

## E. The “Age of Steam” or “Proto-Industrial” Phase of History (1769-1869)

1. The Watt Steam Engine is the invention that triggered the “Age of Steam.”
2. Steam engines were used to create machines like the *Spinning Jenny* (for making thread) and the *power loom* (for weaving thread into cloth), which allowed much more clothing to be made.
3. A steam engine could also be paired with a paddle wheel to make it turn and propel a vessel up stream or across oceans, such as the SS Sirius which traveled across the Atlantic ocean in just 19 days in **1837**, compared to the Mayflower, which took 63 days.
4. Soon, steam engines were paired with very basic carriages, of the same kind that were pulled by horses, and soon steam “locomotives” were operating on “railroads.”
5. Progress in this area was slow. That’s why I call it the “proto-industrial” phase of history. In the *pre-industrial* era, there was almost *no* progress. In the *proto-industrial* period, there was progress—but it was slow compared to today’s rate of change.



A factory with steam powered looms could produce thousands of times more clothing than traditional “cottage” industry with the same amount of human labor.

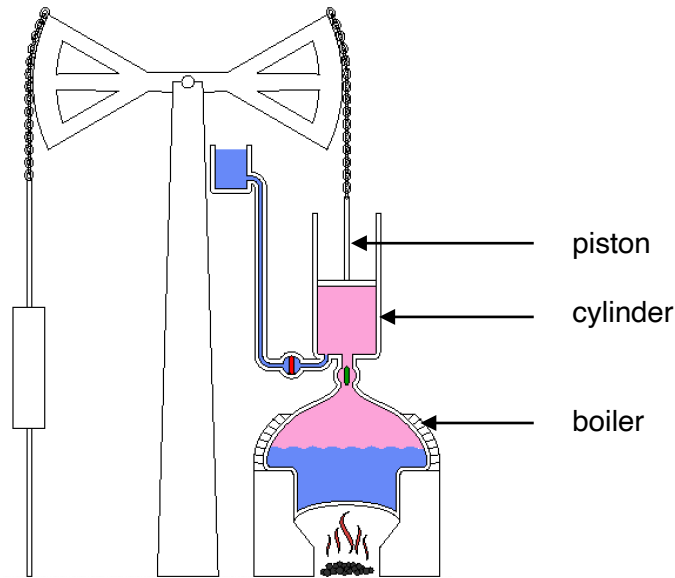


Early steam “locomotives” did lose the first races against horse-drawn carriages, but advancements in steam power soon proved the worth of the new technology.

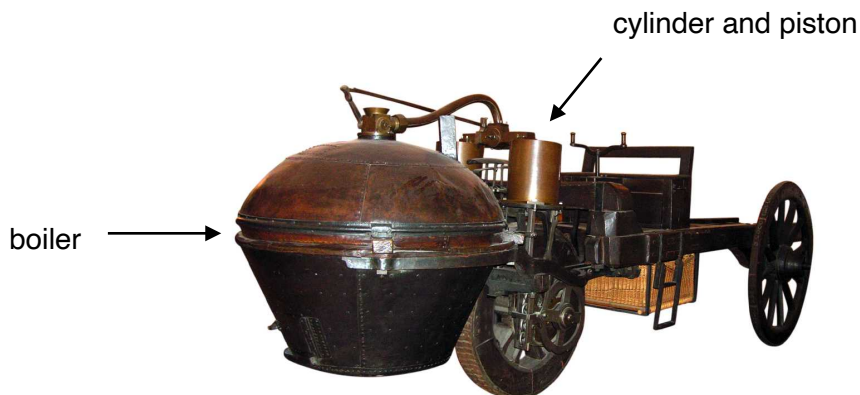
6. The Age of Steam or Proto-Industrial phase of history is almost exactly **one century**. That’s handy, especially when trying to remember the dates. **C. 1769**, the Watt Steam Engine was invented, and in **1869** the first *transcontinental* railroad was completed, linking California to the East Coast.
7. Just as steam technology was peaking, it was already becoming obsolete. In **1870**, the Standard Oil company of John D. Rockefeller was formed. This company would propel a whole new industry forward by making gasoline. Rockefeller became possibly the richest man in all of history. The “*Industrial Revolution*” was truly beginning.

F. The Second Power Revolution, Part 1: Oil

8. Steam engines could never have been used in cars and planes because they are too large and heavy. A steam engine gets its power from a vessel called a “boiler” in which water is boiled to create steam, usually by burning coal. The pressure created by that steam then enters the “engine”—a cylinder in which pressure changes move a piston, as in the diagram of a simple steam engine below.



2. Steam engines are sometimes called “external combustion engines,” because the burning of the fuel is done outside the engine itself, in the boiler. If a car had such an engine, it would look something like this:

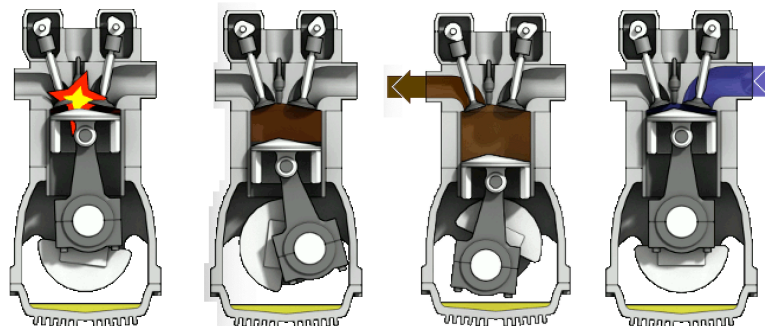


3. By contrast, “internal combustion engines” are much smaller and lighter.



The first Mercedes Benz - 1885!

4. They are called “internal combustion engines” because gasoline is burned inside the cylinder of the engine, which creates a lot of power!



Little explosions inside your family car 30-50 times per *second* are what let us move down the road so quickly!

5. Small and light engines were needed for the first airplane, flown by the Wright Brothers in **1903**, and then in automobiles like the Ford Model-T, which started being made in **1908**.
6. Meanwhile, another kind of power was also being invented!

## G. The Second Power Revolution, Part 2: Electricity

1. The ability to make electricity is what allows us to have lightbulbs, refrigerators and televisions, among so many other things!
2. Many of these inventions are based on the science of “electro-magnetism,” which has to do with electricity and magnets, and how they work together.
3. The first useful communication device based on electro-magnetism was the telegraph of **c.1837** by Samuel Morse, which used “Morse code” to send a electricity along a wire over great distances.
4. Later, electricity was used by amazing inventors, such as Alexander Graham Bell, who invented the telephone **c.1876** and Thomas Edison, who invented the light bulb **c.1879**.
5. Making electricity at power plants became possible **c.1882**—which provided enough to light the cities and homes of the world!
6. Who can even begin to calculate what new wonders were created because inventors could work through the night in well-lit laboratories and offices from that point onward?!



Alexander Graham Bell makes his first famous public telephone call in **1876** (left) and Thomas Edison shows off his lightbulb in **1879**.