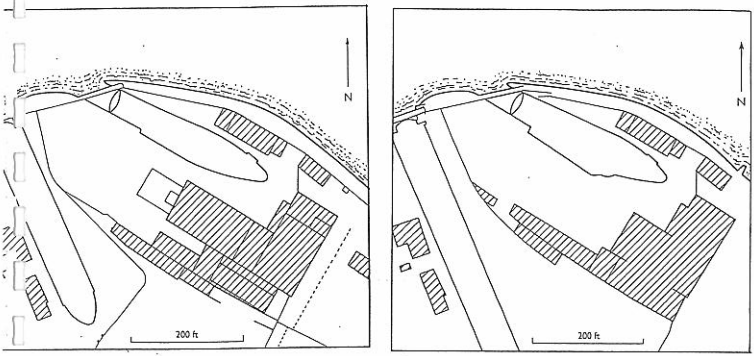
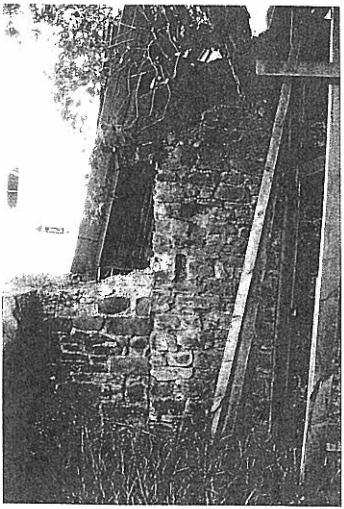


[44] *The S boundary wall in 1855 and after the 1872 boundary change. Based on BRO 40860/65, 66 & BRO 37075/32, redrawn to the same scale by Rupert Ford*



[45] *Walling, possibly 1840s, projecting off the S boundary masonry wall & containing a blocked stone arch.*

feature. Until that occurs, it is suggested that it might be part of the GWSSC east/west through route, extending from the works entrance, south of the factory building to the open area of the site to east. At the extreme east end, the masonry wall gives way to the north end wall of the malthouse, built of relatively poor quality brick, as though it originally butted up against a structure on the GWSSC side of the boundary.

Gas Ferry Road: the east boundary

Gas Ferry Road demarcates the west and east portions of the site. The boundary with the road today is mostly the east wall of the north/south range of the factory, which has an entrance to the Wickham and Norris yard to its south. South of the entrance the boundary to the road is a tall section of roofless red brick walling including unglazed window embrasures.

There was a road here in 1832, but it was private, giving access from Cumberland Road to the site. George Hillhouse, who built a house off the west side of the road had to pay 6d *per annum* for liberty of ingress and egress and the right to place a doorway from his property to this road (BRO, 36075/24a, 24b). The 1841 tithe map shows a route, but probably not a road, north from Cumberland Road to the perimeter of what was the dockyard site. There is no route shown through the site and down to the harbour. The access from Cumberland Road was improved for the floating out when Prince Albert arrived by road, from Temple Meads station. The *Bristol Mirror* reported on 15 July 1843: 'On entering the yard at the small gateway hitherto used, we saw labourers actively engaged in forming a road for a grand entrance' so that the royal party would not be inconvenienced by a narrow & confined path.

In 1840 the gasworks on the opposite side of the harbour was developed and in 1844 a tender for constructing a landing place opposite for the gas ferry was accepted (Bristol RO, 28777(2) a, 262). Users of the ferry must have then walked either way down the towpath and not through the dockyard site.

19th century Bristol Directories do not list Gas Ferry Road, listing businesses either under 'Cumberland Road' or 'Wapping'. When the malthouse was built in 1895, the portion of the road in front was still shown on a plan as a private road (Bristol RO 36075/29)[12].

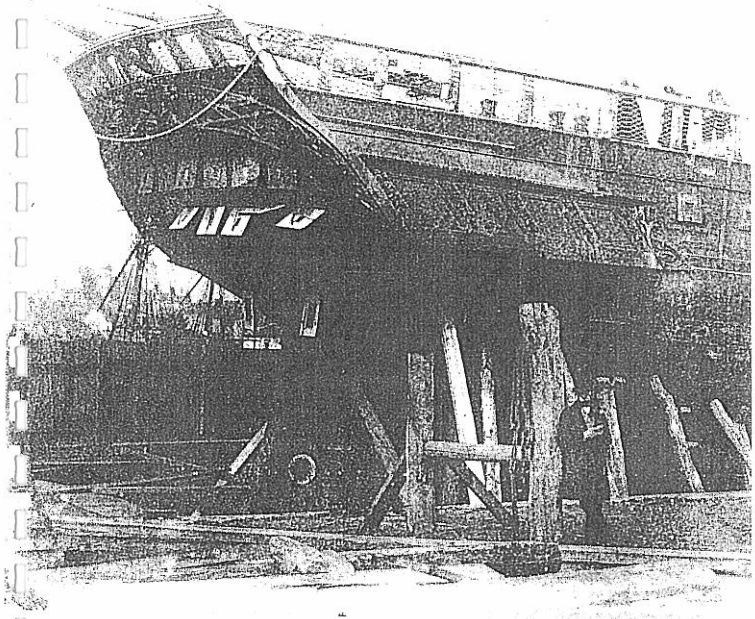
By 1922 pressure on the north end of the road, down to the harbour, must have been intense. By this stage motor vehicles were being used by some of the various companies working out of the site. Access was required into the now-constricted site of the dock by Jefferies, Wickham and Norris (whose office and yard were divided), and possibly by Stothert too. In addition, both the GWR, occupying the land to the east (the harbour railway) and Bristol Corporation required access to the Floating Harbour. The latter two had a legal dispute in 1922: 'as to the width or extent of land of the company over which the Corporation enjoy a right of way to and from the said Dry Dock premises of the Corporation & to and from the towing path & the Public Ferry'.

Today Gas Ferry Road is designed for vehicles, extending down towards the Floating Harbour before turning east into a car park which occupies part of the east portion of the GWSSC dockyard.

The Floating Harbour as an outer north boundary

Wapping Wharf wall, quays and boundaries are listed Grade II.

The construction of the wharf wall to the Floating Harbour alongside the site was undertaken by the city in c.1874-1876, who provided it under Acts of 1866 and 1869 while the Bristol Harbour Railway was being constructed by the Great Western Railway Company and the Bristol and Exeter Railway Company (Macdermot & Clinker, 1964, 92-93). Before that date, the edge seems to have been less well-defined. There was a towpath at least from the creation of the Floating Harbour, but it was probably less important for towing after the 1830s when horses were largely replaced by steam tugs.



[46] *A photograph of between 1853 & 1855, showing the timber boundary between the dock & the towpath and Floating Harbour in Patterson's day, V&A, Ph. 38-1983. © V&A Picture Library,*

The results of a diving survey by Wessex Archaeology and their report, 'SS Great Britain Project: Great Western Dry Dock and Quayside, Archaeological Appraisal', 44626.01 (February 1998) indicates the presence of possible former piles somewhat north of the existing wharf edge. Charcoal-hardened piles (with hard core behind) removed during dredging works in September 1998 (noted by Matthew Tanner) may date from Jessop's work or before. An 1853 painting in the Bristol Museum and Art Gallery, showing the *Demerara* in the Great Western Dock shows the north projection of the Great Western Dock piled with irregularly-spaced vertical timbers, the level of the edge of the harbour dropping down to its east (watercolour by George Wolfe, dated 1853 (BMAG, K111O)). A Wickham and Norris publication of c.1935 refers to two deep water berths on the east portion of the site: 'giving room for two steamers' (c.1935, 7) which, in conjunction with the railway sidings of the harbour railway, made the transference of goods from ship to rail economic. These berths are likely to have been constructed by the Bristol City Council in c.1876.

The GWSSC north boundary

There is no clear illustrative evidence for the physical form of this boundary between 1839 and 1843. Illustrations of the floating out of the *Great Britain* are unreliable. At the 1849 GWSSC AGM (RAIL 1149/60) the directors reported that they had had to make good the towing path in front of the works which had been encroached upon at the time of launching the *Great Britain*', and been compelled 'to throw back the Fence'. This does suggest that their north boundary had always been a fence and possibly a vertical butted timber arrangement, with wide planks, which seems to have been the site boundary in 1853 (BMAG, watercolour K111O). An 1850s photograph of the west end of the dock shows the boundary fence quite clearly as wide butted planks against a structure of thick posts at intervals with a sole plate and two ledges [46]. This seems still to have been the boundary type by the 1890s, judging from photographs e.g BIM, Keen 15/57.

The c.1903 & 1914 dock boundaries

In c.1903 the City proposed a new boundary fence which ran inside the existing buildings on the north side, including the old dock office. While this allowed the City to provide Wickham and Norris with an office and timber yard, there were access problems associated with a change of use that disconnected the dockyard buildings from the dock they had serviced. Wickham and Norris had to get round the east end of the dock to move between their office and yard. The City had extended the dock further to the east, which made matters worse. The east end was also the only point of access to the dock itself from the land, unless the towpath and swing bridge were used, less suitable for bringing goods onto the dockside by road or rail.

The solution was a curved brick wall round the nose of the dock. Two gateways in straight returns alongside the curve gave access to the north and south sides of the dock, which had a narrow inner walkway round the nose. Access to the gateways into the dock was via a kind of open air lobby, formed between the north end of the factory and the plot of land to the north, adjacent to the towpath. Wickham and Norris could cross this space from north to south through additional gates into this lobby on the north and south sides and secure their office and timber yard behind locked gates. The open air lobby must have been horribly busy at times with a lot of very inconvenient gate-shutting and opening for the timber merchants.

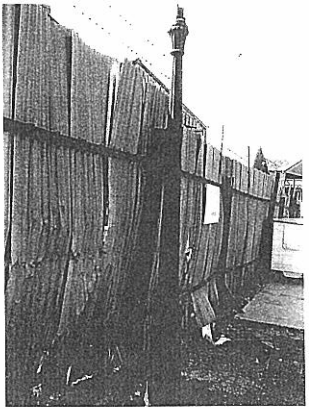
Judging from photographs, the new south boundary of the dock was not built until the Jefferies range was constructed c.1914-1919 (BIM, York, photograph of *Asnières* in the Albion Dock). Whether the new boundary proposed in c.1903 inside the old buildings on the north side was ever erected is uncertain. The outer boundary, to the towpath may have simply been kept. It seems clear that Bristol City Council used the old north wall of a demolished building as a masonry boundary

wall to the towpath, supplemented by the 1890s boundary, this is probably shown, although difficult to make out, in a photograph of c.1918, (BIM, Keen 19/110).

The inner dock boundaries today include the buttressed curved section of brick walling round the nose of the dock, with bullnose brick coping. On the south side the boundary is a motley affair, partly composed of horizontal planks, partly of corrugated iron with strands of barbed wire over, set against posts of recycled rails [47]. A 1930 plan accompanying an agreement of 31 December (Tucketts) shows that a 'hauling way' existed for the timber yard, between this boundary and the old dockyard buildings to S. The hauling way roof was supported on piers/buttresses to the tight south boundary of the dry dock and a surviving brick pier (out of true) must be a remnant of that arrangement.

