

This essay is what I should have been able to write for my PhD thesis way back when. It's title was, "The Impact of the Quantum revolution in Physics on the Biological Sciences." Researching this topic, I had to report to my advisor that the impact was actually negligible. That in itself is interesting, it's as if the lower levels of the Empire State Building had moved to 42nd Street, leaving the upper stories hanging in midair at 34th Street. The aim of this essay is to show that the impact of Quantum Physics is profound, and involves our view of natural law, and how we describe it. The classical Victorian science still taught in school to this day considered matter to be bits of matter moved about by gravity and electromagnetism. Natural law was just describing simple interactions with regular numbers, $F=ma$ being a familiar example. These 'real' numbers measure one aspect: that of size, amount, position etc. One of the mysteries of Victorian science, one that confounded founder Newton, was that of partial reflection in a plate glass window. Quantum physics solved this problem by adding a new aspect to matter: the wavefunction. This was an insubstantial aspect that needed the math that united two aspects into one. This is the math of complex numbers that unites two aspects into one. There are, for example, two aspects of motion—one being linear, unbounded motion, the other circular motion and rotation. $z=(x+yi)=(p@a)$, where i is 1 rotated by 90° ($1/2 \pi$ radians). This is the great leap from the Victorian view. Matter now has 1. a tangible external particle that is local. 2. An intangible internal wavefunction that was somewhat extended and projects onto the particle as a real probability. 3. The wavefunction changes during an interaction are controlled directly by natural law. The question is, how does the NL level project onto the wavefunction. There is a more sophisticated level organizing and unifying all the particle laws into coherent unity, and it is Quaternions that unify two sets of complementary aspects into one. This layer projects as a complex function onto the wavefunction level. This is how quantum physics implicitly describes matter.

<u>Natural law-particles</u> global Quaternion numbers $[a_1 a_2 b_1 b_2]$
<u>Wavefunction</u> extended Complex numbers $[a_1 a_2]$
<u>Particle</u> local Real numbers $[a_1]$

The word 'probability' is used quite differently—and confusingly—in Victorian and modern science. As in gambling, statistics and coin-tossing, a regular probability is an admission of ignorance. In modern science, quantum probability (QP) is so

different it really should have a different name. It is all powerful in its domain; it rules the structure and function of atoms. One day, our Sun will run out of fuel and will eventually collapse inwards. The crush will halt at about Earth's size, however, held up solely by the zero probability of three electrons sharing the same state. Ignorance has nothing to do with it. One point is of note: All the complex numbers used by the wavefunction of physical matter reside in the unit circle—the length is 1 or less—which create real probabilities ranging from zero (forbidden) to 100% (compulsory). What about all the rest of the complex plane? We can add this to other 'loose-ends' of modern physics—solutions to equations that are not seen in nature. These are a few of other loose ends: What is the Dark Energy 72% of the Cosmos? How does it have an antigravity effect? Is it negative energy tachyons? Is it structured with supersymmetric entities? Does it inhabit a complementary metric? Is it governed by the rest of the complex plane? While investigation of quaternions is still in its formation stage, there are some hints of this in the literature: "Like functions of a complex variable, functions of a quaternion variable suggest useful physical models. For example, the original electric and magnetic fields described by Maxwell were functions of a quaternion variable." (Wikipedia) Also, in a Quora-online article on functions of quaternions: "What I had was an out-of-control intuition that these algebras were key to understanding {fundamental laws}..." ## Emergent Properties The wavefunction can have an extension larger than the particle. When two particles interact by coupling with bits from their structures, it starts with their wavefunctions overlapping, lawfully merging so that a bit can be exchanged with high probability. If a stable situation ensues, the outer wavefunctions merge into a united wavefunction that has a novel set of emergent properties. The phenomena of 'Emergent Properties' is when a property emerges in a stable interaction between two or more entities, none of which has that emergent property. For instance; one electron and one proton in their merged 'atomic orbital' has the 'hydrogen' character; Two electrons and two protons have the utterly different 'helium' character; three electrons/protons the active and desirable 'lithium' character, etc. The particles are the same, it is the merged wavefunction level that provides the 'character,' and this is determined by the natural law level. A simple molecular example is water, with its host of properties essential to life and living, none of which are properties of hydrogen or oxygen molecule alone. Natural Law is a hierarchy of laws that pattern the various levels of physics, chemistry and the start of biochemistry: Particle law, Atom law, Evolution of elements in stars, Molecule law, Formation of planets, Oceans and Vulcanism. The culmination of 9 billion years of this hierarchy of Natural Law patterning the developing universe was the planet Earth, with its volcanic structures, called White Smokers, that were the environments for the next great leap. ## Origin of Life Once the Earth had cooled from its fiery birth so that the Ocean was stable, about 4.5 billion years ago (bya), a remarkable thing happened. Molecules and macromolecules organized themselves into LUCA, the Last Universal Common Ancestor, in just a few million years. This pattern has not changed over the eons: all life uses the same 20 amino acids, the same ATP, RNA, DNA, the same core metabolism, the same proton-motive force, etc. The details of this existential change are still being worked out. But a plausible 'womb' for this change is the White Smoker volcanic vent. Here thin mineral membranes separate acidic ocean water, saturated with carbon dioxide, from alkaline vent fluid from the magma field, loaded sulfides and phosphates and the like. The flow of hydrogen ions through the membranes was linked to sulfide and phosphate activation. This stored energy then drove carbon dioxide and hydrogen together to form carbohydrate precursors—the origin of the Proton-motive Force pattern common to all life. The pattern of developing and running a metabolism comes from the next level up in the math hierarchy of natural law, the math that harmonizes 4 sets of pairs, the octonions with 8 aspects harmonized. It is patterns on this octonion level that project, as a quaternion function, onto the set of physical laws making the metabolic patterns probable, and bound to happen sooner or later. The result is LUCA, a biofilm inhabiting a White Smoker. The pattern that the natural law has the emergent property we call life, so it is appropriate to call this emergent property the 'metabolic mind' of LUCA. There were two patterns in natural law for cell walls to be constructed, encapsulating LUCA's descendants. One, more flexible and mobile, enabled the E-bacteria to explore the open ocean, while the other, tougher and inflexible enabled the A-bacteria to explore the more challenging environments. For 2 billion years, these two races altered the world, creating great beds of iron and sulphur, and eventually discoing the photosynthetic pattern in the Logos that allowed stripping the hydrogen from water and, as a waste product, the oxygen which eventually replaced CO₂ in the atmosphere. Together, these two races of bacteria worked together to form stromatolites, one of which was the womb for the next big leap in life's sophistication. ## Sophisticated Life The stromatolites are layered structures of photosynthetic E-bacteria at the top level feeding the

