

## **Knowledge: How do we come by it and what does it mean?**

The first essay in this quintet concluded that authority is the realisation and embodiment of accepted social truths. Social truths are constructed, I argued, through social transactions, the primary forms of which are: consent; coercion; contract; convention. In turn, each of these social transactions depend on a triple foundation of rule, reason and faith. Because we are people with the apparent capacity to exercise free will, we can and do come to different conclusions about these social truths, and hence contest them and their social realisations as authorities. Our abilities and capacities to contest depend on our social conditions: our character, culture, circumstance and context, which I label the 4Cs, since that is where they seem to leave us most of the time. Otherwise, we must forgo expression of free-will and go with the flow, simply reacting to signals and actions, much as inanimate matter.

Given our 4Cs, how do we come to conclusions about the way the world works and the ways it might work better - about our social truths? This is the question about the culture of knowledge and understanding from the wilderness and blizzards of information.

Like you, I need to organise my knowledge on the basis of available information. Here, I try to explain how knowledge arises from information, and understanding from knowledge, in the hope that a little wisdom might result. I, like you, use a transaction or transformation system which we can call cognition - the primary distinction between us and our animal ancestors.

I illustrate the system by outlining my own case study - a process of transformation of vast amounts of information (much of which I do not comprehend or fully understand) mixed with personal judgement (which no-one yet understands) into a story which I can understand and thus, perhaps, believe. While my own judgement might be specifically singular, it is (I suppose), generally commonplace - it more or less follows accepted rules and conventions. We generally use a combination of faith, rule and reason to come to our judgements.

This is my story of how we came to be, as beings in a Maybe universe. The point of this essay is simple. We need such a story, for otherwise we have no idea about what information is and how it came to be. If we do not have a story, we cannot hope to recognise information for what it is, or reorganise it properly into knowledge.

My story is, at best, hopelessly incomplete. It is, in the terms of the first essay, my own vernacular. But I can only improve my understanding by expressing what I think I 'know' and letting others tell me how it compares with their version. You might then judge whether I am completely daft or roughly right - that is, in agreement with you. This, I suggest, is a reasonable approximation of the knowledge process at work. But, in reading the following, remember that understanding grows and takes time. Please be more patient than I usually am in waiting to understand the point. For the present, just read it as a story.

To comprehend the nature of information, and thus the knowledge generation process, we need to begin at the beginning - at the big bang which supposedly started this whole thing. Without the big bang, we are told, we could not exist. There would be no information; no massenergy.

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### *A synopsis of the plot*

My plot is that the universe and everything we know is a flow - a river into which we cannot step in the same place twice. My storyline is that flows operate according to systematic processes and exhibit characteristic structures and patterns. Such systems have been described as 'far-from-equilibrium' by, especially, Ilya Prigogine and Fritjof Capra. Flow systems are never in equilibrium. They flow from one state (e.g. ignorance) to another (e.g. comprehension and understanding), so knowledge is better understood as a flow, rather than a state or stock. Paul Davies, in *The Fifth Miracle*, also argues that information flows are an important, even fundamental, property of the universe and life, while Roy Frieden thinks he can develop nearly all of modern physics simply on the basis of (Fisher) information theory. Similarly, Steven Rose also argues (in *Lifelines*) that we need to think in terms of flows.

Flow systems generate chaotic structures of rich diversity, yet betraying mysterious underlying patterns of repeating self-similarity at many different scales. Flames, rivers and seas are the classic examples. They may be illustrated, and their apparently essential properties explored through Mandelbrot sets and fractals. Such patterns as coastlines, river systems, the blood and nervous systems of the human body, leaf shapes and structures, trees, flowers and so on, all display fractal patterns. Capra titles these flow systems the *Web of Life*, and believes them ingrained in and fundamental to nature.

The reason I use to tell the story? To try and ensure that it is consistent with what I think we already know (that it is veracious); that its logic is coherent (valid) as a plot; that it is as legitimate (valuable) as possible. There are three criteria for the 'truth' of the story - my faith, rules and reason.

