

FIGURE 1. Euler's Argument from Design: $e^{i\pi} + 1 = 0$. This is awesome for some but not so much for modern mathematicians. The vise-like grip of stuff undoubtedly goes back to clay in Mesopotamia. Biblically, 'Adam' means "red clay" in Hebrew.

1. INTRODUCTION

Who thinks of a *pattern* as itself fundamental? Is not a pattern thought to be carried by more fundamental *stuff*? Yes, if you are thinking the *mere being* of an *it* of nature is what is actually the case. No, if you are thinking of the way *mathematical patterns* exist. Indeed, Tegmark[8] put forward the idea that mathematics itself is adequate as a foundation. In trying to confront "It from Bit, or Bit from It", let us drop back to the beginnings of civilization.

2. IT

Philosophy and Greek science started by legend with Thales (624-546 b.c.e.). He attempted to explain the *arche* or ultimate ingredient and the existence of the world without simply pointing to mythological beliefs. Thales, who by legend had travelled to Mesopotamia and to Egypt, said the arche was 'water.' Millennia before, Egyptians had believed the world was a mound of Earth created from the receding waters of the primordial sea. Regular flooding of the Nile and the subsequent deposit of fertile mud was central to earliest Egyptian culture. In Mesopotamia, there was little in the way of wood or stone, so all manner of things, even people, were thought to be made of clay.¹

In Mesopotamia, there was a creation myth now called the *Enuma Elish* which appears in various forms for several millennia. It begins with three water deities, *Tiamat*, the chaos dragon goddess of sea waters, *Abzu*, the abyss god of fresh

¹See Fig.1, Michelangelo, *The Creation of Adam*, the ceiling of the Sistine Chaple, from the internet:[File:Creation of Adam, jpg-Wikimedia Commons](#). As stated there "this work is in the public domain in the United States, and those countries with a copyright term of life of the author plus 100 years or less. This file has been identified as being free of known restrictions under copyright law, including all related and neighboring rights." The remaining images in this paper are simply drawings by the author, Gary Glenn Miller, and are as well in the public domain.

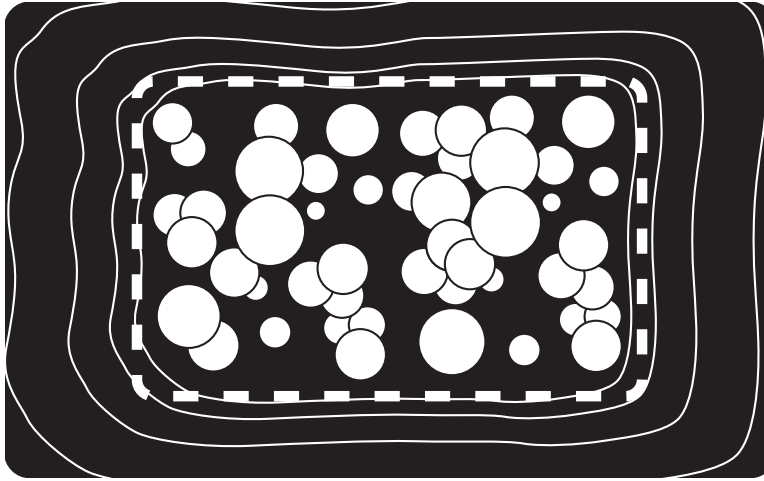


FIGURE 2. A close look at a physical *object*. This “it” must be different enough from its surroundings, and stable enough throughout some time in order that this “it” can be considered as entirely distinguished, stable, and named. Although there may be forms, there do not seem to be, strictly speaking, examples of physical objects.

waters, and his advisor *Mummu*, the maker, all commingling as a single body of water. Thales, who had travelled both to Egypt and to Mesopotamia, would have heard the *Enuma Elish* and would have encountered the idea that water was the primal substance. He would also have encountered the Mesopotamian idea that clay was the stuff from whence all things were made.

Designs might have been stamped on clay pottery, and otherwise patterns of all kinds were thought to be carried by clay. So it is that, through the millennia since those days, we have thought that the mere being of a physical thing, an “It”, was carried by a more fundamental stuff such as clay.

