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**21 and 28 November 2012**

# ECONOMICS 303Y1

# The Economic History of Modern Europe to1914

## Prof. John Munro

## Lecture Topic No. 13:

### III. GREAT BRITAIN AS THE UNCHALLENGED INDUSTRIAL POWER, 1815 - 1873

### C. The 19th Century Transportation Revolutions: Railways and Steamships

## C. The 19th Century Transportation Revolutions: Railways and Steamships

### 1. Introduction: Transport and Economic Growth:

a) **Comments on the era of British economic hegemony: 1815 - 1873**

i) **overview of the post Napoleonic War period:**

(1) when the British Industrial Revolution comes to fruition and

(2) when Britain enjoys the brief status as the world's only and unchallenged industrial power:

- i.e., a relatively brief era of world economic hegemony
- and also a far shorter period than the one that the Dutch had earlier enjoyed

ii) **while again, some major aspects of this topic will take us up to World War I (1914),** we still have to return to the British economy after 1870: to see how Britain fared in the face of new competition

iii) **But, as we shall see in this lecture, only from the 1870s** did Great Britain come to enjoy world hegemony in both:

(1) shipbuilding and oceanic shipping.

(2) and world finance, so closely tied (as was the case historically) to supremacy in shipping.

iv) **Note well: this period, 1870 - 1914, is a supposed era of British economic decline**

b) **But let us now reflect further on the post-1820 era: for we now believe that only from the 1830s (or 1840s) did the Industrial Revolution make its major impact in terms of measurable growth:**

i) **not until then did genuine economic growth occur,** not just in aggregate terms but also in per capita terms

ii) **and that economic growth is manifested in the first clear evidence of a sustained rise in per capita real wages and real incomes,** while population growth continued to rise

iii) **in that sense, the Industrial Revolution had now broken (forever) the so-called Malthusian trap**: when, earlier, before the 1820s, population growth had indeed meant falling real incomes

c) **For those reasons, many economic historians now deride – foolishly, in my opinion – the notion that an Industrial Revolution had occurred in Great Britain between the 1860s and the Napoleonic Wars:**[1]

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[1] See for example the many recent publications of Gregory Clark (just the same, a truly outstanding scholar): most recently - Gregory Clark, *A Farewell to Alms: A Brief Economic History of the World* (Princeton and Oxford: Princeton University Press, 2007). See other publications, especially: Jeffrey Williamson, 'Why Was British Growth So Slow during the Industrial Revolution', *Journal of Economic History*, 44:3 (Sept. 1984), 687-712; N.F.R. Crafts and C.K Harley, 'Output Growth and the British Industrial Revolution: a Restatement of the Crafts-Harley View', *Economic History Review*, 2nd ser., 45:4 (Nov. 1992), 703-30; Carol E. Heim and Philip Mirowski, 'Interest Rates and Crowding-Out during Britain's Industrial Revolution, *Journal of Economic History*, 47:1 (March 1987), 117-39; Joel Mokyr, 'Has the Industrial Revolution Been Crowded Out? Some Reflections on Crafts and Williamson', *Explorations in Economic History*, 24:3 (July 1987), 293-319; Robert Black and Claire Gilmore, 'Crowding Out during Britain's Industrial Revolution', *Journal of Economic History*, 50:1 (March 1990), 109-31; Carol Heim and Philip

i) **But that view is mistaken:** an Industrial Revolution in technological changes – in the three key areas of steam power, metallurgy, and cotton textiles had taken place, but was not then completed

ii) **Note that the completion of the 'industrial revolutions' in both metallurgy and textiles** was not completed until the 1830s or 1840s, at the earliest.

iii) **In any event, no one could rationally expect** that an initial series of technological innovations (in just a few industries) would immediately produce sustained per capita economic growth

iv) **Obviously a gestation period of some decades was necessary:** for the interaction of all these changes to produce those desired effects.

c) **At the same time, we must also examine other major forces for economic growth that took place after the 1820s:** above all the Transportation Revolutions involving both steam and iron (then steel).

i) steam-powered railroads, and then in

ii) steam powered ocean shipping

iii) **And next the ensuing industrial revolutions in steel and mechanical power:** often called the 'Second Industrial Revolution':

(1) the steam turbine: for shipping and electrical power

(2) electrical power and electrical engines and tools

(3) the new coal-based chemicals industries

(4) internal combustion and the very new petroleum industries [and the even newer petroleum based chemicals industry] from the late 19th century.

iv) **Obviously, none of these – especially the transport and steel revolutions – could have taken place:** without the prior innovations in steam power, coal, and metallurgy during the late 18th century.

## 2. <u>General Importance of the Transportation Revolutions:</u>

a) **first: market integration:**

i) **the application of steam power to transportation from the 1830s:**

(1) first in steam-powered railways and then in steam-powered shipping;

(2) this steam-powered transportation revolution, produced, in those two forms, which became

- the single most powerful force for market integration, industrialization,

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Mirowski, 'Crowding Out: A Response to Black and Gilmore', *Journal of Economic History*, 51:3 (Sept. 1991), 701-06; Gregory Clark, 'Debts, Deficits, and Crowding Out: England, 1727 - 1840', *European Review of Economic History*, 5:3 (December 2001), 403-36. For the most recent exposition of this theme, see Pol Antràs and Hans-Joachim Voth, 'Factor Prices and Productivity Growth During the British Industrial Revolution', *Explorations in Economic History*, 40:1 (January 2003), 52-77.

- and indeed general economic growth in the world during the 19th century.

ii) **or, more accurately, the single most potential force for growth,** depending on how it was applied.

b) **econometrics and cliometrics**: their negative role in economic history

i) **Recently, however, the econometric or cliometric school of economic history (Fogel) has downplayed the role of railroads in particular:** in the case of the U.S. suggesting that the net social savings over canals was only about 5%; [2]

ii) **but not everyone accepts these econometric exercises,** or the conclusions of these economic historians.

iii) **It may also be worth noting the following:**

(1) **in an important book,** on the role of the steam engine in the Industrial Revolution, the British economic historian Nicholas von Tunzelmann similarly argues, with cliometrics,

- that the steam engine had a negligible impact on British GNP during the 18th century, and
- thus was not important for at least the early stages of industrialization.[3]

(2) Well, I do not buy that either; and have come to the conclusion that the main function of econometrics or cliometrics, as applied to economic history, is to prove that nothing ever matters.

c) **In the case of Great Britain**: however, previous historians probably did exaggerate the role of railroads.

i) **After all, the Industrial Revolution had achieved its essential foundations long before the railroad;**

ii) **and the railroad did not fundamentally alter the industrial or urban map of Great Britain,** as established much earlier by canals and coalfields.

iii) **Just the same, even in Great Britain, the railroad had very considerable importance**:

(1) ultimately, the railroad, directly and indirectly, was a very major factor in promoting further, more rapid urban industrialization and general economic growth in Great Britain;

(2) and in making Britain industrially pre-eminent, on basis of supremacy in steam and iron technology.

iv) **But at the same time the railroad was ultimately also responsible for the loss of Britain's industrial supremacy,** literally by transporting industrialization abroad, across the Channel, first to continental Europe and then to the Americas.

d) **For continental Europe**:

i) **clearly the railroad provided a much more dramatic stimulus to industrialization:** the railroad made possible for the first time genuine integrated national and continental economies;

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[2] Robert William Fogel, *Railroads and American Economic Growth: Essays in Econometric History* (Baltimore: Johns Hopkins Press, 1964).

[3] G. Nick Von Tunzelmann, *Steam Power and British Industrialization to 1860* (Oxford and New York: Clarendon Press, 1978).

ii) **it was the key force in exploiting continental resources:** in stimulating the growth of the iron, coal, and steel, and engineering industries.

iii) **this will be seen in greater detail, when we come to continental industrialization:** first France, then Germany, and finally Russia, all to 1914.

## 3. The Origins and Construction of British Railroads

a) **Britain's Canal System**: the first stage of the modern transportation revolution

i) **Long before the coming of the railroad,** as we should recall from an earlier lecture:[4]

(1) Britain had undergone a prior transport revolution, of sorts, in the canal network built between ca. 1760 and ca. 1800;

(2) and that canal system had quite adequately served the needs of that era, with the initial stage of industrialization.

ii) **By the 1820s, however, canals had become inadequate:** certainly for the needs of a more rapidly growing and expanding industrial economy:

(1) they were too small, slow, and inefficient,

(2) and thus had themselves become a barrier to further economic growth.

(3) It was commonly said (at the time) that it took cotton longer to go by canal from Liverpool to Manchester than it had in crossing the Atlantic from the U.S. -- from the Carolinas and Georgia.

b) **George Stephenson (1781-1848)**: father of the modern railroad. [5]

i) **Stephenson developed the first practical steam-powered locomotive:**

(1) **Note: a stationery steam engine was the first proposal,** and it was also tried, but failed

(2) Stephenson's revolutionary solution in the early 1820s:

- to have steam-powered locomotion move iron cars
- on wrought iron wheels running on flanged wrought iron rails.

(3) first, in 1825: the Stockton-Darlington Railway (in Durham, in NE England).

(4) then, in 1829-30: the Liverpool-Manchester line (the Rocket)

ii) **But Stephenson was not the original pioneer**:

(1) as just suggested, he completed the work of many engineers before him, in particular Richard Trevethick

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[4] See Lecture Topic no. 5. The year 1759 marks the real beginning of the Canal Era: when the Duke of Bridgewater (appropriately named) built a canal from his coal mines at Worsley (canals partly underground) to Manchester, 20 miles away.

[5] His son Robert (1803–1859) built railroads, locomotives, and bridges.

