# CHAPTER I

## INTRODUCTION

Brownian motion(1,2)was first observed by the botanist, Robert Brown in 1828. He worked with grains of pollen of size varying from one-thousandth to about five-thousandth of an inch (2 - 13 Å ) in length. While examining these granules immersed in water, he observed the unceasing agitation of the granules through microscope. He wondered if the choice of plants essential for the phenomenon. He answered this question by repeating the experiment with many different plants, and found that all granules, if sufficiently small, showed such motion. Further he found the same motion for inorganic and organic substances.

Since 1828, many scientists (3) tried to find the exact theory of this motion and made predictions which could be verified by experiments, but failed. This difficulty was first clarified by Einstein's theory in 1905. His theory was of importance in the struggle between atomism and nonatomism, that before 1905, many scientists did not accept the atomic hypothesis. In macrosopic thermodynamics a thermal equilibrium could exist in which nothing happened. Everything remained in static equilibrium. Boltzmann realized that this state was the result of bombardment of billions of molecules and would not be considered as static. However, it was plausible assumed that the fluctuations were

so rapid that macroscopic phenomena is unobservable. Einstein discovered something that went far beyond Boltzmann's conclusions. His theory demonstrated that the fluctuations cause macroscopically observable change in the system. Pure thermodynamics cannot explain why fluctuations of the equilibrium system should occur. He demonstrated that the atomic hypothesis demands such fluctuations. All quantities in his formulae were measurable, therefore, a check of his theory was possible. Later, Perrin could give a verification of his theoretical predictions. If one, who doubted the soundness of the atomic hypothesis, saw the zigzag motion of suspended particles and the explanations offered by the atomic hypothesis that the fluctuations were the result of random pushes from the heat oscillations of the surrounding fluid molecules, he would realize that it was difficult to find other explanations of such plausibility.

Einstein's theory will be discussed in the next chapter. The developed theory using Langevin and Fokker-Planck equations will be discussed in chapter III and IV respectively. However, physicists hoped to solve by using the laws of dynamics alone. The aim of Ford, Kac and Mazur were trying to serve this purpose. Ford-Kac-Mazur model is introduced in chapter V. The discussions and conclusions will be given in chapter VI.