East of the dock office the existing boundary mostly consists of gateway (probably to transfer timber to and from berthed ships), a wide gate of slender vertical posts, partly lined on the inner face and a small gateway of similar construction, the gate hung off a stout vertical post with a triangular head. West of the existing range on the north side of the dock the boundary is a slight timber fence with wire netting. Wire netting also makes up the boundary with the Albion dockyard at the west end of the site. West of the Jefferies range the boundary with the timber yard is slender vertical planks.

Here and there on site, thick stout planks with triangular heads are used for hanging gates. These may be remnants of former boundary fences. The ladies lavatory on site also includes planking that may have been recycled from the boundary.



[47] *The inner dock boundary (S side) in 1998.*

3.6 - Demolished buildings

A number of buildings are known only from documentary evidence. Their former existence has implications regarding any proposed below-ground disturbance on site.

3.6.1 Pre-GWSSC

A house with outhouses and a garden had been built on the site by 1768 (BRO, EP/E/18/1). This is shown in a painting of c.1800 (BMAG, M5245). Later buildings, associated either with the late 18th century brickworks or the market garden on site are known from map evidence [e.g. 3 & 4].

3.6.2 During the occupancy of the GWSSC

Buildings on site during the occupancy of the GWSSC are known from the tithe map surveyed 1841 [5] and the Ashmead map of 1846 [29]

Gasometer? c.1841-at least c.1855

The tithe map [5] includes a round structure immediately adjacent to the factory. This is suspected to have been a gasometer as the GWSSC dockyard is known to have been gas-lit although a better interpretation might be found. Stephen Hutchinson patented a gasometer in October 1833, Patent 6486. The dimensions on the tithe map are similar to a gasometer installed in the contemporary Great Peter Street gasworks at Westminster. A round building shown on an engraving of the floating out of the *Great Britain* [19] might be the same structure, although it seems to be sited too far south and to be too small for the building shown on the tithe map. It has a post rising from the apex of the conical roof, supporting a disc or sphere. No round buildings are shown in the general area on the 1846 Ashmead map and without the advantage of early photographic evidence it would be assumed that the building had disappeared by 1846. However, a photograph of c.1853-55 [13], showing the *Demerara* in dock, clearly shows the round building (V&A, Ph. 56-1983). The post survives, in the photograph, somewhat truncated, with no disc/sphere.

Buildings on north side of dock

The tithe map of 1841 [5] shows two small buildings on the north perimeter of the site.

i) West Building (before 1841, gone by 1846)

The function of the westernmost building is not known, it may have been a dock office preceding the existing office, constructed between 1846 and 1855. It may, however, be the existing dock office, wrongly located on the tithe map. A building in this location is not shown on the 1846 Ashmead map

ii) Building range to East (possibly before 1841, altered, demolished c.1917)

A building is shown on this site on the 1855 Ashmead map [29] but by this date probably no longer part of the buildings associated with the dock, judging from the boundary shown between NW corner of old workshop and SW corner of building. By the date of the 1888 OS map [8] the building appears to have been somewhat rebuilt and deeper in plan and is rendered on the map as two separate blocks. Photographs show, on the same site, the western one as a 2-storey gabled building, probably masonry, with a slate roof [14]. The rear (north) elevation (BIM, York 3045) had five high-set windows. It had a roof projection, probably a ventilator rather than an axial stack.

The building beyond to east is had a timber projection on the first floor to the south for a hoist, and an external ladder to the first floor. Its north elevation is shown in a pre 1895 photograph of the gasworks ferry (BIM, York 3670). It had a first floor oriel window to east, overlooking the floating harbour.

Although shown on the 1918 OS map [8], a plan accompanying an agreement of 30 November 1917 shows the buildings have been demolished (Tucketts). The land in

question, 800 square yards, was to be let to Wickham & Norris by the GWR. The demolition retained the north masonry wall as a boundary wall to the towpath, because an agreement of December 31 1930 (Tucketts) gave Wickham & Norris permission to demolish a masonry wall and replace it with a fence with moveable sections (to the towpath). This was probably for loading timber.

iii) Building range on north side of dock added between 1841 & 1846, demolished c.1918.

Two buildings on the sites corresponding to those shown in late 19th century photographs, appear on the Ashmead map of 1846 [29] on the north side of the dock. They are not shown on the 1841 tithe map. Both had gone by the OS map of 1918. They must have been erected by the GWSSC and occupied the site now occupied by the entrance-cum-shop. By the late 19th century they comprised an east building of 2 storeys, with a timber-framed front (south) elevation and probably mass rear wall with a hipped tiled roof [14] & see BIM, Keen 56/116 for rear elevation. 4 skylights suggest the first floor was a working space perhaps a sail loft. The west building is shown in photographs as lower-roofed with a W gable end.

Buildings on the south boundary of the GWSSC yard, 1841-1998

The tithe map [5] shows a long thin building here in 1841, It might have been a ropery, or a sawmill. Discrepancies between the tithe map and the subsequent map series strongly suggest that the tithe surveyor may have been inaccurate covering this particular portion of the yard. By 1846 the Ashmead map [29] shows a much wider building on the same site, although this is incompatible with the tithe map rendering of the factory building. The two adjacent sheets of the 1855 Ashmead map do not square up with one another perfectly. However these historic cartographic problems are resolved, it seems that the building on the tithe map was either inaccurately surveyed, or had disappeared by 1846. If it was a matter of inaccurate survey, a somewhat wider, shorter building might have been in this location

By 1872, a plan accompanying a boundary change (likely to be accurate on the boundary, [44]) the wider shorter block on the Ashmead map had been rebuilt or extended to the west. A second small building on the south boundary has also appeared, to be divided by the boundary change between the Albion and old GWSSC dockyard. The boundary change draws a narrow building, on the north side of the boundary (Albion side) into the GWSSC yard. By 1883 (survey date of OS map, published 1885) the results of the boundary change are clearly visible (with the former Albion shed extended to west), but the divided shed at the west end has gone.

There was little change between 1883 and 1903. Judging from an undated but c.1903 BRO plan, the function of the buildings on the south boundary were saw pits (to west) and a boatbuilding shed (to east) with a boiler makers' shop abutting and north of these buildings.

Between 1903 & 1918, the range along the south boundary wall was reduced in scale. A plan of 1930 (accompanies agreement of 31 December 1930, Tucketts) indicates functions. From west to east these are shown as a timber shed (deep plan); manure and shavings; motor shed; stables; chaff house (in angle where boundary narrows); timber shed; mess room. All these buildings had gone by 1945-1952 [9] although there was a brick garage with an oil store off the south boundary. The subsequent surviving timber stores along the boundary are all post 1952 and described above in the section on the timber yard.

West/east range of the factory 1841-?

As explained in the section on the factory above, the west/east range shown on the tithe map is a puzzle. Below ground archaeology might provide some of the answers to the questions raised by the map evidence.

The swing bridge 1849-?1940/41

Map and photographic evidence identifies a former iron swing bridge carrying the towpath across the W end of the dock. This was not

built until the GWSSC were preparing to leave the site in 1849 and was built at the request of the Dock Company who required them to make good the towing path and fence and '...to erect a Bridge across the entrance of the Dock, at an expense of £141'. Between 1843 and 1849 the towpath must have been carried over the caisson on some temporary bridge, if it was not interrupted altogether. The directors commented that the provision of a

swingbridge was advantageous: 'as it renders great facilities to the Tenant in the landing and shipping of goods' (RAIL 1149/60, AGM of GWSSC, March 1849). The bridge is shown in several historic photographs of the site (e.g. BIM, Keen, Vol 35/123) and was a lattice girder type. It is shown on maps and plans into the 1930s. It is not shown on the Goad Fire Insurance plan of 1945/1952 [9] and may have disappeared during the war.

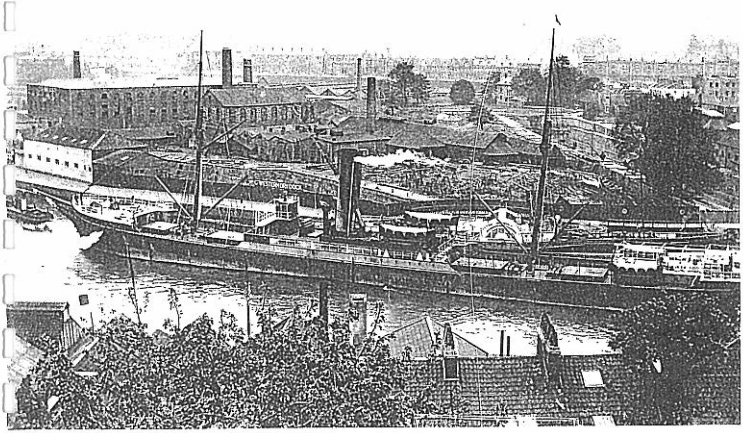
3.6.3 Post the GWSSC Mast-Erecting Shop (?) and infill buildings in the angle between the factory ranges. Before 1855-1940/41 [48]

Between 1846 and 1855 extensive buildings were added in the angle of the old factory. While this work predates Patterson's change of postal address to the site, it post-dates his purchase of the remainder of the lease from the GWSSC and they must have been erected for him. The reuse of the GWSSC factory as a tannery left him without any substantial buildings on site. Combining historic map evidence, the photographic evidence from the 1890s and the documentation for users of the site, an analysis can be proposed. Additional evidence, should it emerge, might require the story to be amended.

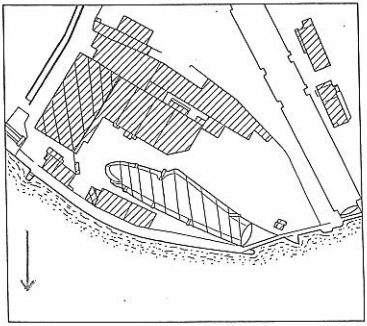
Of the buildings erected for Patterson (or perhaps inherited by him from the GWSSC), the ones to survive, probably until the war, seem to have been the substantial mass wall gabled building, adjacent to and roofed parallel with the old N/S range of the factory. It had 8 round-headed windows on its W side and 3 on the front with a bullseye in the gable. It may have been a mast erecting shop, as it was described in the 1930s (BIM, J4313). The same photograph shows a long, lower range on the south boundary wall of the yard, with a large stack and this seems to have survived through the map sequence from 1855 and is probably Patterson's building too. He added more, between these two, according to map evidence, but they had gone by 1872, if the boundary change map of that date [44] is to be believed, and were replaced by buildings shown on the 1890s photographs. This was a block of 5, low-roofed single-storey ranges, roofed north/south and were probably put up by the Wapping Dock Company. The photographic record indicates that when the timber merchants Wickham and Norris arrived on site in 1905 they were able to use the building adjacent to the factory and the Wapping Dock Company's buildings, but replaced Patterson's range on the south boundary with their own stores. It was bomb damage of 1940/41 that removed these dockyard buildings and replaced them with purpose-built timber stores.

Structure at W end of swing bridge - built between 1872 & 1883, demolished c.1914-1919.

A small building is shown on maps at the root of the swingbridge between 1872 (BRO, 37075/32) & 1883 (survey date of 1885 OS). i.e. during the occupancy of Wapping Dock Co. It was demolished when the Jefferies range was added c.1914-1919 Photographic evidence shows the building to have had a stack and it may have been a watchman's hut, conveniently placed at the access into the yard off the towpath at the root of the swing bridge.



