

# **Technology, Society, and Culture**

**HUMN 432**

**Week 1**

**Landes—**

***The Invention of Invention***

## **5-Major Technological Inventions...over time:**

- 1. Water wheel**
- 2. Eyeglasses**
- 3. Mechanical clock**
- 4. Printing**
- 5. Gunpowder**



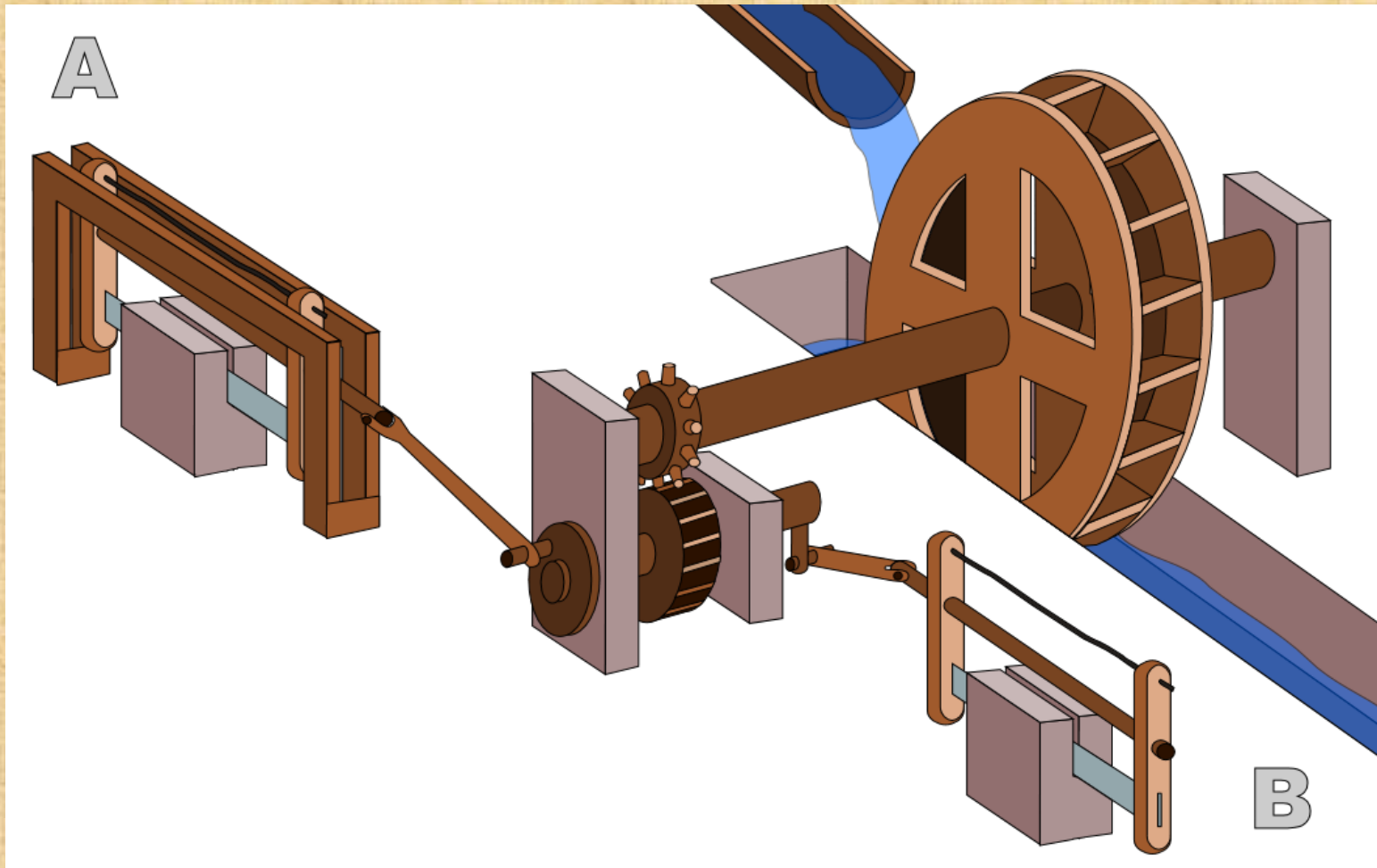
**1. Water wheel was first used by the Roman Empire.**

**Actually, the Greeks used a water wheel before the Romans.**

**This is the Vitruvius water wheel, which was invented in the 3<sup>rd</sup> century BC.**



The water wheel was *first* used by the Roman Empire, but it experienced a renaissance in the first millennium.





**Roman water wheel and aqueduct in Hama. Syria**



**The renaissance of the water wheel occurred  
in Europe around the 1<sup>st</sup> millennium.**

**By that time, Europe had thousands  
of water wheels.**

**In addition, the water wheels  
had improved due to technology,  
and its use enabled Europe to do  
nearly everything with it...  
not just supplying water.**

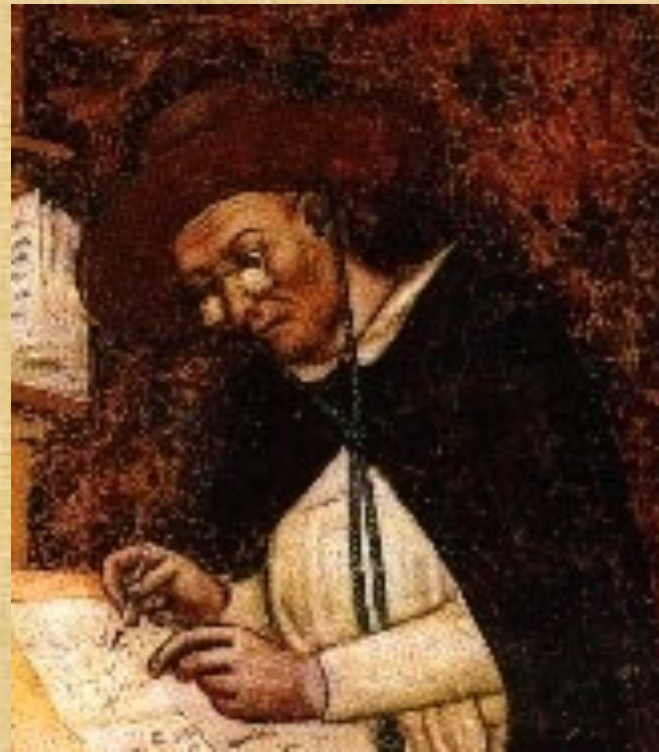
**Landes writes about paper  
being invented in China  
but manufacturing of paper started  
in Europe the 13<sup>th</sup> century  
thanks to the water wheel.**

**It took over a 1000 years of paper  
making by hand to become a product  
made by the water wheel.**



## **2. Eyeglasses resulted in doubling the work-life of skilled laborers and scholars.**

**They were common by the 13<sup>th</sup> century in Europe.**



**The human eye hardens as we age.  
By 40, most people suffer  
from presbyopia or farsightedness.**

**Some form of magnification was used  
in Egypt in the 5<sup>th</sup> century BC and Nero  
in the 1<sup>st</sup> century AD used an emerald  
while enjoying gladiatorial games.**

**Again, like the ancient water wheel,  
tweaking the magnifying ability of the old  
invention in Pisa ca. the 13<sup>th</sup> century.**

**In Florence, they were making both concave and convex lenses.**

**You could buy several sets of glasses at a time. Each pair merely increased the prescription every 2-5 years.**

**The user merely threw away the older pair and put on a new set.**





**The invention of glasses resulted in other inventions due in part to the glasses.**

**The astrolabe was one.**

**This one was made in Paris in 1400.**

**The invention also created a market  
for a host of measuring/calibrating  
tools and gauges.**

**3. The mechanical clock has replaced the older versions of telling time. Sun dials and water clocks were used when the weather permitted.**



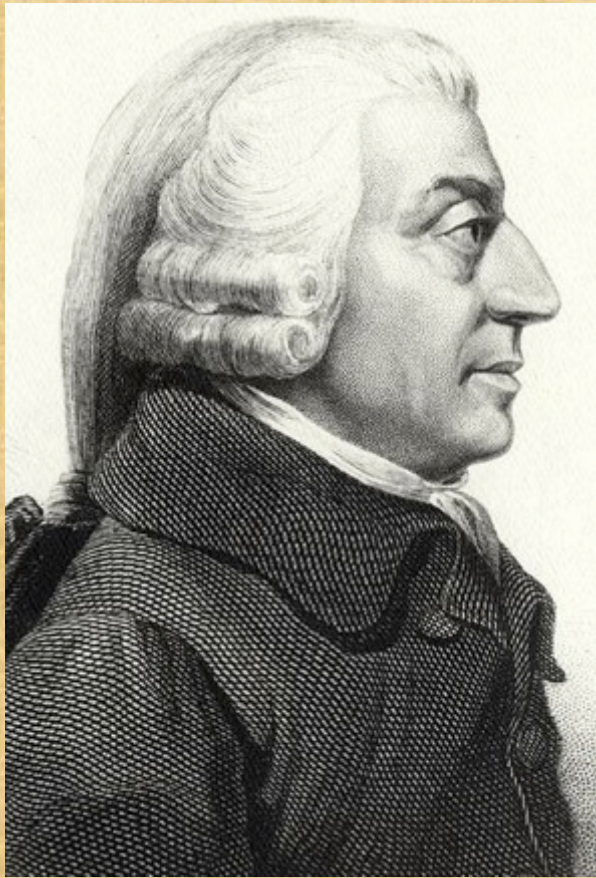


**Europeans had elaborate means  
of telling time from the church  
to commoners.**

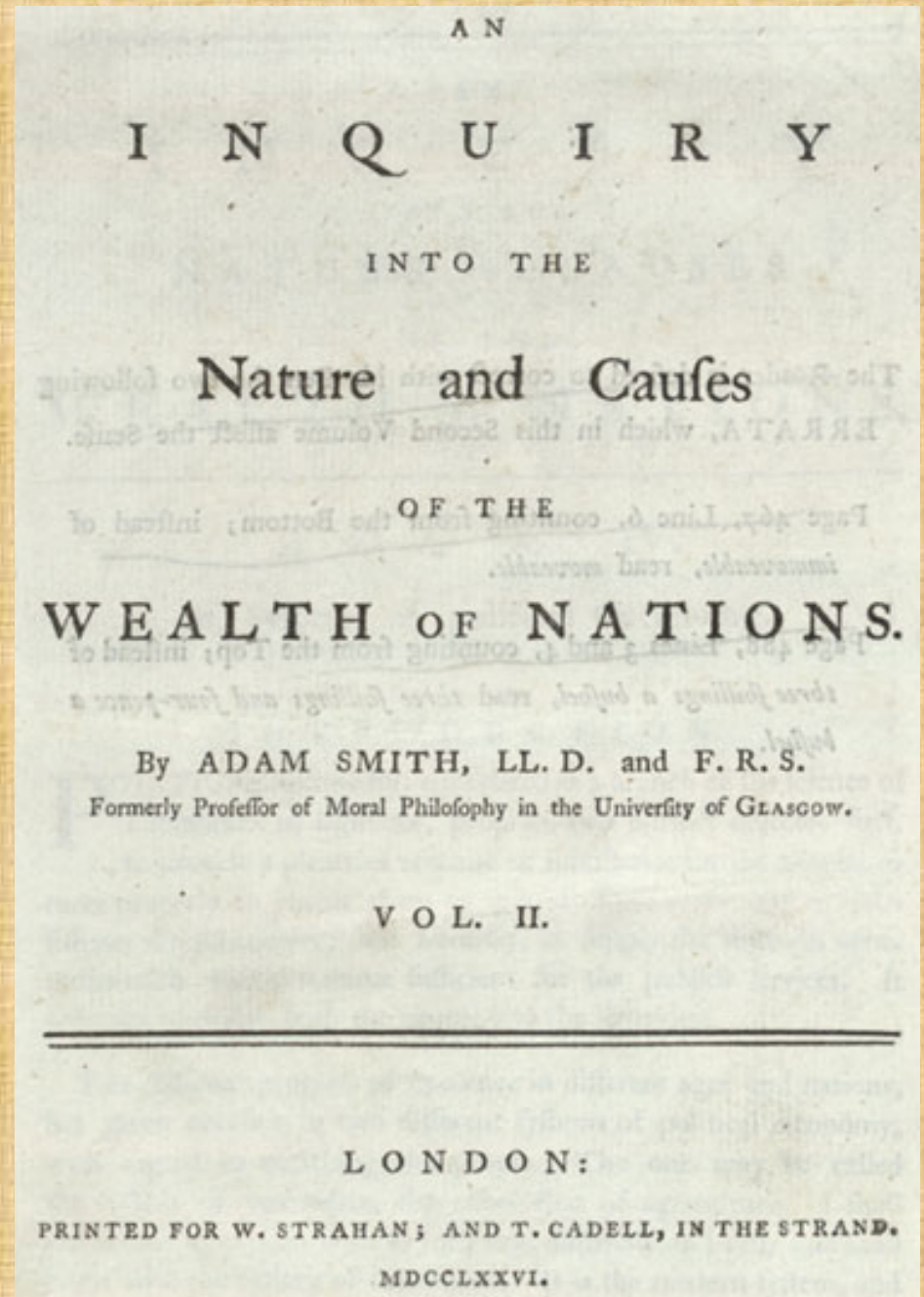
**However, once society divided  
the day into hours, it took the church  
another century to catch up.**

