Are we using the wrong mathematics?

Malcolm Macleod
mail4malcolm@gmx.de

We live in a universe that appears to operate smoothly according to a set of laws which we do not fully understand. Furthermore we have 2 completely different and apparently opposing sciences to describe this universe – the life sciences; biology, organic chemistry, and the physical sciences; inorganic chemistry, physics...

And so we may ask, is it not redundant to have 2 completely different sets of laws to govern a single universe, especially as biological systems clearly integrate seamlessly with physical systems. We know there is a biological science, we ourselves are evidence of this, and so if there is only 1 set of laws that govern our universe, then I submit that these laws may be the laws of organic systems, in other words, the physical sciences may themselves be life sciences.

"Concepts that have proven useful in ordering things easily attain such an authority over us that we forget their Earthly origins and accept them as unalterable facts. The path of scientific advance is often made impassable for a long time through such errors… our conceptions of Physical Reality can never be definitive; we must always be ready to alter them, to alter, that is, the axiomatic basis of physics" -Albert Einstein [1]

Natural systems

Dystopic visions of the future are common in literature and film, while optimistic ones are more rare. This contest encourages us to avoid potentially self-fulfilling prophecies of gloom and doom and to think hard about how to make the world better while avoiding potential catastrophes… how humanity should attempt to steer its own course in light of the radically different modes of thought…

I suggest that regardless of whatever technological advances may be on the horizon, we cannot avoid a repetition of the catastrophes that have plagued our history if we are lacking a fundamental understanding of our universe and our role within it. The principal argument being that we model our societies and social interactions within and without based on the same mathematics that we apply to our material world, in other words that mathematics we learn at schools and then apply to the world around us, whether building tennis racquets or missiles, modeling stock markets or voting patterns, is fundamentally an engineering mathematics. Conversely organic systems use a different set of 'algorithms' if we may use this word, which we could loosely describe as an organic mathematics (the mathematics of organic systems).

Engineering mathematics lends well to programming as it is reducible to logical commands that may produce logical outcomes, conditional commands along the lines of "IF coffee too hot THEN wait ELSE drink".

Likewise an engineer may design a new toaster and then send the final design to the factory. That toaster may be quickly constructed, those that do not pass quality tests rejected, the rest shipped to the sales outlet.

These toasters will never change size, shape, color, etc and will continue to function until their usefulness has expired.

Engineered systems take a complex data set (the design) and turn this without modifications into the finished product. Organic systems however take a relatively simple initial data set (the DNA), a time dimension (where time equates with specialization) and an external input (energy, nutrients…) and produce an extremely complex system that is constantly changing… for example a human fertilized cell begins to resemble a baby after only 3 months, it may function independently of its host (mother) after 9 months and has a fully adult form after 15 years.

Furthermore an 'error' rate is built into the equation, were we to grow toasters, no 2 toasters would be the same, just as their ability to cook toast would also differ. This would reflect redundancy in an engineering sense but diversity in the organic sense.

However, a pure market-place functions according to the precepts of natural selection via consumer choice and selection. As a result the engineered toaster would have to be continuously updated to reflect the latest trends; the organic toaster should auto-update of its own accord.

In organic systems the strength and even survival of a species depends on this diversity and that it is the removal of this diversity from our own systems; whether monoculture crops, education based on rote learning, manipulation of the marketplace, of the internet, a rule by the 1% [22] etc. which removes the 'creative destruction'.

As one example; we are not sure how the human brain functions. It comprises about 200 billion neurons with about 125 trillion synapses in the cerebral cortex alone… yet there is constant activity, much of which is still poorly understood, hence the 'we are only using 10% of the brain' myth [2].

We envision our brains taking in data, running those data through some unknown processes, perhaps even reproducible mathematical algorithms, which somehow then tell us how to behave. However as our brain itself is a natural system, it may be that this activity reflects a neural natural selection process which is constantly creating a myriad of thoughts. Over time some of these thoughts coalesce (their wave functions superimpose) and others cancel. The resulting ideas that survive this natural selection process become the dominate ideas; they may then become articulated, expressed via 'language' spoken or written (as an essay for example).

