



A Brief Comparitive Study of Atomic Theory or Atomism between Western Scientists and Eastern Philosophers.

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⇒ ABSTRACT :-

Atomic theory is one of the most important scientific developments in history, crucial to all the Physical science . Atomism, that is, the Philosophy and science that matter is composed of indivisible particles called atoms. Atomic theory is the Scientific theory that matter is composed of particles called atoms. The definition of the word “atom” has changed over the years in response to Scientific discoveries.

This paper critically analyses how atomistic thinking progressed from Philosophical speculation to scientific experiments by comparing Eastern Vaisesika’s atomistic theories with those Propounded by modern Western Scientists, taking into considerations their conceptual framework, methodology, and philosophical implications. Atomism is an integral part of the philosophy, finding its expression in the notion that all matter is reducible to indivisible particles that combine into complex structures. Atoms consists of protons, neutrons & electrons. The number of protons in an atom is called the atomic number.

Key Words: Vaisheskia Philosophy, Atomism, Modern Atomic theory, Atoms matter, Substance or particles, critical analysis, methodology.

⇒ INTRODUCTION:-

Atomic theory or, “Atomism”, that is, the Philosophy and science that matter is composed of indivisible particles called atoms. Philosophy is called mother of all subjects. Atomic theory began as a Philosophical concept in ancient Greek(Democritus) and India (Kannad’s Vaishesika school) and entered the scientific mainstream in the early 19th century. Atomism is an integral Part of the philosophy, finding its expression in the notion that all matter is reducibles to indivisible & eternal Particles that combine into complex structures. While Vaishesika’s approach to integrating metaphysical categories with Logical reasoning finds its counterpart in modern science through empirical research and mathematical modelling atomic theory. As a matter of fact that atomistic thinking Progressed from Philosophial speculation to Scientific experiments, reflecting a continued quest for an understanding of the basic nature of reality.

⇒ The Historical Development of Atomic Theory:-

The word “atom” is derived from the ancient Greek word ‘atomos’ which means “uncuttable” or “non-devisible”. This ancient idea was based in Philosophical reasoning rather than scientific reasoning.

Atomic theory began as a Philosophical concept in ancient Greece (Democritus) and India (Kannada) and entered the Scientific mainstream in the early 19th century. Greek atomism, with Philosophers like Leucippus & Democritus developed atomic theory, considering atoms as the basic units of matter.

The ancient atomic theory was proposed in the 5th century BCE by the Greek Philosophers Leucippus & Democritus and was revived in the 1st century BCE by the Roman philosopher & poet Lucretius. The Greek philosopher Empedocles (450 B.C.) made one of the first attempts to explain the matter, claiming that matter was composed of four “elements”- earth, air, wind, & fire, in varying quantities. Greek atomism deals only with quantitative differences in atomic size & shape in that matter is made up of indivisible particles, where atoms differ from one another only in their physical dimensions. (The modern atomic theory, which has undergone continuous refinement, began to flourish at the beginning of the 19th century with the work of the English chemist John Datto.)

➤ **Western scientists & philosophers:-**

(I) Dalton is considered the father of modern Atomic theory.

Since the 1800s, scientists have presented models that provided a greater understanding of the atom. Their models help explain what atoms are, what they look like, & how they behave. These scientists & their models are-

- 1- Dalton & His Atomic model or the solid sphere model or Biliard model (1803).
- 2- J.J. Thomson’s Plum Pudding model.
- 3- Rutherford’s Neu-clear model
- 4- Bohr’s Planetary model.
- 5- Schrodinger’s Electron cloud model
- 6- James Chadwick’s wave mechanical model.

a- The atomic theory of John Dalton, also known as the John Dalton’s atomic model or the solid sphere model, or Billiard Model, was the first comprehensive attempt to describe matter in terms of atoms (in 1803). All matter is composed of atoms.

Dalton imagined atoms as tiny and solid balls that could not be broken down into anything simpler. His model portrays atoms as solid spheres.

To him, atoms of the same element are identical in mass, size, & other properties.

Atoms of different elements are different in mass, size, & other properties.

Atoms combine in chemical reactions. Atoms rearrange to make different substances during chemical reactions.

Atoms combine to form compounds. Atoms of different elements combine in fixed whole-number ratios to form compounds.

