

The Pythagorean Atom

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Atoms and the Ancients

It is common today to credit Newton with the discovery that the same laws of physics apply to the objects in the sky and the objects on the earth, though all the pre-Socratic philosophers were of the same opinion, as were, for that matter, Kepler and Bruno. The difference is just that Newton knew a mathematical formula that explained both orbits and falling. Empedocles and Anaxagoras knew how to conduct experiments and the value of doing so in physical investigations, a piece of knowledge that was also subsequently virtually lost for the next two millennia, though Archimedes also knew it. Empedocles and Anaxagoras likewise knew that people are descended from marine life. Empedocles even expanded this idea into a crude theory of survival of the fit, whereas Aristotle believed in fixed species. Perhaps the ancients also dealt with other explanations that will be credited to some future scientist.

The basic structure of matter might also have been a subject that the ancients had some insight into that has been lost in modern times. Thales and the other early Ionian physicists (Anaximander, Anaximenes, Pythagoras and Heraclitus) believed that any form of matter could be transformed into any other. Thales stated that all the many apparently different substances were, in fact, different forms of the only substance. Parmenides and his students Zeno and Melissus, on the other hand, caused all later philosophers, even Anaxagoras, Empedocles, Leucippus and Democritus, to be confused about this.

During the Middle Ages the alchemists retained or resurrected something of the more ancient tradition. They believed merely in the transmutability into each other of the things that they considered material substances, but they had either no idea or else bad ideas about how such transmutations were to be accomplished. The chemists disagreed with the alchemists on this point. In his later years, Newton worked on this problem, but modern physicists seldom entertain the idea that the alchemists could have been correct in any way or that Thales could have been onto something even more significant than the alchemists were.

But what if Thales and the alchemists were correct? If what makes lead different from gold is not that they are made of different stuffs, then one may argue whether they are or are not transmutable into each other. What if lead and gold consist of one stuff differently arranged? Then the way to turn lead into gold would be to rearrange the stuff of which both lead and gold consist. Such a process would, in fact, be a transformation. Of course,

this would apply not only to lead and gold but also, for example, to light and electricity. All physical objects and not merely the ones that can be dug up out of the ground could be transformable into each other if there were a basic common stuff.

Lucretius, Epicurus, Democritus, Leucippus and probably Pythagoras before them believed that physical stuff is an aggregate of indivisible pieces. Since the Eleatics are known to have been Pythagoreans before they became Eleatics, this theory can reasonably be nothing other than the teaching of Pythagoras. Examining the extant material concerning the teaching of Pythagoras tends to confirm this conjecture rather than to contradict it. The Eleatics, who are the outlying group of philosophers who are philosophically nearest to the early atomists, say that someone before Leucippus knew that matter is composed of a basic stuff. Though they chronologically precede the philosophers commonly recognized as atomists, their teaching can hardly be interpreted as anything other than a critique of a still earlier theory that is a version of the atomic theory.

This theory states that the smallest parts of things are the smallest parts of things because they have no parts themselves and that the reason for this is that they are too small to have any parts. The atomic theory of Leucippus and Democritus differs from this theory only in rejecting the just stated hypothesis about smallest parts and replacing it with a "more sophisticated" doctrine that physical stuff consists of parts that, by virtue of being solid, are physically indivisible even though they are mathematically divisible. The original version of what is otherwise the atomic theory lacks this "sophistication" and is thereby more sensible.

Lucretius and Epicurus both clearly state that all the smallest parts of things move at the same constant speed, which is faster than anything else moves. Again, one may conjecture on the basis of what is preserved from earlier times that this was an original and integral portion of the smallest-parts doctrine and goes back to Pythagoras. It is apparently a proposition that has been unattended to in modern times even to declare it impossible to believe even though it appears in no uncertain terms in material that has been read at least once by every educated person.

The same phenomenon occurs in ancient times, with the one exception that Zeno's argument of the Stadium. This argument makes little sense as quoted by Aristotle but does make sense if it is viewed as an attempt to refute the doctrine that atoms move at a constant speed. Thus the situation seems to be

- 1) that the doctrine was always an integral part of the ancient atomic theory,
- 2) that it was mentioned exactly once in ancient times by a non-atomist,
- 3) that nobody subsequently understood that one mention to be what it was, and
- 4) that none of the people responsible for the revival of the atomic theory in modern times paid the slightest attention to this idea.

