Philosophical and Scientific Reflections on the Pythagorean Tetraktys

Giuseppe Chindemi, adapted by Mary Jones, S.R.C.

One of the best known Pythagorean concepts is that of the Tetraktys. We will continue our examination of numbers with an investigation into this fundamental concept of the Tetraktys and the amazing correspondences that link it to modern science.

To the Pythagoreans, the *arché* was the *First Principle* in the world and manifested as numbers and the laws underlying them. Pythagoras believed that the ultimate "substance" of all things, material and immaterial, was to be found in numbers. On the one hand, numbers had a special physical existence in the form of counting chips or numeric symbols and words for numbers that could be written down. On the other hand, numbers were also purely abstract formulating principles.

This was understood by the builders of medieval cathedrals who, when producing their grandiose architectural works, were influenced by the tenets and beauty of Pythagorean geometry. They attempted to encode the secret symbolism of their "high knowledge" in their constructions in such a way that their knowledge would be understood only by those who had "eyes to see and ears to hear," following the Pythagorean principle that "truth is divulged only to those who seek."

If numbers were associated with order they reasoned, and everything was determined by number, it followed that everything in the universe must be ordered. For the ancient Greeks the word *kósmos* meant first and foremost "order." By virtue of the harmony, system, and order to be found in the universe, Pythagoreans called the universe itself the cosmos. To the Greeks, this word also carried the suggestion of "beauty" as well as "order."

The Pattern in All Things

Pythagoreans saw a deep and mysterious patterned structure in nature. They were convinced that a great power lay in numbers..., maybe even the power that had created the universe. They therefore believed that all Nature and all beings manifested in it did so in accordance with numbers, so that the entire universe, through these numbers, became the manifestation of perfect harmony.

To disseminate and conceal their teachings about this, the Pythagoreans synthesized their ideas into one symbol: the sacred Tetraktys (*tetraktys* in Greek means "fourness"). For them it was the very expression of Divinity, the image of the created and eternal realms. When the Pythagoreans took an oath, they used the following ritual formula: "I swear by the one

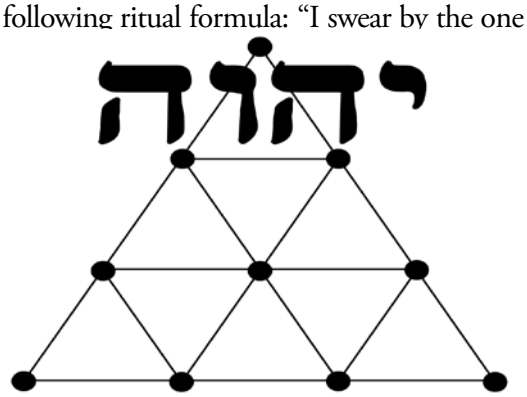

Figure 1: The Pythagorean Tetraktys and the Hebrew Tetragrammaton.

who gave my soul the Tetraktys, the source and root of ever-flowing nature, that...."

In this article, we will reflect on the profound symbolism of the number *four* and examine how frequently it is found in nature. It will explain that the Pythagorean teachings concerning this number—which they regarded as the root or source of ever-flowing nature—continue to be valid vis-à-vis the teachings of modern science.

However, before addressing the scientific aspects, we will make some brief comments on the esoteric aspects. To Jewish people, the *Tetragrammaton* represented the ineffable name of God in the four Hebrew letters *Yod*, *He*, *Vav*, *He*. According to the Pythagoreans, the Tetraktys similarly formed the basis of their entire belief system. (See Figure 1.) They regarded four, the square, as the number of "universal manifestation." In our own times we talk about the concept of the "perfect square," and to ancient Egyptians it was the basis of eternal stability.

Geometry and the Tetraktys

Pythagoras made a particular study of geometry, which he apparently learned while in Egypt, where there were many geometrical problems that the Egyptians were adept at solving. Every year after the annual flood in the Nile valley had obliterated property lines, the Egyptians were forced to re-measure the land for cultivation. There was therefore a need to perfect the science of geometry, the original meaning of which was "earth measure." Who doesn't marvel at the perfection of geometry made manifest in the Pyramids of Giza? What monumental accuracy!