### *Faith*

To defend legitimacy, I appeal to Gödel's incompleteness theorem. This, in vernacular terms, says that no system of logic (no story, in other words) can be completely self-contained. Proved for number theory - the most rigorous of our logic systems - it says that the consistency and coherence of the logic has to rely on at least one 'given outside determinant' or g.o.d. For the logic to be useful and valuable, therefore, it is sensible to be both explicit about what the g.o.ds are, and keep their number as small as possible, lest we stretch the credulity of the audience too far.

The conventional story is that it and we all began with a big bang. Which leaves far too many questions unanswered to satisfy my credulity. I am not alone in thinking the big bang story unconvincing. Sir John Maddox, twice editor of *Nature*, also thinks so. So, I start with something more credible - nothing at all. An indefinite and infinite pool or mass or whatever, at complete maximum entropy, with absolutely no order or structure or pattern, absolutely cold and still. Complete ignorance - the *tabula rasa* - which I call May. You can call it god, if you like. I'll stick to May, which just happens to be the name of my current mother in law.

Clearly, since we are now here and the stars are in the sky, May must contain within it the capacity to produce everything we see, and thus also everything that we can ever hope to see and know. It must, therefore, contain all the massenergy there can ever be - hence its name. And it must be infinite, since any notion of finite implies a boundary (an order), hence its capital letter. And, finally, it must flow and grow for anything to happen, for us to happen,

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and for us to be able to recognise and then comprehend the universe. May, and its capacity to conceive as a maybe and grow to a be, is my faith.

### Rules

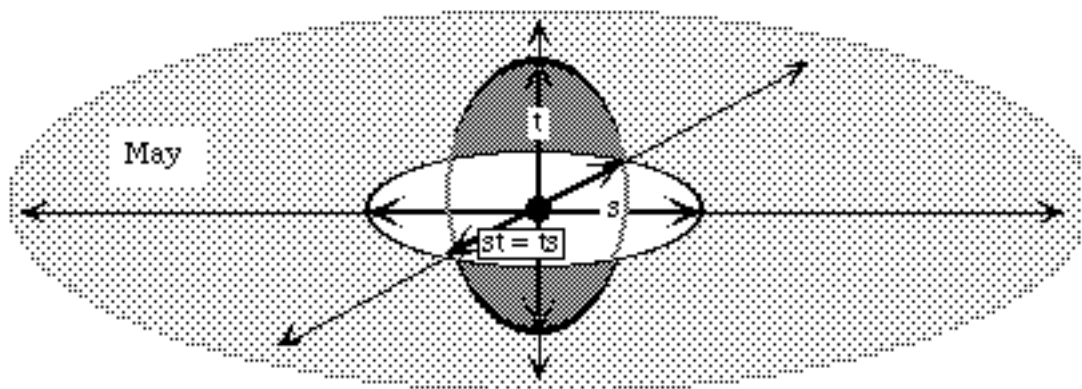
I have three basic rules according to which I attempt to construct the story of how the universe, and thus we, might have come into being from May.

Rule 1: keep things simple. To safeguard veracity, I use a principle which, so far as I am aware, physicists have not so far found necessary or useful. I assert that any real (and thus whole) object, structure or whatever has necessarily to be consistent with Fermat's Last Theorem. This theorem says that only systems of the form  $z^2 = x^2 + y^2$  can exist as whole numbers. Thanks to Andrew Wiles, we now know this to be a mathematical truth. Multi-dimensional systems (of the form  $z^n = x^n + y^n$ , where  $n$  is any number greater than 2) are "wholly" impossible or imaginary. I interpret this as saying that, ultimately, we have to be able to reduce what we are talking about to two, and only two, dimensions to be sure that what we observe is whole, and thus real, and not just an artefact of our imaginations. At first sight, this may seem far-fetched and paradoxical, but the story illustrates what I mean.