It does need to be noted that the reason that Lucretius adduces for this proposition is silly. This is that things fall faster in a less dense medium, so that the fastest speed of all would obtain for things that fell through empty space. The notion that the motion of the atoms through the void is principally a falling motion seems to be an invention of Epicurus's and a corruption of earlier atomic theory. The Eleatics, in any case, argue that the world does not have parts and especially that it does not have smallest parts or parts of size zero. They say that empty space does not exist, that motion is impossible and especially (if my interpretation of the Stadium is correct) that it makes no sense to speak of units all moving at the same constant speed.

It is reasonable to infer that it was the teaching of Pythagoras that the world consists of smallest parts, all of size zero, i.e., the same size as points, all of which move through otherwise empty space at the same constant speed. Pythagoras knew that the book of nature is written in the language of mathematics, as Galileo said somewhat later. Archimedes knew this also. Even Plato knew it, if in a perverse version. Socrates, one gathers, couldn't have cared less.

The things that we have been calling "atoms" since 1802 are not the partless parts of physical objects or the elements of the world. Dalton mistakenly called them atoms, under the impression that they were indivisible. They are actually chemical entities. Similarly, the things that are called "subatomic particles" or "elementary particles" are never subatomic nor are they, generally, elementary. They are also not particles except in the sense in which the earth or a galaxy is a particle. Even those that are parts of the things that Dalton, by mistake, called atoms, assuming that these are conglomerates of protons, neutrons and electrons, are not the smallest parts of those things but are themselves complex objects composed of less complex objects. It is only the objects that are not complex objects and that have no smaller parts that should rightfully be called either "atoms" or "elementary particles" or even "particles."

Ancient Theories of Chemical Combinations

In the original and coherent version of the atomic theory, as in the real world, there could be only one kind of atom and different substances would then be composed of the same atoms in different arrangements. This theory is a natural development of Ionian monism. Thales, no doubt was aware that water could turn into ice or steam, that water and earth and air and light from the sun ("fire") could turn into olives and grain and that food could then, when eaten, turn into blood and bones. He was certainly aware at least of such chemical processes as smelting and fermentation and he postulated that all the apparently different substances were merely different forms of one substance any of which could be transformed into any other. One can conjecture that Thales thought of olive presses, which he himself operated, as turning solids into liquids.

We're back in an era before changes of state and separating a mixture into components were relegated to physics and oxidation and reduction to chemistry. Anaximenes, the third headmaster of the school founded by Thales, explained these transformations as being processes of rarefaction and condensation. This requires that the difference

between dense and rare be a quantitative matter of how much substance there is in a given amount of space, which powerfully suggests that some of space is empty.

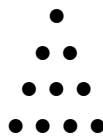
Pythagoras didn't quite understand the difference between empty space and air and spoke of darkness as if it were, like mist, a substance, the Pythagorean doctrine is one of individuals isolated from each other by and forming geometrical patterns within an otherwise empty field. The sacred symbol of the Order, believed by them to be the great revelation given to mankind by the Master and to hold the secret of the structure of the cosmos is

a
a a
a a a
a a a a

Since 'a' is just the normal Greek symbol for the number one, we might better capture the meaning of the tetractys by transliterating it as

1
1 1
1 1 1
1 1 1 1

One usually sees this diagram printed as



The last diagram appears almost as if it had been redesigned by someone who meant to say, "I disagree with the opinion of Pythagoras that the world is composed of ones and wish to assert instead that it is composed of tiny billiard balls."

After Parmenides and Zeno made it seem as if the concept of empty space were self-contradictory, most philosophically aware people retreated from the atomic theory to the alternate theory of continuous substances. Monism was no longer a viable option, since, without the possibility of empty space, materials of different densities would have to be just that. Some substances, for example, muddy water, are obviously mixtures of other substances, but there would have to be some elementary substances of which the mixtures could be mixtures.

Two elementary substances would be insufficient to explain the world since two substances would give us only a continuum such as the various degrees of muddy water ranging from pure water to dry dirt. Three would be better, though it would still provide

only a two-dimensional array of possible mixtures. The real world is more complicated than that.