The painting illustrated in Figure 2 is *The Last Supper*, by Leonardo da Vinci (1498), in the church of Santa Maria delle Grazie in Milan. This master artist and scientist is known to have had links with the Rosicrucian initiatory tradition, and if you look carefully, the symbolically loaded numbers three and four can be seen in the famous fresco. Looking at the painting, we see that the two side walls converge forming the sides of a triangle whose apex is high above the figure of Christ, who himself appears shaped like a triangle. On each side wall are four large panels in front of which are placed groups of apostles, six on each side of Christ, each side divided into two groups of three, with the Messiah at the center. The whole painting strongly suggests that Leonardo took deliberate inspiration from the sacred Pythagorean symbolism of the Tetraktys.

Figure 2: Leonardo da Vinci, *The Last Supper*, 1495-1498.

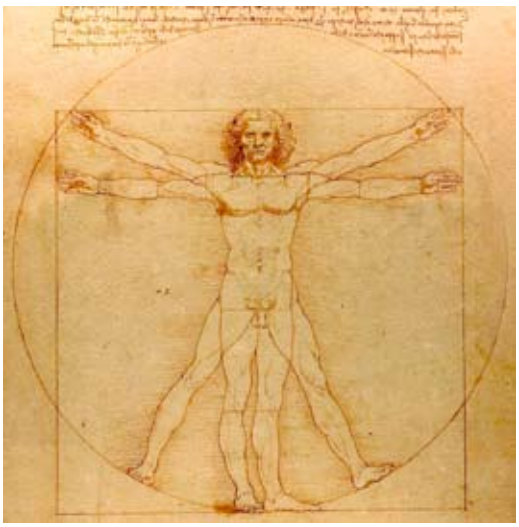

Figure 3: Leonardo da Vinci, *Vitruvian Man* 1485-90, Galleria dell'Accademia, Venice. Photo by Luc Viatour.

Leonardo also used the Tetraktys as inspiration for his drawing of the *Vitruvian Man* (Figure 3). If you look at the image carefully, you will see the visible similarities between this and the sacred Tetraktys, expressing the pure perfection and complete harmony of the idealized human body. The symbol of the Tetraktys is therefore manifestly inherent in the universe and can be shown in the sequence of geometric dimensions that characterizes the physical world:

- 1 is a point, the *zero* dimension.
- 2 represents a *line*, the first dimension.
- 3 represents a *surface*, the second dimension.
- 4 represents a *solid*, the third dimension.

The sum of the numbers 1+2+3+4 gives the number 10, the symbol of perfection.

The Monad

In answer to the question "How did One begin?" the Pythagoreans looked at the world around them, suspecting that there was something special about the numbers 1, 2, 3, and 4. They were alert for hidden connections. The One, i.e., the *Monad* or fundamental *Archê*, is unique. It represents unity and indivisibility; the "uncuttable" atom of creation. The One is represented by the numeric symbol 1, which in turn embodies the original unity, the source of all creation (Figure 4).

The Monad is the primordial unity at the base of all creation. It is the origin of all things and the source of permanence in the universe. It is both male and female, odd and even; not a number in itself, but the source of all other numbers. The One is however incomplete. It needs an opposite in order to manifest and this gives rise to the even number 2. As the number 1 represents at the same time the principle of unity and the principle of the separation of opposites contained within it (odd and even), this separation is represented by the number 2.

- The principle of *unity* is 1, the One.
- The principle of *duality* is 2, the Dyad.

The Monad became the first principle of the original Dyad, odd and even, in which are rooted all other polarities of the Universe. All things are defined by number, and the original Monad *includes within itself* the plurality that flows from it.

But, what of the transition between the numbers 1, 2, 3, and 4? Having considered 1 and 2, it became evident that the Monad was capable of becoming an *emerging multiplicity*. The symbolism of 1 in the *macrocosm* is Unity, the First Cause, the original light

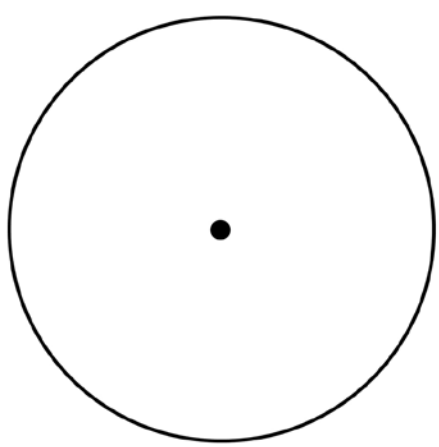

Figure 4: The Monad.

emanating from the primordial darkness, the Hebrew Yod, the Greek Logos, the Cabalistic En-Soph, the Vedic Brahman, the Islamic Allah. But in the biological *microcosm*, it is the "stem cell" from which all manner of cells can emerge through division: 1 becomes 2.