**Society became more organized,  
accurate, controlled the labor, etc.**

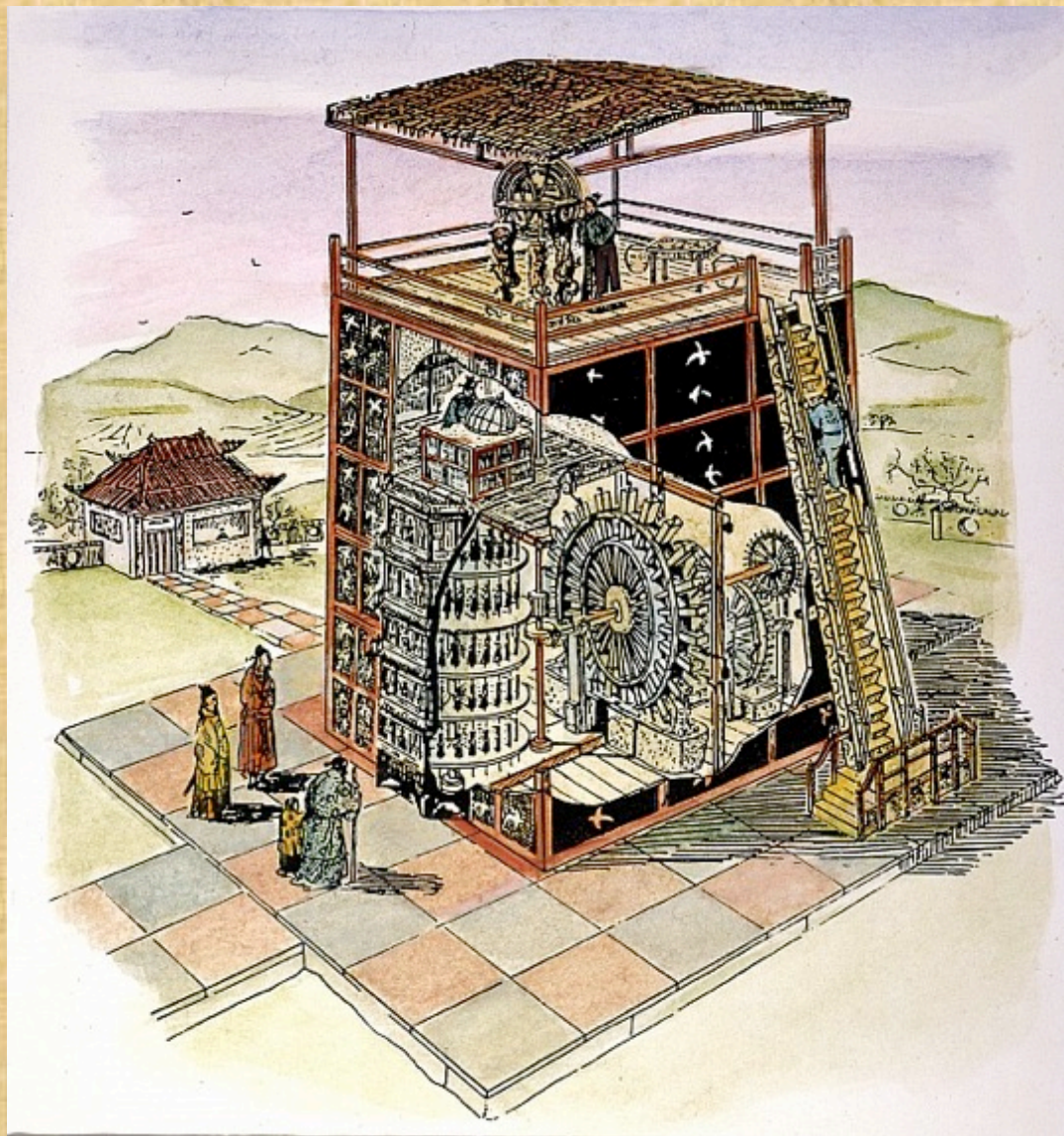
**Productivity, as a concept,  
was the result of the clock.**



**Years later, the clock was the instrument that made for the wealth of nations based upon productivity according to Adam Smith.**







**During the Tang and Sung dynasties (10<sup>th</sup> to 12<sup>th</sup> centuries), the Chinese created several astronomical water clocks.**

**While mechanically they functioned well, water pollution clogged the internal mechanism.**



**The Chinese not only polluted the water clocks, but they also *polluted* the numbering system with names instead of 1-12.**

<b>Earthly Branch</b>	<b>Mandarin name</b>
1	子
2	丑
3	寅
4	卯
5	辰
6	巳
7	午
8	未
9	申
10	酉
11	戌
12	亥

**The Muslims in the Middle East  
were interested in the clock so as  
to set the times of prayers.**

**Landes talks a great deal  
about the public sense of time,  
which the Chinese and the Arab  
world had really no concept.**



# 4. Printing along with paper had its origins in China in the 9<sup>th</sup> and 10<sup>th</sup> centuries.





**Again, the Chinese don't use  
an alphabet but use ideographs.**

**As a consequence, moveable type  
is greatly restricted.**

**Also, instead of a lot of words,  
they used large pictures...as in  
*a picture is worth 1000 words.***

**In addition, unless the word-pictures  
were used a great deal, people didn't  
remember many word-pictures.**

**That produces widespread  
illiteracy as a result.**

**The Italian and later  
the Northern Renaissance  
in Europe was helped  
by the printing press.**



**In Europe and in addition to the printing press, the rise of the common or vernacular removed Latin as the common language.**

