Increased Speed

- Average Speed - 20 to 25 mph (1835)
- Great Western Railway
  - 35 to 40 mph, 7” Gauge
- Large Wheels
  - Stephenson - 7.8’ to 10’ Diameter Driving Wheel
- Larger Boilers
  - 1829 Rocket - 6’
  - 1832 Bury - 8’
  - 1845 Long Boiler - 12’

North Star

- Stephenson (1830s)
- Cylinder
  - 16” Diameter, 16” Stroke
- 7’ Wheels
- 21 tons
- Heating Surface
  - 711 sq. ft.
- Pulled
  - 80 tons At 30.5 mph
  - 45 tons At 38.5 mph
- Fifty Built (1840-1845)

French Copy Of Stephenson’s

- Taylor (1837)
- Built For Paris-Saint-Germain Line

Crampton

- Conceived By Thomas Crampton In England
- Built By Derosne & Call In France (1849)
- Larger Driving Wheels Behind Boiler - Lower Boiler
- Cylinder (15” Diameter, 22” Stroke)
- Boiler Pressure (10 psi)
- 20 Years
  - 25 hp Of Seguin To 400 hp Of Crampton

Engerth

- Wilheim Engerth (1853)
- 3% Grade
- 10 Wheels
- Austria
  - 3215’ Semmering Pass

France

- Built By Robert-
  - Fin.Th. Pans-Vendome.
  - Line, 1818

- Built By Robert-
  - Fin.Th. Pans-Vendome.
  - Line, 1844
Passenger Coaches

- 1830s - Adaptation of Stagecoaches
- 1840s - First Specially Designed
  - Leaf Springs & Wood Frame
- 1850s
  - Reinforced Metal Frame
  - Comfort Was Addressed
- 1860s - Interior Lighting
  - Oil Lamps, Kerosene Lamps, Compressed Gas

Brakes

- Wooden Rails Offered Resistance
- Tightening Brakeshoes On Felly Or Band
- Only Locomotive (Mid 1840s)
- Selected Cars Had Brakepeople (1850s)
- Vacuum Brake
- More Weight & Speed
  - All Cars Had Brakepeople
  - Delay Time From Hand Signals
- George Westinghouse (1869)
  - Compressed Air

Brakes (Continued)

Signaling

- Manually (1837)
  - Handheld Red flag Or Lantern With Red Lights
- Telegraph On London-Blackwell Line (1840)
- Red Discs To Show Track Status (1843)
- Vignier (1844)
  - Push/Pull Interlocking System

Signaling (Continued)

Pneumatic Railroads

- Danish Engineer Medhurst (1810)
  - Suggested Pneumatic System
- Around 1840
  - Pumping Stations Were Tried
- First Pneumatic Railroad (1844)
  - Ireland, 1.75 miles
- 2' Diameter Piston Moved Along Tube Sealed With a Leather Tongue
Pneumatic Railroads (Continued)

Development of Railroads

- Cost
- Great Britain
- France
- United States

Average Cost (1852)

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<th>Per Kilometer In Francs</th>
<th>Great Britain</th>
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<tr>
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<tr>
<td>Belgium</td>
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<tr>
<td>Germany</td>
<td>201,000</td>
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<tr>
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Great Britain
Liverpool-Manchester Line

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France

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France (1837)
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