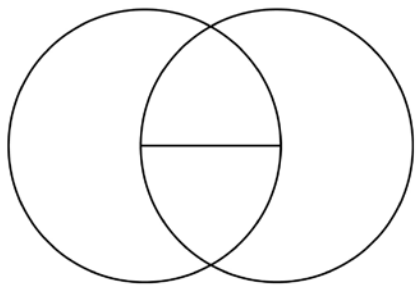

Figure 5: The Dyad.

The Dyad

The *Dyad* or 2, exists in everything where there are two opposing polarities (Figure 5). The transition from Monad to Dyad represents the first step in the process of creation: unity polarizes within itself to become a duality. The Dyad *is* the polarization, the opposition, the divergence, the divisibility, the change. It is the source of opposites, but sometimes appears as nothing more than the two extreme points of the same thing.

We read in *The Kybalion*, a well-known hermetic text, that "Everything is dual; everything has two poles; every [thing] has its opposite. The similar and dissimilar are the same; opposites are identical in nature, but of different grades." Two therefore, represents the cosmic opposites: light-dark, male-female, good-evil, active-passive, sun-moon, Yin Yang, all of which are references to the two active ingredients of the Universe. In mathematical terms, 2 is the beginning of all other natural numbers.

The Triad

Rosicrucians will be very familiar with the next step, mystically known as *The Law of the Triangle*. The polarization of the Dyad, in tension with the unity of the Monad, produces the next step in creation, the Triad (Figure 6). Kabbalists see this in the movement of the lightning flash from *Kether* (Crown) through *Chokmah* (Wisdom), to the third Sephira, *Binah* (Understanding).

The mystic and philosopher Georg Wilhelm Friedrich Hegel (1770 – 1831) was one of the founders of the German idealist school of thought. In popular thought, he is perhaps best known for "the Hegelian Triad": Thesis, Antithesis, Synthesis. This is a philosophical reflection and application of the law of the Triangle. Hegel was deeply influenced by, and involved in the Hermetic tradition,[1] and therefore it is no surprise that he would interpret the Divine Triangle in this way, and immortalize it in philosophical thinking.

Another mystic, British poet, artist and seer William Blake (1757 – 1827) was a student of the writings of Jacob Böhme and Emmanuel Swedenborg. His poetic realization of the law of the Triangle expresses its Dynamic reality: "Without Contraries, there is no Progression."[2]

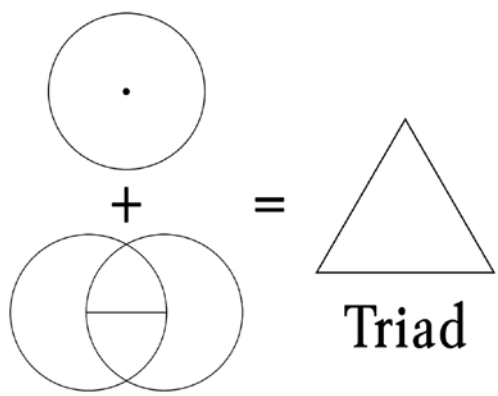

Figure 6: The Triad.

The Tetrad

Four, the *Tetrad*, derives from the Triad with the addition of another unit (Figure 7). It is the first of equal numbers, since the numeral 2 for Pythagoreans is not a true number but a principle. Four is 2 to the power of 2 (2 x 2). Geometrically, with 4 we have the third

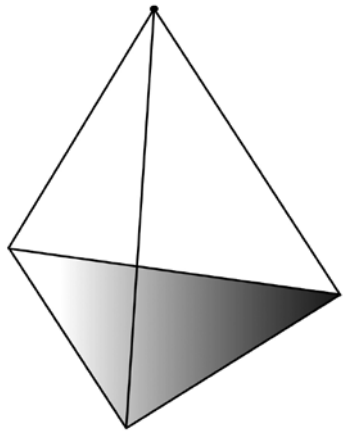

Figure 7: The Tetrad

dimension, since adding a point outside the triad, makes a pyramid or tetrahedron, which is the first solid figure, representing *volume*. Four, then, is the final manifestation of the Divine, the end point of the path of unity which distinguishes itself in duality, recomposes in the triad, and manifests itself in multiplicity in Nature.

