Attempt to Explain Nature

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History of Atomic Theory

In The Beginning

Actually, the thought about electricity came before atoms. In about 600 B.C. Thales of Miletus discovered that a piece of amber, after rubbing it with fur, attracts bits of hair and feathers and other light objects. He suggested that this mysterious force came from the amber. Thales, however, did not connect this force with any atomic particle.

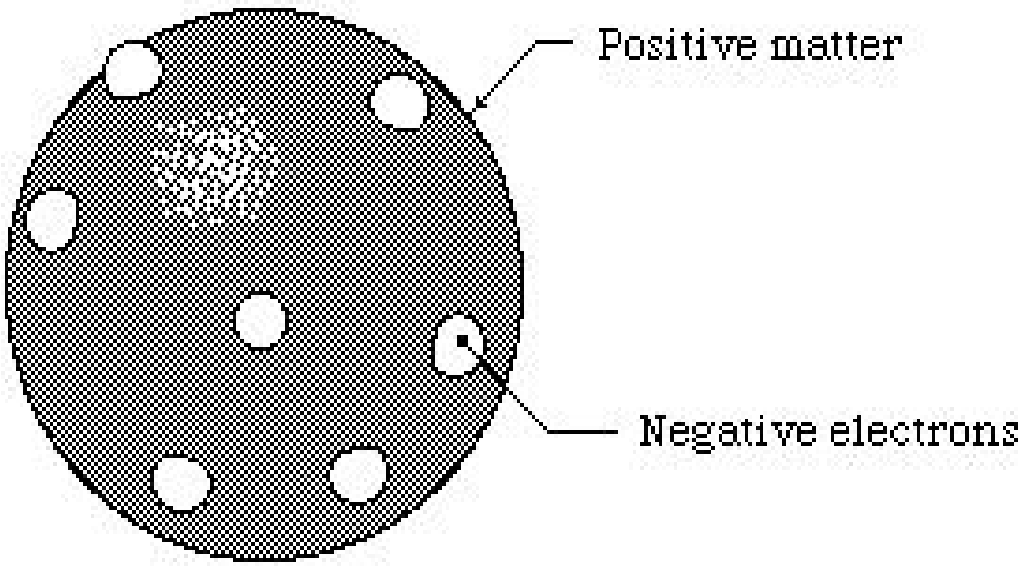
Not until around 460 B.C., did a Greek philosopher, Democritus, develop the idea of atoms. He asked this question: If you break a piece of matter in half, and then break it in half again, how many breaks will you have to make before you can break it no further? Democritus thought that it ended at some point, a smallest possible bit of matter. He called these basic matter particles, atoms.

Unfortunately, the atomic ideas of Democritus had no lasting effects on other Greek philosophers, including Aristotle. In fact, Aristotle dismissed the atomic idea as worthless. People considered Aristotle's opinions very important and if Aristotle thought the atomic idea had no merit, then most other people thought the same too. (Primates have great mimicking ability.)

For more than 2000 years nobody did anything to continue the explorations that the Greeks had started into the nature of matter. Not until the early 1800's did people begin again to question the structure of matter.

John Dalton and Atoms

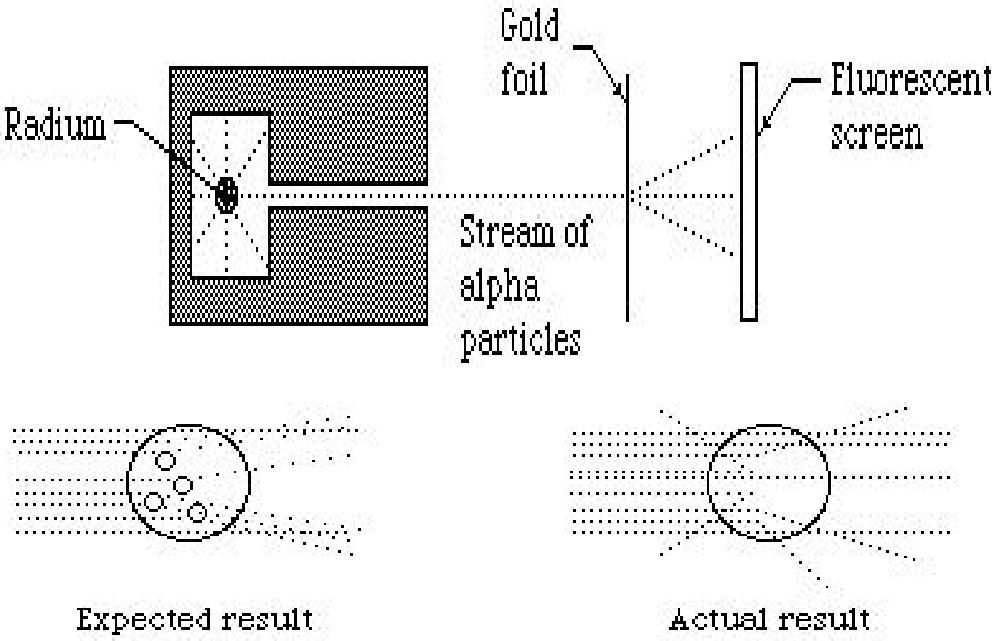
In the 1800's an English chemist, John Dalton performed experiments with various chemicals that showed that matter, indeed, seem to consist



