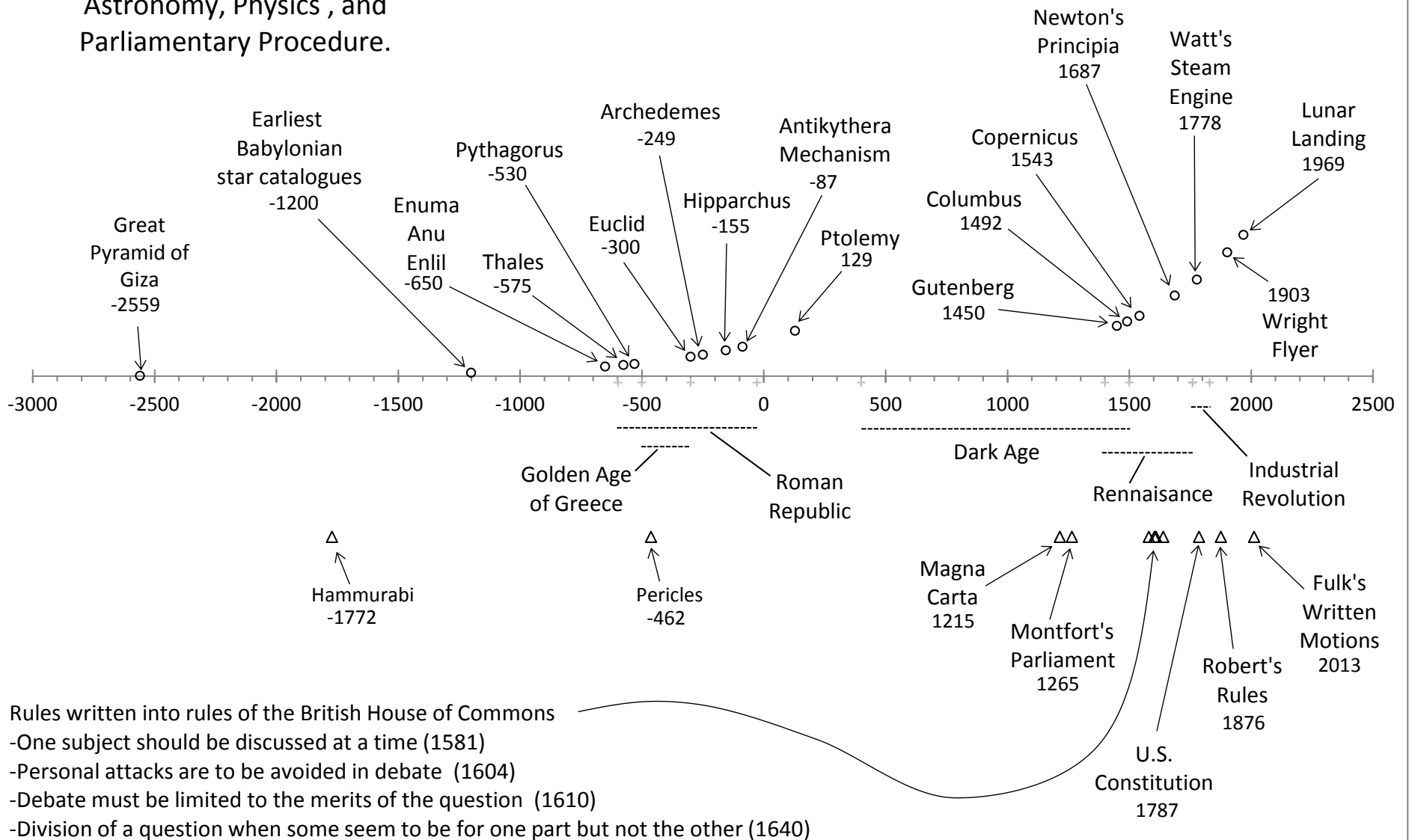


Timeline for Laws of Mathematics, Astronomy, Physics, and Parliamentary Procedure.



