16.2: Spontaneous Processes and Molecular Probability

Processes like formation of $HgBr_2$, which have a downhill character, are called **spontaneous processes**. When we attempt to reverse a spontaneous process, as in decomposition of $HgBr_2$, an uphill battle must invariably be fought and we are dealing with a **nonspontaneous process**.

Below are two videos of a process, one going forward in time, and the other rewinding back through time.

It is clear that the first video of nitrogen triiodide exploding at the touch of a feather is going forward in time. It is also as immediately obvious that the second video, of nitrogen triiodide "unexploding" is going backward. We know instinctively from everyday experience that such a process would be unnatural, and simply would not occur. Exploding is not the only process for which we have this basic intuition on. Below is another video going backward in time to show a processes we know is unnatural and would not occur spontaneously in real life:

In the above video, a dye is "unmixed." The dye goes from being fully dispersed in solution to returning back to a concentrated drop separate from the rest of the solution. The mixing of the dye is spontaneous, we expect it to happen, so we know that the video must be in reverse, showing a process we intuitively know is unnatural.

These two examples show processes we know from basic world experience go in one direction, and do not go in the opposite (reverse) direction. There must be an underlying reason for one direction being spontaneous while the other is not. Understanding this reason will allow one to determine which direction a process will go when it is less obvious than the explosion in the first example. Following the chemist's view of the world, we can understand what is occurring macroscopically by considering what is occurring with molecules and atoms at the microscopic level.