(steam-powered locomotion, ca. 1800).

(2) The idea of iron cars on iron rails goes back to coal-mining in the mid-18th century: from which the original gauge is derived.

c) **The Railway Booms:**

i) **Stephenson's successes, especially with the Liverpool-Manchester line:** sparked a railway building mania in the 1830s.

ii) **There were in total three major railway-building booms:**

(1) 1830 - 1836,

- ending with the depression of 1836-42,
- in part sparked by overinvestment in badly organised railway companies,
- when they went bankrupt, a financial panic ensued
- but a contemporary US financial panic, a default on British loans, and Andrew Jackson's restrictions on American banking provided equally important factors for the depression.

(2) 1842 - 1845,

- ending in a crisis;[6]
- then with a lesser part of that boom from 1847 to 1852.

(3) 1860- 1873

iii) **By 1875, almost all the main lines,** and over 70% of the total track had been laid (with the last major line built in 1899).

d) **Major Problems of British Railways**:

i) **lack of state direction and planning**:

(1) so that too many short, competing lines were built, and

(2) too many lines were constructed without direct connections between them.

(3) We will see, next term, that continental countries learned from these British errors: to engage in better state planning and co-ordination in having railways built

ii) **Lack of a uniform railway gauge**: was a major manifestation of that problem: [7]

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[6] See this recent study on the British railway mania of the 1840s: Gareth Campbell, John D. Turner, and Clive B. Walker, 'The Role of the Media in a Bubble', *Explorations in Economic History*, 49:4 (October 2012), 461-81. Concerning the British Railway Mania of the 1840s.

[7] On this see the very recent article: Douglas J. Puffert, 'Path Dependence in Spatial Networks: The Standardization of Railway Track Gauge', *Explorations in Economic History*, 39:3 (July 2002), 282-314. Some time ago, a student enrolled in ECO 303Y kindly supplied me with information from a web-site to the effect that the 4 ft. 8 inch gauge was based on wheel-ruts in old Roman roads: 'Roman war chariots first

(1) the two main gauges (out of several) were:

- the Stephenson gauge of 4 ft. 8.5 inches (the 4 ft 8 inch gauge used in coal mines, but with an extra half inch added for the flanged wheels); and
- the Brunel gauge of 7 ft. (= 2.836 metres: used on the Great Western railway in the SW, from London to Bristol).

(2) Parliament did pass an act in 1846 to make the Stephenson gauge the only permitted gauge for all future railways;

(3) but conversion and uniformity was not fully achieved, in fact, until the 1890s.

e) **Amalgamation**: from market forces helped to resolve the main problems.

i) **The 2nd railway boom of the 1840s ended in a bust and depression in 1845-47,** forcing the amalgamation of many weak companies.

ii) **Overall, a total of 1100 railway companies,** formed over the course of the 19th century, were reduced to 128, by 1900, with just 15 ended up controlling 75% of the business.

iii) **The four biggest were**:

(1) London and North Western;

(2) the Midland Railway;

(3) the Great Western (London to Bristol); and

(4) the North Eastern.

f) **The Role of the State**:

i) **the British Government played a very secondary role in the construction and operation of British railways,** as just indicated, especially in contrast to state participation on the continent.

ii) **the government, through statutes passed by Parliament, did the following:**

(1) to incorporate railway companies**,** and limited liability for investors;

(2) to grant them powers to expropriate land (by 'eminent domain', discussed earlier), and

(3) to give them monopoly rights of way

iii) **Railway Clearing Act of 1842: permitted a single transaction (for persons,** later for goods) for transport over several lines.

iv) **Proposed nationalization:**

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formed the initial ruts, which everyone else had to match for fear of destroying their wagon wheels. Since the chariots were made for (or by) Imperial Rome, they were all alike in the matter of wheel spacing'. From: http://hvac-talk.com/vbb/showthread.php?threadid=5173 . No mention is made of this possible Roman origin in Puffert's article cited above.

(1) **In 1844,** Parliament passed a law allowing the government to take over railway companies after 21 years,

(2) But not until a century later, in the later 1940s, after World War II, did Parliament, with a Labour government, make use of this power to nationalize the railways (which, under, a subsequent Conservative regime were again privatized, producing several railway companies).

v) **The Railway Commission of 1873:**

(1) In 1873: parliament established a national Railway Commission to regulate railway traffic and fares.

(2) It was later said that this commission had just enough power to annoy the railway companies, but not enough to protect the public.

## 4. <u>Economic Significance of the Railroads for British Economic Growth</u>

a) **capital financing and capital formation**:

i) **Total railway investments by 1914:** greatly exceeded the aggregate capital investments in iron, steel, coal, and cotton.

(1) By 1870, with some 75% of total track and installations now constructed, the railway companies had invested about £630 million sterling into building these railroads:

(2) and by 1914, more than double that amount had been invested: £1,330 million.

ii) **Historically, it can be argued, the railways were the first heavy consumer of industrial capital.**

(1) Indeed, 50 years ago Phyllis Deane established a new orthodoxy in declaring that

- building British railways had meant a quantum leap forward in capital formation:
- lifting net capital formation above that magical 10% level of NNP –
- i.e., the level that Rostow and others had earlier asserted was necessary for a 'take-off' into modern industrialization.[8]

(2) Her figures, given in an earlier lecture, for:

**Net Domestic Capital Formation as a Percentage of NDCF**:

| | |
|---|---|
| **1700 - 1760** | 3% - 5% of NDCF |
| **1760 - 1780** | 5% - 6% of NDCF |
| **1780 - 1800** | 6% - 8% of NDCF |
| **1800 - 1830** | 8% - 10% of NDCF |
| **1830 - 1850** | 10% - 12%+ of NDCF |

(3) Railway investment at its peak, in 1846-47, probably accounted for about two-thirds of total capital

[8] In: Phyllis Deane and W.A. Cole, *British Economic Growth, 1688 - 1959* (Cambridge, 1960), p. 234; also Phyllis Deane, *The First Industrial Revolution* (London, 1965).

investment; and alone for 7.5% of NNI.

iii) **Subsequently (1978), however, Charles Feinstein (Cambridge) modified these dramatic views,** as the following table on the screen may suggest:

**Estimates of Railway Investments, Total Investments in Transportation, Gross Domestic Capital Formation, and Gross Domestic Product in England, 1771 - 1850**

**Annual Means per Decade, in £ millions, at constant 1851-60 prices**

| Decade | Railway Invest-ments | Railway Investment as % of GDCF | Total Transport Invest-ments | Gross Domestic Capital Formation | Gross Domestic Product | GDCF as a Percentage of the GDP |
|---|---|---|---|---|---|---|
| **1771-80** | | | 2.03 | 7.05 | 100 | 7% |
| **1781-90** | | | 2.11 | 11.12 | 110 | 10% |
| **1791-1800** | | | 3.13 | 14.31 | 135 | 11% |
| **1801-10** | | | 3.47 | 16.57 | 160 | 10% |
| **1811-20** | 0.10 | 0.5% | 3.78 | 20.51 | 200 | 10% |
| **1821-30** | 0.10 | 0.4% | 4.26 | 28.29 | 275 | 10% |
| **1831-40** | 3.67 | 9.5% | 8.95 | 38.59 | 365 | 11% |
| **1841-50** | 14.11 | 28.5% | 19.89 | 49.43 | 450 | 11% |
| **1851-60** | 8.78 | 15.1% | 18.12 | 57.99 | 595 | 10% |

**Source**: Charles Feinstein, 'Capital Formation in Great Britain,' in Peter Mathias and M. M. Postan, eds., *Cambridge Economic History of Europe*, Vol. VII: *The Industrial Economies*, part i (Cambridge, 1978), Tables 6 and 28, pp. 40, 91.

(1) **Feinstein contends** that the 10% level was achieved earlier (as Rostow had suggested), perhaps by the 1780s.

(2) But, as I had noted earlier in the topic on Banking during the Industrial Revolution,

- those Feinstein estimates are for *gross* capital formation as percentages of GNP,
- while Deane's estimates are for *net* capital formation (as a percentage of NNI).

(3) For a very brief period, in the mid-1840s, railway investments

- did indeed account for a large share of total investment;
- but over the longer term, looking at the figures decade by decade, we find no dramatic upsurge in capital investment as share of GNP.

(4) If we can trust Feinstein's figures, such investment accounts for a steady 10%-11% from the 1780s to the 1860s.

iv) **Capital Markets:**

(1) It has also been argued that railway investments were important, qualitatively, in developing capital markets, especially in restoring the joint-stock company to public favour (after the Bubble Act had been rescinded).

(2) Initially that was partly true: railway investments were highly popular and profitable; and the risk was more limited.

(3) Parliament did in fact grant the right of incorporation with limited liability to railway joint-stock companies and thus to their investors, since

- railways clearly served the public good, and
- since they required massive capital investments, which could only be raised from tapping savings of the middle class, who were willing to invest only with limited liability.

(4) But, as was noted in the previous lecture, Parliament was not willing to grant limited liability to investors in general until the 1850s: Acts of 1856-57.

v) **Unquestionably railways were an important factor in developing the British capital market in general**:

(1) especially in opening up the business of the London Stock Exchange to trading in industrial shares – and not just in government stock (Consols) and related issues: e.g., Bank of England

(2) and then in developing the provincial stock exchanges of Birmingham and Manchester.

b) **Role of the Railroad in fostering larger-scale forms of industry**:

i) **in greatly expanding the size of the potential market**:

(1) **Transport Costs:** combination of far greater speed, greater regularity of transport, and greatly improved communications cut the unit costs of transport by as much as one half for bulk goods:

- especially for transporting bulk raw materials, such as coal, iron, and cotton.