**Gutenberg printed with moveable type the Bible starting in 1452 and finished in 1455.**

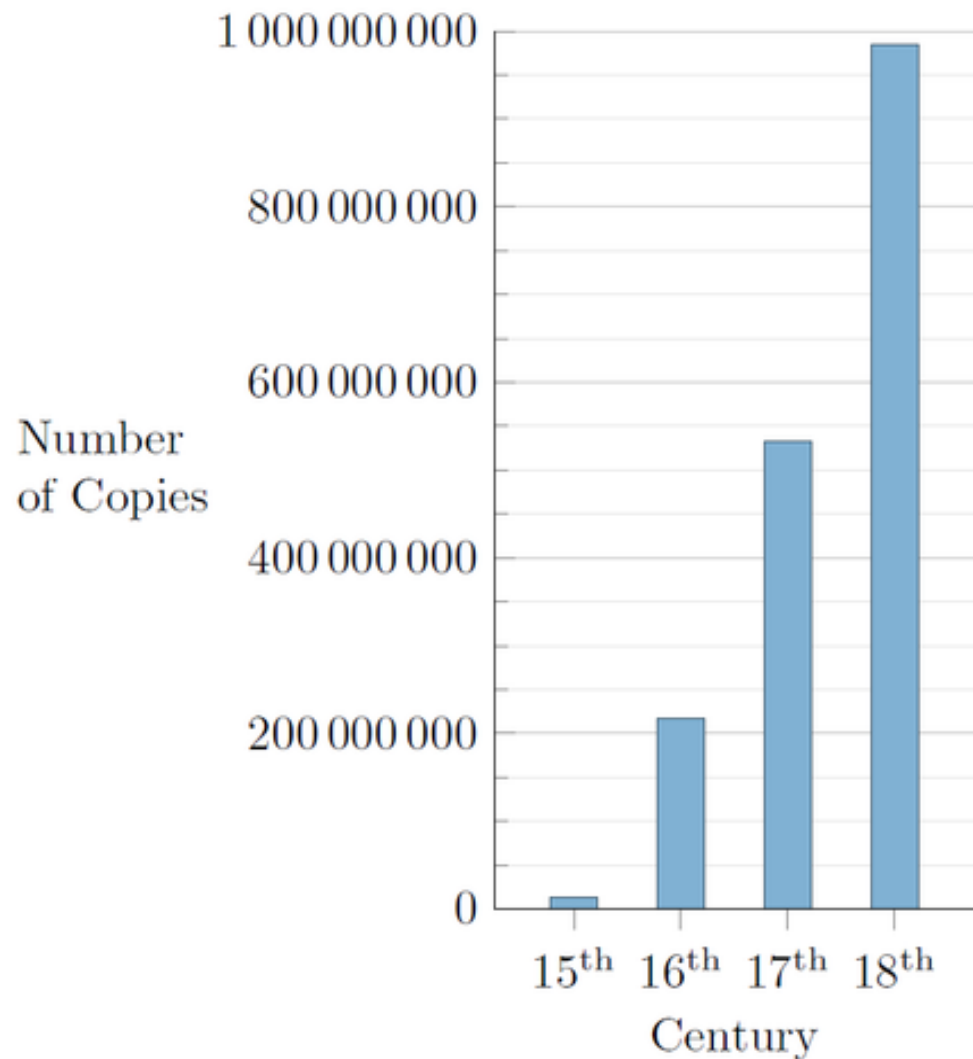


**Interestingly, Islam was against  
the Qur'an being printed.**

**The Catholic Church wasn't happy  
with the Bible getting translated  
into the vernacular either.**

**Landes points out that  
the vernacular Bible predated Luther  
and the Protestant Reformation.**

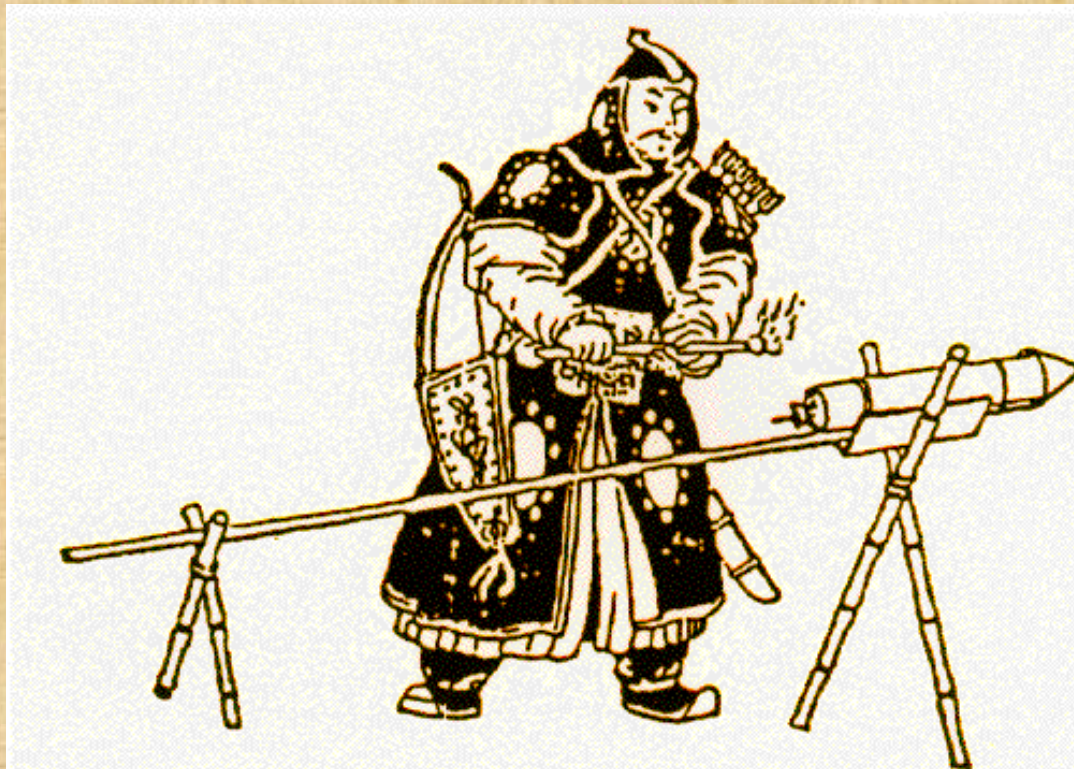
## European Output of Printed Books ca. 1450–1800\*



\*without Southeast Europe (Ottoman realm) and Russia

**5. Gunpowder was another invention from China but essentially went nowhere.**

**They used it as much for entertainment as for combat.**





**The Chinese went from lances to rockets,  
but the design was more for causing fires  
than for actual killing people.**

**During the Tang Dynasty (ca. 1000),  
they used these rockets in wars  
and called them “flying fire.”**

**During the Ming Dynasty (14<sup>th</sup>-17<sup>th</sup> centuries),  
the Chinese used the “flying fire crow.”**



**The Chinese used fine-grain gun powder,  
but the Europeans by the 16<sup>th</sup> century  
had mastered the process of *corning*  
the powder into small granules  
or chunks the compressed powder.**



**Landes concludes his article with something with which I absolutely agree. Problems, pains, defeats, etc. are great learning tools... if we spend time addressing the problem.**

**Europe after the fall of the Roman Empire entered the Dark Ages. The lights of learning, knowledge, and culture went out throughout all of Europe.**

**During this time, Islam was dominant. From 750-1100, they were light-years ahead of anything in Europe when it came to science, technology, and learning.**



**The one big ethical mistake that Europe made was starting its Jihad called the First Crusade against what they called the infidels.**

**There is not a single thing that the Crusades did from the 11<sup>th</sup> to the 13<sup>th</sup> century that was positive.**





**They won the First Crusade for a brief time but then lost every attempt to free the Holy Lands, which were not theirs anyway. However, while pillaging cities, what single thing did they discover and bring to Europe?**



**The European's Greco-Roman culture  
was lost during the Dark Ages.**

**Who we are today in the West  
is based upon the Greeks and  
to a lesser extent on the Romans.  
However, that Greco-Roman mindset,  
thinking process, ideas, values, etc.  
had been lost to Europe  
but the Middle East still had it.**

**The Crusades resulted in the rebirth of the West,  
which we call the Renaissance,  
which means in French, *rinascere*  
or “to be reborn” as in the Greco-Roman  
*Weltanschauung* being reborn.**

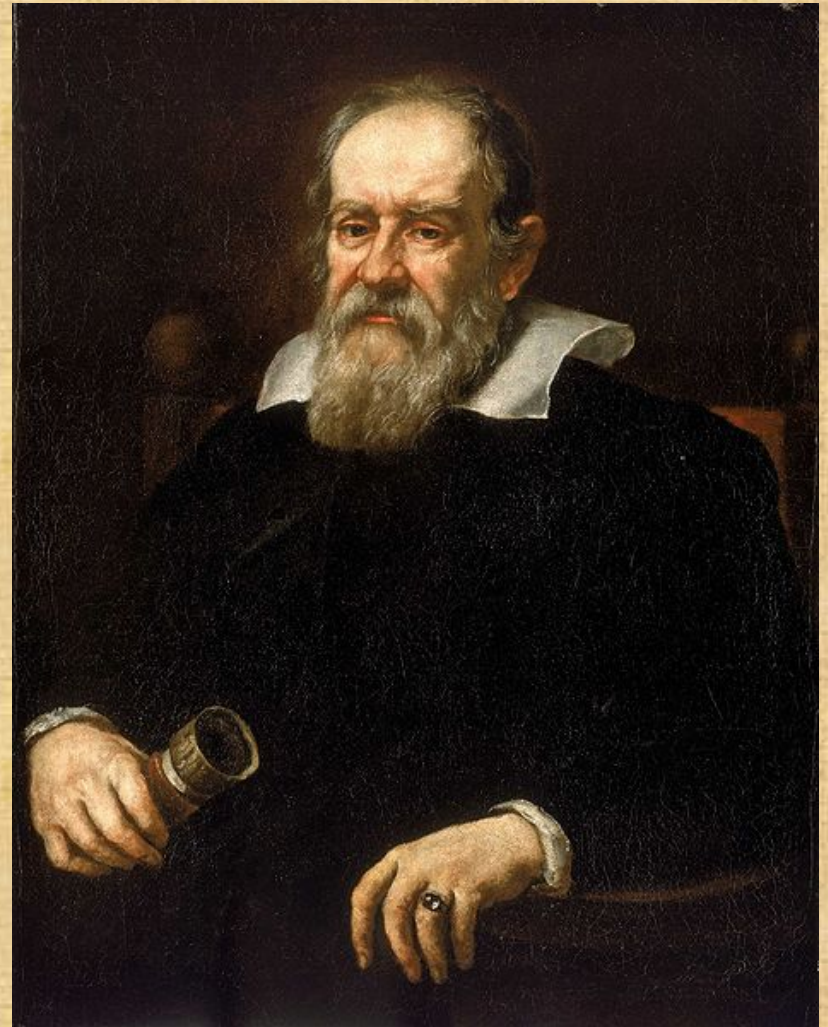
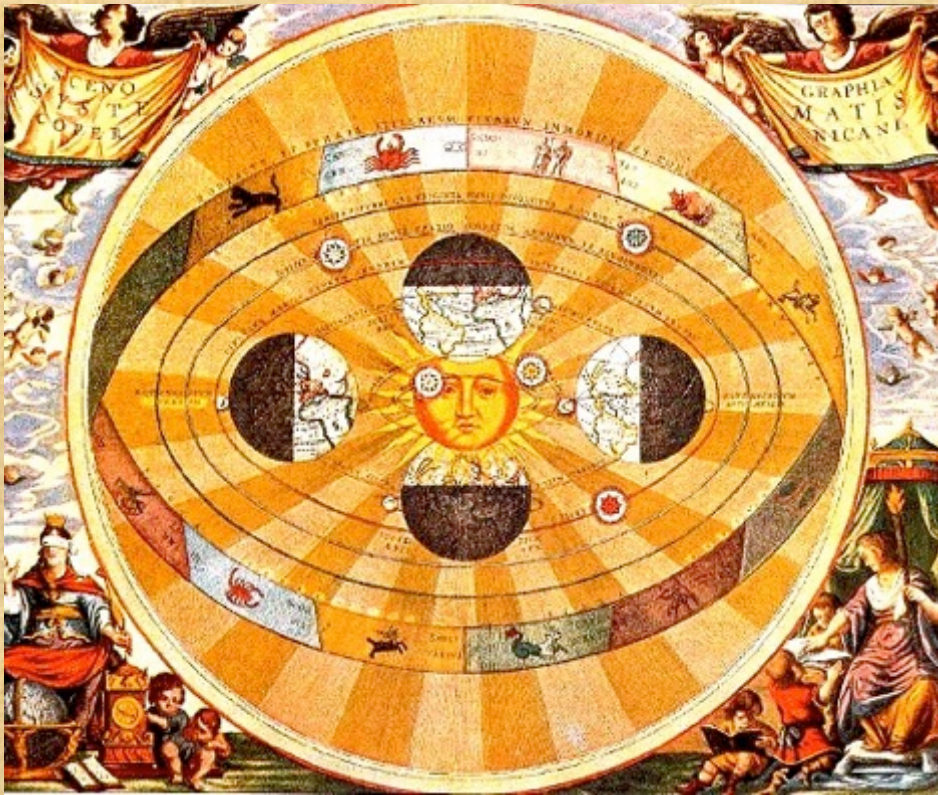
**Then a catch-22 occurred within Islam.  
While they developed good science and inventions,  
they were also running counter to the Qur'an.  
For the conservative Muslim, truth has  
already been revealed.**

**Landes wrote, “What led *back* to the truth was useful  
and permissible; all the rest was error and deceit.”**

**Now, the Christian church did the same thing.**

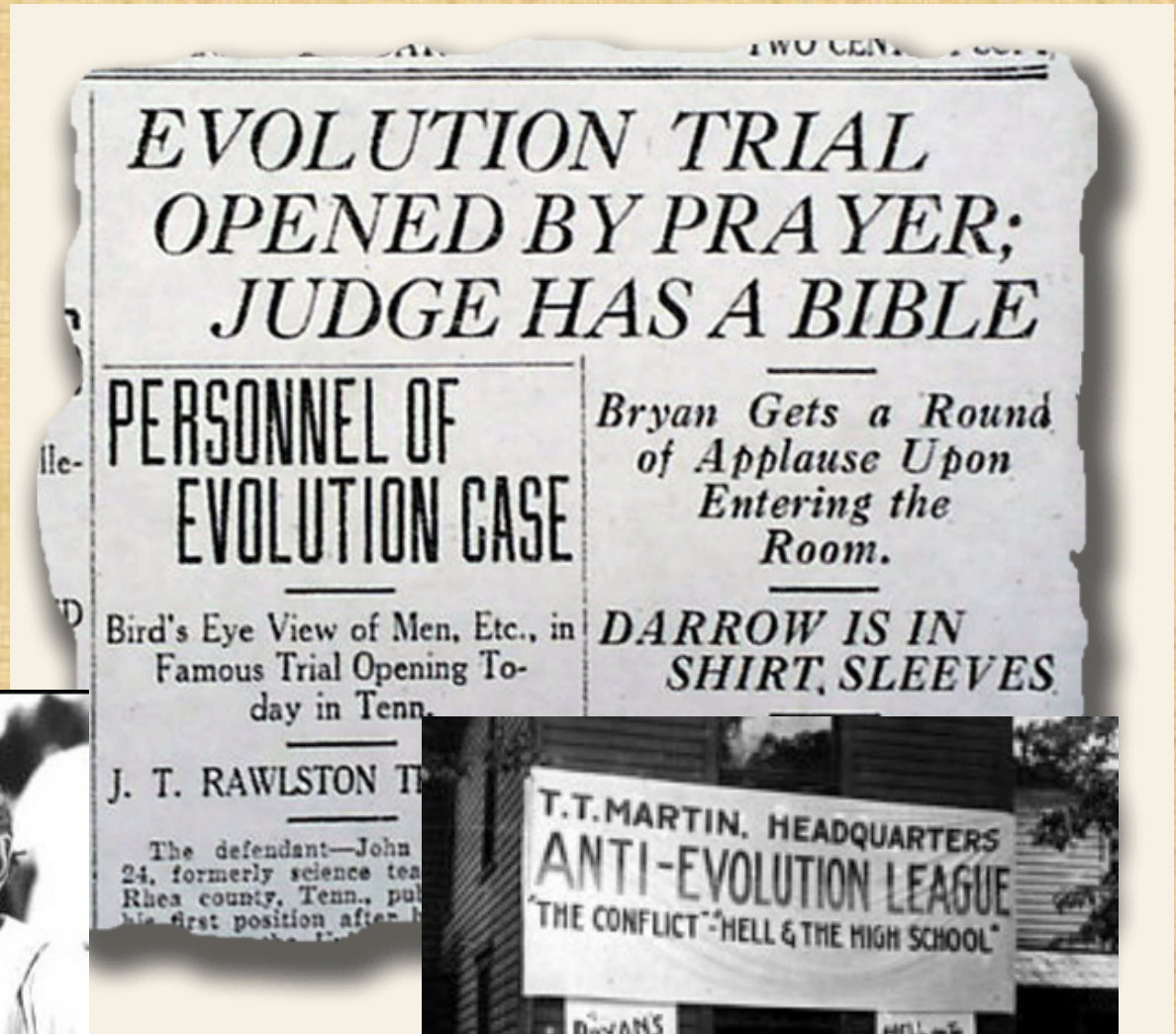


**There was Galileo's silly notion  
of the heliocentric universe.**





Then there was  
the Scopes  
Monkey Trial.



