SUMMARY OF THE HISTORY IN REED, PP. 19-40

Reed has timelines on pp. 20-21, but below are the essential features, all of which we discussed in the Friday, April 20 class. Rebecca gave a presentation on the 1895 discovery, and Trey gave a presentation on the 1932 discovery.

Pre-nuclear physics

1803 Dalton hypothesizes that an element consists of atoms, although he has no idea what an atom is. It is just something small and unique and identical for each type of element
1815 Prout proposes the protyle, wherein each element is characterized by how many protyoles it has (hydrogen, 1 protyle; helium, 2 protyoles, lithium, 3 protyoles, etc., although they of course have not even discovered helium yet)

Radiation

- 1895 Roöntgen discovers that cathode ray tubes produce X-rays
- 1896 Becquerel discovers that uranium is radioactive (even when it isn't exposed to sunlight, which was his original suspicion and reason for studying uranium), and he shows that the "Becquerel rays" are of two types and that they ionize air
- 1897 Thomson characterizes the cathode rays, which we now call electrons (more precisely, he is able to determine the charge-to-mass ratio of the cathode ray (I said that part right in Friday's class, but **saying that Thomson balanced the electric force against the gravitational force I had completely wrong—that was Millikan in 1909—sorry**)
- 1898 The Curies isolate polonium and radium which are much more radioactive than uranium and thorium

Nuclear Reactions and Isotopes

- 1900 Villard discovers gamma rays, which add to the growing catalog of radiation, eventually these are determined to be high-energy photons, and therefore no different in principle from X-rays and light
- 1900 Rutherford (with Soddy in 1903) discover that thorium produces what we now call Radon, but which they were thinking was probably Argon
- 1903 P. Curie and Laborde, and independently Rutherford and Soddy, realize that each nuclear reaction releases about 100,000x as much energy as a typical chemical reaction (instead of something like 10 eV per reaction, something more like 1 MeV per reaction)
- 1907 Thomson modifies the apparatus he characterized the cathode ray with so that he can measure the charge-to-mass ratio of positively-charged rays, such as an alpha particle, or any atom that has lost one of its electrons
- 1909 Rutherford and Royds demonstrate that the alpha particle is the same as a Helium nucleus by showing that stopped alpha particles behave like Helium—of course they don't know about nuclei yet
- 1909 Geiger and Marsden discover that alpha particles are sometimes inexplicably reflected back from gold foil, which is very damaging for the "plum pudding" conceptualization of the atom
- 1911 Rutherford hypothesizes the nucleus to explain the experiments of Geiger and Marsden
- 1912 Aston and Thomson use positive-ray measurements with ionized neon to demonstrate that there are two types of neon, that we now know as Neon-20 and Neon-22 (and the list of isotopes starts to build—there are close to three times as many isotopes as elements now known)

Later nuclear physics that sets off the search for chain reactions

- 1932 Chadwick hypothesizes the neutron to explain the unexpectedly energetic dislodging of protons from wax (other experimenters almost had it too, but Chadwick is the one that realizes the explanation that is needed)