Consider the elusive but necessarily fundamental concept of *spacetime*. According to this principle, spacetime can only exist meaningfully as the combination of two primary two-dimensional planes - a 'space' plane or *field* [ $F = s*st$ ]; and a 'time' plane or *history* [ $H = ts*t$ ]; at right angles to each other. The common axis between these two planes we call spacetime or timespace ( $st$  and  $ts$  respectively).

This is how an observable "maybe" might be thought of as emerging in May, as an integrated bit of organised space and time. In my story, any reality thus exists in three dimensions ( $s$ ,  $st (=ts)$  and  $t$ ) which neatly (or should that be nearly) accords with common sense and experience. A picture may help.

### Spacetime in the Maybe Universe



But we also need matter and action, for a 'moment' in May to make any sense. How do we know things make sense, if and when they emerge from May? Because they exhibit or exist according to rule 2. Rule 2 is Einstein's famous equation of conservation:  $e = mc^2$ . Things primordially exist as mass (matter) or energy (action), where their two states are necessarily connected through the speed of light. We can tell they are there by the signals (information) they give - their gravity as matter, or their energy as action. Simply too much human knowledge and understanding is consistent with this fundamental equation for it to be

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substantially wrong. Things (and ideas) matter, and/or they act. The energy of their action is (potentially at least) equal to their mass (matter) times the speed of light squared. Clear now? No, I thought not. We need more of a story.

Why doesn't May remain as a *tabula rasa*? The reason is that rule 3 applies. Rule 3 is the Heisenberg Uncertainty Principle, which is fundamental to present physical understandings of the world of quantum mechanics and the foundation of our universe. I interpret this principle as describing the essential nature of flow systems. My interpretation of this principle comes in three corollaries.

The first corollary is the 'creative' mode. This says that anything possible, however remotely improbable, will happen as an event somewhere sometime. Since it is possible for an observable event to happen in May, exhibiting time and space, and mass and energy, the principle assures us that such an event will happen. It is this principle which describes the fundamental processes of our flow systems. Physicists describe such unlikely but inevitable events as 'vacuum fluctuations', which some agree began the universe.

The second corollary is the 'existence' mode. When such an event occurs, it can only exist as a finite 'event-domain'. This defines the possible structures which emerge in our flow systems. This is the common form of the uncertainty principle. It is written symbolically as  $\Delta X \Delta Y \geq k$ , which says that any change in X times an associated change in Y has to be at least as great as some finite and well defined constant, k.

If we try to know exactly where a particle or thing is, we make change in space (X) as close to zero as possible - a pin-point. But then we cannot possibly know where it has come from or where it is going to, because change in Y (time) must tend to infinity according to the existence corollary. Our structures (or facts or events), then, are finite and discrete, and cannot be infinitely divided and still make sense. They cannot be uniquely identified as points. They are, necessarily and fundamentally, quantum in nature, however continuous and infinitely divisible they may seem when we look at them from a distance.

But the things we know also exist as matter, and we only know they matter when they act - when they display some evidence of their existence. As and when the moment happens as a realisation of May, it must, according to our present understandings, behave according to Einstein's fundamental equation:  $e = \pm mc^2$ . Plus or minus? Yes, the famous equation actually comes in both the positive and the negative forms. Why? Because ...

The full equation is far more intimidating and much less memorable:  $e^2 = m^2c^4 + p^2c^2$ , where e is energy, m is rest-mass, c is the speed of light and p is momentum, as mass times velocity. We think we know that this equation applies to all persistent physical systems - the ones which we see and measure, and with which we experiment, and live. It simplifies, for systems which are at rest rather than moving (for which momentum is zero), to  $e^2 = m^2c^4$ . This further simplifies to  $e = \pm mc^2$ , which (if we ignore the apparently meaningless notion of negative energy, mass or the speed of light) further simplifies to  $e = mc^2$ . See? No, I don't suppose you do. This is supposed to be knowledge, but it doesn't make much sense unless you happen to be trained in the right language and the right stories. For most of us, it is mostly meaningless information.