**Science from 750-1100  
was primarily Muslim...  
but even during and after  
their golden age of science,  
it did not help the Muslim  
technology or society—  
and essentially still does not.**



**What did not happen in the Muslim Middle East  
also did not happen in China.**

**Landes writes, “One generally assumes that  
knowledge and know-how are cumulative....”**

**That assumption was not true  
in both the Middle East and China.**

**Why?**

**In China, especially during the Ming dynasty  
in 14<sup>th</sup>-17<sup>th</sup> centuries, outside trade  
with the rest of the world was stopped.**

**This prohibition of overseas trade resulted  
in creating smuggling and trading behind  
the government's back.**

**The result was massive dysfunction of government.**

**Sexism was also a reason. If one keeps women in the homes, they are not able to get out and produce within the economy.**

**This effectively reduces the available workforce in half.**



**Still another reason was that  
the government's totalitarianism  
essentially controlled thinking  
and action due to customs and laws.**

**In Europe, the free enterprise system and competition was widespread.**

**Europe began moving away from the control of the church... even before the Protestant Reformation.**

**China did not allow overseas travel or trade. Ironically, the church sowed the seeds of independence of the masses by calling for the Crusades, which meant overseas travel.**

**The Crusades caused the Renaissance.**

**Europe possess the “cultivation of invention”  
or *joie de trouver* = to find joy.**

**Landes suggests several reasons why Europe  
possess the drive of invention to invent.**

- 1. Judeo-Christian work ethic**
- 2. Supremacy of humans over animism**
- 3. Linear time over cyclical time**
- 4. Human pride is the driver**

**This is seen in hubris, playing God,  
not knowing our limitations.**





**Week 1**

**Cowan—**

***Industrial Society and  
Technological Systems***

**The birth of the Industrial Revolution occurred  
in America *during* and after the Civil War.**

**From the founding until the Civil War,  
America was an agrarian nation and society.**



# **This is a breakdown of the % of US farmers of the population.**

<http://inventors.about.com/library/inventors/blfarm4.htm>

**1776 – 90%**

**1860 – 58%**

**1870 – 53%**

**1920 – 27%**

**1960 – 8.3%**

**1970 – 4.6%**

**1990 – 2.6%**

**Cowan wrote, “...in the process of industrialization individuals become more dependent on one another because they are linked together in large, complex networks that are...both physical and social: technological systems.”**

# **Industrialization, Dependency, and Technological Systems**

**From 1870 to the present, we have become more and more industrialized and at the same moment more and more dependent.**



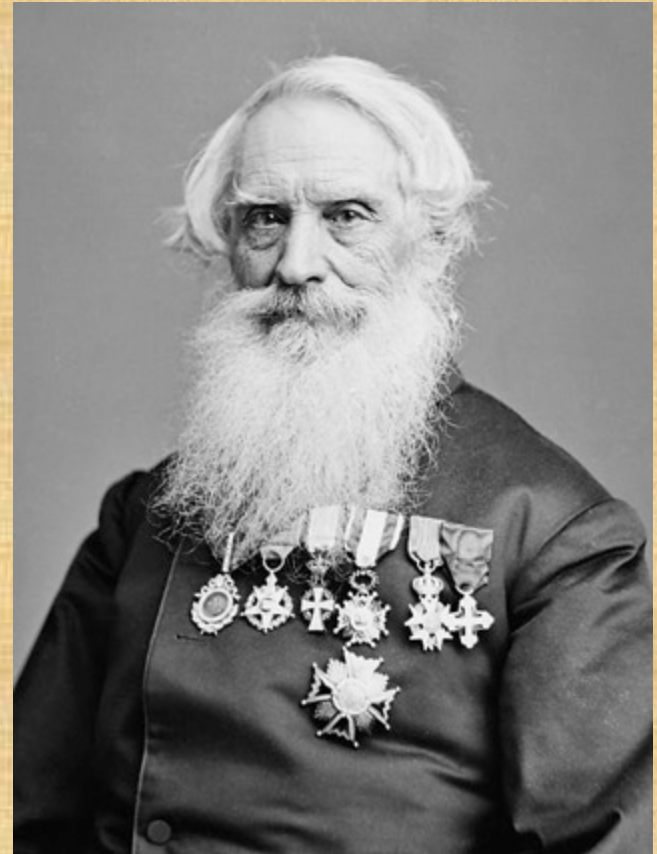
**A hunter-gather picks up the food.**

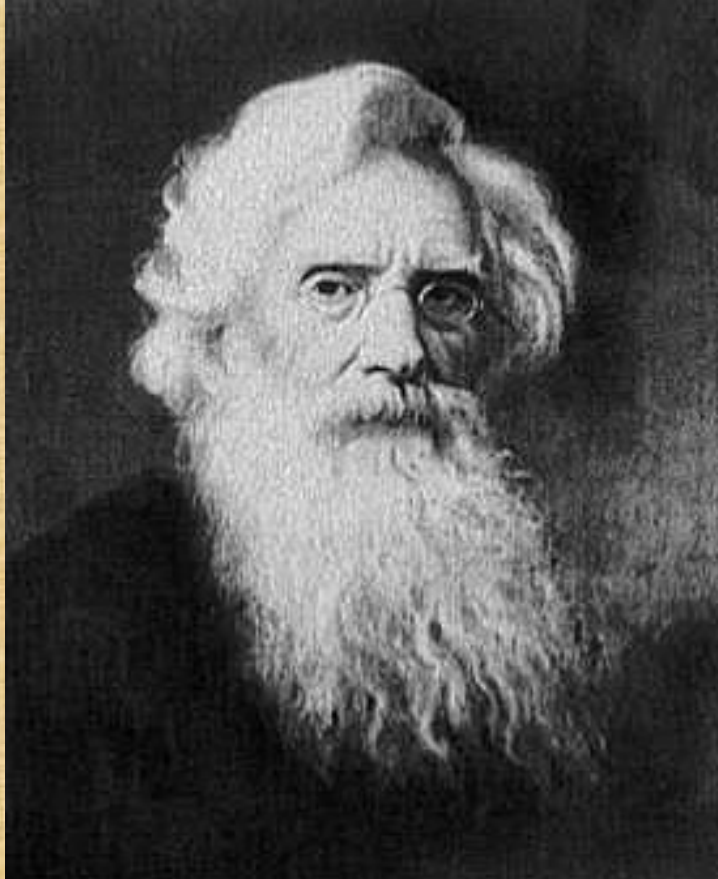
**Premodern (Native Americans prior to Europeans) would work together to grow corn, potatoes, etc. and process the food by drying, cooking, and storing it, which was a group endeavor.**

**However, in our society, to get almost everything, like food, cars, clothing, computers, etc. there are tens of thousands of people upon which we depend.**

# The Telegraph System

**Once we developed means of transmitting electricity from place to place and storage batteries, Samuel Morse used electricity to send dots and dashes.**



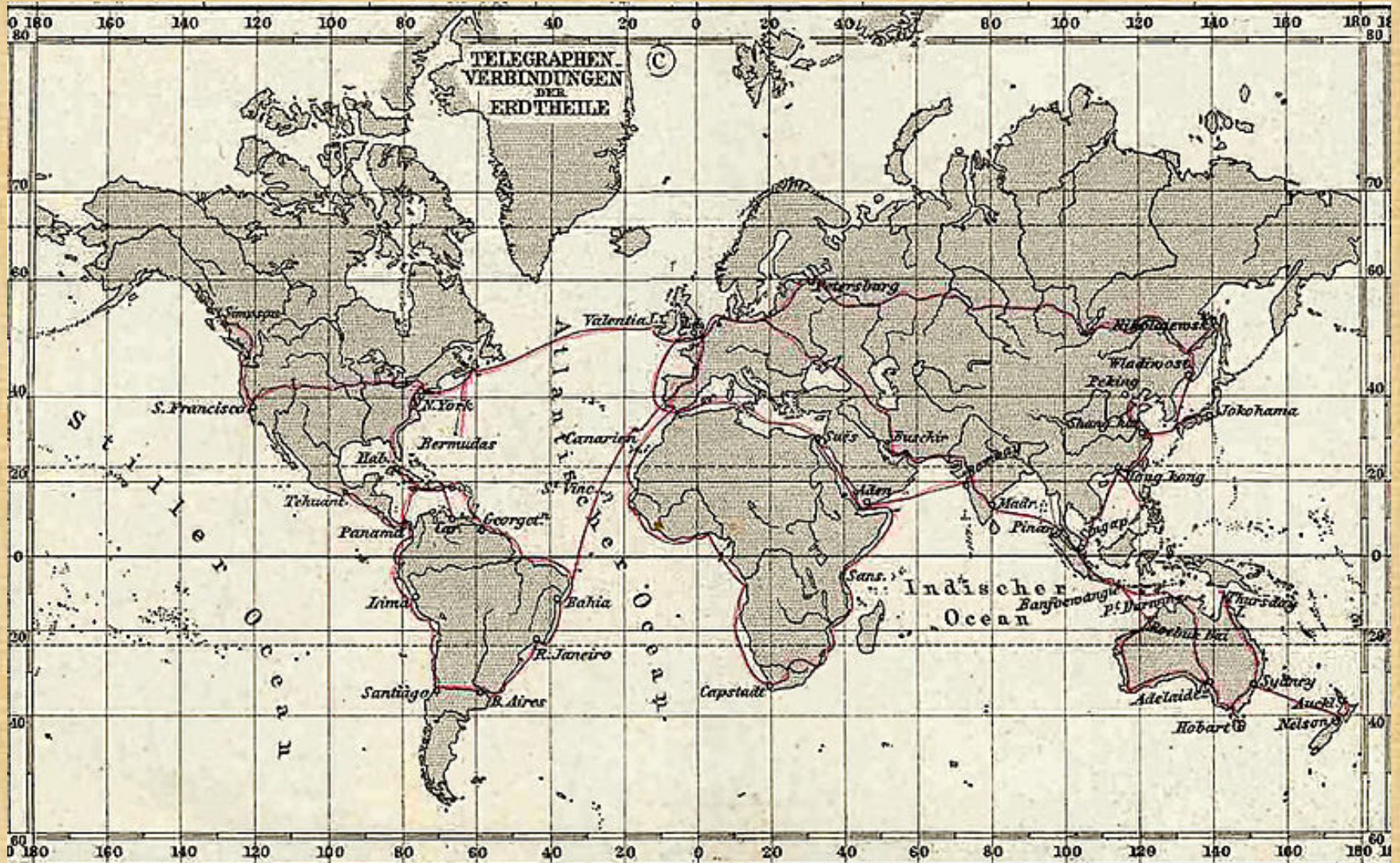


**On May 24, 1844, Morse sent  
his first message  
from Washington to Baltimore.  
He transmitted,  
“What hath God wrought?”**

[http://www.history.com/topics/telegraph/  
videos#the-telegraph-and-telephone](http://www.history.com/topics/telegraph/videos#the-telegraph-and-telephone)



This is the network in 1891 for telegraph lines.



