KINETIC THEORY

MOLECULAR NATURE OF MATTER

MOLECULAR NATURE OF MATTER PHYSICS

Richard Feynman, a famous physicist from the 20th century, believed that the idea that "everything is made of tiny atoms" is really important. He thought that if humanity faces big problems like nuclear disasters or environmental issues and all our scientific knowledge gets lost, we should make sure to pass on this "Atomic Hypothesis" to the next generation of beings in the universe. The Atomic Hypothesis says that everything is made up of atoms, these tiny things that are always moving, and they pull towards each other when they're a bit apart but push away if they get too close.

The idea that matter might not be smooth and continuous was thought about in different places and cultures. People like Kanada in India and Democritus in Greece had the idea that matter could be made of tiny, indivisible parts. But it was John Dalton who's often given credit for the "Atomic Theory" we use in science today. He came up with this theory to explain how elements combine to make compounds, following some specific rules. One rule says that any compound always has a fixed proportion of its parts by their weight. Another rule says that when two elements make more than one compound, the weights of the other elements are in a simple ratio.

About 200 years ago, to explain some rules, Dalton suggested that the smallest parts of an element are called atoms. Each element has its own unique atoms that look the same, but they're different from atoms of other elements. When a small group of these atoms from different elements get together, they form a compound. Another idea from the early 19th century by a scientist named Gay Lussac says that when gases combine to make another gas, the amounts are in simple ratios. Avogadro's law, or hypothesis, tells us that if you have equal volumes of any gases at the same temperature and pressure, they have the same number of tiny molecules inside.

All of this, when you put it together, explains what Gay Lussac was talking about. Because elements are often in the form of molecules, we can also call Dalton's atomic theory the molecular theory of matter. Scientists now really believe in this theory. But it's interesting to know that even at the end of the 1800s, there were some famous scientists who didn't believe in the idea of atoms!

From various recent observations, we now understand that matter is made of tiny particles called molecules, and we can even see them with special microscopes. These molecules are very small, about the size of an angstrom (which is a tiny measurement). In solid materials, like a tightly packed box of marbles, the molecules are close together, a few angstroms apart. In liquids, they're also close, and they can move around, which is why liquids can flow. In gases, the molecules are more spread out, with larger distances between them. The average distance a molecule travels before bumping into another is called the "mean free path," and in gases, it's much longer.

Even though gases might seem still, they are actually very active, with molecules constantly moving and colliding with each other. This dynamic activity keeps things in balance, and only the overall properties stay the same.

The atomic theory is just the start of our exploration. We now understand that atoms are not the tiniest things; they have a center called a nucleus and particles called electrons around it. The nucleus itself is made up of protons and neutrons, and even they are made up of smaller parts called quarks. But there might be even smaller things, like string-like particles. Nature always has new surprises, but the search for knowledge is usually fun, and the discoveries are amazing.

In this chapter, we'll focus on understanding how gases (and a bit about solids) behave, thinking of them as a bunch of tiny moving particles that never stop.