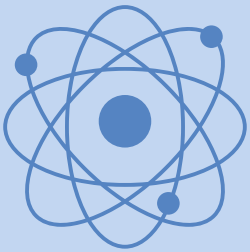
The Discovery of the Atom

‘The smallest indivisible particle to ever exist’ is how most of us familiarise ourselves with the atom, the most basic particles of elements. Atoms are present in all matter to ever exist, having a radius of 0.1 nanometers, just about big enough to view through an electron microscope. But have you ever wondered how the building blocks of ordinary matter were discovered?

We can trace the first shreds of the atoms discovery all the way back to the 5th Century BCE, where Ancient Greek philosophers Leucippus and Democritus developed their “Theory of Atomism”, hypothesising that the whole universe was made up of small, indivisible particles differing in shape and size that remained moving through a void or space at all times and could join together. Democritus named these particles atomos, the Greek word for indivisible.

In 600 BC, renowned Indian philosopher Maharishi Kanada also birthed the idea of a particle that could not be divided any further. The founder of the Vaisheshika School of Indian Philosophy, Kanada realised there was a limit to the number of parts he could break his food into, and termed the smallest particle, unable to see with a naked eye, as parmanu. He also theorised that these particles were eternal and could unite together to form dwinuka, constituting of similar properties of its parmanu.

Although old-age evidence of atom discovery exists, we can most strongly link this to British Chemist John Dalton, who revived the 2000 year old theories of an atom in the early 1800s. Dalton worked hard to deepen his research results, modernising one of science’s most significant theories and proving the existence of an atom. To demonstrate his discovery, he performed experiments such as researching the properties of gases and concluding that they were made up of tiny particles constantly moving in a random motion. He also investigated the properties of compounds, showing that different compounds have different elements or ratios, and that a given compound is always made up of the same elements in the same whole-number ratio. Dalton hypothesised that only if elements are composed of distinct, non-subdividable particles could this occur.



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Dalton further developed an “Atomic Theory” on the basis of his research, which was very easily adapted by scientists worldwide. This theory revolutionalised science and consisted of five main ideas:

1. All matter is comprised of tiny, definite particles called atoms.

2. Atoms are indivisible and indestructible.

3. All atoms of a particular element share identical properties, including weight.

4. Atoms of different elements contain different mass. And

5. Atoms of different elements combine in fixed whole-number ratios when forming compounds.

Dalton’s atomic theory initially faced controversy, as atoms were too small to be seen at the time. This changed in 1931 when German engineer Ernst Ruska developed the first electron microscope. His invention revolutionised scientific research, allowing scientists to observe structures at micrometre, nanometre, and even atomic scales. It became a vital tool in biomedical research, enabling the study of tissues, cells, and organelles in unprecedented detail.

In 1897, British scientist J.J. Thomson discovered that all matter, regardless of its origin, contained identical subatomic particles smaller than atoms—initially called corpuscles and later known as electrons. These negatively charged particles formed a crucial part of atomic structure. In 1904, Thomson proposed the first atomic model, which depicted the atom as a uniformly charged sphere without a nucleus. However, this model was soon challenged by his own student, Ernest Rutherford.

Rutherford, a New Zealand-based scientist, is credited with discovering the atomic nucleus. Through his gold foil experiment, he demonstrated that atoms are mostly empty space, with a dense, positively charged nucleus at the center surrounded by orbiting electrons. This ground-breaking discovery reshaped atomic theory, paving the way for the modern understanding of atomic structure.

Today, the study of atoms remains fundamental to science, influencing fields such as healthcare, technology, medicine, energy, and our understanding of the universe. The journey from early atomic speculations by Leucippus to Rutherford’s discoveries exemplifies the progress of scientific inquiry and its lasting impact on the world.

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CITATIONS

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