The four sets: the Monad, the Dyad, the Triad and the Tetrad complete the Whole. The number one is a single geometrical point. When linked to another point, it becomes a line. If we add a third point and link it to the other two we get a triangle, making three points connected by three lines, which is the first plane figure. If we connect point number 4 to this triangle, we have a pyramid, the first solid figure, a three-dimensional body. Point, line, surface, and volume is the totality of the material world of the senses. Four represents completion. Everything in nature is completed in the progression from 1 to 4. Because it completes the progression 1+2+3+4=10, it was the symbol of the human soul and also the numerical model for the cosmos.

Tetraktys and Physics

In the previous paragraphs we looked at the Tetraktys on a philosophical level; now we will look at it on a more cosmological scale. Let us therefore examine the concordances from the microcosm to the macrocosm.

Atomic nuclei are made up of elementary particles that form the basic constituents of matter. They are divided into three families:

- *Leptons*: 6 in number: electrons, muons, tauons, and their three neutrinos.
- *Quarks*: 6 "flavors," which combine to form protons and neutrons.
- Their corresponding *antiparticles*: antiprotons, antineutrons, anti-electrons or positrons, produced by particle accelerators in atomic physics laboratories.

All matter in the universe is subject to 4 fundamental interactions or *forces* acting on it: *gravity*, *electromagnetism*, and the *strong* and *weak* nuclear forces. All matter has its own gravitational field whose energy is transmitted by "gravitons," a hypothetical elementary particle. Gravity is a natural phenomenon where objects with mass attract one another. It is this that accounts for the orbit of the Moon around Earth, the maintenance of the orbits of the planets of our solar system around the Sun, and on a macrocosmic scale, the clustering of galaxies.

The electromagnetic force arises from the exchange of photons, which produces things such as light, x-rays and radio waves. The *strong nuclear force* is the force that holds

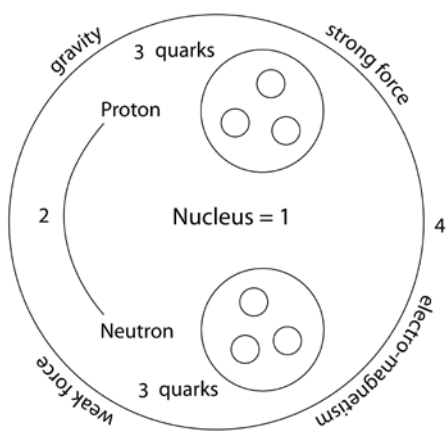

Figure 8: The Tetraktys is inferred in the sub-atomic structure illustrated here.

quarks and gluons together to form protons and neutrons in the nucleus of the atom. It is this force that transmits gluons that form the *pi* and *rho* mesons, which in turn transmit the nuclear force. The *weak nuclear force* affects all left-handed leptons and quarks as well as neutrinos. It is responsible for the reaction of nuclear fusion in the Sun and stars.

Where does the Tetraktys come into this? The nucleus represents the number 1. The proton and the neutron represent 2, the duality. Each proton and neutron consists of 3 quarks, the triad. Four or the Tetrad is inferred in the 4 universal forces (Figure 8). We also find the number 6 in the number of types of the subatomic leptons and quarks. Here we can see the symbolic link to the Pythagorean tradition, since the above are the result of the sum or multiplication of 1, 2, and 3, which along with 4 reproduce the pyramidal structure of the Tetraktys. Science and the Hermetic Tradition have therefore found an element of commonality many centuries after Pythagoras.

Creation of the Universe

Modern physicists suspect that the four fundamental forces of nature are in fact merely different projections of a single force and that we and the surrounding universe exist only thanks to the particles and antiparticles that came into being following the primordial space-time expansion of the universe in the so-called "Big Bang" (Figure 9). At the time of that initial explosion, the universe had an identical number of particles and antiparticles which, compared to those of the present, possessed a much heavier mass.

