CHAPTER 4

The Statistical Interpretation of Entropy

4.1 INTRODUCTION

Classical thermodynamics is *phenomenological*; that is, it deals with matter as it appears to our senses. In this regard, we use our senses to describe the properties of matter such as pressure, volume, and temperature. Classical thermodynamics does not delve into the more fundamental aspect, of what does matter consist? In this chapter, we will use the understanding of matter consisting of atoms and molecules and introduce the use of statistics to the approach of the topic of thermodynamics. This starting place moves us from the realm of classical thermodynamics to statistical thermodynamics. Our excursion will be brief, but it is hoped that it will give the reader a better physical understanding of entropy.

In Chapter 3, the introduction of entropy as a thermodynamic state function was facilitated by the realization that there exist possible and impossible spontaneous processes, and by the examination of the thermal energy and work effects occurring during these processes. From the formal statements of the Second Law of Thermodynamics, as developed from classical thermodynamics arguments, it is difficult to assign a *physical significance* or a *physical quality* to entropy. In this respect, entropy differs from internal energy in spite of the fact that, within the scope of classical thermodynamics, both properties are extensive thermodynamic functions of the state of a system. The ready acceptance of the First Law of Thermodynamics in the nineteenth century, after its enunciation, was due to the easily understood physical significance of internal energy, whereas the lack of a corresponding understanding of entropy caused the acceptance of the Second Law of Thermodynamics to be slower. A more physical interpretation of entropy had to await the development of statistical thermodynamics and the subsequent development of quantum mechanics.