Dalton model was based on the Law of conservation of mass & the law of constant composition. Atoms can neither be created nor destroyed.

According to Dalton’s atomic theory, the matter is composed of tiny & definite particles or of discrete units called “atoms”, as opposed to the obsolete notion that matter could be divided into any arbitrary small quantity. His atomic theory was the first to describe all matter in terms of atoms & their properties.

Dalton proposed that each chemical element is composed of atoms of a single, unique type, & though they can not be altered or destroyed by chemical means, they can combine to form more complex structures (chemical compounds). He had no concept of Protons, neutrons, or electrons.

b- J.J. Thomson- Plumpudding model
(Father of Electrons)

In 1897, J.J. Thomson discovered the electron, a negatively charged subatomic particle, through experiments with Cathode ray tubes. Following his discovery, Thomson Proposed that atoms are made up of a sphere of positive charge with negatively charged electrons scattered throughout, like Plums in pudding or seeds in a watermelon.

Key Features:-

- (i) The atom is a sphere of positive charge.
- (ii) Electrons are embedded within this positive sphere.
- (iii) The atom is electrically neutral, with the positive and negative charges balancing each other out.

c- Ernest Rutherford:
(Father of proton-1911)

Following his discovery of Proton in 1911, in his atomic model or Nuclear model, Rutherford described the atom as having a tiny, dense, positively charged core (the nucleus) surrounded by orbiting, negatively charged electrons, much like a planetary system.

Key Features:-

Nuclear Atom- He introduced the concept of a “nuclear atom”, where the positive charge & nearly all the mass of an atom are concentrated in a small, dense region called the nucleus.

Electrons Orbit the Nucleus:- He proposed that negatively charged particles, called electrons, orbit the nucleus in circular paths, similar to Planets orbiting the sun.

Mostly Empty space:- The atom is mostly empty space, with the electrons occupying the vast space around the nucleus.

Note:- Rutherford’s model emerged from his famous gold foil experiment.

d- Niels Bohr’s Planetary Model-1913

Niels Bohr’s atomic model, known as “Planetary model”, proposed in 1913, depicts an atom as having a small, positively charged nucleus with electrons orbiting in specific, quantized energy levels or shells, rather than in any arbitrary path.

Key Features:-

(i) Planetary model:- Bohr’s model is often referred to as the “Planetary model” because it depicts electrons orbiting the nucleus, similar to how planets orbit the sun.

(ii) Quantized Energy levels:- Electrons can only exist in specific, fixed energy levels or orbit around the nucleus, and they can not exist in the space between these orbits.

(iii) Energy Emission/ Absorption:- Electrons can move from one energy level to another by absorbing or emitting energy in the form of Light(Photons).

(iv) Stable Orbit:- Electrons in these orbits do not radiate energy & remain in stable orbits.

(v) Shell:- Orbits or energy levels are designated as K,L,M,N, Shells.

e- Werner Heisenberg & Erwin Schrodinger:-

The modern atomic model is the culmination of experiments and research done by a few scientists. Werner Heisenberg and Erwin Schrodinger are most credited for discovering the probabilistic nature of the electron and applying it to the model of the atom. They represented the atom as a nucleus with protons and neutrons, surrounded by a cloud of electrons.

The Erwin Schrodinger model of the atom is composed of the nucleus of the atom which contains protons & neutrons & is surrounded by an electron cloud. This is sometimes called the cloud model. The Schrodinger model of atom assumes that the electron is a wave & tries to describe the regions in space, or orbitals, where electrons are most likely to be found.

f-James Chadwick- “Father of neutron” in 1932

J. Chadwick discovered that atoms consisted not only of protons and electrons but also neutrons. Chadwick discovered the neutron (in 1932), a neutral subatomic particle that has approximately the same mass as proton. Neutrons occupy the nucleus of the atom. Or

Chadwick conceived that the atom was understood as a nucleus with protons & neutrons, assuming almost the entire mass of the atom, with the electrons orbiting the nucleus in their corresponding energy levels.

g- Albert Einstein-

Albert Einstein’s most significant contribution to atomic theory was his mathematical proof of the existence of atoms & molecules in 1905, using the concept of Brownian motion & developing a model to describe it.

Einstein developed a mathematical model to describe Brownian motion, which allowed for the calculation of the size of atoms & molecules.

