16.11: Entropy, Randomness, and Disorder

A very useful, though somewhat rough, description of the entropy of a substance is as a measure of the *randomness or disorder* of the atoms and molecules which constitute that substance. In these terms the second law of thermodynamics is seen as a tendency for the disorder of the universe to increase. This way of looking at entropy is entirely compatible with the approach presented above. A situation which we intuitively recognize as being orderly is also one which can only be achieved in a limited number of ways. By contrast, situations which we recognize as disordered, random, or chaotic, can he achieved in a whole variety of ways. In other words, *W*, and hence *S*, is small for an ordered situation but large for a disordered situation.

There are limits to the lengths one can take this order-disorder approach to entropy, though. It does not lend itself to a quantitative treatment, and it is also difficult to explain some things like the effect of mass in these terms. There is nothing in our intuition about order, for example, which suggests that 1 mol Xe gas is more disordered than 1 mol He gas, even though its entropy is in fact larger.