At the beginnings of civilizations it was clay. In the Mechanical Age of the 17th century, how much of a surprise is it that Kepler would say that nature was like a “Giant Clockwork”. God may have made the Clockwork and set it in motion according to his “Laws” only to step out of the picture so that matter is determined to move as it must. With the Romantic Reaction of the 19th century, humankind found it difficult to live in a universe where “the stars blindly run” and, as B.Russell said, apart from life on Earth, the physical universe is “..as sterile and lifeless as the surface of the Moon.” These are but ephemeral matters. It is perhaps, then, not such a surprise, due to the importance of computers in this Information Age, that thinkers would think of nature as a *cyberexistence* built on information.

3. BIT

Let us imagine a virtual reality, a *VR*, is generated in a computer. Suppose further all the senses of a person are wired into such a computer so that he only observes events in that *VR*. Wired in from birth, he believes the *VR* is his “real world” and his *avatar* body in that *VR* is his “real body.” Indeed, popular movies,

such as *The Matrix*, and VR literature, such as Stanislaw Lem's 1960 short story, *Lion Tichy's Memories*, develop just such a scenario.

All that could seem *actual* to a wired-in person are the patterns generated by computer. VR things may seem to have heft. However, this is just an illusion of feedback between computer generated patterns and a wired-in person's body. To us, who stand outside, we can see that perhaps he is wired-in to a Mac computer and Apple software; but the wired-in person cannot know that. Indeed, the computer hardware may be entirely irrelevant. Suppose, for example, there is a population of wired-in people each with their own computer which variously is a Mac or a Windows computer. Imagine, like the commercially available "Second Life", the computers are all wired together over an internet and that all the corresponding VR's amalgamate to one VR regardless of the specific choice of computer. Here the population of avatars may communicate with each other. Some may even choose to built their own VR house or otherwise live their VR lives. As Shakespeare once wrote they are "such stuff as dreams are made on." Here all is a matter of *witnessed pattern* ultimately in the form of discrete *bits of information*. The stuff of the world and the computer hardware is completely irrelevant. It is no matter to such a person whether his computer is a Mac or not.

Aristotle originally had two different meanings of 'substance'. One agreed with our ordinary meaning, exemplified by clay, and the other had to do with the linguistic matter of *identity, i.e.* when are two things the same. Much later, Locke and Hume explored experience and appearances. Kant carried this much further with the idea that except for mathematics we never can witness the ultimate reality of the things-in-themselves. Instead, in the 19th century, it became common knowledge the whatever 'reality' might mean, it was a question of *belief* and not experience. By the 20th century, not only was fundamental stuff, whether clay, water, electric field, or strings, philosophically believed to be this or that; but also it differed from person to person. However, the idea that somehow there are fundamental patterns, whether or not there is stuff, survives. It is an idea that goes back to the beginnings.

For a further discussion and access to the literature, see Tegmark and Wheeler [9], and Tegmark [8].

4. THE PYTHAGOREANS

The idea that there are fundamental patterns was a key matter for the early Greek Pythagoreans, [3]. They coined the terms 'Cosmos' for the patterned Universe and 'Mathematics' for learning. There were four areas of mathematics and two kinds of pattern: *discrete pattern* and *continuous pattern*. *Static* pattern was later called 'Form.' The paragon of discrete static pattern was the Arithmetic of positive whole numbers, *i.e., natural numbers*; while, the paragon of continuous static pattern was supplied by the figures of the Geometry we now call "Euclidean geometry." The other two areas of arcane mathematics were *dynamic*. The Dynamic Discrete had *Music* as its model example, while, the Continuous Dynamic had *Astronomy* as its model example. These four areas were associated with the first four natural numbers 1, 2, 3, and 4 and called '*the Tetrakys*'. The sacred oath of the Pythagoreans was to the tetrakys.

Pythagoras, the legendary founder and sage of the religious cult of the Pythagoreans, is thought to have lived from ca. 570 to ca.490 BCE. He apparently spent his

early years on the island of Samos, off the coast of modern Turkey and close to the earlier Thales' hometown of Miletus. When middle-aged, Pythagoras is believed to have moved to the southern Italian town of Crotona, which is not far from the town Elea of his contemporary philosopher Parmenides. Pythagoras was regarded as the first scientific boxer and emphasized the Olympic games. His daughter married Milo of Crotona, the greatest Olympic wrestler, sometimes called "Milo the Giant." Milo held six Olympic victories, opponents refused to wrestle him, and he was the source of many legends. The Pythagoreans met in Crotona in Milo's house until it was burnt; they then dispersed and went underground. The Pythagorean mathematicians were vegetarians, they believed in reincarnation, and their secret symbol was the 5-pointed star ★. They meditated on patterns.