And so, for our ancestors living in the jungle, 99 times out of 100, if 'input = see lion' then 'output = flee', but there would have been some situations when that was not the optimum solution. If they relied only on conditional logic and there was no way to generate unique alternative options based on the same input, and so to learn, then we may not be here today. Likewise, what we refer to as genius is often the ability to take two apparently unrelated ideas and find or build a (neural) path that links them, giving that 'Eureka' moment.

Consequently that apparent redundancy of neural activity (neurons firing without any apparent purpose) might not help us play chess against a supercomputer, but it does mean we could solve a unique and unforeseen problem where the supercomputer cannot, and with the adaptive advantages that may bring. And so our education systems, rather than concentrating on rote learning should reflect and enhance this.

The reason this may be more than a mere philosophical debate is because of the possibility I noted earlier that it is not only carbon based life forms that follow these organic rules but the entire universe itself, and that it is our artificial delineation between the organic and the inorganic that has rendered us unable to create sustainable systems.

If this is indeed correct, then we need to recognize that our engineering approach to mathematics is inadequate and perhaps even inappropriate for organizing organic systems, which would cover all systems, and that if we could develop an understanding of organic mathematics then we could apply that to modeling our societies; whether political, economic, educational etc.

Organic universe

An organic universe would presumably follow a cosmological natural selection [3] process where there were no laws of physics in the beginning, rather there was an initial set of conditions (the universe DNA) whose parameters were such that the electron and proton and the laws of physics and the planet earth were the natural outcomes.

Lee Smolin, a physicist at the Perimeter Institute, first popularized in his 1997 book 'The Life of the Cosmos' [4] the concept that a cosmological natural selection might occur via the same rules as those which apply in biology.

For example, directly following the big-bang, as the universe mass-density and temperature is of extreme proportions, there would be a plethora of sub atomic species formed… slowly however, as our universe grows, the mass density of the universe reduces and the universe cools, the most stable forms in a geometrical sense (electrons, protons etc) would tend to predominate… the less successful (less symmetrical) 'species' (which we are generating in the LHC) returning to the particle energy pool to be recycled. The electron charge for example has been shown to be perfectly symmetrical [19].

As time progressed, the universe began to specialize with atoms and molecules beginning to form… the universe constantly growing both in size and complexity. It would not have been necessary for the laws of physics, the structure of particles; the 4 forces or other such minutiae as would be required by a static (engineering) design. These details are all natural outcomes of this initial condition.

Cellular automation [5] is often quoted as an example. A cellular automaton consists of a regular grid of cells, each in one of a finite number of states, such as on and off. For each cell, a set of cells called its neighborhood (usually including the cell itself) is defined relative to the specified cell. An initial state (time t=0) is selected by assigning a state for each cell. A new generation is created (advancing t by 1), according to some fixed rule (generally, a mathematical function) that determines the new state of each cell in terms of the current state of the cell and the states of the cells in its neighborhood.

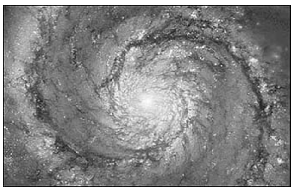
The 1970s 'Game of Life' [6] rules are: If a cell has 2 black neighbors, it stays the same. If it has 3 black neighbors, it becomes black. In all other situations it becomes white. Despite its simplicity, the system fluctuates between apparent randomness and order.

In 1969, Konrad Zuse (Calculating Space), proposed that the physical laws of the universe are discrete by nature, and that the entire universe is the output of a deterministic computation on a single cellular automaton. Stephen Wolfram's 2002 book 'A New kind of Science' argued that the complexity in nature may be due to cellular automata.

Spiral example

The Fibonacci spiral [7] (or golden spiral) is the classic example of a mathematical rule that is followed by both organic and inorganic systems. In geometry, the golden spiral is a form of logarithmic spiral whose growth factor is $\varphi = 1.618033\ldots$, the golden ratio.