[48] *Some of the demolished buildings, shown in a photograph of c.1890, BIM, Keen 22/147. © Bristol Industrial Museum. This can be compared with a 1902 plan (BCC), scaled down, & reproduced upside down. Hatched buildings survive above ground.*



4 - Understanding the Ship
Part Two: The *ss Great Britain*

The 'Great Britain' was built in the Great Western Dock by the GWSSC between 1839 and 1843, when she was floated out into the Floating Harbour. Her original design, in which I K Brunel played a major role, was a turning point in the history of ship design, combining large size, iron construction, the screw propeller & a balanced rudder for transatlantic voyages. An accidental stranding off Ireland in 1846 was a disaster for the GWSSC & cut short her New York runs. Sold, repaired & refitted she became commercially successful as an emigrant steam clipper to Australia during the gold rush, with a major refit in 1857. The Australia run, which continued until 1876, moved her off the stage of marine engineering at the cutting edge, and into the theatre of representative social history. It is a reminder that her survival was not just a matter of physical strength but depended on matching it with a viable function that, like the 'Great Eastern', was not the one originally anticipated.

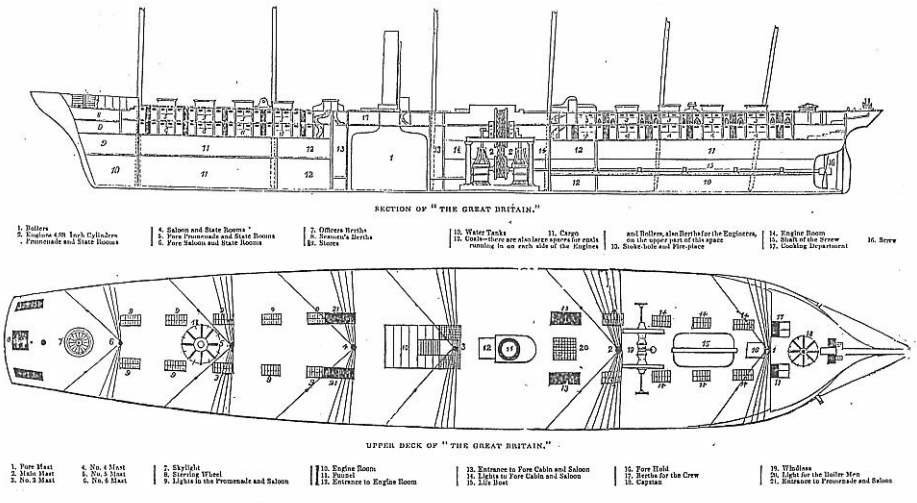
Records of her Australian voyages survive. For two months or more she became the physical and enclosed world of c.600 individuals in transition. She also brought back bullion and cotton, the dead for burial as well as carrying the mails both ways between Australia and England. There were troop-carrying duties during the Crimean War & Indian Mutiny. In 1882 she was converted to sail alone and functioned as a windjammer freighter. She was then used as a floating store in the Falkland Islands until 1933. After a failed preservation attempt in 1933 her neglected physical condition led to her being beached at Sparrow Cove, near Port Stanley in 1937. She was finally rescued in 1970, brought back to Bristol and returned to the same dock in which she had been built. Since then the ss "Great Britain" Project has concentrated on restoration and presenting her to the public. She is now a registered museum.

The *Great Britain* has been thoroughly investigated and analysed by Dr Ewan Corlett, a trustee of the NMM for 17 years, in *The Iron Ship*, first published in 1975, 2nd edition in 1990. This was written with the advantage of an intimate physical knowledge of the ship from rescue to the present day, including seeing features that are no longer *in situ* or no longer exist. This study owes a large debt to his work and inevitably goes over old ground.

The history of the ship falls into two very different historical camps. In her original phase, her role as a pioneering vessel, the Eve of all modern shipping, has dominated. The involvement of I K Brunel has transferred his charisma - in popular as well as scholarly minds - to the ship and undoubtedly played a crucial part in the fund-raising for the rescue and preservation, and the visitor numbers the ship attracts. This has made the ship, to date, the territory of historians of engineering and naval architecture. This will continue to be the case and the ship's technology, still visible in her surviving fabric, must never be underrated. There is, however, room for others aboard and there are areas of her history that deserve to be further opened up.

The imbalance between documentary history & fabric survival

The documented history of the ship, and the history to be found in her surviving fabric, is overwhelming in quantity but uneven in spread. As usual for complex, evolved structures, the two strands of historical evidence, paper and surviving fabric, are far from being a perfect match. Paper documentation provides evidence of twelve refits, some far more drastic than others, before the restoration programme which began after the ship was rescued from the Falkland Islands. This programme has had an extensive impact on her fabric and must be considered as a 'phase', extending over nearly 30 years.



[49] *A section and upper deck plan of the 'Great Britain', first phase, published in the ILN 5 Feb 1845. Details of published sections of the ship's first phase are not always consistent.*

The detail available on the refits is variable, ranging from extensive coverage in newspapers and the technical press of the day to a single line in Lloyds Register archives. The extent to which the fabric of the ship reveals her complex history is also diverse. She is extremely rich in archaeological information because her method of construction has left a wealth of evidence in the structure. Every redundant rivet hole tells a story, but until a full archaeological record of the ship is made, the whole narrative of the ship's fabric cannot be fully understood.

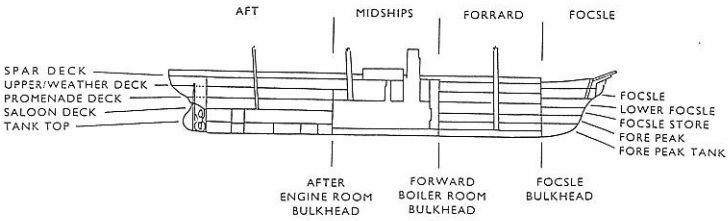
Known Phases	Synopsis of known Documentation	Identified surviving fabric
Phase 1 1839-1845	Contemporary Descriptions Patterson's signed drawings of the lines 2 simplified long sections Deck plans Drawings of the engines and some constructional detail Extensive technical debate Photograph Contemporary exterior images Contemporary engravings of the interior	Extensive.
Phase 2 1846 refit	Contemporary descriptions Contemporary exterior images	No physical evidence identified to date.
Phase 3 1851-52 Major refit	Contemporary descriptions Contemporary exterior images Contemporary engraving of the interior	Some physical evidence.
Phase 4 1853 refit	Brief description	Possible physical evidence identified.
Phase 5 1855, trooping	No descriptions of changes to the fabric	No physical evidence identified to date.
Phase 6 1856/57, major refit	Contemporary descriptions Contemporary exterior images Long section Deck plan	Some physical evidence, some *ex situ* elements identified.
Phase 7 1857, trooping	No descriptions of changes to the fabric	No physical evidence identified to date.
Phase 8 1861, minor alteration	Single line in Lloyds Register (No. 23460)	No physical evidence identified to date.
Phase 9 1866, refit some bulb beams and box stringer introduced	Single line in Lloyds Register (No. 23460) Photograph	Changes described identified in the fabric.
Phase 10 1871, minor alterations	Single line in Lloyds Register (No. 23460) Photograph	Some changes described identified in the fabric. Possible *ex situ* element (mast) - depends on more certain dating.
Phase 11 1881, converted to sail	Transverse section Photographs	Extensive alterations identified in the fabric. Possible *ex situ* elements (masts) - depends on more certain dating.
Phase 12 1886-7, hulked	Photographs	Damage to structure identified in the fabric
Phase 13 1970-1998, restoration	Records of contracts Photographs Long section with frame numbers	Extensive but not always easily identifiable

It can be seen from above that the phases of the ship that can be interpreted as having the most impact on her surviving fabric are her original phase of construction, 1839-1845 (for the purposes of this report this includes repairs following damage during her trials), Phase 3 of 1851/52, preparing her for her Australian phase; Phase 8, during her Australian period and identified only from a single line in Lloyd's Register archives (23460); Phase 11, her conversion to a sailing ship in 1881/82 and, finally, the restoration programme since 1970. A full, intelligent archaeological survey keyed to the documentary history will almost certainly identify information in the fabric that dates from other phases of the ship, and will refine and possibly amend this analysis but these five periods of change are likely to remain the crucial ones for understanding the surviving fabric.

The following summary of the ship's history has concentrated on the main phases of known historic change that are demonstrated in her fabric.

ss GREAT BRITAIN:

Working Nomenclature for Area Identification



4.1 - The Great Western Steamship Company Period

The *ss Great Britain* was built between 1839 and 1843 by the Great Western Steamship Company. The slave trade, important to the late 18th century & early 19th century Bristol economy, was officially ended. The Great Western Railway was under construction. Mechanical engineering was a rapidly expanding area of business. Since the early 18th century Bristol's reputation for trade and ship-building had been in decline relative to the growth of Liverpool. While nothing could overcome Liverpool's natural maritime advantages, especially as ships became larger, in 1804-9 Bristol's Floating Harbour had been constructed by William Jessop by sending the tidal Avon through a new cut while embanking and locking its old course. Jessop's creation liberated shipping and ship-building from the extreme tides of the Avon, although its management by the Bristol Dock Company imposed heavy dues on ship-builders and the harbour tended to silt up. As it happened, this gave Brunel the opportunity to offer advice on improvements, but the Bristol Riots of October 1831, arguably as much about local as national issues of misgovernment, put the project on hold until 1832.

The Bristol Networks of the 1830s & 1840s

L T C Rolt's brilliant summary of the first phase of the ship in *Isambard Kingdom Brunel: A Biography* (f.p 1957), describes the Bristol context in which Brunel found patronage and success. Buchanan and Williams' *Brunel's Bristol* (1982) extends an understanding of the personal network Brunel developed with Bristol merchants and businessmen. Brunel was one element in the Great Western Steamship Company, which richly deserves further research. It proved possible for the company to raise extremely large sums of shareholders' money for a project that was recognised as financially wildly risky from an early stage, teetered on the brink of disaster during the process of construction, and turned out to be a financial failure on a very large scale. Complex links between the directors of the company and other Bristol organisations: the Bristol Dock Company, the Society of Merchant Venturers and the City Corporation, played their part in creating (sometimes by opposition to one another) the local context which made construction and completion possible. The impact of the success of the Great Western Railway, in which not only Brunel, but five of the nine original directors of the Great Western Steamship Company were closely involved, must also have played its part in encouraging the directors to battle on and shareholders to dip regularly into their pockets.

Connection with Maudslay, Sons & Field[13]

If the story of the ship is revealing about Bristol at a particular time, it also provides information about the network of professional engineers in the 1830s and 1840s. The relationship between the builders of the *Great Britain* and the manufacturing engineers, Maudslay, Sons & Field (who tendered for the ship's engines) is particularly interesting. Thomas Guppy, who collaborated with Brunel on the design of the *Great Britain*, had been apprenticed to the firm. One of the reasons why Brunel fell out with Humphrys, the designer of the proposed trunk engines for the ship, was Humphrys' poaching of a talented young engineer from Maudslay, Sons and Field to the Great Western Steamship Company, an example of head-hunting which threatened Brunel's professional network.