5. PATTERN

We would say a "pattern" is the utmost generalization. Whatever, a "pattern" is, *it passes over, under, or across itself*. It is synonymous with A.N.Whitehead's *Process and Reality* idea of utmost "extension." As the Pythagorean's thought, there is perhaps no better subject to think about when trying to confront "pattern" than ancient Music. Because the ideas of bits of information and discrete or continuous, static pattern or "form" are well known, we only need to develop the "dynamic" notion of pattern.

To arrive at a general "dynamic" notion of pattern, *imagine the actual performance of improvised jazz*. As the performance unfolds to create an overall process, it is a dynamic patterning that passes over its passages of notes and silences which we call its *aspects*. Let us regard the evolving patterning, as well as all its aspects, to be a "pattern" even though we are thinking of an activity rather than a thing. If it were recorded or existed as a musical score, the music would be an "it"; however, the live music is an evolving activity to be expressed as a verb and not a noun.

Now while the finished results of mathematics are obviously patterns, let us be bold to say that the activity of doing mathematics is like the previous jazz example in that it is a creative activity. Not only are the mathematical discoveries this way, but also the expression of *logic* in doing the live mathematics is an activity of pattern.

6. THE ARCHE: 1, 2, 3, 4

C.S.Peirce (1839–1914), perhaps the greatest American philosopher, originated pragmatism [6]. He spent most of his life dealing with various versions of his trichotomy about pattern: *Firstness*, *Secondness*, and *Thirdness*. To this, we add a *Fourthness* which is a form of self-reference or feedback and has been studied at length by Maturana and Varela in *The Tree of Knowledge* and other works. The first three may be understood in terms of static pattern or form, while fourthness is related to biological feedback and is dynamic.

The system of those four generating notions about pattern flesh out Jung's *Quaternio* which he regarded by the end of his life as generating all the *Archetypes*, (see M.von Franz [10]). Moreover, upon interpreting legends, this Quaternio is essentially the arcane Pythagorean idea of the Tetrakys, the generator of the Cosmos.

No one in recent times has spent more time and energy on *self-reference* or on the idea that something like the principles of biological *evolution* are key to physics than the late John Archibald Wheeler.

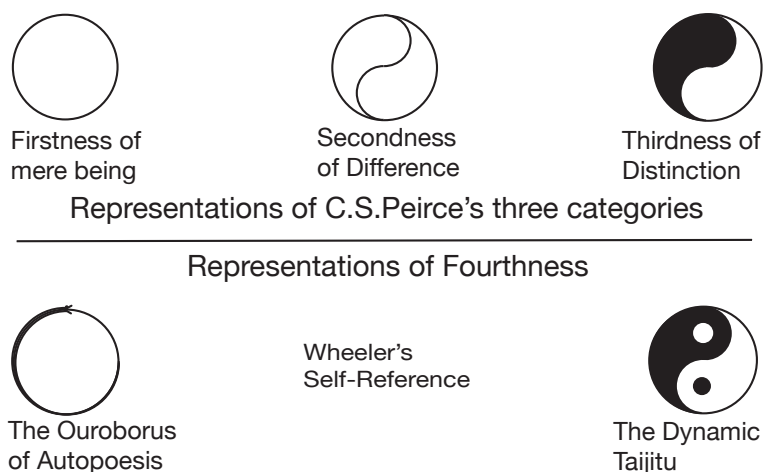


FIGURE 3. The Quaternio

- *Firstness or the Absoluteness of Mere Being.* Peirce also called this *unitarity* the *suchness* of mere being. Take, for example, a basic unary property such as being “red.”

- *Secondness or the Relativity of Difference.* John Duns Scotus (c. 1266–8 November 1308), the famous Franciscan theologian, called this basic binarity *haecity* or *thisness*.

- *Thirdness or the Sign of Distinction.* An alternative such as a bit of 0,1 information, a logical asserted ‘true’, the name of something, or an ego are all assignments to make a thisness a *thing*.