The Fibonacci series is; 1,1,2,3,5,8,13,21,34,55,89,144,… where the previous 2 numbers sum to form the subsequent number. Examples of such logarithmic spirals can be found in nature (shells), natural systems (hurricanes) and physical systems (spiral galaxies) and so forth…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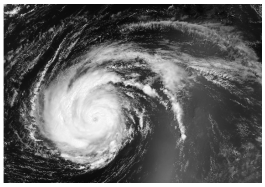
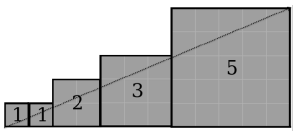
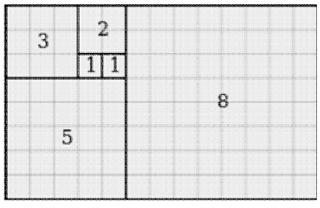


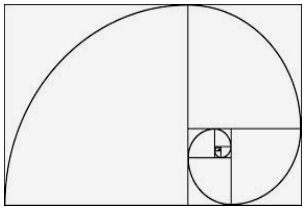
image: nasa.gov/


image: wiki/Golden_ratio

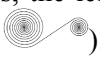
If we represent this number series with a series of squares and add these squares along a straight line then we get the following progression; x-axis/y-axis = $1 + \varphi = 2.61803398\ldots$ we can then fold these squares around each other to form our golden spiral. We may therefore propose a geometrical rationale for this series being found in nature, should this folding lend to a low energy state.







If the spiral is a fundamental geometry then we must ask why. The first attempt at a Planck unit theory of nature was by an unknown Cro-Magnon 'physicist' 24,000 years ago who engraved onto a mammoth tooth a spiral with a clockwise rotation (seen from the center) made up not by lines but by rows of dots [8].

If we replace these dots with Planck units, what then might a Cro-Magnon Planck universe look like? If it grows organically then it would have an initial information set (the big bang 'DNA'), a time dimension (t_u = 13.8 billion years) and an external input (as it rotates, the left spiral feeds the right spiral, the analogy would be playing a cassette tape from start to end ). The rules would appear simple, the complexity arising as a function of time.

Let us suppose that the left spiral is a (contracting) white-hole universe feeding an (expanding) black-hole universe (the right spiral) dot by dot with each transferred dot being a Planck micro black hole (which also corresponds to the information set aka the 'DNA' and/or cell).

Each additional dot also corresponds to a single unit of Planck time t_p and so we have (Planck) time, the universe time-line which is the spiral itself and the arrow of time (the uni-directional growth of the black hole universe as the spirals rotate and these micro black hole dots are transferred 1 by 1 from the white hole universe). All events which occur in the universe occur along this timeline, it is a constant. Furthermore the velocity at which the universe expands = grows would be the speed of light and this is also a constant.

Each micro black-hole dot adds 1 unit of Planck mass m_P and 1 unit of Planck volume (3-D space from Planck length l_p) to the black hole universe and so as this universe grows the mass/volume (and temperature/volume) ratio drop.

As the black hole universe is growing (it is not a closed system) and as its fabric is a black hole, we do not need either a separate dark energy or dark matter…, and as both the expansion velocity –c and the universe timeline itself are constants, we also do not need relativity [15].

We can calculate the mass, volume and temperature of our Cro-Magnon universe.
t_{age} = dimensionless units of Planck time; i.e.: if t_{sec} = 1s then $t_{age} = .9275547 \times 10^{43}$

$$t_p = 2.l_p/c$$

$$mass : m_{universe} = 2.t_{age}.m_P$$

$$volume : v_{universe} = 4.\pi.r^3/3 \quad (r = 4.l_p.t_{age} = 2.c.t_{sec})$$

$$\frac{m_{universe}}{v_{universe}} = \frac{3.m_P}{128.\pi.t_{age}^2.l_p^3}\left(\frac{kg}{m^3}\right) \qquad (1)$$

$$\frac{m_{universe}}{v_{universe}} = \frac{3}{32.\pi.t_{sec}^2.G} \qquad (3)$$

When we solve this (see results below) we find the solution corresponds to the mass density for dark matter, and as we are measuring the fabric of our black hole universe dark matter may be an appropriate description. It does however suggest that it is not (the vacuum of) space which is the absence of matter but rather matter which is the absence of space. When we look at the Freidman equation, we note that if we replace $\boldsymbol{p}$ with eq.3 then $\sqrt{\boldsymbol{\lambda}} = \boldsymbol{r} = \boldsymbol{2.c.t_{sec}}$ (the radius of the universe);