The GWSSC - Success with the *Great Western*

The company's prospectus, issued in January 1836, stated that its aim was: 'to establish regular lines of steamships between Bristol and those Western ports to which her geographical positions renders her most eligible, the first to be directed towards the United States' (Farr, *The ss "Great Western"*, 1988, 1-2). While detractors doubted that a

commercially-laden steam vessel could carry enough coal to undertake the Atlantic route, competing companies were formed in London and Liverpool at about the same time. As Rolt records, Brunel had argued his way out of a common 1830s assumption, that if the size of any ship were doubled, she would need twice the power and twice the quantity of coal. Brunel formulated the theory that: 'whereas the carrying capacity of a hull increases as the cube of its dimensions, its resistance, or in other word the power needed to drive it through the water, only increases as the square of those dimensions' (Rolt, 1957, 190). This meant that the coal-carrying capacity of a steam vessel was sufficient to cross the Atlantic if she could be built large enough.

Brunel was appointed to design the company's first ship, *The Great Western.* She was built by William Patterson, a ship-builder who had been apprenticed in Rotherhithe and in partnership in Bristol since at least 1831 (Hudleston, BRO 30299/14). She was a wooden paddle steamer, her engines made by the great engineering firm, Maudslay, Sons and Field and fitted on the Thames. The *Great Western* was launched in Bristol on 19 July 1837 and made her first journey to New York from Bristol on 8 April 1838, arriving 15 days later on 23 April. This voyage turned into a race with the smaller *Sirius*, chartered by a competing company, the British and American Steam Navigation Company (whose own purpose-built vessel, the *British Queen*, was still incomplete). The *Great Western* was not only ready a season in advance of the competition, but although surprise tactics for the start date found the *Sirius* in New York before her, she beat the *Sirius* in time by four days, having steamed 220 miles farther and had coal to spare. She continued to ply very successfully between Bristol and New York.

The GWSSC was only just over two years old by the spring of 1838. Its reasons for confidence were that it had successfully built and seen operational, on one voyage, the largest steam-&-sail vessel in Europe, and had proved that Atlantic ships of this type could be commercially viable. If this seems a slender basis for expansion, the exhilaration of success, as well as the need for more ships to bid for mail contracts on regular service[14], prompted the decision to build a second ship in May 1838 (HB) - the same month in which the *Great Western* returned home.

Phase 1 -1839-1845

The Building Committee of the *Great Britain*

The building committee of the *Great Britain* consisted of Brunel, as consulting engineer, Thomas Guppy, a director (but after October 1840 the supervisor of the works), and Captain Christopher Claxton, R.N, Managing Director. The committee was assisted by William Patterson, ship-builder and Francis Humphrys, who was hired as engineer for the project. The first four had already shared the experience of an epoch-making success with the *Great Western.*

Patterson, Brunel and Guppy were all innovators. Patterson had been employed on the *Great Western* as a man known to be: 'open to conviction and not prejudiced in favour of either quaint or old-fashioned notions in ship-building' (quoted in Farr, *The ss "Great Western"*, 1988, 2). The first completed section of Brunel's Great Western Railway opened in June 1838, the abutments of his Clifton Suspension Bridge in Bristol had been built and the Thames Tunnel project with his father was in progress. Guppy was an engineer and businessman, who had been apprenticed to Maudslay, Sons and Field, and ran the Friars Sugar Refining Factory in Bristol (Rolt, 1957, 66). He has been described as the 'virtual founder' of the GWR Co (Rolt, 1957, 66). He was also an inventor who had patented a radical system of masts as early as 1824 (Greenhill and Allington, 1985, 4) and continued to patent marine devices afterwards, including the iron lifeboats of the *Great Britain.* Claxton's views on the objectives of the company reflect the managing director's sense of an endeavour that was more than just commercial. To him, along with their rival, the British and American Steam Navigation Company, their enterprise was '...glorious efforts... to exalt science and settle disputed theories' (Claxton

to Charles Babbage, November 27 1838, BL ADD 37191, f.39).

In combination, the formidable individuals of the building committee began a project where the early plans for a ship similar to, but improving on the *Great Western*, were transformed in a kind of enterprise and design euphoria, via several intermediate stages, into the *Great Britain*. The ship that came out of the dock in 1843 was nothing at all like the *Great Western*, although it developed some of her technological principles, for instance longitudinal strength. The new ship was built of iron, twice the tonnage of any previous ship, screw-propelled and with rigging unlike any other. The activities of the building committee were only possible in the context of the company's culture of commercial ambition on a gigantic scale. Like the design of the ship, this developed at speed in a matter of four years.

The Company's Ambitions Develop

The GWSSC's initial plan to establish a Bristol works for building their second ship and refitting the *Great Western*, turned into nothing less than the erection of the first integrated iron steamship works in the world. Brunel cautioned against the directors making their own engines, because of the level of financial risk, but his advice was ignored (HB). The ambition of the company can be judged by the fact that their facilities for steamship maintenance and manufacture outdistanced those of the contemporary Royal Navy.

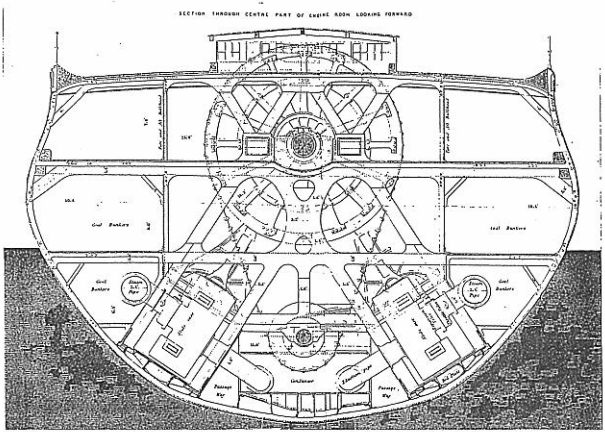
By March 1840 the directors were proposing to make use of what, by then, was their (or rather their shareholders') massive investment in machinery by carrying out engine-building and repair for other clients. The only brake on their progress in this direction were the shareholders, led by William Acraman, a Bristol engineer (who had provided the crank shaft of the *Great Western*). Acraman found himself funding his own competition and led dissent amongst the shareholders which spilled out into condemnation in the engineering press.

What seemed appalling, was the prospect of a joint stock company running a marine engineering business in which the directors were cushioned from failure by risking not their own, but shareholders' money: ' As to the propriety of engaging as a rival to private manufacturers, public opinion is too strongly against such a practice to render any further comment necessary, while as concerns the shareholders, if this departure be allowed from their original plans, there is no reason why the Directors should not set up chain-cable works, rope walks, sail lofts, machine biscuit bakeries, or anything connected or not connected with shipping' (*The Civil Engineer and Architect's Journal*, Vol 3, May 1840)[15]

Design and Construction go Hand-in-hand

Something of the creativity in developing the design of the ship can be judged from the changing proposals between May 1838, when the directors decided on building a second ship, and July 1839, when work began. Tender drawings for engines in the Science Museum show the first design for a paddle steamer with a wooden hull, similar in amidships shape to the *Great Western* (Corlett, 1990, 14). By late November 1838, wood had been dropped in favour of iron (Claxton to Charles Babbage, November 27 1838, BL ADD 37191, f.39), although it was still assumed that, like the *Great Western*, engines would be built by an established engineering firm (HB). The size of the proposed ship increased at least three times, fetching up with a massive overall length of 322ft and an extreme breadth of 50ft 6ins. Her displacement at load draught was 3,675 tons. Until spring of 1842, she was known as the *Mammoth*.

The *Great Britain* has been compared in her influence on modern ships with the DC3 Dakota's influence on big passenger aircraft (Greenhill in Gardiner, 1993, 8). Her defining features were not invented out of thin air by the building committee, but were adapted, taken to new extremes and combined. Corlett's *The Iron Ship* (1990, 27-39)



[50] *An amidships section showing the engines & including useful constructional detail from Phase 1. from J Weale's 'The Great Britain Atlantic Steam Ship' (1847)*

Gardiner (1993, 21-24) and Caldwell (1976, 146-150) recount her place in the history of iron vessels. By 1838, when the GWSSC building committee resolved on iron, different ship-builders had employed, often as a one-off element, and on nothing like the scale, most of the features which were combined and enlarged with such verve on the *Great Britain*. Iron was available at prices that made sense in terms of the economics of wood versus iron, given the extra capacity and lightness obtained from iron over wood in a ship of comparable size. A patent on iron steamboats was taken out in 1820, the first example being the *Aaron Manby* (116 tons) completed in 1822 & built for service on the River Seine. John Laird had used transverse watertight iron bulkheads in the construction of the *Garry Owen* (1834), an iron paddle steamer of 236 tons. The *Storm* a 70 foot iron vessel designed and built in 1834 by Scott Russell was framed entirely longitudinally. Lloyd's had classed (meaning they were prepared to insure) two iron vessels by 1838.

If forerunners existed, there was no body of technical literature available, nor standards set for iron ships. John Grantham's seminal texts, *Iron as a Material for Ship-Building & Iron ship-building with practical illustrations*, were not published until 1842 & 1858. As Claxton recalled in 1845, research and development by the GWSSC in making their decision to build in iron was practical, not theoretical. If the value of iron ships had been recognised by 1845, '...five years ago, when they [the directors] boldly decided to build their ship of iron, the case was different. The Directors then instituted the most searching inquiries, without experience, and with scarcely any theory to guide them' (Claxton, 1845).

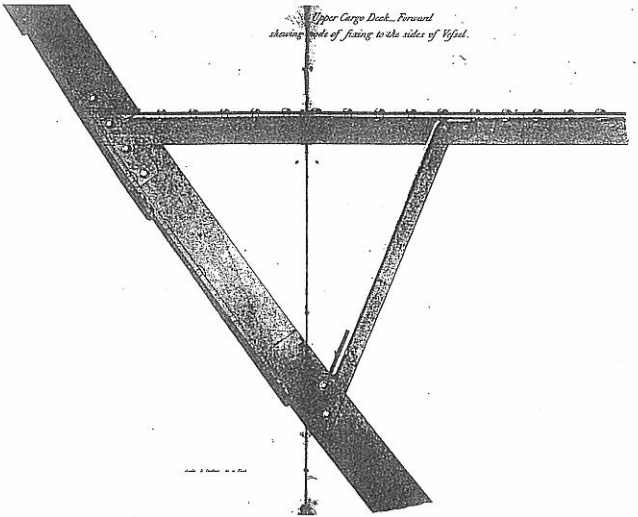
Those searching inquiries included taking passages on one of the larger early iron ships, the *Rainbow* (700 tons), which called at Bristol in 1838. She was a channel packet carrying goods and passengers, built by Lairds. Claxton and Patterson made several trips in the vessel and this convinced them of the practicality of iron construction, and particularly important, of the success of Professor Airey's mechanism for adjusting compasses, which were affected by the magnetism of iron ships. As Claxton stated: 'It became manifest that iron would afford greater strength, greater buoyancy, and more capacity at less expense than wood' (Claxton, 1845). Dry rot, vermin and the stench of bilge water that characterised wood vessels would all be avoided.

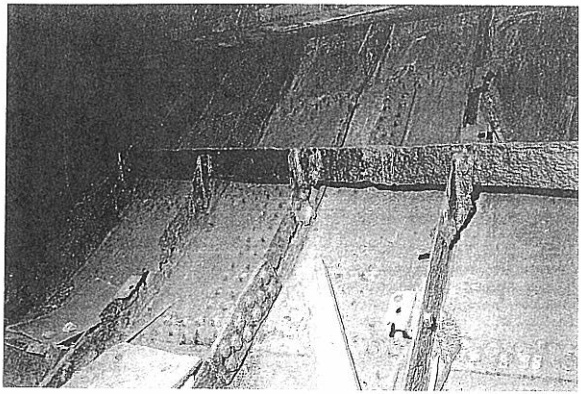
The unusual keel of the new ship was laid on 19 July, 1839. Her lines, drawn by William Patterson were universally praised for their beauty and fineness in the contemporary press and made a major contribution to the later adaptability of the ship, even to sail in 1882. Patterson's relationship with the ship eventually spanned 28 years including work on her refits in Liverpool in 1851/52 and 1857. The lines are little changed today, although the present false keel was added in 1852 and the arrangement of the propeller and rudder is a post 1970 re-creation of the first phase, removing later amendments.