The most popular view was that there were four elementary substances: earth, water, air and fire. This list appears less silly than it seems to us today if we read it as 'solid, liquid, gas and plasma' or as 'solid matter, liquid matter, gaseous matter and pure energy'. (However, the notion of putting energy on a par with matter, though also popular today, is erroneous.) This list of four elements is often attributed to Empedocles, but it is older. Empedocles put forth a theory, quoted by Aristotle, in which earth, water, air and fire are themselves mixtures of more truly elementary substances: the hot, the cold, the dry and the wet. Fire was hot and dry; air was hot and wet; water was cold and wet; and earth was cold and dry.

The latter-day atomists, today falsely credited with having invented the atomic theory, early proposed a compromise theory in which there are as many different kinds of atoms, differing from each other in size or shape, or both, as there are elementary substances. Plato, without doubt having the ideas from latter-day Pythagoreans, discusses in the *Timaeos* a version of the atomic theory in which the shapes of the atoms of earth, water, air and fire are identified as, respectively, the cube, the regular icosahedron, the regular octahedron and the regular tetrahedron. The cube is composed of six identical squares assembled in such a way that each square has the same relationship to each of its four neighboring squares, while the regular tetrahedron, the regular octahedron and the regular icosahedron are similar assemblages of, respectively, four, eight and twenty equilateral triangles.

This version of the atomic theory may be fleshed out into a general theory of physics that contains several interesting observations. Earth packs solidly because cubes do. Water flows more or less smoothly because icosahedra, being nearly round, roll well. Fire hurts when you touch it because tetrahedra have sharp corners. This theory also yields a general theory of chemistry, in which elements are transformed into each other by ripping the polyhedra apart into triangles and reassembling the triangles into other polyhedra. Of course, such chemical recombination stumbles over the fact that, whereas the tetrahedron, octahedron and icosahedron are all composed of equilateral triangles, the cube is made from squares, which can be decomposed easily into isosceles right triangles but only with some difficulty into equilateral triangles.

Plato was aware also that there are five regular polyhedra and not just four, the fifth being the regular dodecahedron, which is composed of twelve equilateral pentagons. Absurdly, in the *Timaeos*, he employs the fifth as the shape of the bulwark holding up the sphere of the fixed stars. Somebody, perhaps a more mature Plato reflecting on the asymmetry in the version of the atomic theory presented in the *Timaeos*, much more sensibly invented a fifth elementary substance having atoms the shape of the fifth Platonic solid. It is not known whether the same person who invented the fifth elementary substance is responsible for the idea that the stars and planets or that the sky is composed of this fifth substance, although even in the *Timaeos*, the dodecahedron is associated with the sky. It

is in any case this notion that gives the word 'quintessence' (i.e., fifth elementary substance) its ethereal connotation.

The notion is pat, because the pentagon can be easily divided into triangles only by dividing it into five triangles that are isosceles triangles the third side of which is $2 \sin(p/5)$ times as long as the other two sides. It is certainly easier to suppose that the fifth element is not chemically interconvertible with the other four than to solve the problem of how to decompose equilateral pentagons into equilateral triangles or into isosceles right triangles or, conversely, to build equilateral pentagons out of equilateral triangles or isosceles right triangles.

We can account for all the growth and decay we see about us if we suppose that the globe on which we reside is composed of four terrestrial elements and is a region where these elements are continuously being transformed into each other. We can further account for the constancy we see in the sky if the heavens are composed of a fifth element that is not susceptible to breakdown and recombination of its parts. The theory would be even simpler if we supposed that only water, air and fire were transmutable into each other and that earth participates only by being mixed in with different proportions of water, air and fire. But then again, it would also be simpler if earth, water, air and fire could mix also with ether.

Aristotle, who was not an atomist, had his own reasons for liking the notion that the heavens were composed of a non-terrestrial substance. The whole point of positing the existence of a fifth elementary substance has to have been to account in a rational way for the existence of a fifth regular polyhedron. This was done in the context of an atomic theory that identified the other four regular polyhedra as the shapes of the atoms of the traditional four elements. Aristotle was comfortable with the Empedoclean theory of four continuous substances composed of the four binary combinations of the pair hot and cold with the pair wet and dry, supplemented by a fifth continuous element, the ether, of which the sky is composed.