The logo for Western Union, featuring the words "WESTERN" and "UNION" in a bold, yellow, sans-serif font, stacked vertically. To the right of the text is a vertical bar, and a registered trademark symbol (®) is positioned to the upper right of the bar.

**WESTERN  
UNION** | |<sup>®</sup>

**By 1866, Western Union Telegraph  
had been formed by acquisitions and mergers.**



## CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable sign above or preceding the address.

# WESTERN UNION

NEWCOMB CARLTON, PRESIDENT

J. C. WELLEVER, FIRST VICE PRESIDENT

## SIGNS

DL = Day Letter  
 NM = Night Message  
 NL = Night Letter  
 LCO = Deferred Cable  
 NLT = Cable Night Letter  
 WLT = Week-End Letter

The filing time as shown in the date line on full-rate telegrams and day letters, and the time of receipt at destination as shown on all messages, is STANDARD TIME.

## Received at

34BV A 10

JACKSON MISS 547P OCT 10 1930

CLAYTON MAYNOR

CAPTAIN MILLSAPS FOOTBALL TEAM A &amp; M COLLEGE

CONGRATULATIONS WE ARE PROUD OF OUR TEAM PARADED CAPITAL

R&amp;H RIDGEWAY SEC

720

*Received in Starkville after  
 1913 win over Miss A & M*

THE QUICKEST, SUREST AND SAFEST WAY TO SEND MONEY IS BY TELEGRAPH OR CABLE





**From 1860-1880, the telegraph had changed the *network* of information gathering and distribution.**

**It was used in the Mexican-American War in 1847 to get news and information.**

**During the Civil War, it was used by the military for planning and the entire war effort.**

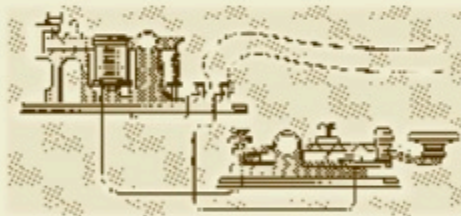
**In fact, Lincoln used the telegraph to communicate with his generals.**



# MR. LINCOLN'S HIGH-TECH WAR

• THOMAS B. ALLEN & ROGER MACBRIDE ALLEN •

HOW THE NORTH USED



THE TELEGRAPH,  
RAILROADS,



SURVEILLANCE



BALLOONS,



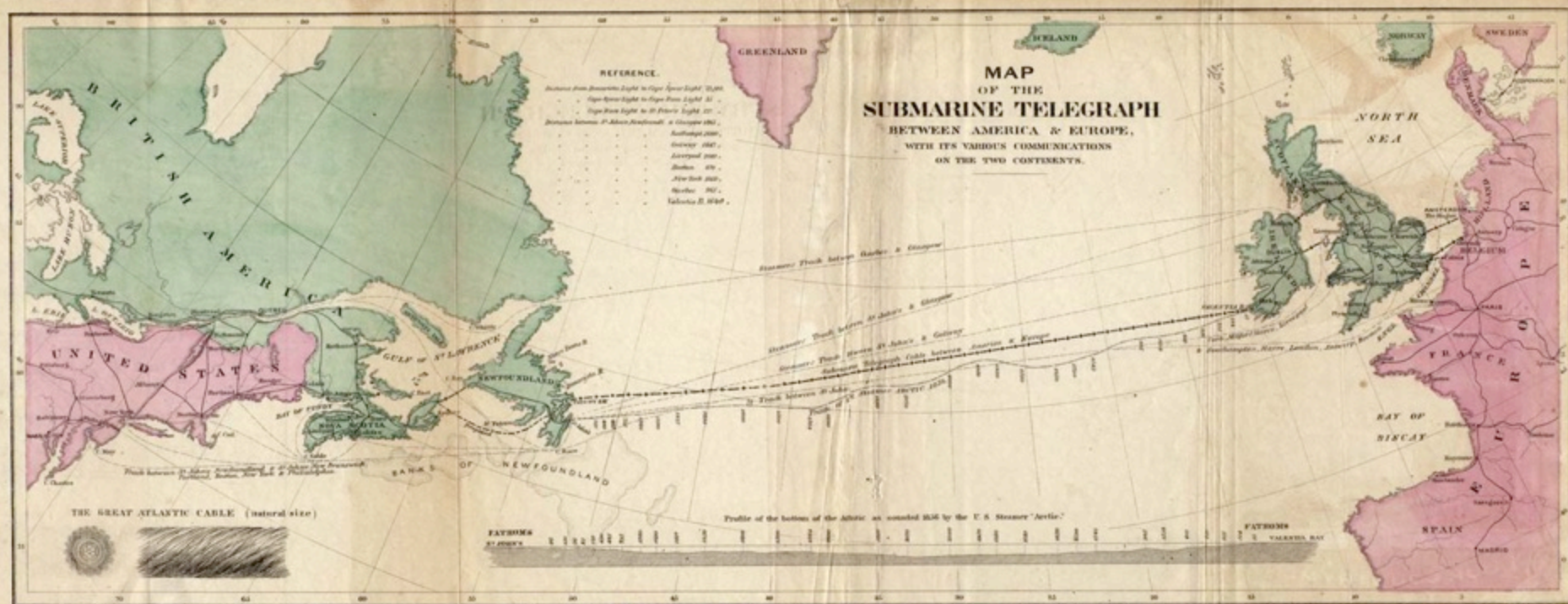
IRON-  
CLADS,

HIGH-POWERED  
WEAPONS,

• AND MORE TO WIN THE CIVIL WAR •

**The Gilded Age from 1880-1900 used the telegraph for making money, buying and selling stocks, etc.**





Printed for HOWE'S ADVENTURES & ACHIEVEMENTS OF AMERICANS.

The Atlantic cable in 1866 allowed for instant international communication along with trade and commerce.

**By the mid-19<sup>th</sup> century, the States and Western Europe were tied to a vast network that allowed for their economies to function.**

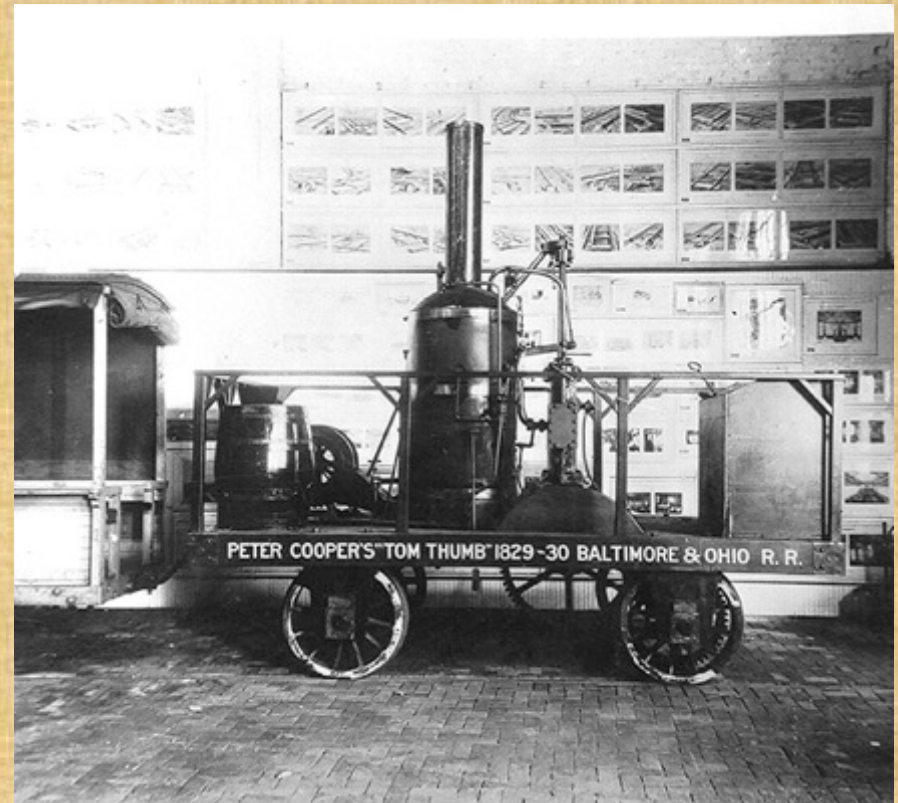
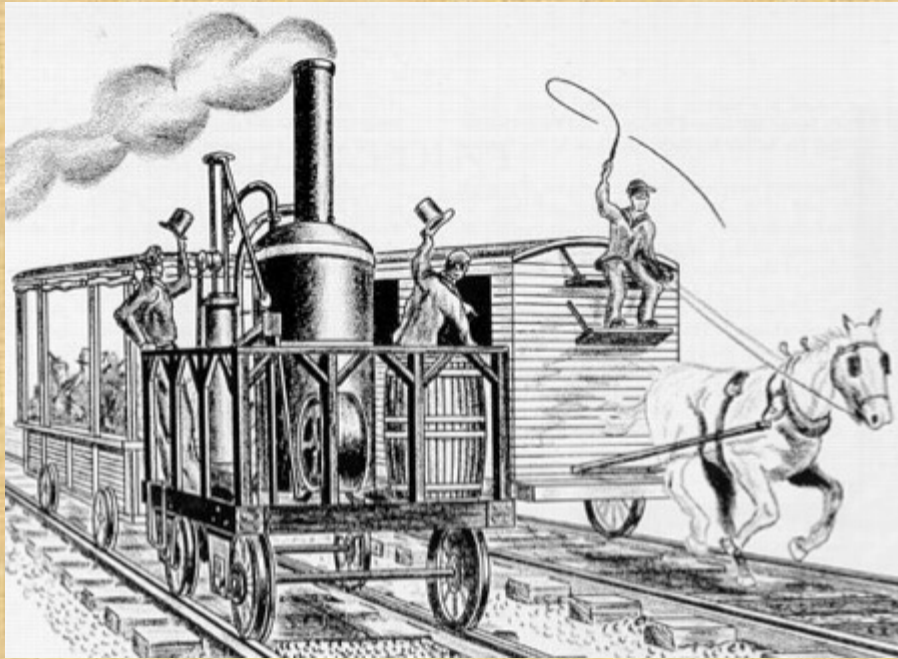
**Turn off the telegraph, those two societies would have ground to a halt.**



# The Railroad System

Railroads were another networking system within America by 1830s.