- railroads thus helped to lower production costs and market prices and thus
- to expand the volume of sales and the scope of the market.

(2) **Communications**:

- 1838: note that the electric telegraph began in 1838, and was constructed in conjunction with railroads, which operated it.
- 1866: first trans-Atlantic cable to provide an international telegraph link between the Americas and Europe (with the UK)

ii) **by eliminating inefficient, small scale local monopolies that had previously been protected by high transport costs:**

(1) high transport costs indeed have been called the 'tariffs of bad roads'.

(2) Thus a few large-scale nationally oriented firms could replaced many small inefficient local businesses.

iii) **Working Capital:** by providing large savings on working capital (permitting larger capital investments in larger-scale firms).

(1) Thus the combination of railroad and telegraph made supplies so much more regular and dependable, permitting much more rapid responses to business changes,

- that firms could now operate on far smaller inventories:
- consider the modern Japanese method of 'just-in-time' production by computerized inventory controls and instant computer communications with dealers.

(2) Smaller inventories thus meant a great savings on working capital, and either lower interest costs, or shift of investment to fixed capital.

iv) **Nevertheless these factors are cited as theoretical potential factors for promoting economic growth:** and larger scale, potentials which were not realized in many regions and sectors until much later.

c) **Specific effects of railways for the coal, iron, steel industries**: as the major stimulus for industrial growth.

i) **new coal and iron fields:**

(1) railways helped to open up vast new coal and iron fields in Lancashire, Yorkshire and N.E. England (Durham-Northumberland) and especially Scotland: regions which became major iron and coal producers.

(2) Discovery of new coal fields by railway surveying and construction: was one major reason, as it came to be as well on the continent

(3) As early as 1840s, British coal output had risen by about 70%, as consequence of:

- discoveries of new coal fields, as explain above
- significant cost reductions in exploiting new coal fields and transporting coal

- increased demand for coal, from and because of railways: as follows

ii) **Railways increased coal consumption quite rapidly, for three reasons**:

(1) coal to produce iron for rails and rolling stock, bridges, etc.

(2) coal as fuel for steam locomotives.

(3) coal as a much cheaper domestic fuel, as railways lowered the cost of obtaining and supply coal; as prices fell quantity consumed grew rapidly.

iii) **The iron industry similarly received a strong stimulus from railway construction**:

(1) in supplying wrought iron rails, iron for rolling stock, bridges, stations, etc.

(2) In the boom of the 1840s, up to 30% of total iron production in Britain went to railway construction;

(3) by the 1850s, that share had fallen to about 10% of total iron production.

iv) **But from that time, the 1850s, the British iron industry found new customers on the continent and overseas,** as other countries began building their railways, initially using British railway iron.

d) **Effect of the Railways on British Agriculture**:

i) **brought all agricultural land finally within the market economy,** especially land for livestock products, perishable fruits, etc.

ii) **for livestock in particular,** the railroad eliminated previous losses from driving cattle to market on hoof (i.e., the loss of weight that cattle suffered when herded to market).

iii) **for fruit and vegetable farming:**

(1) since such forms of agriculture involved highly perishable products, the railroad obviously provided an enormous benefit, encouraging a much more rapid expansion in this form of commercial farming;

(2) and the expansion of such farming obviously also provided better feeding of the new industrial cities.

iv) **labour mobility**:

(1) the railroad literally moved hundreds of thousands of people off the land, especially in drawing on rural labour to build railway.

(2) the railway provided a much more elastic, more mobile labour supply for urban industries.

(3) So rapid was this population movement that

- by the 1840s there appeared genuine labour scarcities in agriculture,
- and that in turn provided a much stronger incentive for the mechanization of agriculture [as we shall see in the first lecture in January].

e) **Effect of the Railroad on Urban Industrial Location**:

i) **in strong contrast to continental Europe and North America,** as already noted:

(1) British railway construction did not have any real marked effect on either industrial location or

urbanization.

(2) other than to intensify both industrial and urban growth, and especially the growth of suburbs, providing very cheap transport of workers from homes to factories.

(3) As we have already seen, urban industrial location in Britain had already been determined some time ago.

- by that combination of coalfields and canals, especially for the metallurgical industries.
- and also, along with coal, by climate and water supplies, for the cotton industries.

ii) **Thus British railways were built largely on an already established pattern**:

(1) the earliest railroads were in fact built to supplement rather than to displace canals:

(2) Further construction largely duplicated canal patterns, so that no important town served by canals ever suffered from the establishment of railroads.

(3) Nor were any towns established by railroads: with exceptions of railway junction towns of Crewe and Swindon.

iii) **In general, therefore, and to repeat: the major impact of railways was to promote urban growth,** and more especially the growth of industrial suburbs.

f) **Reasons why the full impact of British railways on British economic growth was delayed (until after the 1850s):**

i) **Railway traffic was initially greater in carrying passengers than in freight;**

ii) **not until the 1850s,** did freight (goods, merchandise) account for even half the revenues of British railways.

iii) **Reason for this was partly technological:** not until the 1850s were steam locomotives powerful enough to haul freight trains economically.

iv) **Not until the 1850s also did railway amalgamation have their desired effect:**

(1) with direct linkages between major cities to provide sufficient economies of scale and savings on transaction costs,

(2) thus providing for a more economic hauling of freight.

v) **Canals**: in responding to railway competition, became much more efficient and cut their fares, so that they were carrying more cargo than they had been in the 1820s.

g) **The Biggest impact of railways on British economic growth:** may have come in the period after 1870 to World War I:

i) **that period witnessed a three-fold growth in passenger traffic and a four-fold growth in freight traffic,** while overall rate of population growth was in fact declining (growth rate declining, but total population of course continued to grow).

ii) **the percentage of the labour force involved in railways grew from 3% in 1870 to 4.5% in 1914,** when railways became the single largest employer of labour in the British economy.

h) **Britain was of course not alone in building railroads**: but retained its supremacy

i) **Britain maintained a lead in track milage (or 'kilometrage') over continental countries until the 1870s,** when Germany overtook Britain (to be seen later; but for now, see the table).

ii) **Even so, no European country overtook Britain in the actual density of railways:** the number of tracks per square kilometre.

iii) **Britain's railways were also generally better built:** to handle traffic at much higher speeds.

iv) **But because of this, and her role as a pioneer,** Britain's railway construction costs were also substantially higher than on the continent.

**Railway Tracks Open at Decennial Intervals, 1840 - 1914, in kilometres:**

**For Britain, Belgium, France, Germany, and Russia***

| **Year** | **BRITAIN** | **Belgium** | **France** | **Germany** | **Russia** |
|---|---|---|---|---|---|
| **1840** | 2,390 | 335 | 498 | 468 | 27 |
| **1850** | 9,791 | 903 | 2,914 | 5,856 | 500 |
| **1860** | 14,594 | 1,730 | 9,166 | 11,088 | 1,625 |
| **1870** | 21,545 | 2,897 | 16,464 | 18,875 | 10,731 |
| **1880** | 25,045 | 4,112 | 23,233[a] | 33,836[b] | 22,864 |
| **1890** | 27,810 | 4,525 | 33,278 | 42,868 | 30,594 |
| **1900** | 30,061 | 4,591 | 38,107 | 51,675 | 53,231 |
| **1910** | 32,163 | 4,678 | 40,483 | 61,205 | 66,579 |
| **1913** | 32,613 | n.a. | 40,768 | 63,375 | 70,153 |

* 1 km. = 0.6214 miles.

a. Excluding Alsace-Lorraine: ceded to Germany in 1871
b. Including Alsace-Lorraine: acquired from France in 1871

**Sources:** B.R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics* (Cambridge, 1962), pp. 225-26; Carlo Cipolla, ed., *Fontana Economic History of Europe*, Vol. IV:2: *The Emergence of Industrial Societies* (London, 1973), pp. 790, 794.

## 5. The Transportation Revolution in Shipping: Steam and Iron

a) **The significance of this similarly steam-based transportation revolution**:

- was to create for the first time a truly integrated world economy:
- to permit the full operation of an international division of labour or regional specialization, according to the law of comparative advantage.

i) **the combination of railroads and steam shipping opened up vast new areas of the world for settlement and agricultural development,** directly linked to a world market economy: new lands in Russia (Ukraine, Volga), North America, Australia; the Argentine.

ii) **Meant a vast increase in world supplies of grain and meat at much lower prices;**

(1) for western Europe, such food supplies permitted both a rapid growth in population and

(2) a shift of resources from agriculture to manufacturing and commerce.

b) **Particular significance for Great Britain**: was in fact much greater than for other European countries (in contrast to impact of the railroad).

c) **In at least four ways, Britain benefited strongly from this revolution in shipping,** gains that solidified British economic hegemony in the later 19th century:

i) **The revolution in steam-shipping finally gave Britain an unchallenged world supremacy in shipbuilding, from the 1870s**: because of British supremacy in steam and iron engineering.

ii) **It gave Britain world supremacy in shipping, in international trade, and in finance**:

(1) it thereby gave Britain a much larger source of foreign earnings from shipping, trade, and finance, adding about 30% extra to the export incomes Britain derived from manufacturing.

(2) As with the Dutch and Italians before them, so the British supremacy in world banking and finance was due essentially to supremacy in shipping and trade.