layers of E- and A-bacteria below. Both the E- and A-bacteria have different thick cell walls to protect themselves. In the protective ‘womb’ of the stromatolite, however, these could be jettisoned, and more intimate interactions could occur. Adapting along probable patterns provided by natural law, commensal interactions developed where the waste of one was a nutrient for another. While the details along the Law-provided pathways are “a black hole in the heart of biology” according to Dr. Lane’s The Vital Question, the end result was LECA, the Last Eukaryotic Common Ancestor. This was the Law-directed patterning of an entity composed of an E-bacterium—the ancestor of all mitochondria—living inside an A-bacterium. Their merged internal aspects had an emergent property, the eukaryote mind. This is a cellular pattern that all ameba, fungi, plants and animals share, descended from LECA. A similar adoption occurred later when a photosynthetic E-bacteria joined and became the ancestors of the chloroplasts in plants. Along the path to LECA, the lineage gained a host of novel emergent properties: o Containing DNA in a nucleus o Fragmenting genes into translated exons and control introns o Sex, with haploid gametes generated by doubling of diploid genomes followed by reduction to haploid and mating to diploid. The LECA was probably a pair of cells, the parents of the eukaryote lineage that we are a part of. The first signs of this innovation appear in the fossil record about 1.7 bya, just 2/3rd along Earth’s history. Now this level of eukaryote emergent properties, the eukaryote mind, is organizing and unifying the lower minds of A-and E-bacteria, and needs the higher level of the sedenions that unify 8-pairs, of 16 complementary aspects. This level has hardly been explored by mathematicians, so all we can say, from the previous levels, that the sedenions level of Logos control of the lower lever is by the output of an octonion function.

Natural Law and Levels of Mind				
math level				
16	Eukaryote mind sedenion #	function ↓		
8		E-bacteria mind A-bacteria mind octonion #	function ↓	
4			LUCA metabolic mind quaternion #	function
2				wavefunc complex
1				

Modern Life About 0.5 bya, the Cambrian explosion occurred, when the Law-derived patterns of multicellular plants and animals appeared on Earth. Of primary importance to us was that the Last Chordate Common Ancestor (with a primitive spine) emerged at this time, alongside those of echinoderms (starfish), mollusks, worms, and arthropods (insects). All of these innovations were organized and harmonized by a higher level of natural law. This is level unifying 16 pairs, 32 aspects and it has yet to be even named by the mathematicians. Yet another level of math sophistication has the emergent properties that characterize the Primate mind, and the final level, the emergent property of the human mind. The basic pattern of the hierarchy of Natural Laws is the same from top to bottom. If the sequence—2, 4, 8, 16, 32, 64—seems familiar, it is the sequence to the history of the modern computer's ability to manipulate information: 2-bit , 4-nibble, 8- byte, 16-HP 2100, 32-Mac Plus Motorola 68000, 64-Mac Book Air. But I'm not quite sure of the connection or it's utility. This ends my current view of the 'effect of the quantum revolution in physics on the biological sciences' as also revolutionary.

Natural Law and Higher Levels of Mind					
math level					
256	Human Mind 256-nion #	function ↓			
128		Primate Mind 128-nion #	function ↓		
64			Animal Mind 64-nion #	function ↓	
32				Multicellular mind 32-nion #	function ↓
16					Eukaryote mind sedenion #