The building committee were obliged to work within local constraints. The ship would have to pass through the locks between the Floating Harbour and the Cumberland Basin, on her way out to sea. Amidships, the design provided desired breadth, but only at a height that would allow passage through the locks (HB). The overall length of the ship was also constrained by the width of the Floating Harbour into which she would be floated out diagonally. The notorious horseshoe bend in the River Avon, where strandings were commonplace was also a limiting factor.

The Structural Ironwork

Guppy described the ship's structural iron work in a paper to the Institution of Civil Engineers, read on March 4 1845. The ship had no external keel, but a double bottom with 10 longitudinal iron 'sleepers'. Two narrow docking keels were attached at the lower bilges. These were unprecedented in England at the time, although known in some French ships. Her frames and beams were of angle iron with diagonal iron struts between [51]. J R Hill, who described her while under construction, described horizontal stiffening





[51] *A detail of the upper cargo deck construction from a plate in J Weale's 'The Great Britain Atlantic Steam Ship' (1847). A 1998 photograph shows that the lower joint of the strut series to the angle iron frames, frames (repaired) and plating survive.*

provided by flat plate iron members between the beams and the deck planks 'to provide against the possibility of the whole structure springing or bending' (*Mechanics Magazine*, no 996, September 10 1842). The two forward cargo decks were iron, the saloon and promenade decks wooden. The planks of the saloon deck were placed crossways, as here, at the load floatation plane of the ship, transverse stiffness was considered to be more important than longitudinal strength. She had 5 transverse watertight bulkheads for safety and strength, 3 rising through all decks to the upper deck.

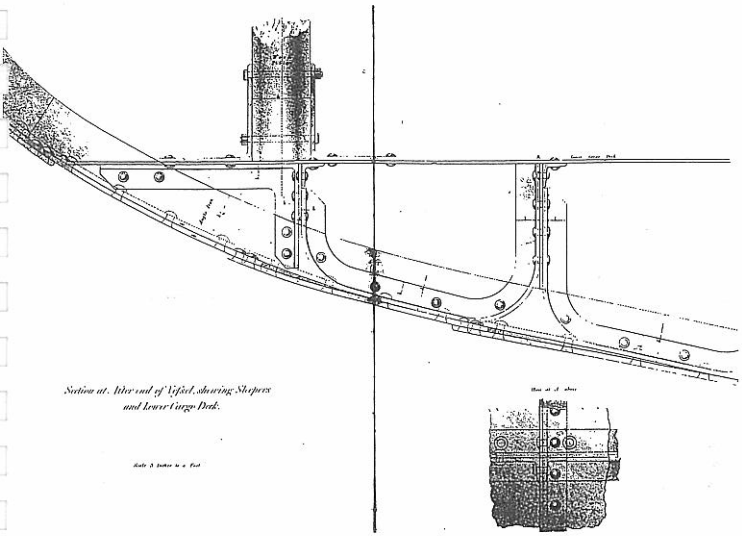
The plating was graduated in thickness according to its location, for maximum strength and minimum weight. It was thickest at the end pieces of the keel, where it was an inch thick. Technical analysis of the plating and framing has been covered in detail by Corlett (1990, Chapter 4). The strakes, the horizontal tiers of iron plate, were lapped over one another and riveted together with a tapered liner between plates and frames. This method was chosen in preference to the butt joint technique, riveted and strapped, on the basis of strength tests carried out at the company's works (which were extensively used for research and development) and because it involved a smaller quantity of iron. (Guppy, March 4, 1845). As Corlett notes, the lapped system made it easier to lift out damaged plates and replace them. Curiously Guppy does not refer to the change in method in the upper strakes: 'in which all the plates were worked directly onto the frames with no liners and with flush longitudinal joints covered by external straps' (Corlett, 1990, 29). The strakes were composed of plates, the largest only 6ft long (reflecting the limitations of economically rolling wrought iron plates at the time) and requiring a huge amount of labour in the jointing. It has been suggested that the method of construction was one where the plates were riveted together first around wooden formas, the iron frames then shaped to this shell and fitted afterwards (Greenhill, in Gardiner, 1993, 22) although the actual methods of converting design into construction are not known for sure in detail.

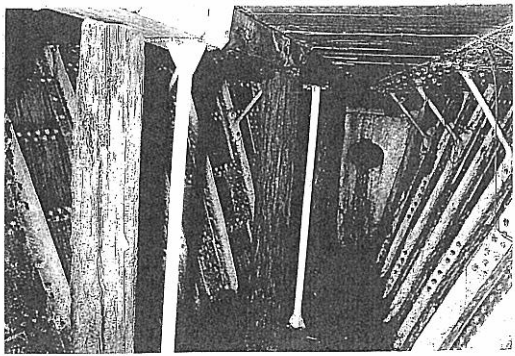
The original iron for the ship was from Coalbrookdale, as reported at the March AGM (RAIL 1149/60). The plating for this period was of an extremely high quality for the period and the survival of the ship today owes much to meticulous supervision and the craftsmanship of her original builders. These, drawn from many different places, including Liverpool[16], saturated local lodging places during the period of construction. A householder wrote to the local press: 'what an influx of mechanics and labourers has arisen from the Great Western Steam Ship Company's works; and the demand for lodgings in the Hotwell-road and its neighbourhood is so great, that I have heard a gentleman who has a vacant space of ground in that quarter, is about to erect many tenements thereon' (*Bristol Mirror*, December 21 1839).

The *ss Great Britain* was not constructed exclusively of iron. In addition to her saloon and promenade decks, which were wooden, she contained other structural timberwork including longitudinal timber stringers. The angle iron beams of her decks were supported by wooden stanchions which rose through the deck levels, being secured to the upper one (Guppy, 4 March 1845) [52]. Timber was also used for the support both of her engines and of the shaft of the screw propeller with which she was to be fitted.

Propulsion

The design of the engines of the ship was not settled until after October 1840. As with the hull, the engine design underwent radical change as a result of the building committee's researches and access to new technology. Initially, the paddle-driven version was to make use of the trunk engines of Francis Humphrys, who had been hired for that reason. However, Humphrys' right to the patent was called into question, and the firm that held the manufacturing rights proved expensive. The GWWSC decided to manufacture the engines themselves, in spite of Brunel's warnings against the level of risk that might be incurred. The trunk engine





[52] *The first phase double bottom shown in a plate from J Weale's 'The Great Britain Atlantic Steam Ship' (1847). The base of one of the wooden stanchions that supported the decks is shown. A 1998 photograph shows first phase stanchions still in situ (augmented with later iron stanchions).*

scheme was abandoned when the engines were already in progress. Screw propulsion was finally settled on by the building committee.

Corlett recounts the birth of commercial screw propulsion (1990, 46-58), centred round the inventions of Francis Pettit Smith and Captain John Ericsson, who took out patents for screw propellers in May and July 1836 respectively. Smith's ideas were developed in the ship *Archimedes*, built by the Ship Propeller Company. Trials conducted on the *Archimedes* were followed by a sales tour round the British coast, introducing the screw propeller to a potential market. The *Archimedes* visited Bristol in May 1840. During the next three months experiments were made by Brunel, Guppy and Claxton on the screw in the *Archimedes* and at the dockyard (HB). Trips in the *Archimedes* convinced them that, with important amendments, the screw propeller was preferable. On 10 October Brunel provided a report (SSGB, 1997.008), famous amongst engineering historians, laying out in detail his reasons for recommending the screw and abandoning Humphry's engines and the paddle steamer design. This could be done with relatively little alteration to the existing construction of the ship and his advice was accepted.

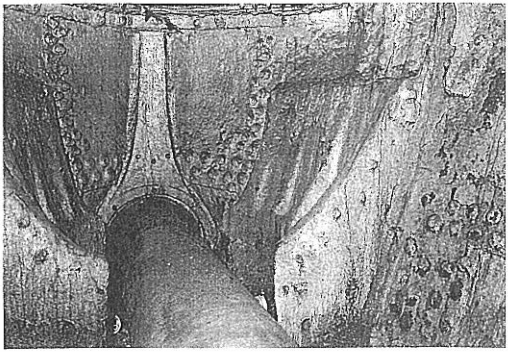
The most detailed account of the engines is in Corlett's Chapter 7 (1990, 59-66) and pp.185-193, written by James D Richard, from the vantage point of creating replica engines since 1976. Brunel and Guppy between them, advanced a design for the screw propeller shaft [53] and employed an engine similar to the triangle engine, patented by Brunel's father, Marc Brunel in 1822 and used in his Thames Tunnel project. By September 1842 the machinery, built in the company's works was described as in: 'a forward state, and a great part ready for putting into the vessel' (*Mechanics Magazine*, no 996, September 10 1842). Corlett comments that the engine, if inferior to Marc Brunel's triangle engine, was in advance of most of its contemporaries and the chain drive that transmitted the power from the crankshaft to the propeller: 'was a triumph of logical and practical engineering'. (1990, 66). The contemporary technical press was doubtful, particularly regarding the boilers (e.g *Mechanics Magazine* no 1161, 8 November 1845), and there were early amendments to the ship's machinery (LB 4, Brunel to Claxton, Dec 19 1845). Greenhill notes that the shipping world had to wait another generation before an efficient engine could be added to the use of the screw for propulsion and the use of metal and large size in the *Great Britain* (in Gardiner, 1993, 21).

The general arrangements of the first phase of the ship are known from written descriptions, deck plans, long sections and engravings of the 1840s [54] and described in detail in Corlett (1990, 67-81).

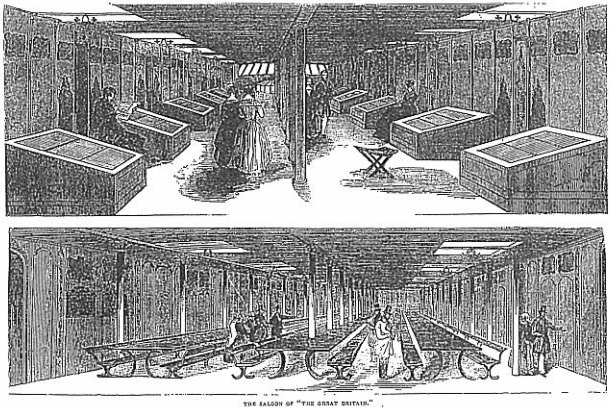
The Rigging

The physical evidence of the original rigging has disappeared. The rigging attracted scarcely any contemporary comment relative to the hull and engines. The designer may have been Guppy, who had already patented a system of bipod masts in 1824. Claxton recorded that the design of the rigging had been determined by 'economy of labour'. Had either the *Great Western* or the *Great Britain* been ship rigged: 'the former would require a crew of more than 100 seamen, and the latter that of a large frigate' (Claxton, 1845). As it was, the *Great Britain* needed only 30 before the mast. Greenhill and Allington, describe the rig as: 'a brilliant pioneering example of what in the current jargon is called 'sail assist' and as an equally able pioneering development of the big schooner' (1985, 4) and it is the subject of continued research. It was a six-masted schooner rig with only the mainmast carrying square sails. The heel of each mast except the main was stepped on the upper deck in a fitting that allowed it to pivot fore and aft. Iron wire rigging was used instead of hemp.