**BRITISH SHIPBUILDING AND SHIPPING REVENUES**

**Decennial Averages of the Values of British Shipbuilding**
**and Decennial Values of Net Foreign Earnings from Shipping**
**in Millions of Current Pounds Sterling, 1820/9 to 1900/09**
**Mean of 1840-49 = 100**

| Decade | Value of Ship Tonnage Constructed in £ millions | Index: mean of 1840-9 = 100 | Net Foreign Earnings from Overseas Shipping in £ millions | Index: mean of 1840-9 = 100 |
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**Source:** Phyllis Deane and W.A. Cole, *British Economic Growth, 1688 - 1959* (Cambridge, 1960), p. 234.

iii) **It gave Britain a military power and naval supremacy that permitted Britain to control the seas and the world's transport routes**:

(1) so that her commercial and overseas imperial (or colonial) power, and related overseas investments could grow unchecked to World War I.[9]

(2) Thus: 'Britannia rules the waves' – or ' Britain waives the rules', as one wag put it.

iv) **It permitted the law of comparative advantage to operate**:

[9] This aspect is closely related to the next topic on foreign trade, and especially the first term essay topic on the Imperialism of Free Trade.

(1) promoting a shift of resources from agriculture to manufacturing, commerce, and finance:

(2) thus allowing Britain to feed her population more cheaply with food imports obtained from export earnings.

(3) As we shall see later, in the first lecture in January, on agriculture, that resulted in a very rapid contraction of the agricultural sector, much more rapid than in other countries.

(4) In our next and last lecture this Fall semester: we will instead examine the structural changes in British foreign trade, made possible by these transportation revolutions.

d) **The situation on the eve of the transportation revolution**:

i) **Supremacy of New England:**

(1) in the late 18th century, world shipbuilding supremacy had passed from the Dutch, from Holland, not to England, but instead to New England, in the USA. [the states of Maine, Vermont, Massachusetts, Rhode Island, and Connecticut]

(2) that was essentially because of New England's very abundant and cheap domestic supplies of ship-timbers and other naval stores.

ii) **Thanks to the protective umbrella of England's Navigation Laws,** and especially thanks to New England's participation in the triangular trades with the Caribbean and Britain, New England had developed a very large-scale and efficient shipbuilding industry and merchant marine.

iii) **The Yankee Clippers:** exemplified that New England supremacy in shipbuilding and shipping:

iv) **That New England supremacy was finally nullified by British steam and iron engineering technology,** but not in fact until after the 1870s;

v) **when the British threat emerged in the mid-century,** New Englanders responded by improving the Clipper’s design, so that their shipping enjoyed an Indian Summer of prosperity, to the 1870s.

e) **The Development of Steam-Powered Iron Shipping**: **the Paddle-Wheelers** [10]

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[10] From Answers.com: The paddle wheel is a large wheel, generally built of a steel framework, upon the outer edge of which are fitted numerous paddle blades (called floats or bunkets). In the water, the bottom quarter or so of the wheel is underwater. Rotation of the paddle wheel produces thrust, forward or backward as required. More advanced paddle wheel designs have featured feathering methods that keep each paddle blade oriented closer to vertical while it's in the water; this increases efficiency. The first paddle steamer was the Pyroscaphe built by Marquis Claude de Jouffroy of Lyon in France, in 1783. It had a horizontal double-acting steam engine driving two 13.1 ft (4 m) paddle wheels on the sides of the craft. On July 15, 1783 it steamed successfully up the Saône for fifteen minutes before the engine failed. Political events interrupted further development. The next successful attempt at a paddle-driven steam ship was by the Scottish engineer William Symington who suggested steam power to Patrick Miller of Dalswinton.[1] Experimental boats built in 1788 and 1789 worked successfully; in 1802, Symington built a barge-hauler, Charlotte Dundas, for the Forth and Clyde Canal Company. It successfully hauled two 70-ton barges almost 20 miles (30 km) in 6 hours

i) **The Paddle-Wheeler was the first step, from the late 18th and early 19th century**:

(1) 1783: a French inventor, Marques Claude de Jouffroy: experimented with a steam powered paddle wheeler on the rive Sâone, near Lyon: but was not successful (after a 15-minute journey)

(2) 1788: Scottish engineers William Symington and Patrrick Dalswinton:

- from 1788-89, succeeded in developing prototype paddle-wheelers on the Clyde-Firth Canal in Scotland.

- 1802: they used more advanced paddle wheelers to haul cargo for the Forth and Clyde Canal Company
- but opposition came from the company directors who feared damages to the canals

(3) An American, named Robert Fulton (1765-1815), perfected the steam-powered paddle-wheeler in 1807: between New York and Albany (New York state capital).

(4) By the 1830s, these paddle-wheelers were in common use in river and coastal trade in American and Europe.

ii) **But the paddle-wheeler was quite impractical for long-distance sea voyages for several reasons**:

(1) it could hardly cope with ocean storms and high waves.

(2) its machinery and coal-fuels too up too much space at expense of cargo.

(3) in general, it was far too inefficient and unsafe for long voyages and so could hardly compete with the Yankee Clippers.

iii) **For steam-powered ocean shipping to be economically feasible, there had to be two sets of interrelated technological changes**:

(1) a new power system that would greatly increase speed but occupy a far smaller space, for both machinery and the fuel.

(2) a new type of construction and new materials that would withstand the stress created by such a vast increase in mechanical power.

f) **The Coming of Iron Built Ships**:

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against a strong headwind on test in 1802. There was much enthusiasm, but some directors of the company were concerned about the banks of the canal being damaged by the wash from a powered vessel, and no more were ordered. The first sea-going trip of a paddle steamer was that of the *Albany* in 1808 , which steamed from the Hudson River along the coast to the Delaware River. [i.e., in the year after Fulton's paddle wheeler of 1807, for the Hudson river from Albany to New York]. This was purely for the purpose of moving a river-boat to a new market, but the use of paddle-steamers for short coastal trips began soon after that. The first paddle-steamer to make a long ocean voyage was the Savannah, built in 1819 expressly for this service. Savannah set out for Liverpool on May 22, 1819, sighting Ireland after 23 days at sea. This was the first powered crossing of the Atlantic, although Savannah also carried a full rig of sail to assist the engines when winds were favorable.

i) **Why Iron was required**:

(1) Because iron, as just suggested, has far greater resistance than wood to vibrations and stress from steam-powered machinery.

(2) Iron built ships have 25% less weight than wooden ships of the same dimensions and water displacement.

(3) Iron ships (when finally properly built) are in general more durable:

- i.e., they do not leak as much or break up as easily in storms.
- but in fairness, the first iron-built ships were worse than wooden ones in these respects, and suffered problems of rust and corrosion.

(4) Iron built ships came to cost less than wooden ships.

- Thanks to the industrial revolution, iron was becoming increasingly more plentiful and cheaper, while ship timbers were becoming much more costly.
- From the 1840s, iron built ships were on average 15% cheaper than wooden ships.

ii) **Economies of scale was perhaps the most important factor:**

(1) for iron built ships (and especially those with screw propellers) could be constructed with vastly greater sizes and tonnage capacities than could wooden sailing ships;

(2) much evidence indicates that most shipping companies preferred to invest their total capital funds more in increasing the scale of their ships than in multiplying the number of ships to be operated.

iii) **From the 1840s, iron built ships were becoming important,**

(1) first with the British Navy,

(2) and then with the East India Co for Asian shipping;

(3) and from the 1850s, for trans-Atlantic shipping:

- for cargo, mail, and passengers,
- to be considered later, as a separate and very important topic

g) **Innovations in steam-powered shipping**: Changes to displace both the paddle-wheelers and the Yankee Clippers took surprisingly long:

i) **Brunel's Screw Propeller of 1836**: was the initial and crucial innovation.

(1) It replaced the clumsy, space-occupying, and fuel-guzzling engine for the paddle-wheeler with a very compact yet extremely powerful device.

(2) But to be practical, it required a new type of steam engine.

ii) **The Compound Steam Engine**: using two or more connected piston cylinders finally created sufficient power to allow the screw propeller to drive a large ship through ocean waves with only half the fuel.

(1) Though invented in 1854, it took to the early 1860s to be perfected.

(2) Furthermore, it really required steel construction, rather than wrought iron, to withstand the enormous stresses created; and so that had to await the steel-making revolution of the 1860s.

iii) **Further innovations that completed that breakthrough to displace the Yankee Clippers**:

(1) the triple and then quadruple compound steam engines,

(2) and then most especially the steam-turbine of Charles Parsons (1884), a crucial part of the so-called 'Second Industrial Revolution in Mechanical Power'.

iv) **The overall result was indeed a revolution in transportation, from the 1840s to the 1890s:**

(1) the power of marine steam-engines had been increased 10 fold, as the pressure was increased from 20 lb. to 200 lb. per sq. in. [you can do the metric conversions, which will not, of course, provide these nice even numbers: i.e., from 0.907 kg to 9.072 kg per 0.0254 $m^2$]

(2) fuel consumption reduced by 90% from 10 lb. coal per hp to just 1 lb.

v) **Speed of trans-Atlantic voyages:**

(1) steam-powered iron and then steel-hulled ships cut the travelling time by about two thirds:

(2) from an average of 5 weeks with wooden sailing ships in the 1840s, to about 12 days by the late 1860s.