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It is here that we need the third corollary of the Uncertainty Principle: the ‘behavioural’ mode. This says that nothing can return exactly to its starting point, but is part of an inexorable flow from one state to the next in timespace or massenergy or whatever, where all states are definitionally and thus observationally and actually different from all other states. It is this corollary that describes the patterns of our flow systems. It is this property which makes the proper maths complicated, and the simple maths misleading. In other words, the order in which we try to observe facts or things is important. If we get things back to front, or out of order, things are most likely not to make any sense.

### *My story*

My Maybe universe begins, not with a bang, but with a whisper. As a *moment* in May, of realised, persistent and observable spacetime and massenergy. A moment as a discrete (quantum) event, occupying a specific and measurable (and self-defined) bit of time and space. I suspect that this describes the Higgs particle which the physicists always find dropping out of their maths, but have not yet managed to identify in their particle accelerators. The importance of this particle, according to Sir John Maddox, in *What remains to be discovered*, “cannot be exaggerated .. the standard story will be in serious trouble if the Higgs particle does not appear on cue.”

In my story, the relevant *quantum* of the May pool which emerges as the moment can be expressed as  $E$  [equal to  $e^2 = \pm m^2 c^4$ ], a Higgs field. The ambiguous sign signifies the maximally entropic state of May. It might be positive or it might be negative, with the mean value being zero - the *tabula rasa*. Creative uncertainty generates *matter* (M), as a maybe, which in turn may exhibit *action* (A) and become a be. Steven Rose calls these emergent structures beings and becomings. Each of these transformations (or flows) is non-commutative - they behave differently in reverse, if indeed they can go backwards at all.

Matter is expressed as  $e^2 = -m^2 c^4$ , signifying that it is the antithesis of the May from which it emerged. The negative sign also signifies the ‘shadow’ left in May by its emergence. This shadow I suppose to be anti-matter, which physicists are confident exists. They are, I gather, rather puzzled that total anti-matter in the universe cannot be equal to total matter, otherwise the universe could not exist - each would annihilate the other in a mass of expressed energy - a bang. Each exists and balances in my story, because they are the product of a flow and cannot commute. One cannot exist without the other.

If and when Matter acts, it displays Action (A) according to  $e^2 = +m^2 c^4$ . There is a flow of matter into action. Energy is expressed matter, and matter is potential (virtual) energy. Matter is an inactive and still moment. Action is an active but stationary moment. Both ‘realities’ are defined or observed only through the universal constant, the speed of light (c). It is only these structures and processes which we can reliably observe as ‘objective’ knowledge or fact (the reliable interpretation of information). Everything else we think we see and know must be inferred.

So what, then, is the speed of light in this story? The answer is four-fold. We now have four primary transformations or flows. Each of these flows can be thought of as a speed of light. Or, equivalently, as a rate of realisation.

First, we have the establishment of the momentary space and its unique relationship with its spacetime, which we may call the *Circumstance* of the moment. The circumstance is here

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defined as space times spacetime - the field of the moment. As space grows, so too does (space)time, at a rate which we can call a speed of light. Our space field is our circumstance.

The second flow is the rate at which matter is realised from May, which we may call its *Culture*. It is this flow which generates the gravity of the moment in May, as the effect of the condensation of the quantum of May into a material form of matter, which we can only detect because of its gravitational attraction. And gravity, we now know, thanks to Einstein, bends space into a curve, or a circle for our moment. And, to do so, matter must spin, which our physicists assure us is a fundamental property of particles, or matter. Our cultures give us our spins.

The third primary flow is the establishment of timespace and thus time, via the spacetime axis of circumstance. This generates a *Context* for any action (the field of its energy) as a relationship between space and time and thus a speed of light. Our contexts give us our futures - our possibilities for making histories.

Fourth and finally, we have the flow (or exhibition, or realisation) of action from matter. From this flow we discern the *Character* of the moment, which we see as light, or heat, or sound. Our characters are revealed by our actions.

Do you begin to see the light now? Given these 4Cs - circumstance, culture, context and character - we can now see what moments of information might mean. And the system depends on multiplication - it is a flow - not simply an addition as the combination of two states. But, as an important addition, it is a non-commuting multiplication. The states reciprocate. In the terms of some current literatures, they are reflexive. If these flows do happen in reverse, the results are different. But that is another story. At least this one seems to explain the common information of  $e = mc^2$ , in a way which I, for one, have not found sensible before.