- *Fourthness or the Self-reference of Autopoesis.* J.A.Wheeler, in discussing the participation of the observer in the observed, introduced the idea of Self-reference as a fundamental quantum feature of nature. The idea of a dynamic pattern of feedback is central to Taoism and often depicted by the familiar Chinese emblem of the *Taijitu*. There the ying and yang are balanced by a growing spot of the other within each aspect. In arcane alchemical terms “fourthness” is represented as an *Ouroborus* dragon that produces itself by devouring its own tail.

For a discussion and access to the literature, see [6], [11] and the works of Wheeler in the references.

None of the four basic *archetypes* that go together to form the Quaternio are clear and distinct in themselves. Rather, these four aspects of the overall pattern are interdependent as is often the case with patterns. Together they form a creative dynamic system which, like the case discussed of live jazz, is about actuality. In other words, it is about an evolving creative “Now.”

7. THE FIRE IN THE EQUATIONS

Wheeler once spoke of a magician’s apprentice who wrote the ultimate equations of a fully unified theory of physics on cold floor tiles. The apprentice waved his wand and try as he might the equations lay as dead matters of form on the tiles. The lesson here is that such matters of form as equations cannot account for the *being* of nature. Steven Hawking later talked about “the fire in the equations”

to make the same point. And, long before either of these, Plato in the *Timaeus* faced the same problem sometimes called “the channel is not the stream.” Plato introduced god, the demi-urge, and according to Cornford [1], Greek philosophy fell from reason into theurgy at that point. Hawking talked about the lack of a boundary at the Big Bang and about going before the Big Bang is like travelling south from the south pole. Wheeler left it open as to what might be missing from the ultimate equations of physics. However, towards the end of his life, according to the Physics Newsletter from the Princeton Physics Department, he came in regularly and continued to work on how biological evolution might have a hidden lesson for physics.

8. EVOLUTION AND MEANING

Usually we adopt a *referential semantics*, a theory of meaning in terms of pointing to matters that exist. For example, we have ‘Bill = William’ just in case ‘Bill’ and ‘William’ both point to the same existence, *i.e.*, both name the same object. While one of Adam’s main jobs was to name “stuff”, without stuff we adopt an unusual meaning of ‘meaning’ due to Quine [7]. To set the stage, a metaphor of a boat was popularized by W. V. O. Quine (1960, pp. 3-4):

”Neurath has likened science to a boat which, if we are to rebuild it, we must rebuild plank by plank while staying afloat in it. The philosopher and the scientist are in the same boat. Our boat stays afloat because at each alteration we keep the bulk of it intact as a going concern.”

So it is the patterns of life involve a feedback holism which represents *Fourthness* or autopoiesis discussed at length by Maturana and Varela [4].

Fourthness expresses the feedback given by natural selection. In the biosphere, a ‘lion’ and a ‘lamb’ carry their own evolved meanings of predator and prey. Moreover, humans are in nature. As, for example, we are two-thirds water, which like all other stuff, exchanges with environmental stuff; let us notice that we too are essentially patterns. In doing physics, we must remember we are not distant observers but witnesses participating with the other patterns of nature.

9. CONCLUSION

“The Quantum”, as Wheeler would say for the principle underlying quantum physics, remains unsurpassed. It is entirely warranted by the physical evidence. Yet, all of us find it so hard to grasp. The answer here to this and so many other of Wheeler’s issues is to hold onto pattern and to let go of stuff.

“The Quantum” requires technical developments. It must be left to a later work.

We have seen how the idea of substance goes back to clay with the beginnings of civilization in Mesopotamia. We have seen how the idea of fundamental “Pattern” goes back to the Pythagoreans with the beginnings of Western thought in ancient Greece. We have seen how extending the static idea of Form to include the Pythagorean Dynamic sets the stage for a creative evolving notion of “Pattern.” We have indicated how C.S.Peirce’s *Firstness*, *Secondness*, and *Thirdness*, Carl Jung’s *Quaternio* of archetypes, and, therefore, the Pythagorean *Tetrakys* can be considered as *arche*, *i.e.*, as adequate *generators* of our Cosmos of “Pattern.” We have seen how evolutionary biology can be seen to represent *Fourthness*” as a key

self-producing autopoiesis. Then, we have seen how the “meanings” in nature are given by feedback loops rather than by pointing to things that simply exist.

Thus, we have set the stage for *Pattern theory* as a foundation.

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