(3) By 1913, the average transit time had fallen to 9 days from Southampton or Hamburg to New York.

h) **Trans-Atlantic passenger shipping:**

i) **Importance of chronometers for longitude:**

(1) note, first of all: passenger shipping, with sailing ships, would never have been possible without the relatively recent invention of a proper maritime chronometer to measure time and thus longitude

(2) Why time: because the circumference of the world is measured in 360 degrees of longitude

- i.e., around the world, in 24 hours of time zones, there are 360 degrees of longitude: 180 degrees on each side of the international date line (with zero being Greenwich, near London).
- thus if we divide 360 by 24 (hours of the day) we get 15 degrees of longitude
- thus every movement of 15 degrees longitude west from Greenwich, England, at zero (0) degrees longitude, means one hour of time difference from Greenwich
- So, if you know the longitude, you thereby know the local time difference from Greenwich
- or conversely, for this era, if you can calculate the exact time difference for any place in the world from Greenwich, England, you know the longitude
- in Toronto, at 79 degrees longitude, we are five hours behind Greenwich in local time (thus 79/15 = 5.26 hours)

(2) John Harrison: an English carpenter finally demonstrated the solution in 1764:

- he was responding to Parliament's offer of a prize of £10,000 to any one who could successfully demonstrate a mechanism and technique to measure longitude while at sea

- that in turn was the consequence of a horrible shipwreck of a British naval sailing ship, in the Channel islands in the early 18th century
- Thus, after decades of experimentation with various clocks, successfully tested a very small clock or chronometer, impervious to ocean waves, salt, and moisture
- to measure the exact time in relation to London and Greenwich Mean Time, on a trans-Atlantic voyage to the Caribbean (Jamaica).
- and thus to measure the exact distance in degrees of longitude of that point in the Caribbean from London:
- without that knowledge of exact longitude, sailing ships were often literally 'lost at sea', without any accurate knowledge of their location, when blown off course by ocean storms.[11]

ii) **Trans-Atlantic ocean-shipping began with Britain's *Inman Line*:** in 1857, from London to New York:

(1) initially for the prime purposes of sending mail, since they were safer, more reliable,

(2) and, of great importance, also speedier than wooden sailing ships.

iii) **But then quickly passengers became important:** and from late 1850s, the Inman Line offered much superior service over sailing ships:[12]

(1) with individual berths for each passenger, containing towels and soap

(2) and separate compartments for women,

(3) with three cooked meals a day, with vegetables and citrus fruits

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[11] See in particular Dava Sobel, *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time* (New York, 1995; republished New York, 1996); William J. H. Andrewes, ed., *The Quest for Longitude: The Proceedings of the Longitude Symposium Harvard University, Cambridge, Massachusetts, November 4-6, 1993* (Cambridge, Mass., Collection of Historical Scientific Instruments, Harvard, 1996); Dava Sobel and William J.H. Andrewes, *The Illustrated Longitude* (London, 1998); Michael Kennedy, *The Global Positioning System and GIS* (Ann Arbor, 1996). These works inspired the recent Public Broadcasting System television production: 'Lost at Sea: the Search for Longitude' (October 1998): 'It is known that longitude can be found by comparing a ship's local time to the time at the port of origin. The challenge is finding a clock -- a chronometer -- that can keep time at sea, where temperature-changes, humidity, gravity and a ship's movement affect accuracy'. Some of these issues are discussed in my journal article (with an online working paper): John Munro, 'The "New Institutional Economics" and the Changing Fortunes of Fairs in Medieval and Early Modern Europe: the Textile Trades, Warfare, and Transaction Costs', *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte*, 88:1 (2001), 1 - 47.

[12] See Drew Keeling, 'Costs, Risks, and Migration Networks between Europe and the United States, 1900-1914', in Torsten Feys, ed., *Maritime Transport and Migration: the Connections between Martime and Migration Networks*, Research in Maritime History no. 33 (St. John's, Nfld: the International Maritime Economic History Association, 2007).

(4) on board-doctors, a very major factor, for preventing spread of contagious diseases

(5) But for this resplendent service,

- Inman charged steerage passengers twice the rates of sailing ships of 1850s,
- which most felt was well worth the extra price.

iv) **In 1860, the Cunard line was organized as a chief competitor,** followed the White Star Line (infamous for the Titanic).

v) **the safety factor: especially for passengers:**

(1) As noted, iron built (later steel-built) ships were far sturdier, far more resistant to the impact of ocean waves during storms, and much less likely to leak.

(2) Screw propeller iron ships were much less likely to suffer damages to their propulsion systems in trans Atlantic voyages than were the sails of sailing ships;

(3) and also far less likely to suffer severe or fatal damages from fires.

(4) and far less likely to be driven off course by ocean storms than were wooden sailing ships

(5) The vast increase in the scale of iron-built ships meant that they were far less likely to capsize or breakup in the event of collisions (the Titanic excepted, of course)

(6) The speed of travel meant that passengers were far less likely to contract and die from infectious diseases, or from scurvy or other malnutrition related diseases

(7) Passengers also benefitted from

- more free deck space,
- more access to fresh air;
- and better, more nutritious food.

(8) In sum, steam-powered iron ships reduced fatalities on the trans-Atlantic run by 90%, compared to the sailing ships of the 1840s.

(9) the telegraph: note again that the first trans-Atlantic cable for the telegraph was laid in 1866.

vii) **The results were:**

(1) a vast increase in shipping scale, as just emphasized,

(2) and a consequent fall in ocean freight rates of 60% or more, just from the 1870s to 1900.[13]

viii) **The following comparison shows the dramatic difference**:

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[13] See Karl Gunnar Persson, 'Mind the Gap! Transport Costs and Price Convergence in the Nineteenth-Century Atlantic Economy', *European Review of Economic History*, 8:2 (August 2004), 125-47.

| | Atlantic Ocean Liners | |
|---|---|---|
| | **Sirius (1838)** | **Mauritania (1907)** |
| **tonnage** | 700 | 31,938 |
| **horsepower** | 320 | 70,000 |
| **speed in knots** | 7.5 | 25.0 |
| **material** | wood | steel |
| **engines** | paddle and sail | quadruple screws with steam-turbine |
| **time to cross the Atlantic** | 16 days | 4 days and 11 hours |
| | | |

ix) **International Migration:** rapidly increased thanks in part to the revolution in steam-powered iron shipping, offering both relative safety, speed, and vast economies of scale

(1) Obviously speed reduced the costs of maintaining passengers on the trans-Atlantic runs, and as noted greatly reduce the dangers of fatalities (as just noted, and to repeat, by over 90%).

(2) Vast increases in scale meant that large numbers of immigrants could be packed into such ships, especially and the cavernous and very unpleasant steerage class arrangements.

(3) Passengers accounted for over 20% of the tonnage arriving in New York around 1900

(4) but the relative value was probably much higher (i.e., than normal freight)

(i) **To sum up the British Hegemony in steam and iron shipping**:

i) **1870 marks the first year that the tonnage of steam shipping built in Britain exceeded that of sail;**

ii) **but the really decisive shift on a world scale:** to mark the British victory over New England came in the 1880s.

iii) **The great age of British dominance in world shipbuilding:**

(1) was just 30 years from the 1870s to just after 1900.

(2) In that period, Britain built over two thirds of the world's ships

iv) **But the peak had been reached just after 1900, when further technological and economic changes marked end of British supremacy**:

(1) the shift from iron to steel construction in an era when Britain no longer had supremacy in steel production, which had been taken over by Germany and the U.S.

(2) Indeed, by 1900, the largest international shipping enterprise were two Hamburg-based German

Companies:

- the Hamburg-American Packet Company (HAPAG);
- not far behind was the NDL: Norddeutscher Lloyd
- the leading British shipping lines were now Cunard and White Star
- the White Star line, by the way, went bankrupt because of the Titanic disaster.

(3) The Diesel engine: the invention of a new form of shipping power in the Diesel engine, invented by the German engineer Rudolf Diesel in 1900.

- This engine burned crude oil in place of coal, meaning that far less space was occupied with fuel and machinery, and the fuel also became much cheaper.
- The British were very slow to adapt to this new shipping technology, and did not make the shift until the 1920s.

v) **But before then,** World War I and its consequences had decisively knocked Britain out of the world leadership in both shipbuilding and ocean shipping.

**Table 1:** **Railway Tracks Open at Decennial Intervals, 1840 - 1914, in kilometres:**

**For Britain, Belgium, France, Germany, and Russia***

| Year | **BRITAIN** | **Belgium** | **France** | **Germany** | **Russia** |
|---|---|---|---|---|---|
| **1840** | 2,390 | 335 | 498 | 468 | 27 |
| **1850** | 9,791 | 903 | 2,914 | 5,856 | 500 |
| **1860** | 14,594 | 1,730 | 9,166 | 11,088 | 1625 |
| **1870** | 21,545 | 2,897 | 16,464 | 18,875 | 10,731 |
| **1880** | 25,045 | 4,112 | 23,233[a] | 33,836[b] | 22,864 |
| **1890** | 27,810 | 4,525 | 33,278 | 42,868 | 30,594 |
| **1900** | 30,061 | 4,591 | 38,107 | 51,675 | 53,231 |
| **1910** | 32,163 | 4,678 | 40,483 | 61,205 | 66,579 |
| **1913** | 32,613 | n.a. | 40,768 | 63,375 | 70,153 |

* 1 km. = 0.6214 miles.

a. Excluding Alsace-Lorraine: ceded to Germany in 1871
b. Including Alsace-Lorraine: acquired from France in 1871

**Sources:**

B.R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics* (Cambridge, 1962), pp. 225-26; Carlo Cipolla, ed., *Fontana Economic History of Europe*, Vol. IV:2: *The Emergence of Industrial Societies* (London, 1973), pp. 790, 794.