*So what?*

To continue the full story now will try your patience and interest too far for this essay. The logic necessarily becomes rather fierce, and needs more maths - not a suitable subject for an essay. Or for your author, come to that. So the rest of it will have to be brief and in outline.

Once a moment exists, it must generate some change in the neighbouring pool of May - some balancing order elsewhere. Otherwise, it will tend to exhibit simply as the mean of its dual primordial states, which is zero. According to this logic, there will be a chain reaction in the moment's space plane, generating a two-dimensional plane made of strings of organised space "maybes" and their matter/antimatter pairs. The fabric of spacetime - with an associated gravity field, expressing the necessary relationships or relativities between the maybes and their parental pool of May.

Once a moment acts and exhibits energy, it generates a two-dimensional timespace plane, made of strings of balancing electro-magnetic charges. In turn, these charges generate their corresponding spacetime matter-maybes in the space plane. The Maybe universe appears as a single flash, once the initial moment acts (as it must according to the uncertainty principle). And, once it has flashed, the complete fabric of spacetime is established as a system of stationary moments of organised three-dimensional space. With each moment 'knowing' its place and history, since it knows which way to flow - towards the primordial moment. And no further time. Until or unless something else flashes.

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Transmission of light now happens as a wave of successive momentary flashes, each reacting to a neighbour's action. Without action, the fabric is still and dark. Light is not, according to this story, a moving photon. It is the transmission of action as a signal between stationary filaments (moments) in the fabric of spacetime. What physicists catch when they identify a photon might just be a stationary filament of the fabric in the act of flashing. At least this story does not imply the necessity of "aurons" as quantum packets of sound, which a moving photon theory would seem to imply, since sound appears to travel according to the same physical rules as light.

If approximately true, such an explanation would include ripples throughout the fabric from every single signal of information (action), and from every motion of any emergent particle within this gravitationally structured fabric. Since it would be impossible to remove the fabric of spacetime in any physical experiment - May always and universally exists - such universal signalling might well underpin an explanation of the quantum mechanics and particle physicists double-slit and Aspect experiments, which presently seem to defy credible explanation.

For a single and isolated moment, however, the rules imply a necessary balance or resonance between action and matter (without continual replenishment from May, that is). This necessary balance implies a fundamental equality between the energy of matter (which is gravity) and the energy of action. How can these be reconciled? The physicists are convinced that gravity is a phenomenally weaker force than electro-magnetism, which is itself very substantially weaker than the strong nuclear force which holds the nucleons (protons and neutrons) of atoms together.

But in my story, these forces are relative - relative to the space and time they occupy and define. It seems possible that, at sufficiently small scale and sufficiently concise span, these forces can be reconciled through a universal constant which relates gravity to electro-magnetic energy through the local fabrics of spacetime. But, the longer the span or the greater the scope of the fabric considered, the more dispersed and weaker becomes the force of gravity. The strong nuclear force is super-small and super-concise gravity in this story. In other words, get the context and the circumstance right for what we are trying to look at, and the story will make sense. If not, then we can expect to get gibberish.

The continuation of the story is that the elemental matter of our universe - hydrogen atoms - are formed as a consequence of further fluctuations in the fabric of spacetime. The proton is an amalgamation of moments, generated as a consequence of fluctuations in gravity between momentary maybes. The moments themselves are revealed as quarks in the results of particle accelerator experiments, coming in different 'colours' and 'flavours' signifying their birthplace and cultural history on a given string. The electron is a necessary shield of other moments in active (non-material) form to preserve the independent persistence of an hydrogen atom from the reactions and responses of the rest of the field of May. It has to be so preserved, or it could not continue to exist and we could not possibly see it (or be it).

