THE NOBEL PRIZE

Award ceremony speech

Presentation Speech by Professor C.W. Oseen, member of the Nobel Committee for Physics of the Royal Swedish Academy of Sciences, on December 10, 1926

Your Majesty, Your Royal Highnesses, Ladies and Gentlemen.

Nature can be physically explained in two ways. When a group of phenomena is to be understood, we can seek to deduce, on the basis of observations, general laws from which it will be possible to infer concrete phenomena. Or we can proceed from a hypothesis on the structure of matter and seek to explain the phenomena from that. These two methods have been exployed so long as physical research has been carried out.

An example will allow me to show the difference between the phenomenological and the atomistic description of Nature. We all know that air is less dense at the top of a mountain than at ground level. This phenomenon is explained completely by the laws which govern a heavy gas, and there is no reason for not considering the gas as a continuous medium. The problem is herewith solved so far as the phenomenological description is concerned. But for the supporters of the molecular theories the results obtained in this way constitute only a superficial description of the phenomena. For him, a gas evokes the image of a multitude of molecules moving in all directions. Only an explanation which reduces the phenomenon to the laws of molecular movements can be satisfactory to him.

the real existence of molecules.

The idea which Professor Perrin pursued in the early stages of his researches was this. If it follows from the laws governing the movements of molecules that in spite of its weight air is not compressed against the surface of the earth, but that it extends – while becoming rarefied, it is true – well above the highest mountains, in that case, and seeing that the movements of molecules obey the same laws as every other minute body, there must be something analogous for every system of small bodies. If a large quantity of sufficiently small and light particles is distributed in a liquid, not all of them should yet settle at the bottom even if they are heavier than the liquid, but they should distribute themselves at different levels according to a law similar to that for the air. Perrin, now, had to realize this experiment.

He had for this purpose to prepare a system of very small particles, all of which, moreover, should have the same weight and the same size. He succeeded herein by using gamboge, a preparation obtained from a vegetable sap and which can be handled like soap. By rubbing the gamboge between his hands under water, Perrin obtained an emulsion which under the microscope proved to consist of a swarm of spherical particles of different size. He then succeeded in obtaining from it an emulsion of particles of the desired dimension and all of equal size. This was by no means an easy operation which is proved by the fact that after several months of accurate and careful work Perrin was able to obtain from one kilogram of gamboge only some decigrams of particles of the desired size. It then became possible to undertake the experiment. The result was as expected. By means of his gamboge emulsion Perrin was able to determine one of the most important physical constants, Avogadro's number, that is to say the number of molecules of a substance in so many grams as indicated by the molecular weight, or to take a special case, the number of molecules in two grams of hydrogen. The value obtained corresponded, within the limits of error, to that given by the kinetic theory of gases. Vast work to verify this, has not shaken the soundness of the method.

It may perhaps be said that in the work which we have just summarized Perrin has offered indirect evidence for the existence of molecules. Here, follows a direct evidence. Microscopic particles in a liquid are never at rest. They are in perpetual movement, even under conditions of perfect external equilibrium, constant temperature, etc. The only irrefutable explanation for this phenomenon ascribes the movements of the particles to shocks produced on them by the molecules of the liquid themselves. A mathematical theory of this phenomenon has been given by Einstein. The first experimental proof of to speak of Perrin only. His measurements on the Brownian movement showed that Einstein's theory was in perfect agreement with reality. Through these measurements a new determination of Avogadro's number was obtained.

The molecular impacts produce not only a forward movement of the particles distributed in a liquid, but also a rotational movement. The theory of this rotation was developed by Einstein. Measurements in relation herewith were carried out by Perrin. In these measurements he has found another method for determining Avogadro's number.

What then is the result of these researches ? How many molecules are there in two grams of hydrogen? The three methods have given the following answers to this question: 68.2×10^{22}; 68.8×10^{22}; 65×10^{22}.

Professor Perrin. For more than thirty years you have worked with your head and your hands in the service of atomistic ideas. Please, accept our congratulations on the result that you have achieved. Allow me also to express the happiness which we experience in greeting you as a representative of the glorious sciences of France. I ask you to receive from the hands of our King the Nobel Prize in Physics for 1926.

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