**Table 2**: **Estimates of Railway Investments, Total Investments in Transportation, Gross Domestic Capital Formation, and Gross Domestic Product in England, 1771 - 1850**

**Annual Means per Decade, in £ millions, at constant 1851-60 prices**

| Decade | Railway Invest-ments | Railway Investment as % of GDCF | Total Transport Invest-ments | Gross Domestic Capital Formation | Gross Domestic Product | GDCF as a Percentage of the GDP |
|---|---|---|---|---|---|---|
| **1771-80** | | | 2.03 | 7.05 | 100 | 7% |
| **1781-90** | | | 2.11 | 11.12 | 110 | 10% |
| **1791-1800** | | | 3.13 | 14.31 | 135 | 11% |
| **1801-10** | | | 3.47 | 16.57 | 160 | 10% |
| **1811-20** | 0.1 | 0.5% | 3.78 | 20.51 | 200 | 10% |
| **1821-30** | 0.1 | 0.4% | 4.26 | 28.29 | 275 | 10% |
| **1831-40** | 3.67 | 9.5% | 8.95 | 38.59 | 365 | 11% |
| **1841-50** | 14.11 | 28.5% | 19.89 | 49.43 | 450 | 11% |
| **1851-60** | 8.78 | 15.1% | 18.12 | 57.99 | 595 | 10% |

**Source**: Charles Feinstein, 'Capital Formation in Great Britain,' in Peter Mathias and M. M. Postan, eds., *Cambridge Economic History of Europe*, Vol. VII: *The Industrial Economies*, part i (Cambridge, 1978), Tables 6 and 28, pp. 40, 91.

**PHYLLIS DEANE'S VIEW** (from Deane and Cole, *British Economic Growth, 1688-1959*, Cambridge, 1968):

**Net Domestic Capital Formation as a Percentage of NDCF**:

| | |
|---|---|
| **1700 - 1760** | 3% - 5% of NDCF |
| **1760 - 1780** | 5% - 6% of NDCF |
| **1780 - 1800** | 6% - 8% of NDCF |
| **1800 - 1830** | 8% - 10% of NDCF |
| **1830 - 1850** | 10% - 12%+ of NDCF |

**Table 3.**

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**Source:** Phyllis Deane and W.A. Cole, *British Economic Growth, 1688 - 1959* (Cambridge, 1960), p. 234.

**Table 4:** **OCEAN SHIPPING**

**Atlantic Ocean Liners in 1838 and 1907**

| | **Sirius** | **Mauritania** |
|---|---|---|
| **Year** | **1838** | **1907** |
| **tonnage** | 700 | 31,938 |
| **horsepower*** | 320 | 70,000 |
| **speed in knots** | 7.5 | 25.0 |
| **material** | wood | steel |
| **engines** | paddle and sail | quadruple screws with steam-turbine |
| **time to cross Atlantic** | 16 days | 4 days and 11 hours |

* horsepower: 750 watts

## THE ECONOMIC IMPACT OF RAILROADS AND STEAM SHIPPING

### Upon the British Economy, 1830 - 1914

<table>
<tr><td></td><td>Lower Transport Costs</td><td rowspan="3"></td><td>Speed and Reliability</td><td></td><td>Commun-ications: Telegraph (1838)</td></tr>
<tr><td>cheaper raw materials</td><td>cheaper foodstuffs</td><td>more social mobility</td><td>smaller inventories</td><td>better market information</td></tr>
<tr><td colspan="2">Lower production costs & prices of marketable outputs</td><td>more elastic labour supply</td><td colspan="2">capital savings: on working capitals ➔ more fixed capital</td></tr>
<tr><td colspan="2">MARKET EXPANSION by area & income ranges</td><td colspan="2">More commercialized AGRICULTURE ➔ rising productivity per unit of labour and per unit of land</td><td>Agricultural Mechan-ization</td><td>Relative Shift to Livestock and More Specialized Crops</td></tr>
<tr><td colspan="2">REGIONAL SPECIALIZATION and destruction of local monopolies</td><td colspan="2">URBANIZATION: more and larger cities and towns</td><td colspan="2">Transfer of Labour, Capital, Resources into Industry, Commerce & Finance</td></tr>
<tr><td colspan="2">More internationally-oriented specialization in industry, shipping, and finance</td><td colspan="2">cheaper CAPITAL GOODS: i.e., lower costs of plant and machinery with greater efficiencies & productivity</td><td colspan="2">RISING REAL INCOMES: increases in relative demand for livestock products, commercial crops, industrial goods</td></tr>
<tr><td colspan="2">INCREASES IN FOREIGN TRADE: cheaper imports, more exports; exports of railway iron and rolling stock and ships</td><td colspan="2">INCREASES IN INDUSTRIAL SCALE: in Manufacturing Industry and Transport ➔ increased mechanization of industry</td><td colspan="2">INCREASING LIVING STANDARDS ➔ fall in mortality ➔ population growth</td></tr>
<tr><td colspan="2">Increased revenues from banking, insurances, shipping, and overseas investment incomes</td><td colspan="2">Increased capital investments: at home and abroad</td><td colspan="2">Increased tempo of innovations in industry, commerce, and finance</td></tr>
</table>

**A challenge to the student:** draw the arrows to link the boxes together, to demonstrate backward and forward linkages, and interrelationships.

**APPENDIX:**

**THOMAS BRASSEY (1805-1870) AND 19TH-CENTURY RAILWAY CONSTRUCTION**

**From Answers.com and Wikipedia:**

Thomas Brassey (7 November 1805 – 8 December 1870) was an English civil engineering contractor and manufacturer of building materials who was responsible for building much of the world's railways in the 19th century. By 1847, he had built about one-third of the railways in Britain, and by time of his death in 1870 he had built one in every twenty miles of railway in the world. This included three-quarters of the lines in France, major lines in many other European countries and in Canada, Australia, South America and India. He also built the structures associated with those railways, including docks, bridges, viaducts, stations, tunnels and drainage works.

As well as railway engineering, Brassey was active in the development of steamships, mines, locomotive factories, marine telegraphy, and water supply and sewage systems. He built part of the London sewerage system, still in operation today, and was a major shareholder in Brunel's The Great Eastern, the only ship large enough at the time to lay the first transatlantic telegraph cable across the North Atlantic, in 1864.

**Background**

The Brassey family traced themselves back to a Norman ancestor from the town of Brécey in Lower Normandy who crossed to England with William the Conqueror in 1066.[1] Initially their home was at Bulkeley, near Malpas in Cheshire, where they lived for nearly 600 years. At some time, and certainly by 1663, the family moved to Manor Farm in Buerton, a small settlement in the parish of Aldford, 6 miles (10 km) south of Chester.[2] Thomas Brassey was the eldest son of John Brassey, a prosperous farmer, and his wife Elizabeth.[3]
Early years

Thomas Brassey was educated at home until the age of 12, when he was sent to a boarding school in Chester. Aged 16, he became an articled apprentice to a land surveyor and agent, William Lawton. Lawton was the agent of Francis Richard Price of Overton, Flintshire. During the time Brassey was an apprentice he helped to survey the new Shrewsbury to Holyhead road (this is now the A5), assisting the surveyor of the road. While he was engaged in this work he met the engineer for the road, Thomas Telford. When his apprenticeship ended at the age of 21, Brassey was taken into partnership by Lawton, forming the firm of "Lawton and Brassey". Brassey moved to Birkenhead where their business was established. Birkenhead at that time was a very small place; in 1818 it consisted of only four houses. The business flourished and grew, extending into areas beyond land surveying. At the Birkenhead site a brickworks and lime kilns were built. The business either owned or managed sand and stone quarries in Wirral. Amongst other ventures, the firm supplied the bricks for building the custom house for the port which was developing in the town. Many of the bricks needed for the growing city of Liverpool were supplied by the brickworks and Brassey devised new methods of transporting his materials, including a system similar to the modern method of palletting, and using a gravity train to take materials from the quarry to the port. When Lawton died, Brassey became sole manager of the company and sole agent and representative for Francis Price. It was during these years that he gained the basic experience for his future career.[4]

**Early contracts in Britain**

Brassey's first experiences of civil engineering were the construction of 4 miles (6 km) of the New Chester Road at Bromborough,[5] and the building of a bridge at Saughall Massie, on the Wirral.[6] During that time he met George Stephenson, who needed stone to build the Sankey Viaduct on the Liverpool and Manchester Railway. Stephenson and Brassey visited a quarry in Storeton, a village near Birkenhead, following which Stephenson advised Brassey to become involved in building railways. Brassey's first venture into railways was to submit a tender for building the Dutton Viaduct on the Grand Junction Railway, but he lost the contract to William Mackenzie, who had submitted a lower bid.[7] In 1835 Brassey submitted a tender for building the Penkridge Viaduct, further south on the same railway, between Stafford and Wolverhampton, together with 10 miles (16 km) of track. The tender was accepted, the work was successfully completed, and the viaduct opened in 1837. Initially the engineer for the line was George Stephenson, but he was replaced by Joseph Locke, Stephenson's pupil and assistant. During this time Brassey moved to Stafford. Penkridge viaduct still stands and carries trains on the West Coast Main Line.[8]

On completion of the Grand Junction Railway, Locke moved on to design part of the London and Southampton Railway and encouraged Brassey to submit a tender, which was accepted. Brassey undertook work on the section of the railway between Basingstoke and Winchester, and on other parts of the line.[9] The following year Brassey won contracts to build the Chester and Crewe Railway with Robert Stephenson as engineer and, with Locke as the engineer, the Glasgow, Paisley and Greenock Railway and the Sheffield and Manchester Railway.[10]