The rigging anticipated, by 50 years, the use of the multi-mast schooner rig in North American wood vessels of a comparable size (Greenhill and Allington, 1985, 4-5). It only lasted intact on the *Great Britain* for two voyages and was revised in 1846, when the



[53] *Surviving detail from the first phase. The stuffing box, a substantial iron casting where the screw shaft entered the stern of the ship.*



THE SALOON OF "THE GREAT BRITAIN."

[54] *The promenade & saloon decks from engravings in the ILN, showing the system of borrowed lighting from the promenade to the saloon, ILN, 15 February 1845*

wire rigging was removed. Claxton's account of 1845 suggests that the rigging was a sore point with seamen: 'to a seamen's eye they [the hinged masts] have a look of insecurity' and Greenhill & Allington imply that it may have been objections by crews that gave it a short lifespan: 'A contemporary boatswain, coming aboard the vessel, would have found the fundamentals of the religion by which he lived under powerful challenge' (*ibid.*, 18).

Floating Out & Trials

By September 1842, the machinery was ready for putting into the vessel (*Mechanics Magazine*, no 996, September 10). This was done in dock, contrary to some modern accounts, which claim that it was fitted after she was floated out. The dock, which had been designed to float out a lighter weight, had to be deepened under her (RAIL 1149/60)., which must have been a tricky affair The fact that the machinery was ready at all, was something of a wonder, given the protests of the shareholders about the activities of the company. In December 1841, pressure from shareholders, appalled by the prospect of their contributions being risked on ever more ambitious schemes, had forced the company to put the works up for sale at auction, but the directors claimed they could not find a buyer (RAIL 1149/60). Nevertheless, the machinery was completed and fitted through a hole left in her side. This must have been the port side as the site gave little space to starboard.

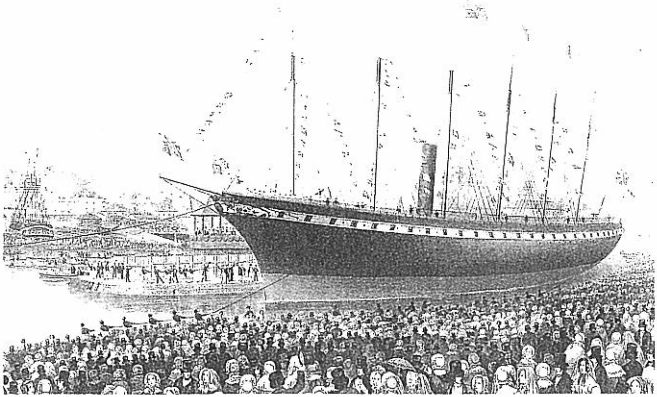
The floating out on 19 July 1843 was a day of community celebration in Bristol [55]. Prince Albert attended, arriving by train at Temple Meads Station. It was the anniversary of the launch of the *Great Western*. There was a banquet for the great and good inside the factory, which had been screened with drapery for the occasion. Something of the excitement generated can be heard in the speech of The Honourable Edward Everett, the American Minister: 'We read in the Arabian Tales of the wonder of magic, of flying steeds, and places starting from the ground. Sir, let us leave magic to the nursery; give me the magic of the mechanical arts (cheers)' (*Bristol Mirror*, July 22, 1843).

After the floating out, the ship lay moored on the opposite side of the Floating Harbour for completion, where she was photographed, possibly by Fox Talbot; a nice example of the application of one piece of new technology to another [56]. Brunel and Guppy continued to amend the design of the screw propeller. It seems to have been this, along with problems of exiting the Floating Harbour, that delayed the project. Brunel was anxious about the propeller but determined to get it right: '...I do not think that any perfection of form must be sacrificed to mere mechanical difficulties of construction' (Brunel to Guppy, August 11 1843, LB 2c, 184)

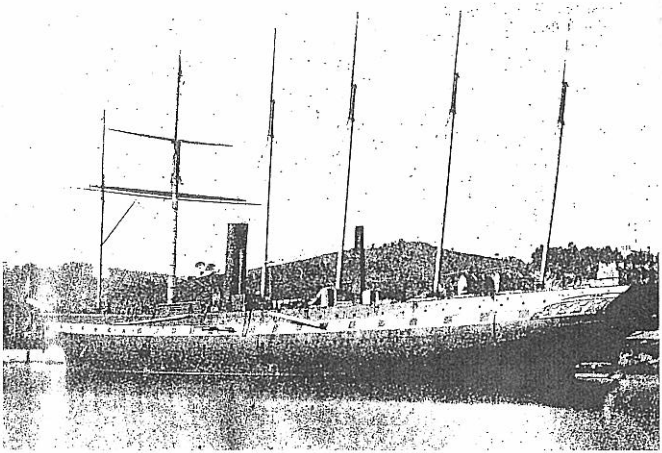
After many delays the Bristol Dock Company finally gave permission for alterations to the entrance to the Cumberland Basin to allow the *Great Britain* to pass through on 11 December 1845. Henry Brunel reports that the reason why the ship famously stuck in the lock was that the engineers had filled her boilers with water. Presumably this was unknown to Brunel, who calculated her draught on the basis of their being empty. She was pulled back in the nick of time, more alterations were made, and she went out at last on 12 December 1844.

Her trials were generally considered successful. There was one mishap. On 24 January, 1845, while off Lundy Island, the ship was struck by a heavy sea to starboard and smaller to port. The shock stove in three of her starboard bow portholes and damaged the focsle deck and some of her carved figurehead. The event was represented by Joseph Walter, a marine painter who was on board at the time (NMM). Interpretation of the ship's surviving fabric identifies amendments made to the focsle when this damage was repaired [57].

In January 1845 she arrived in the Thames and for five months was extensively visited by members of the public as well as by Queen Victoria and Prince Albert.



[55] *'The launch of the Steamship S.S. Great Britain, Bristol 6th July 1843', by Joseph Walter. The date is in error for 19 July.* © *National Maritime Museum, London.*

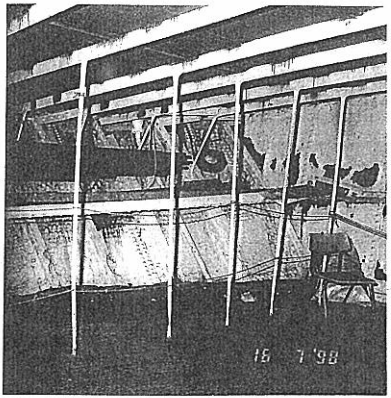


[56] *A photograph of the ship in 1844, moored up on the opposite side of the Floating Harbour.* © *National Maritime Museum, London; negative number 3758.*
This photograph established: a knuckle at the deck edge in the focsle area (as compared with Patterson's drawing of the lines); five bar rail stanchions (as compared with Patterson's drawing of the lines); the position of No 1 mast; that the ratlines were bar, not rope.

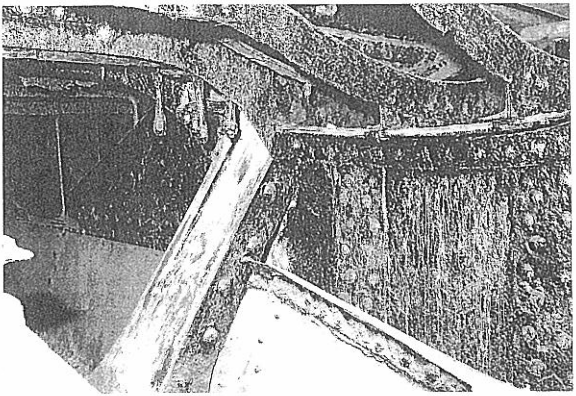
Maiden Voyage to New York

Once in active service, the ship worked out of the port of Liverpool, where all her subsequent refits were undertaken. She made her maiden voyage to New York, leaving Liverpool on 26 July with her crew of 130 and 45 passengers (she had a capacity of 252, Corlett, 1990, 81), arriving at New York on 11 August to a rapturous welcome. The pier at the foot of Clinton Street had been especially extended to accommodate her (Mechanics Magazine no. 1087, June 8 1844).

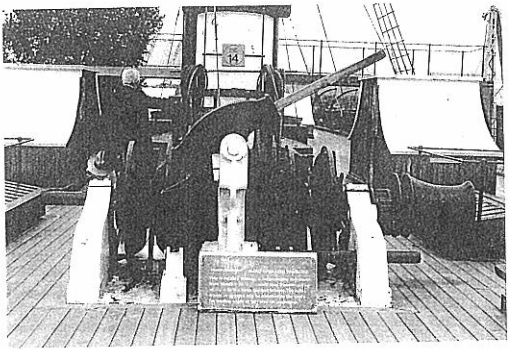
The Great Britain had only a short life as a luxurious transatlantic steamer which allowed little time for her to establish a reputation for speed and reliability (as she was to do later on the Australia run). She never sailed with a full complement of passengers. Although the numbers are not known for two of her journeys, for the others there were only over 100 on three occasions and only once more in numbers than the crew (Corlett, 1990, 214). Her total recorded passenger numbers in her first phase was 560, the actual figure was probably nearer 660. Passenger numbers were greatest on her disastrous voyage to New York in September 1846.



[57] *The focsle in 1998. The slender wrought iron stanchions may represent repair following damage off Lundy during her trials. Officers slept in this space.*



[58] *First phase timber and wrought iron housing under the tank top, aft of the after engine room bulkhead. This has been interpreted as a bearing for the tailshaft (Corlett, 1990, 63-64). It deserves closely-detailed recording & analysis.*



[59] *The windlass. This is probably first phase*

Phase 2 - The First Refit

By November 1845 the ship had completed two return voyages to New York and lay in Liverpool for a refit. This applied to her engines and rigging and, to date, no evidence has been found for any other work in the fabric.

The GWSSC reverted to the builders of the *Great Western's* engines for the refit, employing Field of Maudslay, Sons and Field. Field's work on the fire-flues and steam-ways to the boiler increased the mean pressure on the piston and it was calculated that the horse power had been significantly increased (*Mechanics Magazine* no 1190, May 30 1846).

Structural alterations were also made to the ship. The wire rigging was removed, together with phase one mast no. 3. The ship had proved to roll badly and waling pieces, 110 feet long, 2 feet wide and 2 feet deep, were fitted along each bilge (*Mechanics Magazine* no 1185, April 25 1846)[17]. The six-bladed propeller, which had broken on the second voyage, was replaced by a four bladed propeller of stronger construction, built at Bristol as the reserve screw. At the end of April 1846 Brunel was still very concerned about the machinery (Brunel to Claxton, April 20 1846, LB 4) and urged that sailing be postponed until all was ready.