$$\lambda = \frac{3.c^2}{8.\pi.G.p} = 4.c^2.t_{sec}^2 \qquad (4)$$

The black hole energy distribution of emission as described by Planck's law for $M = m_P$ gives (Planck temperature = T_P, temperature at the big bang = T_{max}) [9];

$$T_{max} = \frac{h.c^3}{16.\pi^2.G.k_B.M} = \frac{T_P}{8.\pi}\,(K) \qquad (6)$$

$$temperature : T_{universe} = \frac{T_{max}}{\sqrt{t_{age}}}\,(K) \qquad (7)$$

The mass/volume formula uses t_{age}^2, the temperature formula uses the $\sqrt{t_{age}}$. We may therefore eliminate the age variable t_{age} and combine both formulas into a single constant.

$$\frac{m_{universe}}{v_{universe}.t_{universe}^4} = \frac{96.\pi^3.m_P}{l_p^3.T_P^4}$$

We note a similarity with the Stefan Boltzmann constant σ [13]

$$\sigma = \frac{2}{15}.\frac{\pi^5.k_B^4}{h^3.c^2} = \frac{2}{15}.\frac{\pi^2.m_P}{t_p^3.T_P^4}$$

However the Stefan Boltzmann constant seems to be using the volume of time instead of the volume of space. Furthermore, it appears to use the formula for the surface area of a 4-D sphere.

$$mass : m_{universe} = t_{age}.m_P$$

$$area : a_{universe} = 2.\pi^2.r^3 \quad (r = 16.t_p.t_{age})$$

$$\frac{m_{universe}}{a_{universe}} = \frac{m_P}{2^{16}.\pi^2.t_{age}^2.l_p^3} \qquad (10)$$

The Stefan Boltzmann constant becomes;

$$\frac{m_{universe}}{a_{universe}.T_{universe}^4} = \frac{\pi^2.m_P}{2.t_p^3.T_P^4} \qquad (11)$$

$$\sigma = \frac{4}{15}.\frac{m_{universe}}{a_{universe}.T_{universe}^4} \qquad (12)$$

This means the radiation density formula can be solved in terms of universe age (eq.10);

$$p_\gamma = \frac{4.\sigma.T_{universe}^4}{c^3}$$

…as can the Hubble constant; H = 3.08567758e22/t_{sec} (1Mpc = 3.08567758e22m).

…and Planck's law for black body spectrum when used to determine f_{max}, the maximum frequency (frequency of maximum intensity) of a black body, where j = ln(e) = 2.718281828459…

$$f_{max} = \frac{j}{8.\pi^2.\sqrt{t_{age}}.t_p} \qquad (20)$$

The presence of a sqrt (i.e.: $\sqrt{t_{age}}$) suggests that the minimum temperature the universe may reach is the inverse of the maximum temperature. From (eq.7) $T_{universe} = T_{min}$ when $t_{age} = T_{max}^4$;

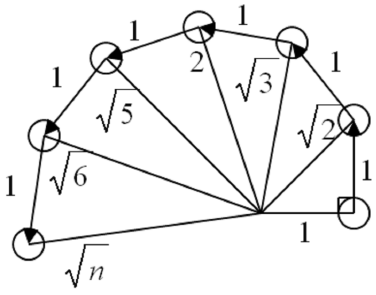
$$T_{min} = \frac{8.\pi}{T_P} = 0.177\ 10^{-30}\ K \qquad (21)$$

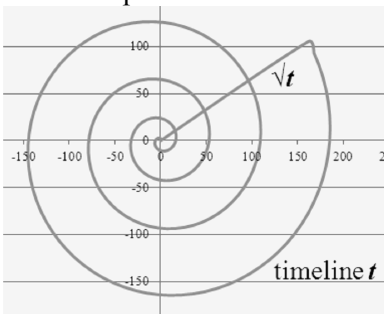
We can thereby calculate the maximum age of the universe, Og's constant [26] becomes; $\Omega = T_{max}^4 = 1.01373253 \times 10^{123}$ units of Planck time t_p (about 0.34632×10^{73} years, see notes: 2). As the next increment would then reach absolute zero, the universe clock would presumably stop.

