tubule is 1200 mOsmol/kg, by the time the fluid reaches the top of the loop and enters the distal convoluted tubule, prior to entering the collecting duct the removal of ions has reduced its osmolality to 100 mOsmol/kg, hypotonic in comparison to the normal blood value of 300.

Urea also, by means of urea transporter 1, passes out of the descending arm of the loop into the medullary interstitium, contributing to the osmolality gradient. Urea transporter 2 moves urea back into the lumen of the thin ascending arm of the loop.

Water carrying a mixture of solutes, some useful and others not required for the functioning of the organism has entered the nephron. Water sufficient to maintain the environment within the organism as a whole has been drawn back into the body. Ions necessary for cell function have been extracted and returned to the body, and excess water together with waste molecules has been passed into the bladder.

Sometimes there is loss of water from the body – through sweating, for example. If the balance of water and solutes is disturbed in this way the blood osmolality will increase. We are dehydrated. The increase triggers release from the pituitary gland – which is in the posterior hypophysis of the hypothalamus – of arginine vasopressin, or anti-diuretic hormone (ADH). The vasopressin molecule is a short chain of three amino acids – Glycine, arginine and proline – attached to a ring of six further acids – cysteine, cysteine, tyrosine, phenylalanine, glutamine and aspartic acid. This hormone, which has a life of approximately twenty minutes, acts on the nephron to create passages for water molecules to pass back out from the ascending arm and distal tubule into the body, thereby reducing the quantity of fluid passing to the bladder. ADH also stimulates reabsorption of urea into the renal interstitium, thereby promoting further reabsorption of water from the filtrate.

Canguilhem: Subjective morbid symptoms and objective symptoms rarely overlap. [But] it is simply capricious for a urologist to say that a person who compains of their kidneys is a person who has nothing wrong with their kidneys. For the sick person the kidneys are a cutaneous-muscular territory in the lumbar region, while for the physician they are vital organs connected to others. the well-known fact about reported pains, whose multiple explanations have been very obscure up to now, prevents one from thinking that the pains experienced by the sick person as major subjective symptoms bear a constant relation to the underlying organs to which they seem to call attention. But most of all, the often prolonged latency of certain degeneracies, the inconspicuousness of certain infestations or infections lead the physician to regard the direct pathological experience of the patient as negligible, even to consider it as systematically falsifying the objective pathological fact.

So, again, it does not follow that because the sick person is clearly mistaken about where and why they are sick, they are also mistaken about the fact that they are sick.

Douglas Hofstadter concludes another loopy tale, I Am A Strange Loop, thus:

We human beings are macroscopic structures in a universe whose laws reside at a microscopic level. As survival-seeking beings, we are driven to seek efficient explanations that make reference only to entities at our own level. ‘we therefore draw conceptual boundaries around entities that we easily perceive, and in so doing we carve out what seems to us to be reality. The ‘I’ we create for each of us is a quintessential example of such a perceived or invented reality, and it does such a good job of explaining our behaviour that it becomes the hub around which the rest of the world seems to rotate. But this ‘I’ notion is just a shorthand for a vast mass of seething and churning of which we are necessarily unaware.

We have traced a mechanism, and it is all, and it is not at all metaphor.

Canghuilhem was fond of quoting an observation from René Leriche, a surgeon who, among others, treated Henri Matisse:

Health is life in the silence of the organs.

I need to piss.