Einstein also made significant contributions to the understanding of the photoelectric effect, which demonstrated the particle- like nature of light, a concept that is fundamental to atomic theory.

⇒ **Modern ATOMIC THEORY OR Atomism:-**

Modern atomic theory evolved from the scientific revolution of the 17th & 18th centuries & was worked on by scientists such as John Dalton, J.J. Thomson, Ernest Rutherford, Niels Bohr, Erwin Schrodinger, &

the list continues. Contemporary atomic theory explains atoms through the subatomic particles that make up atoms, which in turn are governed by quantum Dalton's atomic theory, formulated at the beginning of the 19th century, explained that matter is composed of indivisible atoms that, in fixed ration, combine to form compounds. It was only after the discovery of the electron by Thomson in 1897, Rutherford's nuclear model of the atom in 1911, and Bohr's model on electron orbit in 1913 that knowledge regarding the structure of atoms was drastically developed.

In modern atomic theory, Dalton noticed that chemical substances seemed to combine with each other by discrete & consistent units of weight, and he decided to use the word "atom" to refer to these units.

⇒ **Eastern Scientists & Philosophers :-**

(i) **The Vedas –**

In early days instead of Proton, Neutron, Electron, Molecules & Energy, the ancient sages employed the usage of the words like Brahma, Vishnu, Shiva & Shakti describe a basic structure of the atom in symbolic & allegorical terms. The Vedas sage Vyasa, the author of Maha Bharata, mentions particle like Proton, Neutron & Electron. At the same time, Lord Shiva is greater than anything greatest.

In Bhagawata Skandha3, Adhyaya II, Shlokas 1&2- "If we go on dividing matter, a stage will come when it cannot be divided further. This smallest particle which cannot be divided is Paramanu. The Paramanu is separate from other & it is not in union with any other. Aggregation of such Paramanu makes a matter visible as an apparition."

Here the word Paramanu is used. Atom is divisible into proton, Neutron & Electron. These subatomic particles are Paramanus according to the definition given in the Bhagawata.

The Bhagawata has mentioned at 3-11-5 that two Paramanus together form an Anu, while three Paramanus together form a Trasarenu. This definitely shows that Maitreya knew of Proton, Neutron, Electron & an Atom.

(ii) **Jainism –**

The Jains envisioned the word as consisting wholly of atoms, except for Souls. The atomic theory in Jainism is based on the idea that matter is made up of basic building blocks called paramanus or atoms. Jain believed that- Atoms are indivisible & eternal. Atoms are the Smallest Particles of matter and cannot be divided or perceived by the sense. Atoms are uncreated, indestructible, and cannot be perceived by the sense. Atoms are uncreated, indestructible, and cannot be divided.

Atoms have four qualities. Each atom has a color, taste, smell, and a type of palpability, such as Lightness or heaviness.

Atoms can combine to form aggregates, which can be categorized as fine or coarse. Atoms can combine, change modes & disintegrate.

Atoms can move at incredible speeds & travel across the universe in a short amount of time (quickly)

All atoms are essentially the same, but they can combine in different ways to create the diversity of the world.

Atoms are devoid of consciousness.

Matter is referred to as Pudugala in Jainism. According to the atomic theory of Jainism, an atom is without any point, without a beginning & without an end. It is eternal, which can neither be created nor destroyed but which can in association with other atoms become part of any object. It is invisible & imperceptible to the senses. To the jains, the individual souls who exists in varying states bodies of the beings & the sense objects are essentially made up of atoms only. Souls are not made up of matter. The bodies of the beings & the sense objects are essentially made up of atoms only. Souls are not made up of matter, but they become bound to bodies and sense objects through phenomenal existance. The Jains believe that atoms are uniform in nature, but by coming together in varying degrees & combinations they produce a multitude of material things. Scientific vision of Lord Mahavira, atoms are devoid of Consciousness.

(iii) **Buddhism-**

In Buddhist atomism, atoms are momentary & imperceptible. Buddhist believe in the existence of atoms & consider them to be momentary. They divide atoms into two types:-

Anu= Perceptible atoms

Paramanu= Imperceptible atoms.

Buddhist believe that anu is made up of Paramanus. (They also believe in aesthetic atomism in the reality of atoms) & they consider that the anu is formed of the paramanus.