We begin with the Great Pyramid of Giza to establish that the ancient Egyptians had some knowledge of geometry. It is worth noting that today is closer to Shakespeare's time (1600), than Shakespeare's time was to when his play *Anthony and Cleopatra* was

set (41 BC). Also, Cleopatra was closer to our time, today, than Cleopatra was to the time when the Great Pyramid of Giza was built. In many respects, we are still part of the European Renaissance. [...must insert footnote or paragraph on Arab contributions to all this.]

The Saros cycle was apparently discovered by ancient Babylonians, and can be used to predict lunar eclipses. The oldest known Babylonian known star catalogues date back to 1200 BC. The Greek astronomer Thales probably used Babylonian *Enuma Anu Enlil* tablets in to predict a solar eclipse.

Pythagoras, Euclid, Archimedes, Hipparchus, and Ptolemy were famous ancient Greek thinkers. While Pythagoras did not invent the Pythagorean theorem ($a^2+b^2=c^2$), he or one of his colleagues apparently discovered a proof of it. Euclid's textbook on geometry serves as the basis for *Euclidean Geometry* we learn today, although Euclid's emphasis was as much on construction using straight edge and compass as on rigorous "proof". It has been speculated that Euclid postponed introduction his "5th Postulate" because he suspected that it could be proven, thus foreshadowing the abandonment by that postulate in the 19th century non-Euclidean geometry that eventually evolved into Einstein's Theory of General Relativity in 1916. Recent manuscripts suggest that Archimedes developed mathematical methods often credited to Newton and Leibniz in order to solve problems typically associated with calculus. Hipparchus has been credited with discovering precession of the equinoxes, and he probably relied heavily on prior efforts by the Babylonians. Hipparchus also developed what we now know as trigonometry. The Antikythera Mechanism was an intricate assembly of 30 or more gears was used to predict the motion and eclipses of the Moon. Ptolemy used available data on planetary motion to make precise predictions of the motion of the planets.

Then a European Dark Age interrupted progress. The scientific accomplishments are placed on an exponential curve, with a "pause" of zero growth between the years 400-1000 AD. We offer no metric by which scientific growth would follow such an exponential curve, or that the growth in Europe was at or near zero during the Dark Age. But it might be worth noting that there is something mundane about the two events marking the beginning and end of the Dark Age. The Antikythera Mechanism 's use of gears to describe the motion of the Moon seems more impressive than Ptolemy's heroic but tedious

calculations. Gutenberg's invention was significant because it helped change the world, not because it solved challenging engineering problems. Those who made the Antikythera Mechanism could easily have invented Gutenberg's press, had they considered the mass production of books to be important.

Copernicus proposal that the Sun was the center of the Solar System was published after his death in 1543. Soon afterwards, Tycho and Kepler constructed mathematical formulas that tracked the motion of the planets with greater precision than was achieved by Ptolemy. Meanwhile Galileo and Newton invented a successful effort to find a simple mathematical model for the motion of all objects under the force of gravity. Soon afterwards, Watt improved the steam engine, as one of a countless number of small steps towards industrialization. Then the Wright brothers constructed the first engine powered airplane, and two astronauts walked on the Moon.

Had this pause in scientific progress not occurred, someone like Newton might have invented calculus and physics circa 400 AD. And the engineering and scientific skills available to the ancient Greeks and Romans could easily have led to a person walking on the Moon well before Columbus was born

Virtually none of the Greco-Roman accomplishments occurred in a political environment that resembles what we would call "democracy". Nevertheless, it is clear that scientific and technical progress requires a nourishing environment. The Dark Ages and recent history both show how political disruption can stop progress. For this reason, progress in government and parliamentary procedure are also charted on the same timeline. It must be kept in mind that for much of history, there has been little or no causal correlation between advances in technology and progress towards pluralistic democracy.