When the atomic theory was revived during the Renaissance, it was the pluralistic theory, with its expectation that there is a multitude of different elementary substances each with its own kind of atom. Thus Dalton stepped into a trap set long before his time. Daltonian "atoms" are polyatomic. There is no such thing as a subatomic particle, subatomic being a self-contradictory concept. The things called by that name, except the photon, are not particles, except in the sense in which the earth or a galaxy is a particle, and they are polyatomic rather than subatomic. They are not even subchemonic. What they are is small chemical elements or "chemons".

Neo-Pythagorean Atoms

Understanding more than the ancients or Dalton, we could still devise an atomic theory that, in fact, does deal with basic particles. The elements of the physical universe would be photons and particles that are otherwise like photons but that are in orbit around each other rather than moving as individuals in nearly straight paths. Conversely, the photon would be considered a true particle and not a "wave packet" or an "energy quantum."

Only these elements of the world deserve to be called elementary. The things that Dalton mistakenly called "atoms" because he believed them to be solid and indestructible are neither solid nor indestructible. Later, these things were discovered to have parts and to disintegrate into their parts.

No matter how many photons there are in a region of space and no matter how much energy each photon has, light does not need to be considered lumpy. It could just as easily be considered entirely discontinuous. The same is true of gold. A cubic meter of gold, or any other material, including light, contains n elementary particles for some positive integer n , occupying the same finite number n of points, and exactly one cubic meter of empty space. It is a mistake to think of gold as occupying a continuous volume, area or length. Similarly for light. It is not the case that a suitably intense beam of light is properly thought to be continuous and that the continuity disappears only when the photons get sufficiently sparse.

The photons of an intense beam of light of a given energy per photon merely occupy, say, 10^{14} out of the 10^{24} points in a cubic meter of space instead of only, say, 10^{12} for a feeble beam. You can change 10^{14} to 10^{40} and 10^{12} to 100, if you like, but it won't make much difference. Photons are considerably smaller than gold "atoms" are, but this also makes no difference. The gold "atoms" do not fill the volume that they "occupy." Each gold "atom" is a finite aggregate of punctiform particles within a volume of otherwise empty space.

The Missing Row in the Periodic Table

It doesn't take an Einstein, as they say, to see that a second row of two elements is missing from the periodic table. The periodic table starts with only a single row of two elements, but is then followed by two rows of eight elements, followed by two rows of eighteen elements, and followed by two rows of thirty-two elements. The numbers two, eight, eighteen and thirty-two are the doubles of one, four, nine and sixteen, which are the squares of one, two, three and four.

Most of the things in the last row of the periodic table fall apart as soon as they are made or else nobody has succeeded in making them yet. Should further elements be formable, undoubtedly their chemical properties and their positions in the periodic table would be those of two rows of fifty ($= 2 \times 25$) elements, followed by two rows of seventy-two ($= 2 \times 36$) elements, etc.

This structure is not an arbitrary imposition onto the world of a human fancy, as are the seven days of the week or the six or seven colors of the rainbow or the twelve signs of the zodiac or the twelve notes in the diatonic scale. This structure is really out there. It has to do with the number of solutions that there are to the n -body problem where n is a small positive whole number greater than unity and the n "bodies" are atoms. Either "God forgot to create" the first two elements or else there are two elements that exist but that have not been recognized by humankind as being what they are.

Three Unrecognized "Elements"

Or, since we clearly do not know either where the table begins or where it ends, there could be three unrecognized elements at the beginning of the table. Without knowing either where the table begins or where it ends, we couldn't know whether the inert gases belong at the ends of the rows, as we currently draw the table, or at the beginnings. Since there are precisely three stable subatomic particles, the periodic table could easily be rearranged to include light (Ph), electricity (E), and neutrinium (Nu). Then there would be three unrecognized elements before hydrogen, which would then be the fourth element rather than the first.

(1) The first element would be light, an inert gas, albeit a strange one, with a chemical symbol of Ph. The first element, the photon, and the third element, the neutrino and neutron, are just mixed in with everything else and can be separated out of what they are mixed in only by physical processes since they are chemically inert just like the other inert gases in their column. (The recent reports of molecules containing argon and krypton atoms are of things that are not really molecules. They are cages built of chemically active elements inside which an element of an inert gas is pent.) On the other hand, the second element, the electron, is chemically active and like hydrogen has a valence of plus or minus one.