of elementary lumpy particles (atoms). Although he did not know about their structure, he knew that the evidence pointed to something fundamental. Dalton went on to say that matter is made up of tiny particles, called atoms, that cannot be divided into smaller pieces and cannot be destroyed. He also stated that all atoms of the same element will be exactly the same and that atoms of different elements can combine to form compounds. The really awesome thing about Dalton's model of the atom is that he came up with it without ever seeing the atom! He had no concept of protons, neutrons or electrons. His model was created solely on experiments that were macroscopic, or seen with the unaided eye.

Thomson and the Discovery of Electrons

Now, let's fast-forward to the late 1800s when J.J. Thomson discovered the electron. Thomson used what was called a cathode ray tube, or an electron gun. You've probably seen a cathode ray tube without even knowing it! They are the bulky electronic part of old television sets. Thomson used the cathode ray tube with a magnet and discovered that the green beam it produced was made up of negatively charged material. He performed many experiments and found that the mass of one of these particles was almost 2,000 times lighter than a hydrogen



atom. From this he decided that these particles must have come from somewhere within the atom and that Dalton was incorrect in stating that atoms cannot be divided into smaller pieces. Thomson went one step further and determined that these negatively charged electrons needed something positive to balance them out. So, he determined that they were surrounded by positively-charged material. This became known as the 'plum pudding' model of the atom. The negatively charged plums were surrounded by positively charged pudding.

Rutherford and the Nucleus

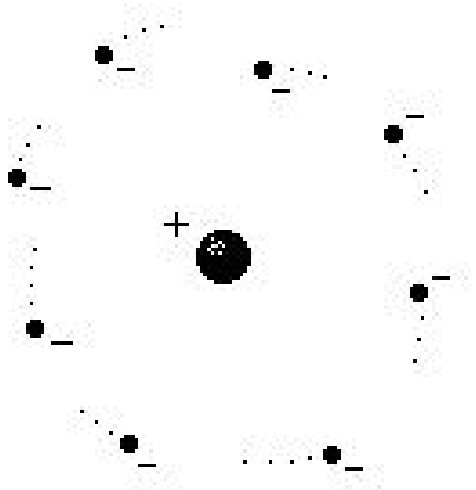
A few years later, Ernest Rutherford, one of Thomson's students, did some tests on Thomson's plum pudding model. The members of his lab fired a beam of positively charged particles called alpha particles at a very thin sheet of gold foil. (Later on you will learn that alpha particles are really just the nuclei of helium atoms.) Because these alpha particles had so much mass, he fully expected that all of the alpha particles would go right through the gold foil. This is because, if Thomson were correct about the plum pudding model of the atom,

the alpha particles would just go through the positively charged matter and hit the detecting screen on the other side.

You have around 7 billion billion billion atoms in your body, yet you replace about 98% of them every year!

The results of the experiments came unexpected. Most of the alpha particles went smoothly through the foil. Only an occasional alpha veered sharply from its original path, sometimes bouncing straight back from the foil! Rutherford reasoned that they must get scattered by tiny bits of positively charged matter. Most of the space around these positive centers had nothing in them. He thought that the electrons must exist somewhere within this empty space. Rutherford thought that the negative electrons orbited a positive center in a manner like the solar system where the planets orbit the sun.