<http://www.youtube.com/watch?v=LMOEKcGggLg>  
[http://cpr.org/Museum/RR\\_Development.html](http://cpr.org/Museum/RR_Development.html)





**Prior to the Civil War, the network was not fully networked together. The major issue was the varying size of gauge or width of the rails.**

**The delays and changing of cars for long connections slowed down interstate commerce.**



**By 1869, the Union Pacific Railroad  
had *networked* the East and West coast.**

**By 1920, America had over ¼ million miles of track.  
What was once a north—south network  
became an east—west network. Today's track network.**

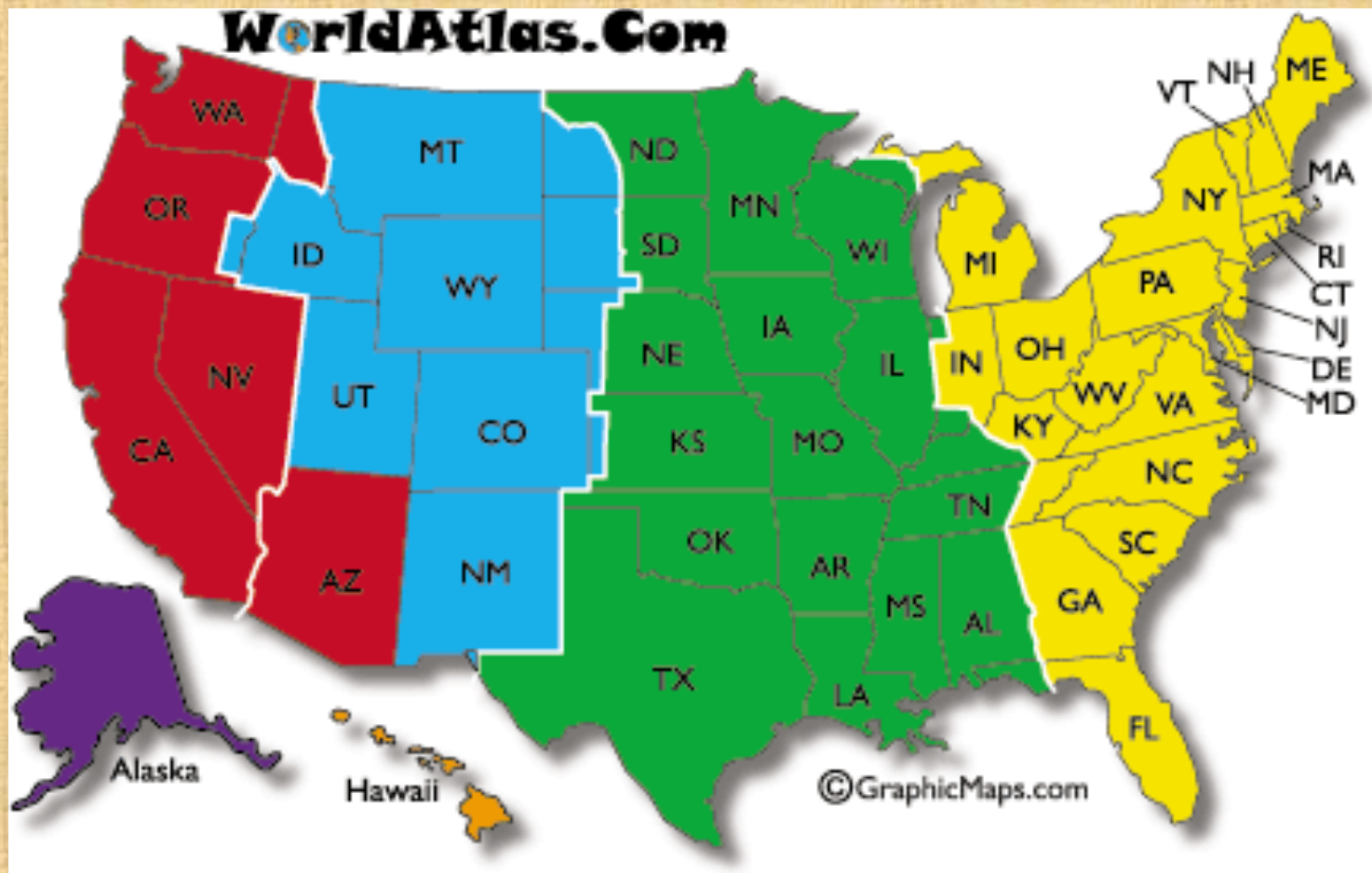




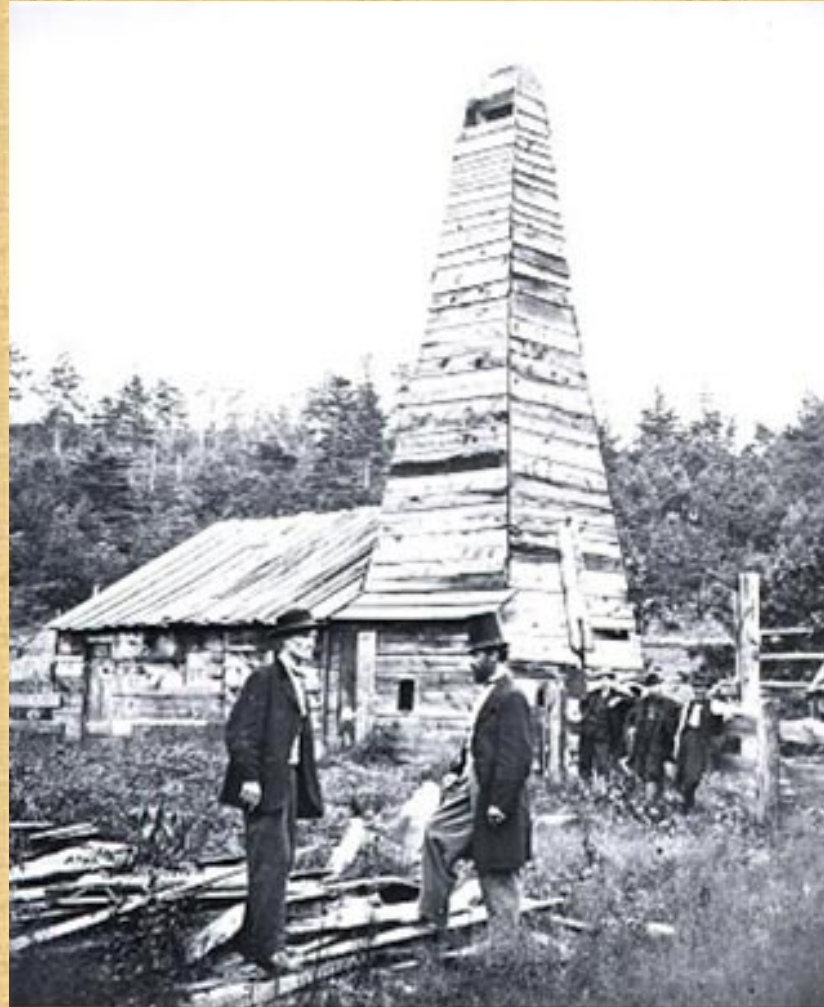
**With the consolidation of the railroads came the standardization of the gauge at 4 ft. 8½ in.**

**In addition, nearly every town was connected (or networked together).**

**Along with the network of connections  
were the printed schedules  
and the development of time zones.**



# The Petroleum System



**Titusville, PA was the first commercial oil well in the world was discovered while looking for water.**



**The Drake Well in Titusville in 1859 predates the first oil well in the Persian Gulf drilled in Bahrain in 1932 by nearly  $\frac{3}{4}$  of a century.**

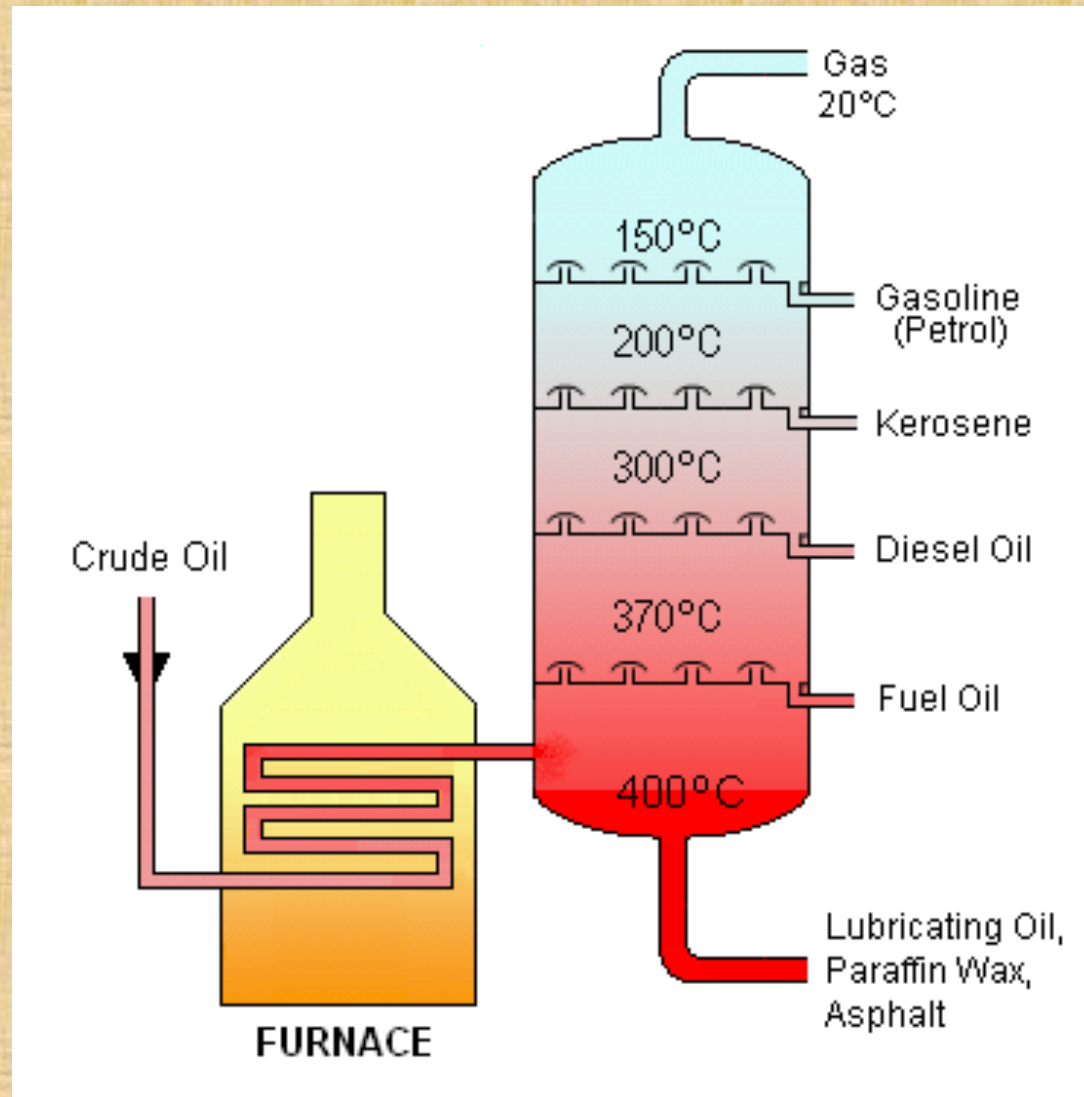
**The oil rush in many ways paralleled the gold rush in size of interest and need, which was dealt with whale oil and regular candles.**