(2) The second chemical element would be electricity with a chemical symbol E. It is a valence-one element like hydrogen and the other elements in its column. We have so far seen it only in its ionic forms, the electron and the positron, the first being common and the latter being rare. Nobody understands why there are more electrons than positrons. One may speculate that there could be an electrically neutral form also. I suspect that one of the three kinds of neutrinos that exist in current theories is really an uncharged electron and that one of them does not exist. I don't know why there should be more than one kind of neutrino. One expects also an E₂ molecule, the existence of which is already confirmed by the cryogenicists, although all they say is that electrons tend to bond in pairs; they haven't understood these pairs as analogs of the H₂ molecule.

(3) The third chemical element would be neutrinium with a chemical symbol of Nu. It is another inert gas. It has a radioactive isotope, the atom of which is the neutron, which, like all other isotopes, has a mass equal approximately to the mass of the isotope immediately below it plus one atomic mass unit.

(4) The fourth element, what is usually called a hydrogen atom, is really an ionically bonded HE molecule consisting of an H⁺ ion (called a proton) and an E⁻ ion (called an electron). This chemical compound, hydrogen electrider, belongs to the family of chemical compounds that includes hydrogen chloride and hydrogen fluoride.

Comparison of the First Three "Elements" with Later "Elements"

The reason that the first three elements are so different from the fourth and its suite that the chemists overlooked them altogether is that any set of three points lies in a plane. Only an orbital system with at least four constituent particles could be a three-dimensional object or set up a "force field" around itself that would keep other three-dimensional objects of low kinetic energy from entering and remaining in the volume that

it commands. Thus while it is possible to fill a vial with water or with hydrogen, there is no such thing as a quart of light or a liter of electricity.

A jar of neutrons is probably possible, though it would be dangerous. A jar of neutrinos is an impossibility. I assume that a neutron is built out of a neutrino and something else, at least one other atom. It enters into combination with the neutrino in such a way as to increase the mass of the complex without changing the chemical properties of the neutrino. Isotopes of other elements are formed in a similar way.

The neutron could perhaps be what would otherwise be considered a molecule composed of two neutrinos, orbiting each other in the same way that two photons orbit each other to make an electron. This is not incompatible with the status of these objects, the photon and the neutrino, as inert gas molecules. Chemical inertness, which is a matter of having a valence of zero, does not imply physical inertness, which would be a matter of not interacting with other objects. The reason that helium, argon or krypton molecules do not form stable orbital systems with each other could be because the distance from each other that they would have to be to do so is less than the size of the entities. This would not necessarily be true, however, of the smaller entities of the same chemical family.

The neutrino can only be a two-dimensional thing and thus has a size of zero in the third dimension. It should be able to combine with anything else in the one empty dimension. The photon is a zero-dimensional thing, having a diameter of zero in every direction. It should be able to combine directly with at least three other such things. It should also be able to orbit any other sufficiently small thing. (A photon cannot orbit the earth, since the distance from the center of the earth that it would have to be to do so is less than the radius of the earth.)

The notion that the neutrino is massless and travels at the speed of light must be false. That the neutrino can travel at nearly the speed of light and does indeed pass through other matter without much interaction we know from their having been detected an hour and a half before we got the light from the supernova in the Magellanic cloud, assuming that this indeed happened. According to the current theories of supernovas, the neutrinos should have been produced at the center of the exploding star at the beginning of the explosion. The light produced at the same time would then have taken hours or days to reach the surface of the star and be radiated into space. The neutrinos, however, would have passed through the star at either the speed of light, if neutrinos have no rest mass, or below the speed of light, if they have some rest mass.

The arrival of the neutrinos here an hour and a half before the light indicates one of two possibilities. The first possibility is that neutrinos travel at the speed of light and the light generated by the explosion took only an hour and a half to get from the center of the star to the surface of the star, which is less than expected. The other possibility is that the light took several hours or several days to get from the center of the star to the surface of the star and the neutrinos traveled at just under the speed of light. The theory of the nature of the world presented here makes the first of these propositions untenable. Since only individual atoms can travel at the speed of light, light, which is known to travel at

that speed, must be single atoms. Neutrinos, then, must be something else and hence must travel more slowly. Something significant happens to the mass of an orbital system when we pass from three constituents to four, but the smaller orbital systems and even the individual atoms are not massless.