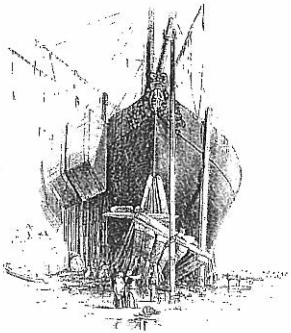
After this, trouble was experienced with the chain transmission system. The teeth of the small drum wheel were wearing excessively and Brunel considered that there was some fault in the adjustment. After arriving at New York on July 21 1846 Captain Hosken found all the teeth on the small drum completely worn into the wood and the driving chains in a very bad state. According to Captain Hosken's log of the journey (with enclosures), many of the angle irons in the ship's bottom were broken and some of the butt plates cracked, though she had made very little water (DM 1539 July 7 1846-August 14 1846). The exact location of this damage is not clear. During a hectic week in New York the carpenters and joiners, reinforced by local men, made new parts for the drum, while 193 chain links were refitted and case hardened, and 65 new links made on shore. The bottom of the ship was given five new plates and bolts fixed on the angle iron timbers and the injured butt plates were well shored down (Hosken, DM *ibid.*)

The Dundrum Bay Disaster

On her fifth departure to New York, the ship left Liverpool on 22 September 1846 and on that night ran ashore in Dundrum Bay off the east coast of Ireland as a result of a serious navigational error by Captain Hosken. Miraculously no life was lost, but the stranding was, effectively, the death of the GWSSC. The Dundrum Bay event can be read from many different perspectives. A letter from a lady passenger was published in the *Illustrated London News*. It described her terror, gave thanks for having been spared, and refuted press accounts which claimed that passengers were robbed by the local populace.

For those with responsibility for the ship, the incident was quite different, but no less emotional. Brunel did not get out to Dundrum until December and, apparently for the first time, nearly fell out with Claxton. When he returned he wrote to Claxton in Ireland. His letter, up-braiding Claxton for pessimism about the rescue of the ship, turned into nothing less than a romantic statement of devotion to her: 'She is beautiful to look at and really how she can be talked of in the way she has been even by you, is positively cruel. It would be like talking away the character of a young woman without any grounds whatever' (Brunel to Claxton, 10 December 1846, quoted in Corlett, 1990, 114). A number of memorable images of the somewhat Heath Robinson methods employed to re-float the ship (which were denounced in the technical press, in spite of their success), were published[18][60].

The damage to the ship was serious. The bottom, from the forward stokehold to about the centre of the engines (i.e. right under the boiler) had been badly damaged as well as parts of the engines (Brunel to Claxton, 10 December 1846, quoted in Corlett, 1990, 114).



[60] *The use of levers and lifting boxes to right the ship, ILN, August 1847.*

[61] *The removal of the stores from the state cabin, ILN, 24 October 1846.*

Internal fittings had to be stripped out to lighten her [61]. It may be, that without this accident, the company would have survived the objections of their shareholders and hung on to their iron steamship factory, developing into a marine engineering outfit as well as a shipping line. After risks at every turn in the undertaking, it was a miserable thing that a simple navigational error should close the book on the company, which was compelled to drag out an existence until 1852 when its assets were finally disposed of.

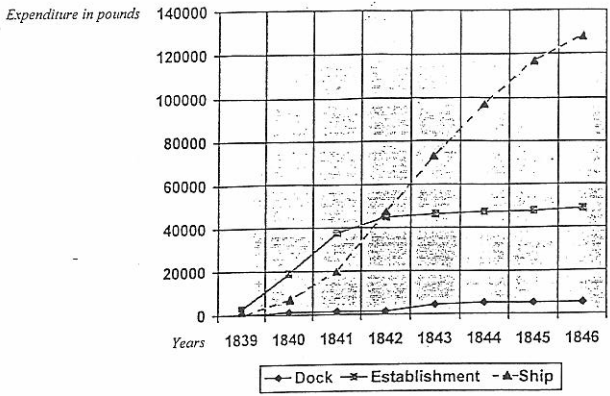
The company's AGM in March 1847 produced a unanimous resolution that all its property should be sold, including the *Great Western* and, should it be salved, the *Great Britain*, though it was somehow managed to add a rider here 'unless circumstances should, in the opinion of the Directors, render some other course desirable' (RAIL 1149/60, March 4 1847). In the same month, a lavish folio of drawings of the ship by Weale was published, *The Great Britain Atlantic Steamship*. This was unfortunate timing, at the lowest point of the ship's fortunes.

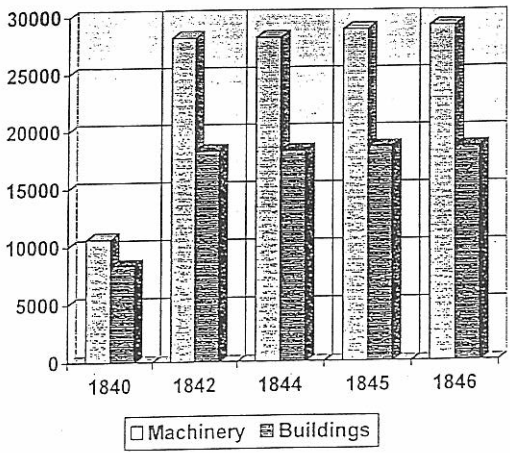
The ship was towed to Liverpool, the operation having cost £12,670. The cost of restoring her was estimated at £21,694 . The point that a wooden ship would have been unlikely to have survived the same event, including 11 months pounding on the beach, without breaking up altogether was little consolation. The AGM of March 1848 was informed that the *Great Western* had been sold to the Royal Mail Company for £25,000 (RAIL 1149/60). Four years earlier an attempt to sell her to the P & O Company for £32,000, made at the insistence of the shareholders, had failed, and the Directors had considered that sum then to be far below her worth. Now, however, it was stated that 'Under the adverse circumstances of the Company, combined with the depression of the Money Market, the Directors cannot but consider this sale an advantageous one…'

The amount received from the Underwriters of the ship was £10,111 (RAIL 1149/60), which did not go far to mend matters. In January 1852 the unlucky – or rash – shareholders were told, at the final meeting of the Company, that Patterson had bought the remainder of the lease on the Yard and dock for £2,500. The final balance for the enterprise read:

Great Britain, balance 31st December 1850	£125,555.5.1	
Less sale, after deducting Expenses, Commission, &c.	£17,658.17.11	
Loss		£107,896.7.2

Works, balance 31st December 1850	£49,523.14.3	
Less sale, after deducting Expenses, &c.	£2,246.13.4	
Loss		£47,227.0.11
Total Loss		**£155,123.8.1**

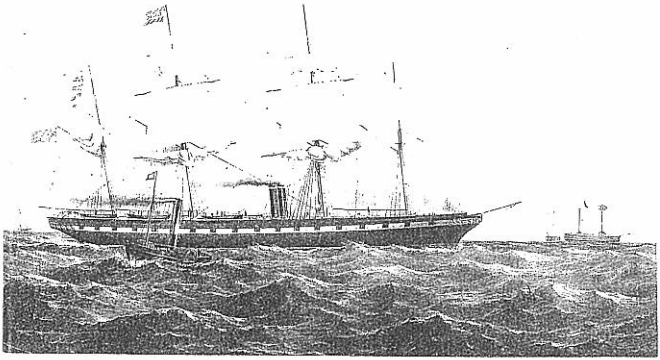




[62] *Graphs produced by Dr David Evans showing expenditure on the dock, establishment and ship by the GWSSC and relative expenditure on machinery and buildings. The figures for each year are cumulative totals, based on information from the reports of the annual general meetings of the GWSSC.*

4.2 - The Australia Emigrant Clipper

Phase 3 - the 1851/52 refit



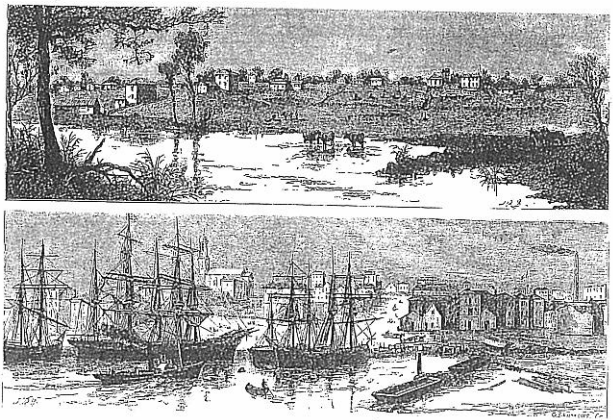
[63] *'Dropping the pilot, Liverpool Bar', 1852. © National Maritime Museum, London*

The 1851/52 refit transformed the *Great Britain* into an emigrant ship to Australia, following the discovery there of payable gold in 1850.

Australia officially ceased to be destination of convicts by 1853, the colonies themselves eventually refusing to allow them to be landed. In 1851/52 the discovery of gold redirected the pattern of emigration massively towards Australia. Assistance with the cost of emigration had begun in England in 1832, with the colonial governments starting schemes of assistance in the late 1830s (Sherington, 1980, 36, 37). These schemes encouraged working people to emigrate. The 1850s gold rush attracted not only miners from Cornwall and Derbyshire, but a new bourgeois population who saw that it provided opportunities, not just for digging, but for providing goods and services, professional skills and women [64] Charles Dickens described crowds of clerks, secretaries and: 'incipient cashiers, struggling and elbowing at the offices of the shipping merchants begging for a berth in their last-advertised, teak-built, poop-decked, copper-bottomed, double-fastened, fast-sailing, surgeon-carrying emigrant ship'[19]

The *Great Britain* was sold in January 1851 to Gibbs, Bright, and Company for £18,000

[64] *'The Last of England', 1864-1866 by Ford Madox Brown, showing a middle class couple leaving for Australia. © The Tate Gallery*



[65] *Melbourne in 1838, before the Gold Rush and in 1885, after it was over. Reproduced from C Turnbull's 'A Concise History of Australia' (1965), 79.*

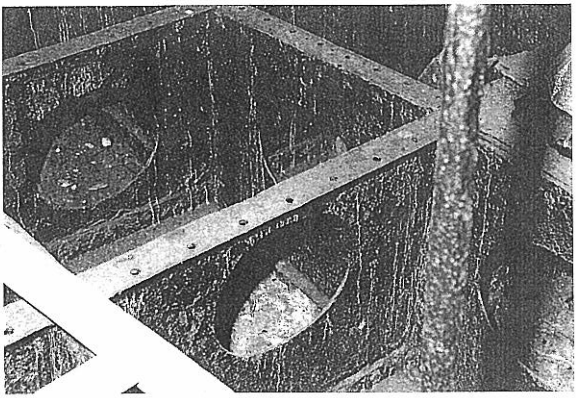
(*ILN*, April 3, 1852). Bright had been one of the Directors of the Great Western Railway and much involved with the Great Western Steam Ship Company as well (Corlett, 1990, 120). Buying the ship at a knock-down price meant that he, at least, got something out of the Company's failure. Another old associate to benefit was Patterson, who not only picked up the lease on the company's dock in Bristol, but was employed to refit, effectively to rebuild, the ship at Liverpool. Work on the ship began in early summer 1851 and she was re-registered as belonging to Gibbs, Bright and Company on April 17 1852. The refit fitted her for the long passage to Australia, with requirements for carrying more coal and more passengers. The total number of passengers carried was to be 730, of whom 50 were first class. Descriptions of the ship after the refit were published in the *ILN*, April 3, 1852 and the *Mechanics Magazine*, no 1505, June 12, 1852. The *ILN* account describes the improved and increased accommodation for passengers, including a 300ft long deckhouse, 31 ft wide, incorporating a grand saloon. The deckhouse was added by Mackay and Miller [68].