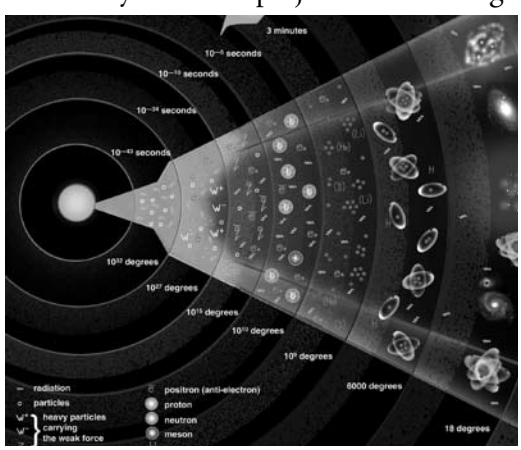

Figure 9: The Universe is believed to have been created about 13.7 billion years ago. At the point of this event, all of the matter and energy of space was contained at one point (monad). This occurrence was not a conventional explosion, rather it was an event filling all of space with all of the particles of the embryonic universe rushing away from each other. From the Rosicrucian Archives.

Following the initial extremely high temperatures after the Big Bang, temperatures decreased and heavy particles underwent a process of annihilation with their antiparticles, giving rise to a plethora of smaller particles and releasing energy in the form of the cosmic microwave radiation—perhaps the *cosmic light* or *Fiat Lux* of Biblical tradition? Temperatures were so high that the random motions of particles were at relativistic speeds, and particle-antiparticle pairs of all kinds were being continuously created and destroyed in collisions. At some point an unknown reaction called *baryogenesis* led to a very small excess of quarks and leptons over anti-quarks and anti-leptons, in the order of 1 part in 30 million. This resulted in the predominance of matter over antimatter in the present universe, though where the "missing" anti-matter is today, is one of the remaining vexing questions of science. We and the universe are therefore the product of that 1 part in 30 million.

Tetraktys and Chemistry

In 1869 the Russian chemist Dmitri Mendeleev (1834-1907) (Figure 10) invented the periodic table of the elements, and classified all known atoms according to their atomic weight and chemical properties. Then in 1914 it was discovered that the key index of these elements was their atomic number. This is the number of protons (positively charged) found in the nucleus of an electrically neutral atom, and is *equal* to the number of electrons which carry a negative charge.

Figure 10: Ilya Yefimovich Repin, *Portrait of Dmitry Ivanovich Mendeleev wearing the Edinburgh University professor robe*. Watercolor, 1885. The State Tretyakov Gallery, Moscow.

Interestingly, if we consider the atomic electron configuration table, and look at the increase of protons and electrons from one element to the next, we find the following sequence of values: 2, 8, 8, 18, 18, 32. These numbers can be expressed as $2x1^2$, $2x2^2$, $2x2^2$, $2x3^2$, $2x3^2$, $2x4^2$, being squares of the numbers of the Tetraktys.

Without entering into a numerical analysis of the entire periodic table of chemical elements, in Group I (the alkali metals), Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Caesium (Cs), and Francium (Fr), are the chemical elements with atomic numbers equal to 3, 11, 19, 37, 55, 87. Taking into account the sequences mentioned above and the fact that Lithium (Li) possesses one proton more than Helium (He), (with the atomic number 2), gives us the formula (1)+2, 8, 8, 18, 18, 32. This can be reduced to the square numbers of Tetraktys as follows: $1+2x1^2$, $2x2^2$, $2x2^2$, $2x3^2$, $2x4^2$. This shows that atoms, of which matter is composed, obey the specific law of numbers that the Pythagoreans had encoded in the Tetraktys.

The Water Molecule

Another model in nature corresponding to the Tetraktys is apparent in the threefold structure of a water molecule (Figure 11). A water molecule has a non-linear shape because it has two pairs of bonded electrons and two unshared pairs. When water solidifies, it becomes *macroreticular* and consists of molecules joined by hydrogen bonds. Each molecule then binds to four other water molecules geometrically in a pyramid when it turns to ice, where all the water molecules are linked by hydrogen bonds.

Raising the temperature results in the intermolecular bonds changing from four to three, then to two with the transformation of ice into liquid water. Raising the temperature further, decreases the intermolecular links steadily, until at 100°C there is no longer any intermolecular connection and the water molecules become detached from each other in the process of evaporation. This is another example of the numbers of the Tetraktys replicated in Nature; the numbers 4, 3, 2, and 1 express the sequence of links in the process of the formation of ice. In nature, the tetrahedron is an example of great stability, which can be found even in the geometric form of a diamond crystal, which in the Mohs scale of mineral hardness, is at the very top of the scale.

