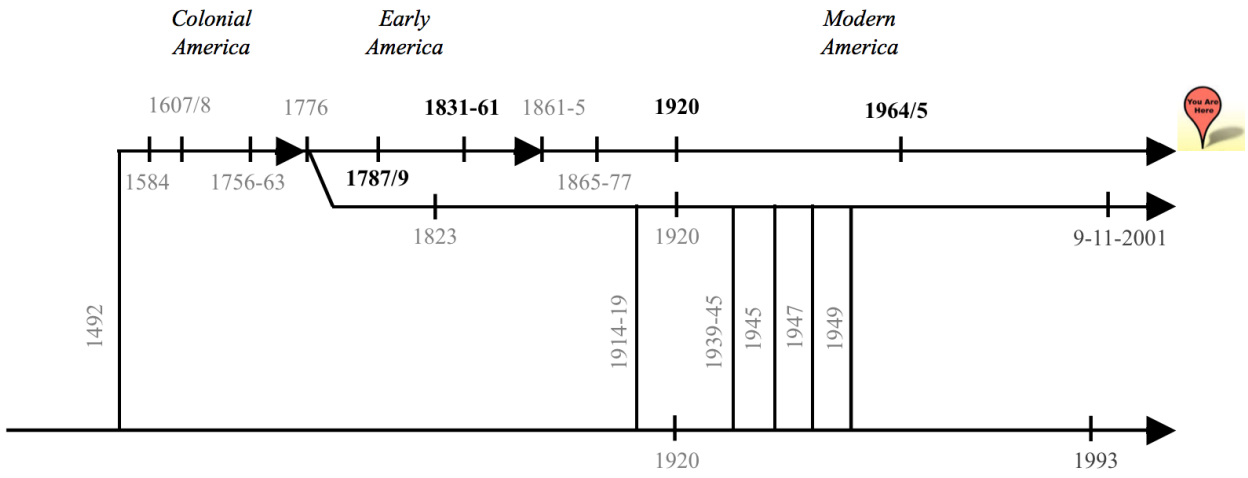
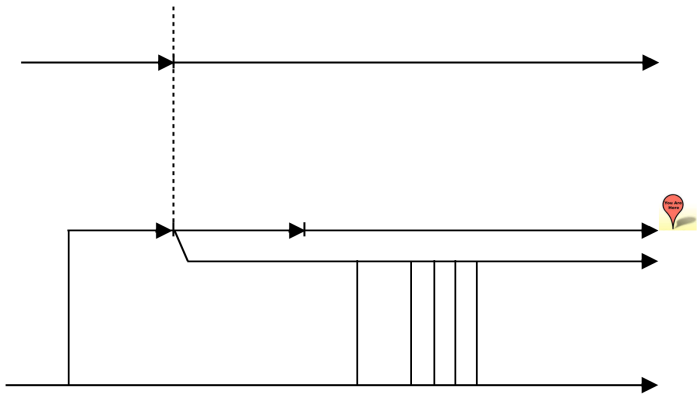
VI. The Story of Technological Progress

A. "3-D" History

1. History is complex. Human life evolves in many different ways at the same time. We have learned to see American history from two main angles so far:
   a) America's relationship to the world, which has changed from political separation to policing the world.
   b) America's evolving form of government, which was initially based on natural rights but included slavery, and then changed into its modern incarnation focused on "civil" rights.
2. By separating the progression of rights from the progression of America's relationship to the rest of the world, we have room to add the anchor fact milestones of the story of rights (**1787/9, 1831-61, 1920,** and **1964/5**) to a timeline of their own within our overall diagram.



3. We will now proceed to add a third "dimension" to the story: technological progress. If we take the progressions we have and add a third line above and parallel to the others, we can include another story. The following simplified diagram illustrates the basic idea:



4. The line representing technology is placed above the line representing American history itself, approximately the same distance away from the line as European history is drawn below.
5. The one feature connecting the top line to the rest of the diagram is a dotted line extending upward from the *Declaration of Independence* of **1776**. This is draw to indicate that an anchor fact milestone occurs in the technology space at almost the same time as the the American Revolution. It is the most transformative technological event in history, so that is where our story of technology begins. Until the point in history, virtually all of humankind stagnated in *pre-industrial* squalor.

