Kiryu Sakakibara
ENGL 1168
9/25/19

Atomic Reconstruction

The concept of the atom has been around since 400 BCE, but as technology and science developed, its model underwent many iterations. With so many changes, scientists even to this day are not sure which model is the ideal one. Searching “atom” in Google results in a variety of different models, confusing and misinforming even more people. So, how were these models created, and how did the world react to them?

Democritus and Leucippus, Greek philosophers, originally thought that tiny, indivisible particles composed everything, and called them atoms. About 2000 years later in 1808, John Dalton added 3 more statements to this concept: atoms of one element are the same, atoms of different elements are different, and compounds are made of different kinds of atoms. This made sense and did not differ too much from the original, so his thoughts became widely accepted.

Everything changed in 1897 when J.J. Thomson started conducting experiments with cathode ray tubes. This device ran an electric current through two metal plates in a vacuum to create a charged beam. After applying electric and magnetic forces, he found that the beam was made of negatively charged particles, and with the charge to mass ratio equation, also found that each particle’s mass was about 1/2000th the mass of a hydrogen atom (Allain). When Thomson tried the experiments again with other metal plates, he found the same results. He named the particle the electron, a fundamental part of the atom. This resulted in the plum pudding model, electrons stuffed in a cloud of positive charge, making the atom neutral. Many scientists were confused and outraged when they realized that this indivisible particle could actually be divided, but this was nowhere near the end.

Kiryu Sakakibara
ENGL 1168
9/25/19

In 1908, Ernest Rutherford conducted an experiment where he shot alpha particles (nuclei of helium atom, or just a cluster of positive charge) at a sheet of gold a few atoms thick to measure the effects of alpha particles on various materials. Surprisingly, he detected that while most particles went straight through, a few bounced in unpredictable directions, sometimes even directly back at the source (Sivulka). Atoms being mostly empty space was the only plausible explanation for this, with electrons orbiting a dense, positively charged cluster of particles. This cluster was what pushed on the positive alpha particles to change their course. Once again, scientists were baffled by this new atomic model, causing chaos as they tried to comprehend just how nothing everything really is. James Chadwick also added onto Rutherford's model by proposing the neutron, mainly to explain why the atomic mass of an element was much more than its atomic number. This fundamentally changed scientists' world view, and opened the way to particle physics.

The Rutherford model still had a big problem: the orbiting electrons should spiral towards the center of the atom while releasing energy (Moroni). To fix this problem, i 1913, Niels Bohr proposed that electrons could only orbit at certain distances from the nucleus called shells, without releasing energy. With this new model, scientists could manipulate electrons and create advanced circuitry. As a consequence, however, the atomic model also became a complicated mess.

With Erwin Schrodinger's most recent quantum cloud model, everyone realized that new and accurate might not always be the best. Instead of rings, the atom is now a cloud of possible electron locations, with no way of knowing where electrons are actually located. To fully explain and comprehend this model, a plethora of knowledge in other topics is required, like quantum

mechanics and orbitals. The fact that these newer models are so complicated is one of the big reasons that different models are still being used today, despite being outdated. The right models are needed for the right times. The Rutherford model is the simplest and most accurate, so TV shows use that model frequently, and is even used as a logo for many organizations. The Bohr model is commonly used in basic chemistry classes due to its clear representation of electrons. Through these iterations, we discovered just how important atoms are, so even using Dalton's spherical model to explain atoms to children might not be a bad idea. Finally, scientists are still trying to find even more accurate representations of atoms, so the creation of another new model is not an impossibility. Even if that happens, nobody is sticking to one specific model, so the transition will be much smoother than in the past when people's world views were being crushed.

Citations:

1. Allain, Rhett. "The Development of the Atomic Model." *Wired*, Conde Nast, 2 Aug. 2018, www.wired.com/2009/09/the-development-of-the-atomic-model/.
2. Sivulka, George. "Experimental Evidence for the Structure of the Atom." *Experimental Evidence for the Structure of the Atom*, 2017, large.stanford.edu/courses/2017/ph241/sivulka2/.
3. Moroni, Luca. "Standing Waves in Bohr's Atomic Model." *Worlds of Math & Physics*, 2018, www.lucamoroni.it/simulations/standing-waves-in-bohrs-atomic-model/.