The Industrial Revolution.

- **When?**
  - 1780-1830.

- **Was it a “revolution”?**
  - No: Cameron.
  - Yes: Landes.
The Industrial Revolution.

- Industrialization vs. economic growth.
  - U. S. wealthier than Britain in 1800, but little industrialization.
  - Growth can come from improvements in traditional activities, e.g., agriculture.

- Per capita growth not “revolutionary” during industrial revolution.
  - Steady balanced growth.
  - But denominator growing rapidly.
    - Increased output sustains rapid population growth.
  - Did growth in “new” sectors contribute to growth in “old” sectors?
The Industrial Revolution.

- Qualitative transformations.
- Technological transformations.
  - *Energy*: animal to water and steam power.
  - *Materials*: wood to iron and steel.
- Organizational Transformation.
  - The factory system.

James Watt's steam engine, 1769.
Britain in 1700.

- Population on England and Wales: 5.2 million.
  - Would grow to 9.1 million by 1800.
  - Would almost double again to 17.8 million by 1850.
Britain in 1700.

- English peasant ate better than continental counterpart.
  - Spent lower proportion of income on food.
  - Implies increased demand for manufactured goods.
- Lower tolls and improved transportation.
  - Canals and turnpikes.
- More urban.
  - By 1800, 25% in cities larger than 5,000 persons.
  - Compare with 10% in France.
  - Cities centers of commerce.
Britain in 1700.

- Increased extent of the market.
  - Large internal market.
  - Merchant fleet spurs international trade.

- Relative wealth of peasantry.
  - Focus on standardized, low-cost items.
  - Useful also in trade with Asia, Africa, and Americas.
  - Quantity not quality: search for lower costs.
Manufacture in 1700.

- Local crafts shops.
- But pressure on urban guilds from rural industry.
  - The putting-out system.
- Woolens dominate.
  - 70% of English exports in 1700.
    - 50% in 1770.
  - Not localized: spread all over England.
  - Link to labor freed by enclosure.
The putting-out system.

- Merchant clothier.
  - Commissions spinners and weavers.
  - Provides wool.
  - Hires workers for finishing and dyeing.

- Cottagers.
  - Own tools: handloom, spinning wheels.
  - Division of labor within household.
    - Men weave, women spin.
    - Children and hired labor.
  - Paid on piece-rate basis.
  - May have garden, cows, etc.
    - Continue to participate in agriculture.

Also called the “domestic” system.
Early textile innovation.

- John Kay’s flying shuttle (1733).
  - Spinning becomes a bottleneck.

- Wyatt-Paul spinning frame (1738).
  - Never technologically successful.
  - Difficulty of wool as material.
The cotton textile industry.

- Cotton arrives in Britain from India.
  - Efficient, skill-intensive hand production.
- Instant popularity of colorful calicoes.
- Woolens industry clamors for protection.
  - Act of 1700 forbids import of printed fabrics.
  - Act of 1719 forbids wearing calicoes.
- British entrepreneurs seize opportunity.
  - Using linen for warp and cotton for weft.
  - Ancient right to produce fustian.

The cotton textile industry.

- Import prohibitions encourage development of indigenous British cotton textile industry.
- Originally, cotton cloth produced by domestic system, on woolens model.
  - Rise of the “fustian masters.”
- Tendency of weaving to concentrate.
  - Manchester and Lancashire.
- Favorable ground for mechanical invention.
  - Cotton more easily mechanized than wool.
- Trajectory of mass production.
Innovation in cotton spinning.

- Hargreaves’ jenny.
  - Patented 1770.
  - Basically a multi-spindle spinning wheel.
  - Powered by a single human.

- Arkwright’s water frame.
  - Based on Wyatt-Paul and thus not patentable.
  - Uses two rollers.
  - Designed for non-human power.
Innovation in cotton spinning.

- Hargreaves’ machines smashed by angry spinners.
- Patent held invalid.
- Hargreaves flees to Nottingham and dies in 1778.
- By 1788, 20,000 jennies in England.
- Completely ousts spinning wheel in Lancashire, which gives up wool for cotton.
Innovation in cotton spinning.

Sir Richard Arkwright (1732-1792)

- Itinerant barber and hair merchant.
- Persuades Nottingham hosiers to back large-scale water-driven factories.
- Makes strong warp thread, allowing all-cotton cloth.
- Arkwright dies with a fortune of £500,000.
Innovation in cotton spinning.

- Combined principles of water frame and jenny.
- Produced thread with fineness of jenny and strength of water frame.
- A “dominant design”: improved but never superseded until the late nineteenth century.

Crompton’s mule (1779)
Innovation in cotton spinning.

Mule spinning, mid-nineteenth century.
Innovation in weaving.

- Power loom: Edmund Cartwright (1787).
  - Catches on slowly as engineering standards improve.
  - Speed/breakage tradeoff.
- Technical advantage of 7.5:1 by 1820.
  - Single operative tends more looms rather than increased output per loom.
The British textile industry.

- Import substitution turns into export powerhouse.
- Leads British economic growth into 19th century.
- Surpasses woolen trade as principal export by 1803.
  - More export oriented than woolens.
- Britain surpasses India in 1790 as largest exporter of calico, not to be overtaken until 1933 (by Japan).

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<tr>
<th>Date</th>
<th>£ (thousands)</th>
<th>% total exports</th>
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<td>1784-86</td>
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<td>1854-56</td>
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British exports of cotton textiles.