**Early contracts in France**

Following the success of the early railways in Britain, the French were encouraged to develop a railway network, in the first place to link with the railway system in Britain. To this end the Paris and Rouen Railway Company was established, and Locke was appointed as its engineer. He considered that the tenders submitted by French contractors were too expensive, and suggested that British contractors should be invited to tender. In the event only two British contractors took the offer seriously, Brassey and William Mackenzie. Instead of trying to outbid each other they tendered jointly, and their tender was accepted in 1841. This set a pattern for Brassey, who from then on worked in partnership with other contractors in most of his ventures. Between 1841 and 1844 Brassey and Mackenzie won contracts to build four French railways, with a total mileage of 437 miles (703 km), the longest of which was the 294-mile (473 km) Orléans and Bordeaux Railway.[11] Following the French revolution of 1848 there was a financial crisis in the country and investment in the railways almost ceased. This meant that Brassey had to seek foreign contracts elsewhere.[12]
Barentin Viaduct after rebuilding

**The collapse of the Barentin viaduct**

In January 1846, during the building of the 58-mile (93 km) long Rouen and Le Havre line, one of the few major structural disasters of Brassey's career occurred, the collapse of the Barentin Viaduct. The viaduct was built of brick at a cost of about £50,000 and was 100 feet (30 m) high. The reason for the collapse was never established, but a possible cause was the nature of the lime used to make the mortar. The contract stipulated that this had to be obtained locally, and the collapse occurred after a few days of heavy rain. Brassey rebuilt the viaduct at his own expense, this time using lime of his own choice. The rebuilt viaduct still stands and is in use today.[13]
"Railway mania"

During the time Brassey was building the early French railways, Britain was experiencing what was known as the "railway mania", when there was massive investment in the railways. Large numbers of lines were being built, but not all of them were built to Brassey's high standards. Brassey was involved in this expansion but was careful to choose his contracts and investors so that he could maintain his standards.[14] During the one year of 1845 he agreed no less than nine contracts in England, Scotland and Wales, with a mileage totalling over 340 miles (547 km).[15] In 1844 Brassey and Locke began building the Lancaster and Carlisle Railway of 70 miles (113 km), which was considered to be one of their greatest lines. It passed through the Lune Valley and then over Shap Fell. Its summit was 916 feet (279 m) high and the line had steep gradients, the maximum being 1 in 75. To the south the line linked by way of the Preston–Lancaster line to the Grand Junction Railway.[16] Two important contracts undertaken in 1845 were the Trent Valley Railway of 50 miles (80 km) and the Chester and Holyhead line of 84 miles (135 km). The former line joined the London and Birmingham Railway at Rugby to the Grand Junction Railway south of Stafford providing a line from London to Scotland which bypassed Birmingham. The latter line provided a link between London and the ferries sailing from Holyhead to Ireland and included Robert Stephenson's tubular Britannia Bridge over the Menai Strait. Also in 1845 Brassey received contracts for the Caledonian Railway which linked the railway at Carlisle with Glasgow and Edinburgh, covering a total distance of 125 miles (201 km) and passing over Beattock Summit. That same year he also began contracts for other railways in Scotland, and in 1846 he started building parts of the Lancashire and Yorkshire Railway between Hull and Liverpool, across the Pennines.[17]

A contract for the Great Northern Railway was agreed in 1847, with William Cubitt as engineer-in-chief, although much of the work was done by William's son Joseph, who was the resident engineer. Brassey was the sole contractor for the line of 75.5 miles (122 km). A particular problem was met in the marshy country of The Fens in providing a firm foundation for the railway and associated structures. Brassey was assisted in solving the problem by one of his agents, Stephen Ballard. Rafts or platforms were made of layers of faggot-wood and peat sods. As these sank, they dispersed the water and so a firm foundation was made.[18] This line is still in use and forms part of the East Coast Main Line. Also in 1847 Brassey began to build the North Staffordshire Railway. By this time the "railway mania" was coming to an end and contracts in Britain were becoming increasingly more difficult to find.[19] By the end of the "railway mania", Brassey had built one-third of all the railways in Britain.[20]
Expansion in Europe

Following the end of the "railway mania" and the drying up of contracts in France, Brassey could have retired as a rich man. Instead he decided to expand his interests, initially in other European countries. His first venture in Spain was the Barcelona and Mataró Railway of 18 miles (29 km) in 1848. In 1850 he undertook his first contract in the Italian States, a short railway of 10 miles (16 km), the Prato and Pistoia Railway. This was to lead to bigger contracts in Italy, the next being the Turin–Novara line of 60 miles (97 km) in 1853, followed by the Central Italian Railway of 52 miles (84 km). In Norway, with Sir Morton Peto and Edward Betts, Brassey built the Oslo to Bergen Railway of 56 miles (90 km) which passes through inhospitable terrain and rises to nearly 6,000 feet (1,829 m). In 1852 he resumed work in France with the Mantes and Caen Railway of 133 miles (214 km) and, in 1854, the Caen and Cherbourg Railway of 94 miles (151 km). The Dutch were relatively slow to start building railways but in 1852 with Locke as engineer, Brassey built the Dutch Rhenish Railway of 43 miles (69 km). Meanwhile he continued to build lines in England, including the Shrewsbury and Hereford Railway of 51 miles (82 km), the Hereford, Ross and Gloucester Railway of 50 miles (80 km), the London, Tilbury and Southend Railway of 50 miles (80 km) and the North Devon Railway from Minehead to Barnstaple of 47 miles (76 km).[21]

**The Grand Trunk Railway of Canada**

In 1852 Brassey took out the largest contract of his career, which was to build the Grand Trunk Railway of Canada. This line passed from Quebec, along the valley of the Saint Lawrence River, and then to the north of Lake Ontario to Toronto. The line totalled 539 miles (867 km) in length. The consulting engineer for the

project was Robert Stephenson and the company's engineer for the whole undertaking was Alexander Ross. Brassey worked in partnership with Peto, Betts and Sir William Jackson. The line crossed the river at Montreal by the Victoria Bridge. This was a tubular bridge designed by Robert Stephenson and was the longest bridge in the world at the time, measuring some 1.75 miles (3 km). The bridge opened in 1859 and the formal opening ceremony was carried out the following year by the Prince of Wales.[22] The construction of the line caused considerable problems. The main problem was the raising of the necessary finance and at one stage Brassey travelled to Canada to appeal personally for assistance. Other difficulties arose from the severity of the Canadian winter, the waterways being frozen for around six months each year, and resistance from Canadian businessmen. The line was an engineering success but a financial failure, with the contractors losing £1 million.[23]
The Canada Works

The contract for the Grand Trunk Railway included all the materials required for building the bridge and the railway, including the rolling stock. In order to manufacture the metallic components, Brassey built a new factory in Birkenhead which he called The Canada Works. A suitable site was found by George Harrison, Brassey's brother-in-law, and the factory was built with a quay alongside to take ocean-going ships. The works was managed by George Harrison with a Mr. Alexander and William Heap as assistants. The machine shop was 900 feet (274 m) in length and included a blacksmiths' shop with 40 furnaces, anvils and steam hammers, a coppersmiths' shop, and fabrication, woodwork and pattern shops. There was also a well-stocked library and a reading room for all the workforce.

The fitting shop was designed to manufacture 40 locomotives a year and a total of 300 were produced in the next eight years. The first locomotive, given its trial in May 1854, was named Lady Elgin, after the wife of the Governor General of Canada of the time, the Earl of Elgin. For the bridge hundreds of thousands of components were required and all were manufactured in Birkenhead or in other English factories to Brassey's specifications. These were all stamped and coded, loaded into ships to be taken to Quebec and then by rail to the site of the bridge for assembly.[24] The central tube of the bridge contained over 10,000 pieces of iron, perforated by holes for half a million rivets, and when it was assembled every piece and hole was true.[25]

**The Grand Crimean Central Railway**

Brassey played a part in helping the English forces to success in the Crimean War. The Black Sea port of Sevastopol was held by the Russians. The British government, in alliance with the French and the Turks, sent an army of 30,000 to Balaclava, another port in a neighbouring bay of the Black Sea, from which to attack Sevastopol. Sevastopol was besieged in September 1854 by the British and allied forces. It was hoped that the siege would be short but with the coming of winter the conditions were appalling and it was proving difficult to transport clothing, food, medical supplies and weaponry from Balaclava to the front.[26] When news of the problem arrived in Britain, Brassey joined with Peto and Betts in offering to build a railway at cost in order to transport these necessary supplies. They shipped out the equipment and materials for building the railway, which had been intended for other undertakings, together with an army of navvies to carry out the work.[27] Within seven weeks, in severe winter conditions, the railway from Balaclava to the troops besieging Sevastopol was completed.[28] It then became possible to move supplies easily to the front and Sevastopol was finally taken in September 1855.[29]

**Worldwide expansion**

In addition to building more railways in Britain and in other European countries, Brassey undertook contracts in other continents. In South America his railways totalled 250 miles (402 km), in Australia 132 miles (212 km), and in India and Nepal 506 miles (814 km).[30]

In 1866 there was a great economic slump, caused by the collapse of the bank of Overend, Gurney and Company, and many of Brassey's colleagues and competitors became insolvent. However, despite setbacks, Brassey survived the crisis and drove ahead with the projects he already had in hand. These included the Lemberg and Czernowicz Railway in Austria which continued to be constructed despite the Austro-Prussian War which was taking place in the locality.[31]

From 1867 Brassey's health was beginning to decline, but he continued to negotiate further contracts, including the Czernowicz and Suczawa Railway in the Austrian Empire. In 1868 he suffered a mild stroke but he continued to work and in April 1869 he embarked on an extensive tour of over 5,000 miles (8,000 km) in Eastern Europe.[32] By the time of his death he had built one mile in every twenty miles of railway in the world.[33]