The Sautrantikas admit atoms as partless & momentary. The Buddhist considers the atoms as transient. According to Goutama atom is partless, indivisible & smallest part of composite things which can not be divided into further parts.

The Buddhist rejoin that as the atoms possess parts because they possess a definite shape & also enter into conjunction among themselves. In Hinayana tradition, atoms have been reinterpreted not as material particles but as dynamic forces or energies.

(iv) Other Philosopher –

Gautama, in his book Nyayasutra said that absolute non-existence of all things is impossible as atoms remain in the end. “Na Pralayanusadbhavat”.

Vatsyayana, in his Nyayabhasya, explained & defined atom as a partless entity. “Niravayavatvani tu Paramanovibhage oalpataraprasamgasya yato nalp Piyastatravastharat”. He has justified the use of the term “Paramanu” for atom.

Vatsyayana, an atom is the smallest part of a composite thing which cannot be divided into smaller parts.

Uddyotakara states that if an atom is divisible then it can not be an atom. Atom is indestructible.

Vacaspati Points out that if an atom is called to be an atom for smallest size which cannot be divided into smaller parts further.

According to Jayanta Bhatta atom is called to be atom as it cannot be further divided. It cannot be produced & destroyed. Therefore, atoms are eternal.

Sridhara says that atoms are eternal because it has no creation and destruction, and it is a partless substance, like ether.

(v) Autobiography of a Yogi by Yogoda Satsanga society of India

Paramahansa Yogananda (Chapter 8, Page 69)

The great botanist & India great Sci The atomic structure of matter was well-known to the ancient Hindus. One of the six systems of Indian philosophy is Vaisesika, from the Sanskrit root visesas, “atomic individuality.” One of the foremost Vaisesika expounders was Aulukya, also called Kanada, “the atom-eater,” born about 2800 years ago.

5 In an article in East-West, April, 1934, a summary of Vaisesika scientific knowledge was given as follows: “Though the modern ‘atomic theory’ is generally considered a new advance of science, it was brilliantly expounded long ago by Kanada, ‘the atom-eater.’ The Sanskrit anus can be properly translated as ‘atom’ in the latter’s literal Greek sense of ‘uncut’ or indivisible. Other scientific expositions of Vaisesika treatises of the B.C. era include (1) the movement of needles toward magnets, (2) the circulation of water in plants, (3) akash or ether, inert and structureless, as a basis for transmitting subtle forces, (4) the solar fire as the cause of all other forms of heat, (5) heat as the cause of molecular change, (6) the law of gravitation as caused by the quality that inheres in earth-atoms to give them their attractive power or downward pull, (7) the kinetic nature of all energy; causation as always rooted in an expenditure of energy or a redistribution of motion, (8) universal dissolution through the disintegration of atoms, (9) the radiation of heat and light rays, infinitely small particles, darting forth in all directions with inconceivable speed (the modern ‘cosmic rays’ theory), (10) the relativity of time and space.

“Vaisesika assigned the origin of the world to atoms, eternal in their nature, i.e., their ultimate peculiarities. These atoms were regarded as possessing an incessant vibratory motion. . . . The recent discovery that an atom is a miniature solar system would be no news to the old Vaisesika philosophers, who also reduced time to its furthest mathematical concept by describing the smallest unit of time (kala) as the period taken by an atom to traverse its own unit of space.”

⇒ **CONCLUSION:-**

The development from Vaisesika’s Philosophical atomism to the modern Scientific theories present the continuous quest for understanding regarding the basic nature of reality. Vaisesika atomism is probably one of the earliest and most sophisticated formulations of atomic thought. We find all physical from the antiquity to the present admit that matter is real & has atomic character. The conceptions of Vaisesika system that atoms are the fundamental particles of matter, that they are infinite in number that the formation & dissolution of the gross things are the respective effects of the mutual combinations and Separations of atoms, that they are eternal & imperceptible are accepted by the modern physics. For the most part, modern atomic theory of

western Scientists is built through centuries of scientific research that goes on to give a better and more evidence- based understanding of matter. Both Vaisesika Philosophy & modern scientific theories have valuable insights to give about atoms & theories have valuable insights to give about atoms & their role in the universe, reflecting the rich interplay between Philosophical & Scientific exploration.

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