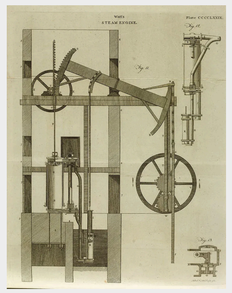
Development of the factory system: steam power + machines

Iron

- Note: Abraham Darby 1709 coke instead of charcoal in making iron
  - Still expensive
    - Cheaper to import
  - Difficult to achieve high quality
- 'Puddling' iron
  - + rolling
  - **Henry Cort**
    - Patents 1783 and 1784
    - Benefitted from
      - Work of others
        - Peter Onions
          - Ironmaster in Wales
          - Carried out puddling experiments
            - Cort knew and refined them
      - Capital - borrowed £30,000
      - + Cheap available coal, transport, entrepreneurship, risk taking
    - Commercialised by Welsh ironmasters 1780s 90s
      - 1785 - south Wales iron foundry produced 500 tons quality iron
      - 1812 - 10,000 tons (new techniques)
  - Advantages
    - Better quality
    - Cheaper

Steam power

- Sparked by Newcomen
- + demand, profit
- James Watt
  - Early 1760s
    - Watt experimenting
      - Support of John Roebuck
        - Had money
        - Had vision
        - Moved to Birmingham when Roebuck couldn't support anymore
          - **Matthew Boulton**
            - Produced metal goods in Birmingham
            - Depended on water power energy
              - Not enough - needed Watt's engine, saw potential
  - **Watt's steam engine**
    - Adapted Newcomen engine
      - From pumping water out of coal machines into a multipurpose source of power
        - Powered mechanisation
    - Patented 1769
    - By 1776
      - Pumped water more efficiently and cheaply than Newcomen's
      - Powering **blast furnaces**
        - **Higher temperature**
          - Better quality iron
          - Reduction in amount of coal needed per tonne of iron made
    - By 1800
      - Variants providing power for hundreds of different enterprises
        - Cotton, wool mills
        - Steam hammers at iron foundries
        - Corn grinders at flour mills
      - Sold abroad
        - Substantial profit
        - Made in Birmingham
          - Loaded onto canal barges in parts
            - Taken to large ports
              - Shipped overseas



  - Inspired others
    - **Richard Trevithick**
      - Mining engineer
      - **1804 first railway steam locomotive** (2)

Textiles

- Biggest employers after agriculture
- Note: early developments such as Kay (weaving), Hargreaves (spinning)
- Richard Arkwright - water frame
  - **1771**
  - Spinning
    - Made raw cotton into useable thread
  - Advantages
    - Productivity - one worker could produce **128 threads** simultaneously
    - Stronger thread
    - Price of cotton dropped
      - + more availability with Eli Whitney's cotton gin
- Samuel Crompton - spinning mule
  - Hybrid machine
    - Spinning jenny
    - Water frame
  - **By 1820**
    - **More than 4 million mules** in British factories
  - Then driven by Watt's steam engine
  - Advantages
    - Even more high quality thread, fewer workers needed (productivity)
      - Boosted profits

Factory system

- Combined production processes in a single site
  - Investment money available, owners saw large profits
  - Started with textiles
- Richard Arkwright - first modern factory

  - **1769 in Derbyshire**
    - Access of raw materials
    - Availability of good water power
    - **"Cromford Mill"**
  - Initially employed **200 people**
    - Skilled men, women and children
      - Trained, disciplined
      - Initially 7 years old
        - Then raised to 10
          - Provided education
            - Parents could not read or write, could not keep any records at work
    - Labour shortage in the area
      - Arkwright built housing to attract more workers
        - Founded a small town
  - Stats
    - First cotton mill on five floors
      - Large machinery in each floor
    - Capable of operating 24 hours a day
  - He made a fortune
- Stats
  - 1770 - 1835 (65 years)
    - 1200 cotton factories
    - 1300 wool factories

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