Rutherford knew that atoms consist of a compact positively charged nucleus, around which circulate negative electrons at a relatively large distance. The nucleus occupies less than one thousand million millionths (10) of the atomic volume, but contains almost all of the atom's mass. If an atom had the size of the earth, the nucleus would have the size of a football stadium.



But there appeared something terribly wrong with Rutherford's model of the atom. The theory of electricity and magnetism predicted that opposite charges attract each other and the electrons should gradually lose energy and spiral inward. Moreover, physicists reasoned that the atoms should give off a rainbow of colors as they do so. But no experiment could verify this rainbow.

Niel-bohrs Atomic Model

In 1912 a Danish physicist, Niels Bohr came up with a theory that said the electrons do not spiral into the nucleus and came up with some rules for what does happen. (This began a new approach to science because for the first time rules had to fit the observation regardless of how they conflicted with the theories of the time.)

Bohr said, "Here's some rules that seem impossible, but they describe the way atoms operate, so let's pretend they're correct and use them." Bohr came up with two rules which agreed with experiment:

RULE 1: Electrons can orbit only at certain allowed distances from the nucleus.

RULE 2: Atoms radiate energy when an electron jumps from a higher-energy orbit to a lower-energy orbit. Also, an atom absorbs energy when an electron gets boosted from a low-energy orbit to a high-energy orbit.

Quantum Theory

Although the mathematical concept of the atom got better, the visual concept of the atom got worse. Regardless, even simplistic visual models can still prove useful. Chemists usually describe the atom as a simple solar system model similar to Bohr's model but without the different orbit shapes. The important emphasis for chemistry attempts to show the groupings of electrons in orbital shells. (The example above shows the first eleven elements.)

Chemical behavior of the elements combine together to create molecules. Molecules may share electrons as the hydrogen and water molecules above illustrates. (Atoms which share electrons have the name “ions.”) The outer electron shell of an atom actually does the sharing and bonding of the atoms. This in turn allows chemists to describe the interactions of chemistry. Even though the orbit model of the atom does not provide an accurate model, it works well for describing chemistry.

A mystery of the nature of the nucleus remained unsolved. The nucleus contains most of the atom’s mass as well as the positive charge. The protons supposedly accounted for this mass. However, a nucleus with twice the charge of another should have twice the number of protons and twice the mass. But this did not prove correct. Rutherford speculated in 1920 that there existed electrically neutral particles with the protons that make up the missing mass but no one accepted his idea at the time.

Not until 1932 did the English physicist James Chadwick finally discover the neutron. He found it to measure slightly heavier than the proton with a mass of 1840 electrons and with no charge (neutral). The proton-neutron together, received the name, “nucleon.”

Although scientists knew that atoms of a particular element have the same number of protons, they discovered that some of these atoms have slightly different masses. They concluded that the variations in mass result, more or less, from the number of neutrons in the nucleus of the atom. Atoms of an element having the same atomic number but different atomic masses get called “isotopes” of that element.

In 1928, Paul Dirac produced equations which predicted an unthinkable thing at the time- a positive charged electron. He did not accept his own theory at the time. In 1932 in experiments with cosmic rays, Carl Anderson discovered the anti-electron, which proved Dirac’s equations. Physicists call it the positron.

For each variety of matter there should exist a corresponding ‘opposite’ or antimatter. Physicists now know that antimatter exists. However, because matter and antimatter annihilates whenever they come in contact, it does not stay around for very long. (By the way, an unsolved problem remains as to why the universe consists of mostly regular matter and not an equal amount of antimatter. Physicists’ call this “symmetry breaking”.)

There exists not only anti-electrons but in 1955, physicists found the anti-proton and later the anti-neutron. This allows the existence for anti-atoms, a true form of antimatter.

When scientists found out about the atomic nucleus, they questioned why the positively charged protons should remain so close without repelling. The scientists realized that there must exist new forces at work and the secrets must lie within the nucleus. They knew that the force which holds the protons together must occur much stronger than the electromagnetic force and that the force must act over very small distances (otherwise they would have noticed this force in interactions between the nucleus and the outer electrons).