**It was not long before those drilling for oil  
could distill the oil for various uses.**



**This is a bit more modern example  
of oil distillation.**



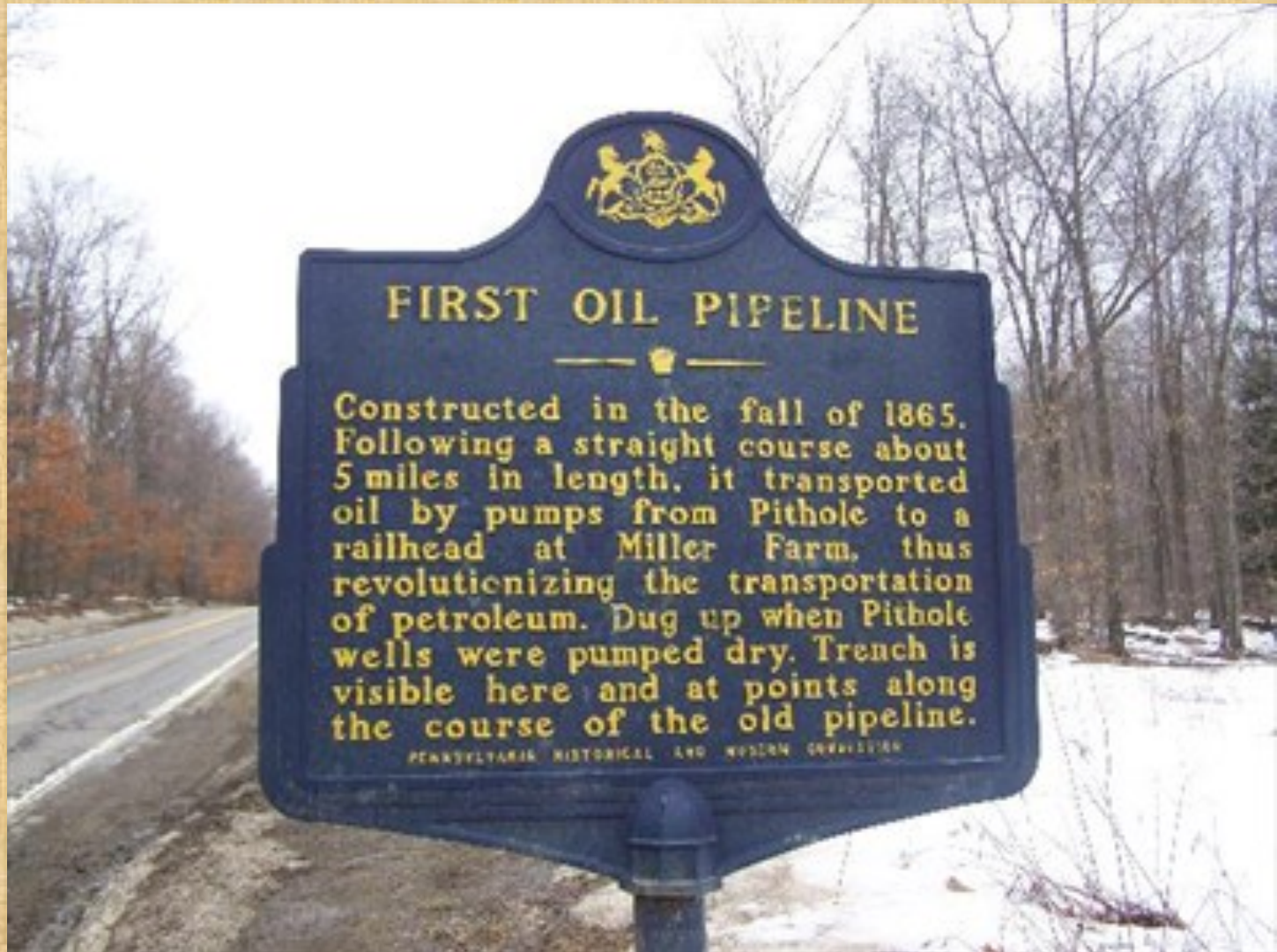


**The oil discovery helped the North during the Civil War.**

**The oil processing had risen to 3 million barrels of oil annually by 1862.**

**The problem of moving oil from the well to the refineries and on to the consumer was a major problem. Rail, barges, and horse drawn wagons were used.**

# Oil pipelines helped resolve the problem starting in 1865.



**The development of the oil industry  
along with its related problems  
brought many financial planners  
and entrepreneurs into the picture.**

**John D. Rockefeller started with buying  
an oil refinery and continued to expand  
into a near monopoly including  
buying up oil fields and pipelines.**

**By around 1880, Rockefeller  
owned/controlled 90%  
of the oil in the States.**



# Rockefeller controlled oil via Standard Oil of...(name a state).







Roc  
H  
levi

than.  
the  
890.

**Rockefeller fought back,  
but he was not successful.**

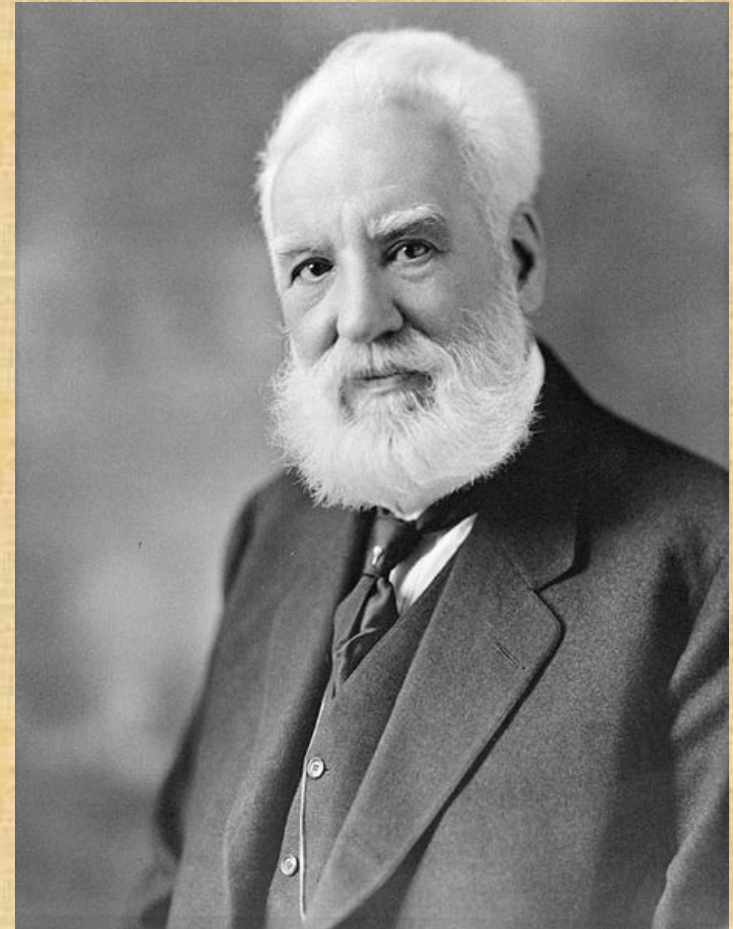
**The expansion of oil fields  
and the pipeline was too much  
for Standard Oil.**



# The Telephone System

**Alexander Graham Bell  
invented the telephone in 1876.  
He also knew that inventors  
were not necessarily good  
at business. He dreamt and  
others managed his company.**

**As a consequence, Bell  
Telephone could control services  
at one location. From 1877—  
1897, they controlled every  
telephone in the nation.**



**Bell Telephone used the telegraph as a model for expansion and use...for businesses.**

**When the patents expired, by 1902, there were nearly 9,000 other what were called independent telephone companies competing with Bell.**

**However, Bell's use of the telegraph model did not think that the ordinary person wanted to communicate among themselves.**

**The cell phone industry learned from that mistake.**

**The independent companies broadened what Bell did not think important. Dial phones replaced telephone operators, party lines, and smaller service venues (farming areas in particular).**

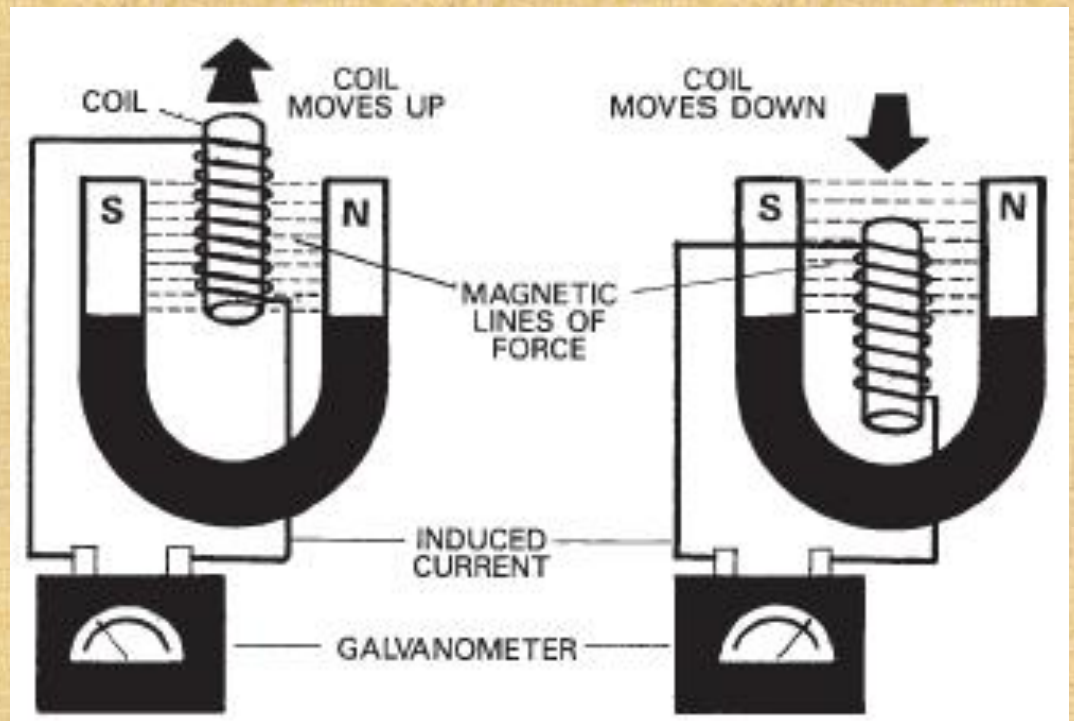
**With more competition, the phone rates went down. Cowan illustrated this with showing the cost of New York charges dropping from \$150 for 1,000 calls in 1880 to \$51 in 1915.**



