

S521

Brownian Motion

動き回る分子-ブラウン運動-

■ Purpose of Exhibition

In the exhibition, titanium oxide microscopic particles move in the water, and are reflected on a television monitor.

Let's observe closely. It turns out that the particles tremble in random motion.

Why do those particles continue to move even if they are not living creatures? Atoms and molecules are so small that they are invisible to our human eyes. From the visible phenomenon called "Brownian Movement", we can understand the world of atoms and molecules.



■ Additional Knowledge

[What is the Brownian Movement?]

Gas and liquid molecules are constantly in thermal motion.

Also, tiny particles in the air and liquid continue to collide with those molecules.

As a result, particles move randomly.

The movement of these particles is called "Brownian Movement". Regardless if its gas or liquid where the tiny particles are floating, the brownian movement occurs. With the Brownian movement, the higher the temperature, the smaller and more violent the tiny particles are.

[Discovery of the Brownian movement]

In 1827, when the British botanist Robert Brown was observing through a microscope, placing pollen into water, he noticed that the particles coming out of the pollen were moving constantly. At first, Brown thought they were living creatures that moved by themselves, however, even those 'non-living' objects that looked like stone powder were moving the same way.

Brown could not explain the reason for the movement, but the name of the discovery is "the Brownian movement".

[What was understood from the Brownian movement?]

We cannot see atoms and molecules directly, but we can see movement of particles under a microscope, and indirectly understand the existence of atoms and molecules.

This 'Brownian movement' has a significant meaning in the history of science. As a conclusion, it has proved the existence of atoms and molecules.

However, in 1905, Albert Einstein believed that the movement of the particles in gas or liquid was the cause of the Brownian movement and analyzed it mathematically (incidentally, that same year Einstein published 3 papers "theory of Brownian motion", "theory of photoelectric effect" and "special relativity").

Then in 1908, the French scientist Jean Perrin, observing the Brownian theory explained that the theory was correct.

By the way, we have explained the particles so far, but in chemical terms they are called "colloidal particles". The size of those particles is 1 millionth of 1 mm to ten thousandth of 1 mm.

On the other hand, the size of an atom is 1 thousand of 10 thousand of 1mm.

Compared with atoms, colloids are quite large.

Because it's a large particle, when dissolved in a liquid it does not give a transparent solution, but more like an opaque suspension. Some examples are milk, ink, paint, filtered water and so on.

There are many things made with colloids in nature and in our daily life, like fog, smoke, konjac jelly, gelatin and mayonnaise.

Article by Keiko Ishida, curator

[Colloid]