Timeline of Events in Chapters 1–4 of *Uncertainty*

Year	Event
400 bce	Democritus proposes that all matter is made of small, indivisible particles called *atomos*.
c. 1650	Pascal and de Fermat work out the laws of mathematical probability for card and dice games.
1670s	Leeuwenhoek develops the microscope and makes first observations of single-celled organisms.
1803	John Dalton proposes that elements combine in fixed proportions leading to him to propose the existence of atoms.
1814	Fraunhofer invents spectroscope and discovers emission and absorption lines in the solar spectrum.
1827	Robert Browning begins study of pollen grains and observes their movement under a microscope.
1860	Kekulé suggests the chemist's atom and the physicist's atom need not be the same thing.
c. 1860	Maxwell develops kinetic theory of gases—which relates the average speed of gas molecules to their temperature—by using a statistical method that treats a large number of molecules with a wide range of energies as equivalent to a smaller number of molecules with a smaller number of energies.
1863	Wiener suggests that Brownian particles suspended in a liquid move as a result of collisions from the liquid's atoms; this suggestion is largely ignored.
1865	Clausius coins the term *entropy* to explain why heat flows from hot bodies to cold bodies, but not from cold bodies to hot bodies.
1877	Boltzmann shows that an increase in entropy corresponds to an increase in the number of possible states of equal energy, suggesting that entropy can only increase.
c. 1880	Poincaré proposes that, given sufficient time, every possible arrangement of atoms must eventually occur, suggesting that entropy can both increase and decrease
c. 1880	Delsaulx suggests that how far and how fast a Brownian particle moves is related to the statistical fluctuations (the "law of large numbers") of molecules hitting the particle.
1885	Balmer derives an empirical equation that models the known visible emission lines for hydrogen atoms.
1889	Gouy suggests that Brownian particles exchange energy with other molecules during collisions.
1896	Boltzmann suggests that the motion of small particles may be due to collisions with atoms.
1896	Röntgen reports the discovery of X-rays emitted from an electrical discharge tube.
1896	Becquerel reports the discovery of *les rayons uraniques* (uranium rays) emitted by uranium.
1897	Thomson discovers the electron.
1898	Curie demonstrates that Becquerel's rays are emitted not by uranium, but by newly discovered radioactive elements polonium and radium.
1898	Rutherford identifies two forms of radioactive emission: alpha particles and beta particles, the latter of which are fast-moving electrons.
1900	Planck suggests that black-body emission—energy released from a hot object—occurs in discrete packets, or *quanta*, that cannot be further subdivided.
1902	Rutherford and Soddy propose the transmutation theory—that radioactive decay results in heavier elements changing into lighter elements—and introduce the concept of a half-life.
1904	Thomson proposes the "plum pudding" model of the atom, in which electrons sit within a "soup" of positive charge.
1905	Einstein develops a theoretical model to predict the drift of Brownian particles, and a theoretical model to explain the photoelectric effect using Planck's quantum.
1907	Rutherford demonstrates that alpha particles are simply helium ions.
1908	Perrin's experiments on Brownian particles confirms Einstein's theory.
1911	Rutherford demonstrates that an atom's positive charge is confined to a small, dense nucleus; his model does not address the electron.
1913	Bohr introduces his model of the hydrogen atom in which a single electron orbits a nucleus, and in which orbits are quantized.