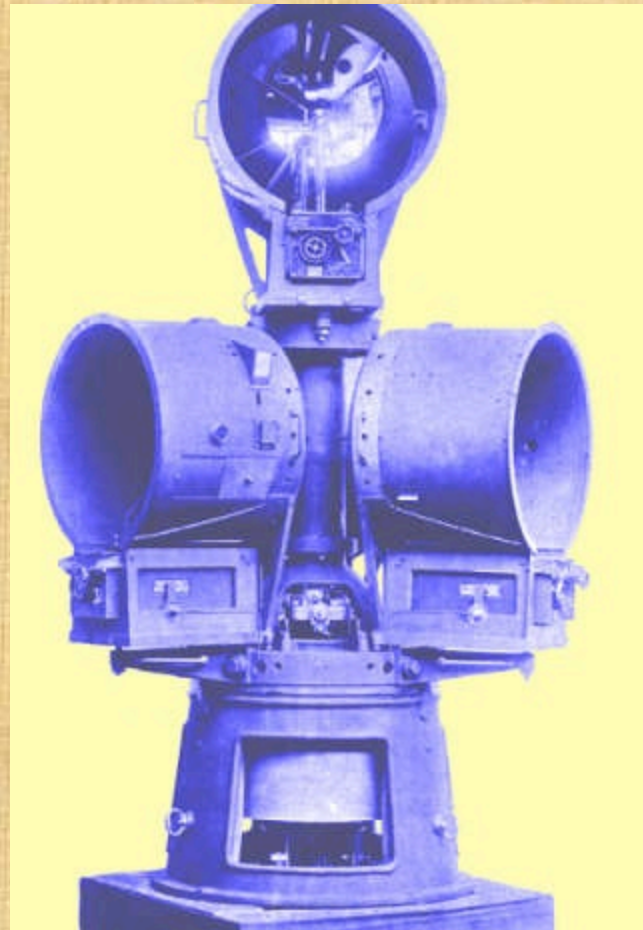
# The Electric System



**Michael Faraday invented the electromagnetic generator.**

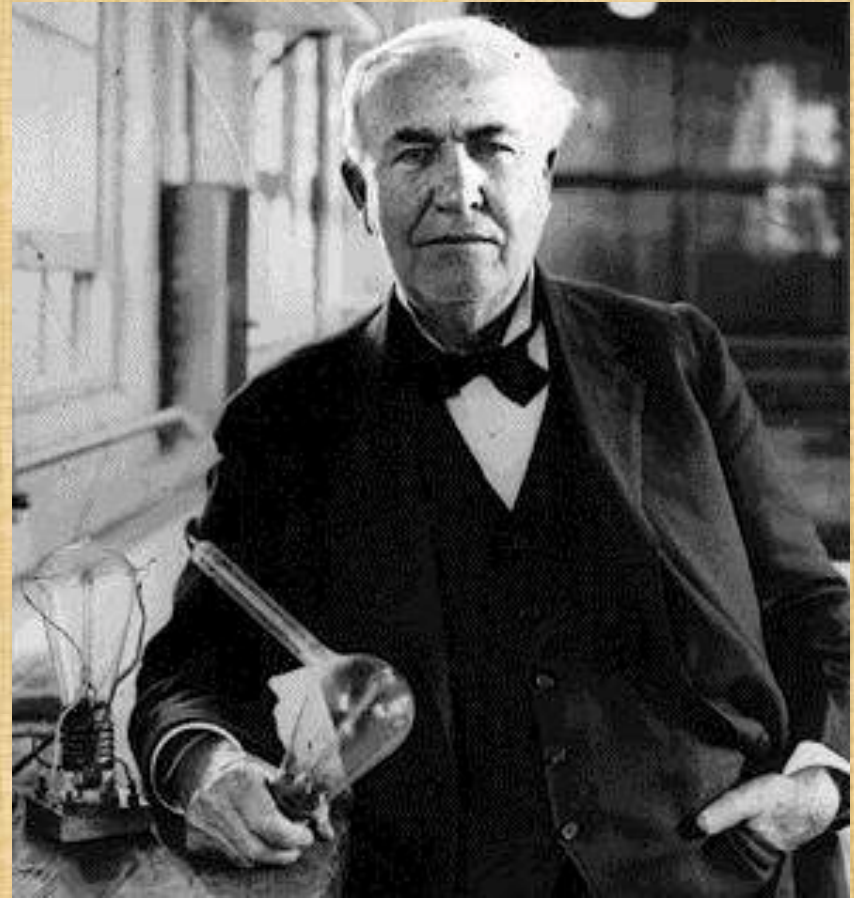


**The generating of a continuous flow of electricity allowed for its use in lighting via the arc lamp... hence it was used safely in lighthouses in England and France.**



**To avoid starting fires  
with the arc lamp, many  
inventors went on a search  
to find a filament and avoid the  
problems with the arc lamp.**

**Thomas Edison won the race.**





## **Something not to forget....**

**“The only man who never makes a mistake is the man who never does anything.”**

**Teddy Roosevelt said this about Edison spending \$100,000 find a workable light filament. Edison failed over 6000 times. Only three of the over 6000 worked well. The process of learning from mistakes is critical...if you plan on learning anything.**

**Henry Ford said that failures or mistakes were an “opportunity to begin again, more intelligently.”**

**Edison created not only the light bulb but the system that distributed the electricity needed for the bulb.**

**Cowan notes that in 1882 there was only one generating plant in the States.**

**By 1902...2,250 plants and by 1920...about 4,000.**

**Edison's various companies formed the General Electric Company.**



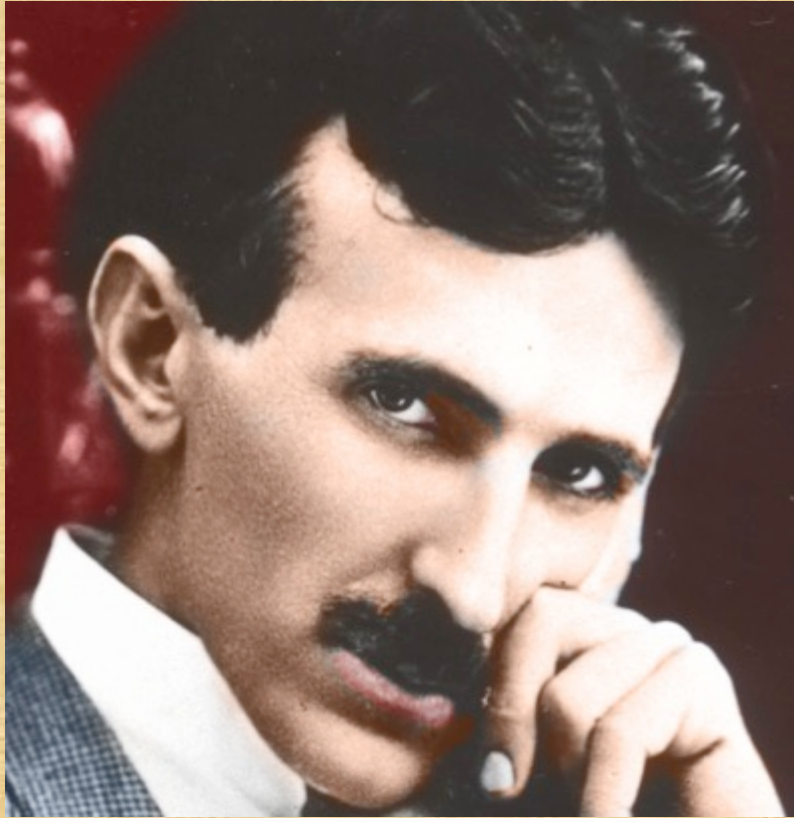
**The transition from making generators to making motors was not difficult.**

**In 1888, Frank Sprague invented the electric motor that could be used in trolleys... after several failed attempts. This was done by using overhead electric cables for the trolleys.**





**In slightly more than a dozen years  
after the Richmond trolleys were working,  
the country had acquired nearly  
23,000 miles of trolley lines.**



**The first generation of motors generally were direct current that needed a *commutator* to convert the alternating current that was produced by the generators to the direct current of the particular motor.**

**Then came Nikola Tesla came to America from Serbia.**

**Tesla made an alternating current motor in 1888.**

**This caused a rapid acceleration of motors in industry. First the cotton mill was made with electric motors in 1894.**

**Then in 1901, there were nearly 400,000 electric motors in factories producing 5 million horsepower.**



**All generating companies,  
which we call utility companies,  
had standardized alternating current  
at 60 cycles per second.**

**Electricity replaced all alternatives  
such as oils, gas, and kerosene  
for lighting by 1920.**

# **The Character of Industrialized Society**

**Regardless of the process of dealing with the old way or the new technological invention, we were becoming more and more a part of a vast network or as Cowan says *enmeshed* into the technology.**

**From 1869 to 1899, there was an absolute role reversal  
in America.**

**We went from a 53% agrarian culture  
and 33% manufacturing output  
to the exact opposite set of numbers.**

**The Industrial Revolution began  
the reversal around the time of the Civil War.**



**The reversal of agrarian/manufacturing in America was also seen in where the masses lived. We moved away from the rural areas into the urban areas.**

**In addition, the East Coast was not the only urban locations in America. There was fairly rapid growth in urban areas in the Midwest and West Coast.**

**Cowan noted that our first 12 presidents were all from farming areas.**

**However, after the Civil War until 1912, the presidents were Republicans except for Grover Cleveland who happened to be the mayor of Buffalo, NY and a pro-business Democrat.**

**The growth of the cities was not without great costs such as often massive illnesses: typhoid fever, dysentery, cholera, and other types of epidemics.**

**Massive urban renewal programs began to fall into place such as running water, health standards improved, paved streets, new water supplies, district parks, etc.**

**The net result was further industrial growth.**



**Cities and urban area became centers for manufacturing and research and development.**

**This is Cowan's list of cities:**

**Minneapolis...flour milling**

**Rochester...shoe making**

**Schenectady...electric equipment**

**New York...clothing**

**Pittsburgh...steel and glass**

**The population of America  
from 1860-1920  
went from 31 to 106 million.**

**America's birth rate increased  
while the death rate decreased  
due to public health improvements.**

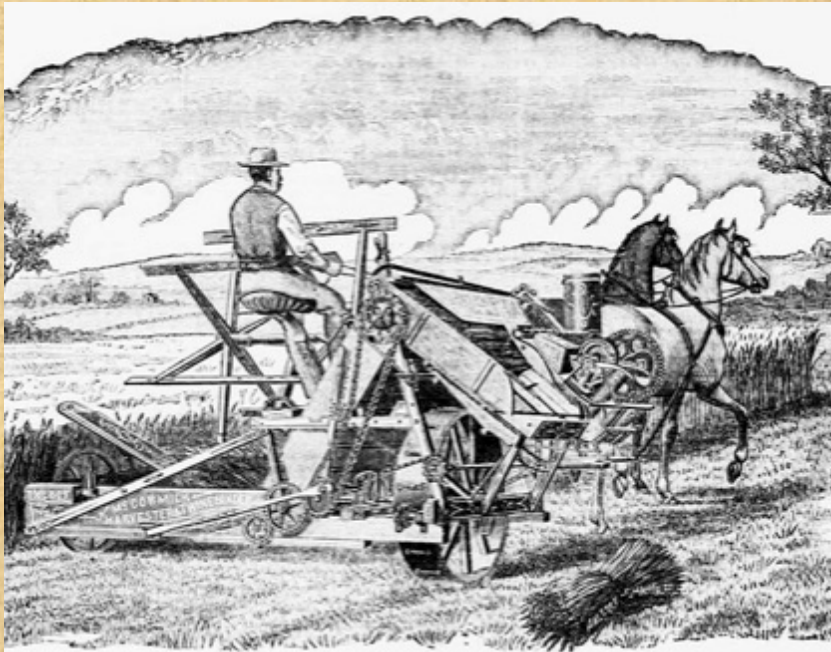
**Immigrants were coming to America in very large numbers. For example, from the end of the Civil War to the Immigration Restriction Acts of 1924, 30 million people came to the States from overseas**





**It is interesting to see the enmeshing or networking of agrarian and manufacturing.**

**For example, the reaper gave way to the harvester, then the self-binder, then the combine, tractors, etc. in less 70 years.**



**The new technology had amazing results.**

**In 1866, we had 15.5 million acres yielding 9.9 bushel/acre.**

**In 1898, we had 44 million acres yielding 15.3 bushel/acre.**

**However, the labor saving costs were more impressive.**

**Before technology, it took 400 people with 200 oxen working ten hours/day to produce 20,000 bushels of wheat.**

**With machines, they could do the same amount with only 6 people and 36 horses.**

**This is the primary reason for the reduction of farmers in America...3/4 of the population didn't have to produce the nation's food.**

**Our nation change radically during and after the Civil War...in farming, transportation, and what we ate regularly.**



# **Conclusion: Industrialization and Technological Systems**

**America had made the great immigration  
from the preindustrial to the industrial society.**

**More Americans were living in towns and cities  
than lived back on the farm.**

**Everything that we did whether eating, working,  
manufacturing, transporting/shipping, etc. were  
networked by railroads, electricity, and petroleum.**

**We lived in a “monopolistically inclined corporations.”**

**While we were living longer (at birth and at death)  
and living standards were improved drastically,  
however we were doing so by being more  
and more tied, networked, enmeshed, and dependent  
upon each other...  
a *vast* number of each others.**

**We had become a vastly enmeshed people...  
and this was done by 1920.**

**What has technology done  
nearly a century later  
with the cell phone, computer, Internet,  
Facebook, Twitter, eCollege, etc.?**