Revisiting the Ancients

This alternative periodic chart reflects an alternative view of how the universe works and includes an atom that is, in fact, indivisible as Pythagoras postulated. This atom is not Dalton's atom that we know is not indivisible. Likewise, the chemical "elements" listed in the periodic table are not actually elements of anything except the table itself and supersets of the non-empty subsets of the table. They are subsets, not elements, of the world. Each chemical "element" corresponds to a material "substance" that is neither continuous nor space-filling but is an assemblage of many tiny physical objects that are all alike in important ways. These tiny physical objects, which Dalton called "atoms" are not indivisible (as the word 'atom' implies) but are themselves assemblages of still smaller physical objects.

The smallest physical objects that are indivisible are, in the terminology of Pythagoras, the ones of which the world is a many, the individuals of which the physical universe is a multitude, the elements of which the physical universe is the set. They are the units of which the things that are numbers are numbers. In the Pythagorean motto "all is number," which means the same as "every physical object is a number," the word 'number' is used as in 'a number of your friends were at the party'. Every physical object is a number of the elements of the physical universe and, moreover, this number is a positive integer. For the elements themselves, the number is the number 1. For any other physical object, the number is some integer greater than 1.

There is one set, the cardinal of which is 0, that consists of none of these elementary entities. Each element of the world itself is identical with, is the same entity as, the singleton set the only element of which is that element of the world and has cardinal 1. In addition, there are non-empty, non-singleton sets of these units, finite proper subsets of the world, the cardinals of which are 2, 3, 4 and their suite. The world, the physical universe, is the set of all of its elements and has cardinal !0.

Although they were confused about how large the indivisible parts of the world are, Leucippus, Democritus and Epicurus were speaking also of the elements of the world when they used the word 'atom'. The different kinds of Dalton's chemical elements are the different stable and quasi-stable orbital systems that the atoms are capable of forming. Only certain specific orbital systems of atoms are possible. If the atoms of an orbital system do not have the right masses or the right distances from each other or the right directions of motion, then the forces that they induce in each other will not have the right magnitudes and directions to keep the orbital system together. Such an orbital system will either not form in the first place or will fly apart some time after it is formed. The set of stable orbital systems of the atoms has the structure given by the periodic table.

The Meaning of the Word 'Atom'

The Daltonian atoms and the Pythagorean atoms are two different concepts. Ever since protons, electrons and neutrons were identified, there has been rampant and massive confusion on the issue of what an atom is. We frequently hear people say such things as "Even the atoms are divisible." If the atoms are not divisible, then the Daltonian entities, which are divisible, are not actually the atoms. If the Daltonian entities are the atoms, then the atoms are divisible and it makes no more sense to say "Even the atoms are divisible" than it makes to say "Even the galaxies are divisible." It is only if one is confused about which entities are atoms or whether or not atoms are divisible that this makes any sense, but even then it makes sense only by reflecting that confusion.

The elements of the physical universe are photons and particles that are otherwise like photons but that are in orbit around each other rather than moving as individuals in nearly straight paths. Conversely, the photon is a true particle and not a "wave packet" or an "energy quantum." Only these elements of the world deserve to be called elementary. The things that Dalton mistakenly called "atoms" because he believed them to be solid and indestructible are neither solid nor indestructible. When these things were later discovered to have parts and to disintegrate into their parts, an extremely strange thing happened.

What should have happened is that people should have said "Hey! These things that we have been calling 'atoms' aren't atoms. Let's rename them 'chemons', for 'chemical entity'." Instead, one reads everywhere such statements as "The ancients were mistaken in believing the atoms to be indivisible, for today we know that atoms are assemblages of subatomic particles." The ancients made no such mistake. The mistake was made by Dalton.

It is as if I were to name my dog "God" and then subject him to a series of tests, after which I should announce to the world, "The theologians are mistaken when they ascribe to God such properties as omniscience and omnipotence, for I can show that God is quite limited in what he knows or can do." It is as if scientists from all over the world should flock to my laboratory and repeat my tests and concur with my pronouncement, generations passing with nobody noticing that I and the theologians do not refer to one and the same entity when using the word "God."

In 1869, when Mendeleev looked for patterns to develop the periodic table as we know it today, he did not complete the work. Looking at Mendeleev's patterns, an alternative table could be postulated that would complement his work. This table would add three substances at the beginning: light (Ph), electricity (E), and neutrinium (Nu). By so doing, we can also ask if there is, in fact, a basic form of matter that all other matter is composed of, the Pythagorean atom.