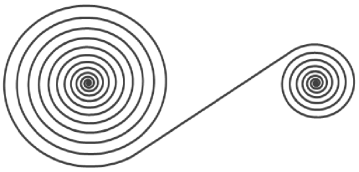
The mid way point ($T_{universe}$ = 1K) would be when $t_u = T_{max}^2$ = 108.77 billion years ($3.18391666 \times 10^{61}$ units of t_p) [15].

What this suggests is that those parameters which are related to mass and volume (mass density) will change in a linear fashion (from big bang to now) but those which relate to temperature (temperature density) will change according to this sqrt progression – with maximum change in the early big bang period. For example, it took 3000 years for the universe temperature to drop from Planck temperature 10^{32}K to 6000K (the temperature of the sun), but another 13.6 billion years to further drop to 2.7K. I have argued in a separate paper that temperature could be a function of the electromagnetic domain [24] and so the mass domains and the electromagnetic domains must thus be treated and measured separately.

When we try to map this we find our Cro-magnon spiral; the length of the right spiral (below) as the universe timeline t_{age} (each spiral triangle '1' refers to 1 unit of Planck time = 1 Planck black hole 'dot') and the radius of the spiral as the sqrt of this timeline $\sqrt{t_{age}}$, = .215 × 10^{-12}s, which in length terms renders our (electromagnetic) universe spiral radius smaller than a human hair (0.03mm)[25].







Results

Big bang (age $t_u = 1t_p$) [20]:
- mass density = 3.85e94 kg.m^{-3}
- temp = 5.4e30 K

t_u = 400 years:
- mass density = 2.8e-12 kg.m^{-3}
- temp = 15877 K

t_u = 13.575e9 years (best fit):	CMB t_u = 13.78e9yrs [11][14]
mass density = 0.244e-26 kg.m^{-3}	density of dark matter = 0.24e-26 kg.m^{-3}
radiation density = 0.464e-30 kg.m^{-3}	0.466 e-30 kg.m^{-3}
Hubble = 69.35 km/s/Mpc	69.3 km/s/Mpc
temp = 2.7255 K	2.725 K
f_{max} = 160.2GHz	160.2 GHz

nb. t_u = 13.575 billion years best fits the CMB data, assuming a non flat universe; Ω = 1.038 [23].

Summary

In the space of an essay it is of course not possible to adequately cover such a wide field, i.e.: contrasting the role of mathematics in organic and inorganic system. Consequently I have merely noted here that common geometrical solutions do exist (see also the list of fundamental constants as geometrical forms [18]), and so an analysis of physical systems could lead to a better understanding of organic systems, should the delineation between the organic and inorganic prove to be artificial.

Our lives are typically separated into the organic and the material and I submit that it has been a mistake to apply the (engineering) mathematics of the material to the workings of the organic… and this has been our fundamental error, not the technologies themselves. Perhaps in this respect our ancestors have much to teach us.

1. The Schwarzschild metric admits negative square root as well as positive square root solutions. The complete Schwarzschild geometry consists of a black hole, a white hole, and two Universes connected at their horizons by a wormhole. The negative square root solution inside the horizon represents a white hole. A white hole is a black hole running backwards in time. Just as black holes swallow things irretrievably, so also do white holes spit them out [16]
2. ... in 1998, two independent groups, led by Riess and Perlmutter used Type 1a supernovae to show that the universe is accelerating. This discovery provided the first direct evidence that the cosmological constant Ω is non-zero, with Ω ~ 1.7 x 10^{-121} Planck units.

This remarkable discovery has highlighted the question of why Ω has this unusually small value. So far, no explanations have been offered for the proximity of Ω to $1/t_u^2$ ~ 1.6 x 10^{-122}, where t_u ~ 8 x 10^{60} is the present expansion age of the universe in Planck time units. Attempts to explain why Ω ~ $1/t_u^2$ have relied upon ensembles of possible universes, in which all possible values of Ω are found [17].

3. Formulas [18] and numerical values for the natural constants taken from [21] (online calculator)
   Formulas [15] and numerical values for the equations listed above [10] (online calculator)

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