In 1932, Werner Heisenberg concluded that charged particles bounce photons of light back and forth between them. This exchange of photons provides a way for the electromagnetic forces to act between the particles. The theory says that a proton shoots a photon at the electron, and the electron shoots a photon back at the proton. These photon exchanges go on all the time, very rapidly. However, because no one can see them (measure them), Heisenberg called these exchange particles, virtual photons. (Virtual meaning, not exactly ‘real’.)

In 1935 a Japanese physicist, Hideki Yukawa, suggested that exchange forces might also describe the strong force between nucleons. However, virtual photons did not have enough strength for this force, so he thought that there must exist a new kind of virtual particle. Yukawa used Heisenberg’s uncertainty principle to explain that a virtual particle could exist for an extremely small fraction of a second. Since

its time of existence occurs nearly exactly, there would occur a great uncertainty in the energy of the virtual particle. This uncertainty allowed the particles to exist very strongly only at certain times and the particles could slip in and out of existence. He also calculated that these particles should be about 250 times as heavy as an electron. Later, in 1947, the physicist Cecil F. Powell detected this particle and called it the "pion."

GOD PARTICLE

The "God particle" is the nickname of a subatomic particle called the Higgs boson. In layman's terms, different subatomic particles are responsible for giving matter different properties. One of the most mysterious and important properties is mass. Some particles, like protons and neutrons, have mass. Others, like photons, do not. The Higgs boson, or "God particle," is believed to be the particle which gives mass to matter. The "God particle" nickname grew out of the long, drawn-out struggles of physicists to find this elusive piece of the cosmic puzzle. What follows is a very brief, very simplified explanation of how the Higgs boson fits into modern physics, and how science is attempting to study it.

The "standard model" of particle physics is a system that attempts to describe the forces, components, and reactions of the basic particles that make up matter. It not only deals with atoms and their components, but the pieces that compose some subatomic particles. This model does have some major gaps, including gravity, and some experimental contradictions. The standard model is still a very good method of understanding particle physics, and it continues to improve. The model predicts that there are certain elementary particles even smaller than protons and neutrons. As of the date of this writing, the only particle predicted by the model which has not been experimentally verified is the "Higgs boson," jokingly referred to as the "God particle."

Each of the subatomic particles contributes to the forces that cause all matter interactions. One of the most important, but least understood, aspects of matter is mass. Science is not entirely sure why some

particles seem mass-less, like photons, and others are “massive.” The standard model predicts that there is an elementary particle, the Higgs boson, which would produce the effect of mass. Confirmation of the Higgs boson would be a major milestone in our understanding of physics.

The “God particle” nickname actually arose when the book *The God Particle: If the Universe Is the Answer, What Is the Question?* by Leon Lederman was published. Since then, it’s taken on a life of its own, in part because of the monumental questions about matter that the God particle might be able to answer. The man who first proposed the Higgs boson’s existence, Peter Higgs, isn’t all that amused by the nickname “God particle,” as he’s an avowed atheist. All the same, there isn’t really any religious intention behind the nickname.

Currently, efforts are under way to confirm the Higgs boson using the Large Hadron Collider, a particle accelerator in Switzerland, which should be able to confirm or refute the existence of the God particle. As with any scientific discovery, God’s amazing creation becomes more and more impressive as we learn more about it. Either result—that the Higgs boson exists, or does not exist—represents a step forward in human knowledge and another step forward in our appreciation of God’s awe-inspiring universe. Whether or not there is a “God particle,” we know this about Christ: “For by him all things were created: things in heaven and on earth, visible and invisible ... all things were created by him and for him” (Colossians 1:16).

Conclusion

While whole-heartedly congratulating the Physicists teams – for their extraordinary discovery – and wishing them greater successes in unraveling the mysteries of the Universe - we also need to look at the huge super structure we are building on the Big Bang Theory. Whether the Big Bang is, or is not a Fact – we will never know. What caused, if at all, the Big Bang, and how and why, are not easily explainable.

There just can't be a reaction without an action – and the action itself is a reaction, which needs another action. This chain never ends in any distant past – even if we take it past any number of billions of years. Nor will it ever end in the future, after any number of billions of years.

We can explain movement, gravitation, mass, no-mass, light, heat, sound, touch, smell, change and so on – in absolutely scientific terms. But, can we put them together and explain INTELLIGENCE?

Can we really explain what intelligence is? Can we explain a consciousness which at least pervades human beings?