Furthermore, the initial aggregation of moments into the elemental atom will happen in one plane - not two. The primordial atom - hydrogen - is 'flat' not round, much as our galaxies are apparently flat, and not round or twisted. That is, it will be flat in its space plane as matter - the proton; and will exhibit action in the orthogonal time plane as the electron. This

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aggregation I suppose to occur as a consequence of the gravity slopes (and thus flows) established from the initial emergence of the moment and the creation of the gravitational fabric of spacetime. In this sense, the formation of the initial proton would twist and distort the local fabric (as popular interpretations of Einstein's relativity seem to suggest). But, to persist as an independent entity, this prototypical proton needs the counter-balance of an electron - to balance its internal energies and momentums. If one does not emerge, the proton is exposed and in danger of decay or annihilation.

The story explains why hydrogen atoms mostly go around in pairs - as molecules. The hydrogen molecule, in this story, is the pairing of two atoms in different planes. Yet such a structure would be fragile and not persistent. Either the pair would disintegrate at the slightest provocation; or something else would happen to make the bond between them more permanent.

The something is the emergence of the neutron - the key distinguishing feature of a helium atom from a hydrogen molecule. In my story, the neutron arises as another and different aggregation of moments from the fabrics of spacetime in adjacent planes to bind hydrogen together into persistent and stable (inert) helium.

Thus we have the primordial elements, from which everything we know can be grown - through super-nova explosions and biggish bangs all over the place. We (our scientists) think we have got much of this already explained, including the unlikely but inevitable emergence of life on earth, and thus us, and all our imaginings.

And that, in outline, is my story of how we came to be. If you do not like it, think of another - the race is wide open. But this is mine, and I'm sticking to it.

*Finally, what is the point of this story?*

Existing knowledge comes bundled in stories which interpret universal information in particular ways. My story shows how it is possible to reconstruct existing information, and come to quite different conclusions from the convention. I have used a story with which we are all roughly familiar, and re-told it in a way which makes more sense to me. But I have chosen a story for which there are few preconceptions and few predispositions among lay people to believe one plot versus another, or ascribe particular significance to one part rather than another. In so doing, I have not behaved typically. Furthermore, I have tried to be careful in explaining how my story is constructed, and what particular beliefs and rules I have used in its construction.

The result is rather different from those told by the experts. Which is right? Which is more credible? Which is more useful? Which is knowledge and understanding and which is fairytale? Are black holes the final material sink into which galaxies are necessarily flowing, or are they the sources from which matter and life is erupting - the congregation of primordial moments about to explode as supernovae, and thereafter the umbilical chord into the pool of May? Is the background radiation we (our scientists) see throughout the cosmos the fading echo of the big bang or the primeval glow of May warming up?

We can only tell the answers through elucidation, debate and experiment - faith in the logic of elucidation, the rules of debate and the reason of experiment. We thus need to explore the



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nature and nurture of our negotiations systems to understand how knowledge becomes treated as truth. This is the subject of the third essay of this quintet.

Meanwhile, the physicists and quantum mechanics are busy searching for a “Theory of Everything” - a ToE - which can integrate relativity, gravity, electro-magnetism and the nuclear forces into one coherent whole - a wholly integrated theory. Various lines of attack are being pursued, including superstring theories, supersymmetry, quantum gravity, Fisher information theory.

I respectfully submit my entry to this race. Of course, my own gravity in telling the story of my toe is sufficiently small compared with the massive conventions of physicists and quantum mechanics, that it is quite likely to be dismissed as rubbish without further thought. But I also strongly suggest that any resulting Toe will have barely entered the water of life.

Meanwhile, too, there seem to be some curious analogies in this story with the ways in which information generates (or can be used to grow) knowledge, and how knowledge can be cultivated into understandings. In particular, there appear to be laws of cognitive dynamics mirroring those of thermal dynamics: the first law being that knowledge is indestructable and universal; the second being that organising knowledge into understanding involves an inevitable friction and frustration, generating inevitable conflict and heat - the subject of the next essay. Otherwise, exploration of these analogies must await more time and space than are here available, and depend on the gravity of the argument as well as on the action (or thought) such gravity might generate.

[4,894 words.]