Tetraktys and Biology

In the microcosm, the Tetraktys is well represented at the biological level of the

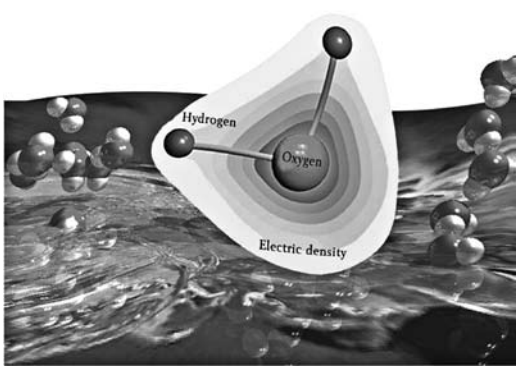

Figure 11: Artist's conception of a water molecule.

molecules of amino acids, the basic building blocks of proteins, whose structural formula shows that Carbon (C), the building block of life, has *four* chains, Nitrogen (N) has *three*, Oxygen (0) has *two*, and Hydrogen (H) has *one*, the sum of which is ten, corresponding to the numbers of the Tetraktys.

Even in the DNA molecule (Figure 12), it is possible to find traces of the numbers of the Tetraktys: a chromosome contains a double strand of DNA, each strand being made up of 3 molecules (a base of nitrogen, a molecule of phosphate, and a molecule of deoxyribose), the first of which (nitrogenous base) consists of 4 chemical varieties: Adenine, Thymine, Cytosine, and Guanine (A, T, C, G). Each nucleotide binds to its complementary nucleotide with 2 or 3 hydrogen bonds and the double helix encloses 10 pairs of nucleotides.

In nature we find that the sperm or male reproductive cells contain the male Y chromosome or the female X chromosome, thereby demonstrating the dual polarity of our species. Each cell has two chromosomes, either XY for a male or XX for a female. When the sperm (X or Y chromosome) combines with the female egg, which always has the X chromosome, a new life form begins. This is a clear demonstration of the Tetraktys, whose numbers act even on the most important biochemical structures of the human body.

Remaining in biology, but on a higher level, let us take a look at the cardiac system, where the sacred numbers of the Pythagorean Tetraktys are related to the morphology of the heart that, as a unit, represents the number 1: it has 2 veins and 3 arteries (brachiocephalic or innominate artery, left common carotid artery and left subclavian, that arise from the arch of the aorta) and finally the 4 pulmonary veins, as well as 4 atria/ventricles. Among further examples of the Tetraktys in nature, may be the pyramidal neurons of the cerebral cortex and the Purkinje cell in the

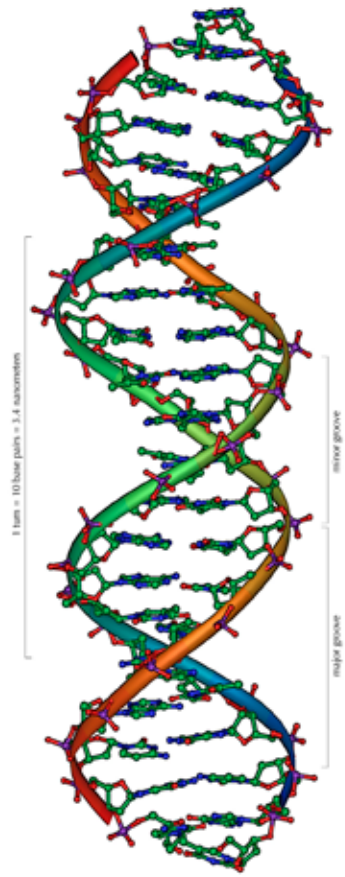

Figure 12: An Overview of the Structure of DNA, © 2006 by Michael Ströck/ Wikimedia Commons.

cerebellar cortex. These cells that preside over the coordination and harmonization of movement seem to offer a clear sign of the relevance of the teachings of Pythagoras.

Conclusion

In this article we have looked at the numbers of the Tetraktys and their correspondences in the fields of chemistry, atomic physics, molecular and cellular biology, and how they relate to the development of living organisms. We have highlighted how systems in the physical universe seem to be governed by wonderful relationships of numbers, something that the Pythagoreans taught over two millennia ago. It should be no surprise that this number system taught in the ancient mystery schools corresponds so convincingly with what we know of the physical universe today.[3]

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ENDNOTES

[1]Glenn Alexander Magee, *Hegel and the Hermetic Tradition* (Ithaca: Cornell University Press, 2001).

[2]William Blake, *The Marriage of Heaven and Hell* (London: Printed by Blake, 1790 – 1793), 66. Available at www.levity.com/alchemy/blake_ma.html.

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