**Non-railway contracts**

Brassey's works were not limited to railways and associated structures. In addition to his factories in Birkenhead, he built an engineering works in France to supply materials for his contracts there. He built a number of drainage systems, and a waterworks at Calcutta. Brassey built docks at Greenock, Birkenhead, Barrow-in-Furness and London. His London docks were the Victoria Docks which had a water area of over 100 acres (40 ha). The contract for this was agreed in 1852 in partnership with Peto and Betts and the docks were opened in 1857. Also included in the contract were warehouses and wine vaults totalling an area of about 25 acres (10 ha). The dockside machinery was worked by hydraulic power supplied by William Armstrong. The dock had links to Brassey's London, Tilbury and Southend Railway and thereby to the entire British rail system.[34]

In 1861 Brassey built part of the London sewerage system for Joseph Bazalgette. This was a stretch of the Metropolitan Mid Level Sewer of 12 miles (19 km) which started at Kensal Green, passed under Bayswater Road, Oxford Street and Clerkenwell to the River Lea. It was one of the earliest ventures to use steam cranes. The undertaking was considered to have been one of Brassey's most difficult.[35] The sewer is still in operation today. He also worked with Bazalgette to build the Victoria Embankment on the north bank of the River Thames from Westminster Bridge to Blackfriars Bridge.[36]

Brassey gave financial help to Brunel to build his ship The Leviathan, which was later called The Great Eastern and which in 1854 was six times larger than any other vessel in the world. Brassey was a major shareholder in the ship and after Brunel's death, he, together with Gooch and Barber, bought the ship for the purpose of laying the first Transatlantic telegraph cable across the North Atlantic in 1864.[37]

Brassey had other ideas which were ahead of his time. He tried to interest the governments of the United Kingdom and Europe in the idea of a tunnel under the English Channel but this came to nothing. He also wanted to build a canal through the Isthmus of Darién (now the Isthmus of Panama) but this idea similarly had no success.[38]

**Working methods**

In most of Brassey's contracts he worked in partnership with other contractors, in particular with Peto and Betts. The planning of the details of the projects was done by the engineers. Sometimes there would be a consulting engineer and below him another engineer who was in charge of the day-to-day activities. During his career Brassey worked with many engineers, the most illustrious being Robert Stephenson, Joseph Locke and Isambard Kingdom Brunel.[39] The day-to-day work was overseen by agents, who managed and controlled the activities of the subcontractors.[40]

The actual work was done by labourers, in those days known as navvies, supervised by gangers (or foremen). In the early days the navvies were mainly English and many of them had formerly worked on building the canals. They were later joined by men from Scotland, Wales and Ireland. The number of Irish workers particularly increased following the potato famine. Brassey paid his navvies and gangers a wage and provided food, clothing, shelter and, in some projects, a lending library. On overseas contracts local labour would be used if it were available, but the work was often done or supplemented by British workers. The agent on the site had overall responsibility for a project. He had to be a man of great capability, working for a fee plus a percentage of the profits, with penalties for late finishing and inducements to complete the work early.[41]

Brassey had considerable skill in choosing good men to work in this way and in delegating the work. Having taken on a contract at an agreed price he would make a suitable sum of money available to the agent to meet the costs. If the agent were able to fulfil the work at a lower cost he could keep the remainder of the money. If unforeseen problems arose and these were reasonable, Brassey would cover these additional costs. He used hundreds of such agents.[42] At the peak of his career, for well over 20 years, Brassey was employing on average some 80,000 people in many countries in four continents.[43]

Despite this he had neither an office nor office staff, dealing with all the correspondence himself. Much of the detail of his works were held in his memory. He travelled with a personal valet and later had a cashier. But all his letters were written by him; it is recorded that on one occasion after the rest of his party had gone to bed, 31 letters had been written by Brassey overnight.[44] Although he won a large number of contracts, his bids were not always successful. It has been calculated that for every contract awarded, around six others had been unsuccessful.[39]

Brassey was given a number of honours to celebrate his achievements, including the French Légion d'honneur, the Italian Order of Saints Maurice and Lazarus and the Austrian Iron Crown (the first time this had been awarded to a foreigner).[45]
Family

In his early days in Birkenhead, Brassey came into contact with Joseph Harrison, a forwarding and shipping agent. In 1831 he married Harrison's second daughter, Maria.[7] They had three sons, Thomas was born in 1836, Henry in 1840 and Albert in 1844; a fourth son died in infancy.[46] Maria gave Thomas considerable support and encouragement throughout his career. She encouraged him to bid for the contract for Dutton Viaduct and, when that was unsuccessful, to apply for the next available contract.[47] Thomas' work led to frequent moves of home in their early years; from Birkenhead to Stafford, Kingston upon Thames, Winchester and then Fareham. On each occasion Maria supervised the packing of their possessions and the removal. The Harrison children had been taught to speak French, while Thomas himself was unable to do so. Therefore when the opportunity arose to apply for the French contracts, Maria was willing to act as interpreter and encouraged Thomas to bid for them. This resulted in moves to Vernon in Normandy, then to Rouen, on to Paris and back again to Rouen.[48] Thomas refused to learn French and Maria acted as interpreter for all his French undertakings.[49] Maria organised the education of their three sons. In time the family established a more-or-less permanent base in Lowndes Square, Belgravia, London.[50]

Brassey's three surviving sons all gained distinction in their own right. Thomas became a Liberal Member of Parliament and Governor of Victoria and was created Earl Brassey in 1911. Henry was Liberal Member of Parliament Member of Parliament for Hastings. His son Henry, a Conservative, was created Baron Brassey of Apethorpe in 1938. Albert was a Conservative Member of Parliament for Banbury.

**Later years**

In 1870 Brassey was told that he had cancer but he continued to visit his working sites. One of his last visits was to the Wolverhampton and Walsall Railway, only a few miles from his first railway contract at Penkridge.[51] In the late summer of 1870 he took to his bed at his home in St Leonards-on-Sea. There he was visited by members of his work force, not only his engineers and agents, but also his navvies, many of whom had walked for days to come and pay their respects.[32]

Also in 1870, Brassey purchased Heythrop Park, a baroque house situated in an estate of 450 acres (1.8 km2) 15 miles (24 km) northeast of Oxford as a wedding present for his third son, Albert.[52]

On 8 December 1870 Thomas Brassey died from a brain haemorrhage in Victoria Hotel, St Leonards and was buried in the churchyard at Catsfield, Sussex where a memorial stone has been erected. His estate was valued at £5,200,000[53] which consisted of "under £3,200,000 in UK" and "over £2,000,000" in a trust fund. The Oxford Dictionary of National Biography describes him as "one of the wealthiest of the self-made Victorians".[54]

It is not easy to be objective about the nature of Thomas Brassey's character because the earliest biography by Helps was commissioned by the Brassey family and the latest, rather short, biography was written by his great-great-grandson, Tom Stacey. There is virtually no remaining material of value to a biographer available today. There is no private correspondence, there are no diaries and none of his personal reminiscences.[43]

Judging by his achievements alone, he must have been a remarkable man. He had enormous drive, an ability to remain calm despite enormous pressures, and extreme skill in organisation. He was a man of honour who always kept his word and his promise. He had no interest in public honours and refused invitations to stand for Parliament. Although he accepted honours from France and Austria, he mislaid the medals and had to request duplicates to please his wife.[55] His great-great-grandson considers that he was successful because he inspired people rather than drove them.[56]

Walker, in his 1969 biography, tried to make an accurate assessment of Brassey using Helps and other sources. He found it difficult to discover anyone who had a bad word to say about him, either during his life or since.[57] Brassey expected a high standard of work from his employees; Cooke states that his "standards of quality were fastidious in the extreme".[58] There can be no doubt about some of his qualities. He was exceptionally hardworking, and had an excellent memory and ability to perform mental arithmetic. He was a good judge of men, which enabled him to select the best people to be his agents. He was scrupulously fair with his subcontractors and kind to his navvies, supporting them financially at their times of need.[59] He would at times undertake contracts of little benefit to himself in order to provide work for his navvies.[60] The only faults which his eldest son could identify were a tendency to praise traits and actions of other people he would condemn in his own family, and an inability to refuse a request.[61] No criticism of him could be found from the engineers with whom he worked, his business associates, his agents or his navvies. He paid his men fairly and generously.[62]

The Oxford Dictionary of National Biography states "His greatest achievement was to raise the status of the civil engineering contractor to the eminence already attained in the mid-nineteenth century by the engineer".[54] Walker regards him as "one of the giants of the nineteenth century".[20]

**Commemorations**

None of his three sons became involved in their father's work and the business was wound up by administrators. The sons created a memorial to their parents in St Erasmus' Chapel in Chester cathedral. This consists of a backcloth to the altar inscribed to their parents' memory, and a bust of their father to the north of the altar.[63] The memorial is by Sir Arthur Blomfield and the bust by M. Wagmiller.[64] There is also a bust of Thomas in Chester's Grosvenor Museum and plaques to his memory in Chester station. Streets named after him in Chester are Brassey Street and Thomas Brassey Close (which is off Lightfoot Street).[65]

In November 2005, Penkridge celebrated the bicentenary of Brassey's birth[66] and a special commemorative train was run from Chester to Holyhead.[65] In January 2007, children from Overchurch Junior School in Upton celebrated the life of Brassey.[67] In April 2007 a plaque was placed on Brassey's first bridge at Saughall Massie.[68] In the village of Bulkeley, near Malpas, Cheshire, is a tree called the 'Brassey Oak' on land once owned by the Brassey family. This was planted to celebrate Thomas' 40th birthday in 1845. It was surrounded by four inscribed sandstone pillars tied together by iron rails but due to the growth of the tree these have burst and the stones have fallen. They have been recovered and in 2007 were replaced in a more accessible place with an information board.[69]