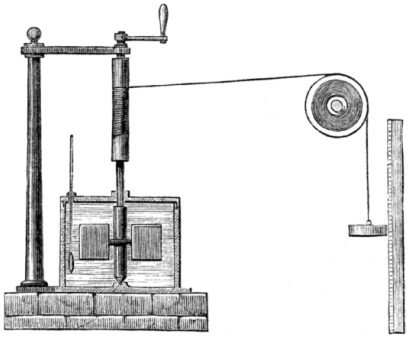
# 12.1: "Lost" Energy and the Discovery of Conservation of Energy

In the previous few chapters, we have taken for granted that conservation of energy is true. However, it actually took quite a while for people to understand and accept conservation of energy. In fact, it was not until the middle of the 19$^{th}$ century that the law of conservation of energy as we currently understand it was stated. The issue, as it has been since at least the time of Aristotle, was friction.

Imagine a simple experiment to try to test conservation of energy: rolling a marble inside of a metal bowl. If you release the marble from a certain height on the side of the bowl, it will roll down to the bottom of the bowl as it converts potential energy to kinetic energy. As it rolls back up the other side of the bowl, it will slow as it converts the kinetic energy back to potential energy. As it slows the marble will go up and up until...it *almost* reaches the same height that you released it from. As this process continues, every pass of the marble will find the height lowering and lowering until the marble eventually stops at the bottom. It is hard to create a theory of conservation of energy when energy (at least the types of energy that you know of) is not being conserved.

Some scientists noticed something, however. When you put a drill into a piece of wood, the wood slows down the motion (i.e. the rotational kinetic energy) of the drill bit. If you touch the drill bit afterwards, though, you will notice something: The drill bit is hot. (In fact, don't actually do this with a modern drill. You will burn yourself.) This gave some of our 19$^{th}$ century scientists the idea that perhaps this motion energy was being turned into some sort of "heat" energy.



While many scientists worked on this problem, the most famous was James Joule. He constructed an apparatus that increased the temperature of water by dropping a large weight. Using this device, Joule found the amount of heat energy (which at that time was measured in calories) that was equivalent to an amount of mechanical energy (which was measured by Joule in "foot-pounds" but which, today, we measure in Joules. (One guess where the name came from.) Essentially, it was found that 1 calorie was equal to 4.18 Joules.

Enough history! What does this mean for us today? Well, it means that we no longer need to ignore friction. We can now start to express where our "lost" energy is going and use this to solve equations that involve heat and mechanical energy. We will begin to develop this theory in the next section.