If Human Beings do have intelligence (and the five senses to receive and record it to some extent), what prevents Earth, Sun, and Galaxies from having extraordinary levels of intelligence – of which we get an infinitesimally small part each – from them? Yes. They give all the intelligence to us – if physical particles, however minute, are the only things we are made up of. And, the Big Bang theory tells us JUST THAT.

In relation to these huge moving masses in the sky – aren't we like the white or red cells in the human body? The cells don't know why they do, what they do. But they do them all the same. Therefore we are alive as human beings. There is obviously a clock work installed within us, and within them, which takes us from birth to death, through a fixed linear path, unless we end the path foolishly midway.

The Indian thinking on all this is wrongly concluded as RELIGION – but it is not religion; it is not mere faith. It is absolute science. What the West does in the outer world, the Indian scientists had done partly in outer world – but mostly in the inner world.

There is no need for blind faith in any of this; each person can prove the ultimate riddle of this Universe and the riddle of creation as such, to himself.

But the search in outer cosmos, will never take us to the end; the ultimate goal. We will never discover anything one hundred percent even about one atom, no, not even about one Higgs Boson particle. The search will be endless. In due course of time, the Higgs Boson Particles will, without an iota of doubt, reveal further sub-sub-sub atomic particles within them.

If anything exists in physical form – it is made up of PARTS.

It can't be otherwise. Its minuteness is immaterial and does not alter this rule. Does it mean, the search is useless? No. Not at all. The external search must continue. It happened in ancient India too.

But, the inner search, a search in a space-less space within us, in the innermost recesses of the Individual, hides the most precious secrets of the world. Search for Intelligence – not just for mass, not for gravitation, not for physical properties. Search for an awareness that pervades the Individual and the entire Universe.

Indian sciences firmly say – that all that is outside of us – is also equally within us in miniature form. The whole Universe is in us in miniature form.

It is a fact that – in the external world, the Bosons, Photons, Electrons, Atoms, the whole earth, the Sun, the whole Galaxy will all fold back into a nothingness some time in future – and then come up again in some form . We do have some proof now that these do disappear into nothingness. It is happening to some star in the cosmos all the time.

Likewise- human beings come up, grow, play, and disappear all the time.

People are willing to believe either science or even religion – which has come up in the last 2000-3000 years. But not earlier than that! Science which had sprung up in Ancient India is looked at with suspicion – and not with absolute scientific spirit. People are unwilling to think straightly - and admit that huge body of scientific knowledge could have come up several lakhs of years back – when the world looked different; and extraordinary levels of scientific spirit was available in India. It had extraordinary levels of knowledge and wisdom even then – which is extremely useful to humanity now.

Today-we simultaneously believe both the Big Bang theory and the 7-Day creation theory. Likewise, we simultaneously believe the Human evolution theory as in Adam-and-Eve story and the Darwinian hypotheses. Aren't we excellent, highly adjusted split personalities?

We do not know who we are; yet, we know, by birth that we are going to a heaven, where we don't know what we will be doing. They don't reform the most glaring FALSITIES in them – as long as we remain mere believers.

At the same time, science co-existed with religion all the time. It was more so in India. The Indian religions do exist partly for the faithful. But, it also provides a huge opportunity for the explorer, for one who is willing to transform himself into a Powerhouse of Intelligence and awareness.

The Inner science that India promoted so perfectly - is more important to us today - than the outer science – and more beneficial too. It is also the shortest route – to more important facts about the Universe. Instead of "split-split-split –And see"; the Inner science takes us to Join-Join-Join-and become one with it.

India may produce a Satyendra Nath Bose – or many such, for the outer search too; but the inner science is India's Forte. India has a lot to achieve in this respect. The world has a lot to gain from it.

Ignoring this takes the world nowhere.

The Inner science is the easiest path to the finest of truths.

References:

Bibliography

1. Gerhard Herzberg, Atomic Spectra and Atomic Structure, Dover Books, Summer, March, 2003
2. Leon Lederman Dick Teresi, The God Particle: If the universe is the answer what is the question, Delta Paperbacks, Summer 2001.
3. Richard P. Feynman, The Strange Theory of Light and Matter, March 1990.
4. Sadhguru Jaggi Vasudev, Enlightenment, Isha Foundation, January 2010