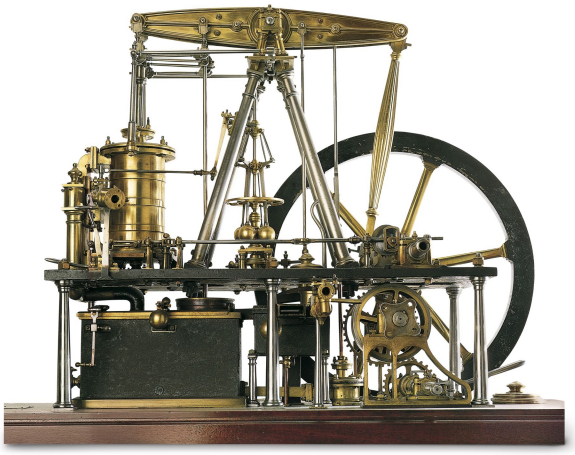
B. Pre-Industrial Life (- c.1769)

1. Studying modern history is without a doubt much more difficult that studying ancient or medieval history, because modern life is characterized by rapid technological advances that not only change how we live, but also how we think about other cultures, how we fight wars, and what we expect from modern government.
2. Pre-industrial life, which is to say, the stage of civilization prior to **c.1769**, where human beings did not possess any of the advanced technology we have today, was much simpler in that regard.
3. The vast majority of human energy was directed towards agriculture. The so-called "Agricultural Revolution" occurred some time before **3000 BC**, leading early civilizations to become fixed in place and focussed on producing crops and domesticating certain types of animals.
4. This permitted just enough of an improvement in the standard of living of our ancestors to give them the spare time to spend on such things as the invention of writing, and thus the recording of history.
5. Amazingly, little beyond the creation of agriculture was accomplished to further material life for the next 5000 years. The pre-industrial era is an era of stagnation on the plateau of subsistence.
6. Consequently, to the best of our ability to reckon the data, modern estimates of life expectancy for human beings worldwide until industrial times was about 25 years. (This is, of course, an average. Some lucky and hardy individuals lived perhaps as long as we do today. By far more people died as babies, infants, children, and young adults from famine, malnutrition, disease, and war.)

B. The Watt Steam Engine (c.1769)

1. The discovery of America by Christopher Columbus in **1492** was made possible by a rebirth of the science of geography after the long European Dark Ages.
2. Other similar revivals took place in many sciences, and new knowledge began to proliferate as a "scientific revolution" took place in modern Europe.
3. Probably the most famous example of this revolution was the creation of the "heliocentric" theory of the universe by Nicolas Copernicus, displacing the previous theory of astronomy that had the Earth in the center (the "geocentric" theory).
4. As science began to progress rapidly, especially in the 1600s, the practical application of scientific knowledge to produce new forms of technology also accelerated.
5. By far the most important of these technological advances was the Steam Engine of James Watt, invented **c.1769.**

a) A steam engine is based on the science of thermodynamics.
b) As anyone can observe, when you boil a pot of water with a lid on it, the steam forces the lid to jump as its escapes.
c) Thermodynamics explains how and why water vapor creates this pressure.
d) If one can create a vessel where water is heated to produce vapor and the pressure created by that vapor is captured as a mechanical force, one can produce an *engine*.
e) Various precursors to the Watt steam engine had been developed around Europe in the century leading up to his model, but none were sufficiently efficient to produce power in a way that could transform human industry.



An early working model of the Watt Steam Engine. Large stationary engines like this were used in mining to raise large amounts of ore up out of the ground.

f) It was by examining a prior engine, made by another engineer named Thomas Newcomen, that James Watt was able to create his breakthrough design, the *Watt* Steam Engine **c.1769.**
g) Because the process of invention is usually long and arduous, it is often difficult to assign a precise date to an invention. Does one choose the first moment when an inventor had the basic idea? Does one choose the time when his first prototype is created? Or is it the first production model? Or the year when (and if) he is able to obtain a patent (official recognition)? It is sometimes impossible to assign a single year, let alone a date, to an invention. For that reason, we will designate the invention of the Watt Steam Engine as occurring **c. ("circa") 1769.**