What Is Fundamental?

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"Chuck Norris counted to infinity…
twice."

If you have the luxury of a graphics display to read this article, you can probably spot the fancy title written in 3D letters. Unfortunately, the third dimension is unreal. It has been implemented in ways that you might consider limited, by means of a two-dimensional shading algorithm. Two dimensions give us the infinite rambling possibilities, nonetheless. If you expect that the third dimension is something fundamentally bigger than the two dimensions you have enjoyed so far, you could be merely trying to compare the two different infinities of possibilities. Recently, mathematicians began to claim that infinities indeed are equal in size, so life in either two or three dimensions is equally fulfilling. [1]

You should not bother denying the value of non-fundamental things. Our genetic code is yet another non-fundamental thing. The universe in which the genetic code readers and writers operate, suggests an unlikely set of initial conditions followed by a long time span of perfecting a biological being and the evolutionary tree as a whole. The genetic code information has authenticity and history. Still, it is not a basic ingredient of this universe or the next one assuming a collapsing, cyclic universe. Let us find a reason to appreciate the fundamental and the non-fundamental things equally.

The third dimension can mean a lot if you are a differential equation. You could exhibit chaos. Your hands could weave delightful patterns that stem from the butterfly effect. We would be unable to claim which patterns, in the end, those would be. They would be too rich or too random to predict.

The two-dimensional beings are a paperweight category in terms of the mass and the energy. The reality of the named, countable, measurable ingredients of nature has been the dominant force for anyone trying to mine for resources such as energy, trying to look for the chemical elements or the basic scientific truths.

I recall the stories that the atom would offer more energy to the humanity because of the new *fundamental* forces of nature hidden inside the atom. The potential energy associated with the force field in the atomic nucleus could be converted into energy. I wonder whether the Large Hadron Collider as a microscope looking for the fundamental ingredients of the universe is planning to deliver any large detonations or just the high electricity bills. Some fundamental ingredients of nature could be uninteresting, in principle. Everything that remains until the end of the universe could be uninteresting, except for the Simpsons episodes.

I remain hopeful that there is no ambiguity about the identity of the fundamental ingredients of nature. Crudely speaking, half of the ingredients are visible such as the protons, neutrons, and the electrons. The other half you might consider as the invisible contents that are interpreted as the force fields. The guesswork of scientists has convinced me too of the invisible magnetism and similar things. Although, I usually negate the existence of the virtual particles out of the sheer boredom. One might argue that the fundamental things ought to be real and should not fluctuate in and out of existence. They need to sit there firmly in the open air. [2]

We perceive the visible universe as a finite bunch of fundamental ingredients. An open question about the universe's origin makes people wander off into infinity and assume that there are more contents hidden out there. One might hypothesize that the "fundamental" means "tasty" in the Nature's Cookbook.

The list of fundamental constants that define this particular universe is not final in a bureaucratic sense because we are lazy. The theories of physics are incomplete; the fossil fuel usage is not over either. The human evolution is still on, similar to an old biological program of development driven by economy rather than by a divine force.

I appreciate the way the FQXI society demands from each of us to include what is fundamentally possible in our written works. If you enjoy the Star Trek spaceships that travel faster than light, you should not base your logic on such objects that are impossible in our universe. If you have been informed about the list of possible things, try to include the idea that nobody understands arguments that are too complex or costly as well. Certain kinds of computational requirements collide with the fundamental limitations.

In nature, we use the measurements rather than blind estimations. We discover the patterns such as the laws of nature and the limitations such as the speed of light or the maximum amount of electricity you can send over a copper wire. The human society could act merely as a random probe in any environment and keep trying to expand those limitations head-on. The random behavior is a suitable algorithm that leads to success.

Experimentalists have produced a magnetic sensor that exhibits high sensitivity to the changing magnetic field, and, the high information bandwidth so that the weak magnetic field can vary fast and deliver meaningful messages. [3] The sensitivity and the bandwidth are the characteristics that work as limiting factors, in opposition to each other. As the two characteristics are implicitly converging, a novel trait appears. The audience feels that the fundamental barriers have been broken whilst reading a prototypical article. Usually, we wait for the news analysis that says that no barrier has been broken in the end. We should not read those analyses in reality.

While the demand to know what is fundamentally possible represents the golden standard that made the civilized world richer, we should point out that the possible outcomes are unknown even in a limited universe. All the fundamentals such as the speed of light are applied simultaneously

to each scenario that you wish to study, as constraints. The fundamental particles, on the other hand, are the dices you can roll out on the table.

In a future set of physics theories, the spacetime, the constants of nature, and other things should stem from the particles of matter and their mutual relationships. To some extent, we can grasp that the spacetime is not given in advance. The local universe is the "self-sufficient" bearer of spacetime, unlike the Newtonian-era absolute spacetime that preceded the universe. The relationships between the particles redefine the observable version of a physical system making a quantum-classical distinction possible.

The commonplace particles of matter such as the atomic constituents cannot simultaneously share the same spot due to the Pauli Exclusion Principle, which does not explain why such behavior ultimately occurs. Maybe it is too naïve for the Mother Nature to answer such a flimsy, "self-evident" question. The presence of matter defines what is visible to the local, material agents and the stacking or ordering of particles.

The Planck's scale has been deemed a fundamental scale suggesting a "bottom line" or the finiteness of the nature. Moreover, the worst thing has happened: I do not know how to make a drawing of an atom anymore. A fundamental visibility cutoff, a quantum-mechanical model ambiguity and complexity have taken their toll. Occasionally, we use the word "fundamental" to drop the curtain on the knowledge or establish its boundary. I hope to spot every day something fundamentally new.

Literature

[1] *Two mathematicians have proved that two different infinities are equal in size, settling a long-standing question. Their proof rests on a surprising link between the sizes of infinities and the complexity of mathematical theories.*
https://www.quantamagazine.org/mathematicians-measure-infinities-find-theyre-equal-20170912

[2] Attributed loosely to Robert D. Klauber in "Student Friendly Quantum Field Theory".

[3] *The best magnetic field sensitivity is obtained using quantum sensors. The increased sensitivity leads in principle to longer communications range. The quantum approach also offers the possibility to get high bandwidth communications like a cellphone has. We need bandwidth to communicate with audio underwater and in other forbidding environments…*
https://www.nist.gov/news-events/news/2018/01/quantum-radio-may-aid-communications-and-mapping-indoors-underground-and