A sailing clutch for the propeller (which proved unsatisfactory) was added. The *Mechanics Magazine* described technical alterations. Brunel's engine and boilers were removed, replaced by oscillating engines of 500 HP made by Penn & Son, which discharged smoke through two side-by-side funnels. Vernon of Liverpool undertook the shipwrights' work. There was extensive strengthening of the structure. The lines of the hull remained unchanged, but 150 feet of the bottom, damaged in the stranding, was replaced, with deeper keelsons throughout [67]. Her frame: 'under the engine and boilers, and for 10 feet beyond at each end' was described as double angle irons This must also have been associated with a permanent repair to the Dundrum Bay damage.

Three double lines of angle iron stringers ran under each deck. Whether these replaced or simply augmented the Baltic timber stringers is unclear. The decks were supported on wrought iron stanchions, carried up continuously to the upper deck, as their original timber predecessors had been.

[66] *Slender wrought iron stanchions surviving in the lower cargo deck. These may be the remains of the 1852 system for supporting the decks.*

The bow and stern were strengthened by double angle-iron framing, the bilge keels applied in 1846 were removed [this must refer to the waling pieces applied to the phase one bilge keels in 1846 and not the keels



[67] *The deeper box keelsons of 1852 survive in the ship.*

[68] *First class dining saloon in the deckhouse by Mackay & Miller. ILN, June 12, 1852.*

themselves] and an oak keel, covered with zinc, added. The balanced rudder had been knocked away in the accident and a conventional type substituted. The six masts were replaced by four, two being iron. The two central masts were square rigged, the others fore and aft rigged. Reports gave out that she would carry 6,000 yards of canvas. This necessarily meant a considerable increase in the crew to handle such an expanse of sail. She was now a sailing ship with auxiliary steam, suitable for making the long passage to Australia. She made a trial journey to New York on May 1 1852 before her first voyage to Australia.

Phase 4 - 1853 Refit

No physical evidence of the third refit has been noted to date in the fabric of the ship, as it focused on the engines and rigging, both of which were removed or altered in subsequent refits. After her return from her first voyage to Melbourne, the ship was still not altogether satisfactory. The three-bladed propeller fitted with the Penn engines was of too fine a pitch, which both increased coal consumption and acted as a drag when the ship was under sail, while the amount of sail carried proved inadequate. Further alterations were therefore made in the summer of that year; a two-bladed Griffiths' propeller (a design which had attracted some Admiralty attention at the Great Exhibition) was fitted, which promised to offer much less resistance when the engine was stopped with the blades in the vertical position, and she was re-masted again – this time with three very large square rigged masts - to carry more sail. Claxton, who was clearly on friendly terms with her owners, sailed on the first trial of July 5 1853, to test the behaviour of the propeller connected and disconnected, and was impressed with the performance – she went better with the propeller fixed vertically than when disconnected, and sailed well (*The Artizan*, Vol 11, cxxvii).

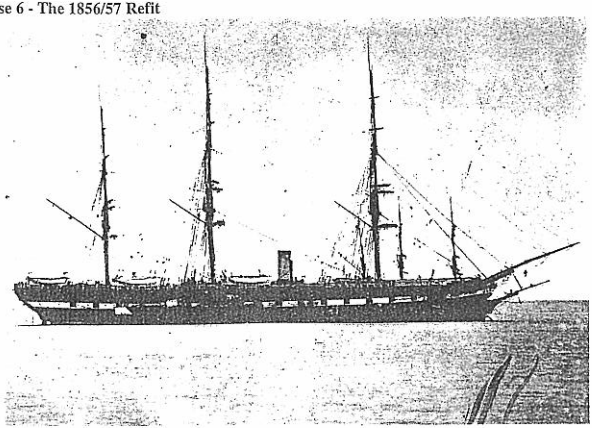
On the Australia run, with a crew of usually about 140, her passenger numbers varied wildly. With 630 on the voyage out on 21 August 1852, she must have been crowded for a journey of 81 days. The length of these voyages (usually about 60-65 days) required more concentrated self-sufficiency than the 13-day trips to New York. She had ice-houses aft of the focsle bulkhead and a music room at one end of the grand saloon and a smoking room at the other end. The return trips, of course, involved fewer passengers and included gold bullion, for which there was a special secure bullion room aft on the port side saloon deck [70]. On her return from Australia after the 1853 refit, she brought back 7 tons of gold, 23 bales of cotton (reputedly the first ever to be imported from Australia), as well as a corpse preserved in vinegar (Neville-Towle, *Diary of a Voyage to Australia* (1852), referred to in Corlett, 1990, 135), presumably coming home for burial.

During her subsequent employment on the Australia run, ownership was transferred to a subsidiary of Gibbs, Bright - the Liverpool and Australian Steam Navigation Company in 1854. She was re-registered in February 1855.

Phase 5 - A Trooping Interlude

The Australia run was interrupted by service as a chartered troop transport during the Crimean War. Corlett lists her voyages as a troop carrier (1990, 215) between March 1855 & May 1856 and a list of the 32 English regiments carried (she also carried French troops), including lists of names, survives (SSGB)[20]. Conversion to a troop transport presumably would have entailed minor internal alterations, mainly to allow for the conveyance of horses. Although nothing to date has been noted of this in her fabric, some indication of the rearrangement is given by the accommodation plans of the ex – P & O liner *Himalaya*, a ship of much the same dimensions as *Great Britain*, which was purchased for use as a troopship and altered for the purpose at Southampton. A set of letters written by Hayward Bright to his father during 1855 gives a view of the performance of the *Great Britain* as well as his own observations on the troops carried (Corlett, 1990, 136-137). The *Great Britain* returned to Liverpool in June 1856, having carried some 40,000 men since March 1854 without accident.

Phase 6 - The 1856/57 Refit

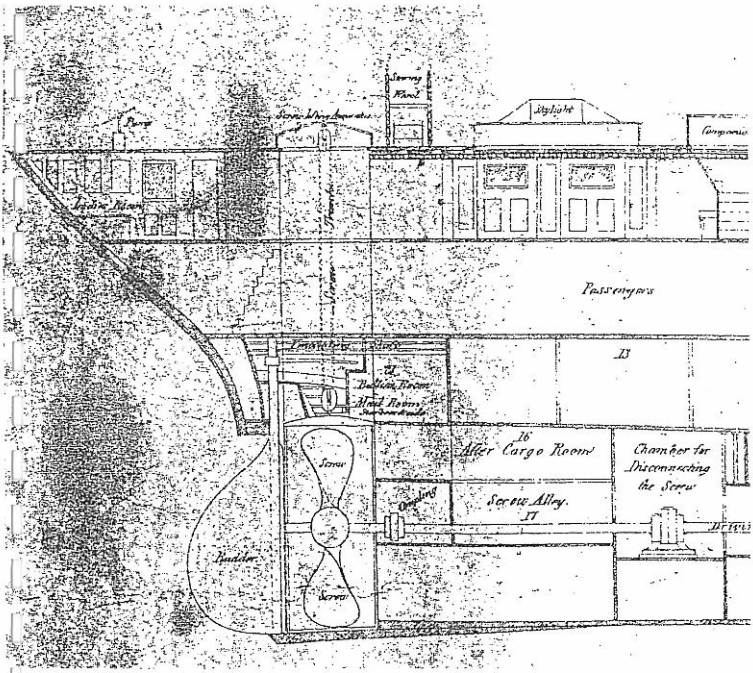


[69] *The 'Great Britain' at anchor in Australia, reproduced from Corlett, 1990, 145.*
© San Francisco Maritime Museum

Following a successful Australian voyage by the *Royal Charter* it was decided to employ the *Great Britain* as a consort to her. On August 5 Bright, Patterson and Vernon, with the Captain and Chief Engineer, held a conference on the ship and determined on a further drastic refit (*The Engineer*, February 6, 1857). This took nine months. A two-bladed Griffiths' screw was fitted, with a lifting frame. This, along with a new stern post was made by the Mersey Foundry, the stern post being the largest forging of its kind made to that date. The Phase 1 stern post was not removed and was rediscovered when the lifting frame was taken out of the ship during restoration work after 1970. Vernon was to publish an illustration of the lifting frame a few years later, but he confused the date with his earlier rehandling of the ship in 1853[21].

The deckhouse that had been added in 1852 was rebuilt and widened to provide additional first-class accommodation and entirely decked over as a spar deck. Bulwarks with ports allowing water to run off were between the poop and forecastle. The existing masts were removed, being replaced by three larger, repositioned, masts. The two funnels were replaced by a single oval one, made by Fawcett, Preston & Co. She was given a new figurehead, carved by Messrs Allan and Clotworthy, representing the royal arms, with a life-sized unicorn and lion (*The Engineer*, February 6 1857). Part of this figurehead survives in the Project's collection. A c.1857 long section of the ship to indicate capacity (SSGB) is a precious drawn record of her internal arrangements[22] [70].

While the ship was being worked on in the Sandon Graving Dock her magnetic field was determined in January 1856, December 1856, January 6 1857 and January 24 1857, in connection with the investigations being made by the Liverpool Compass Committee. Profiles of the ship in January 1856 and January 1857 were published and clearly show the alterations. Though apparently a scientific record, the January 1857 illustration does not



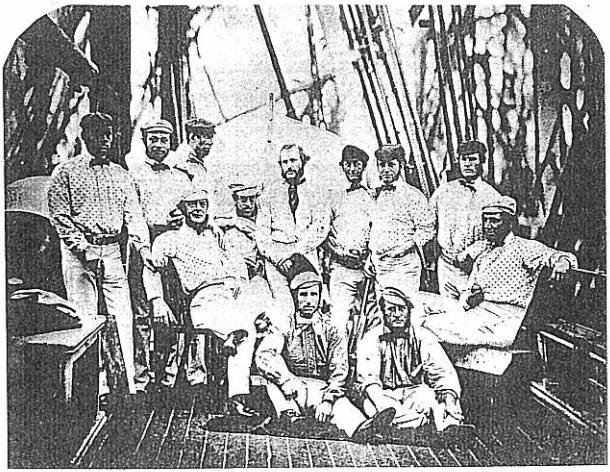
[70] *Part of the 1857 capacity plan showing the 1857 rudder, two-bladed Griffiths screw propeller and lifting frame. The plan shows the extended deckhouse with 'the ladies room' in the stern and the bullion room and starboard side mail room (SSGB)*

show the rudder as illustrated by Vernon (and as surviving now) [71, 72].

She now accommodated nearly 600 passengers, divided into 3 classes; about 2,000 tons of coal and 1,000 tons of cargo, besides stores and water.

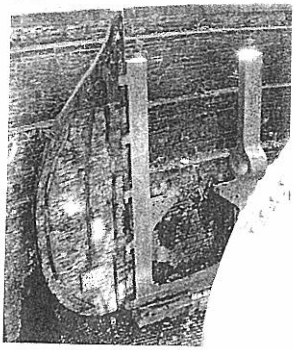
Phase 7. After a single trip to Melbourne and back, she was commissioned for trooping again, this time carrying 17th Lancers to Bombay and the Indian Mutiny. On her return she made one voyage to New York, resuming the Australia run in November 1858.

Passengers produced magazines on board to occupy their time on the long Australian voyages. *The Vain Effort*, published on board on the homeward run in 1859 and printed on arrival in 1860 included a list of all 504 passengers and the cargo. The livestock shipped for fresh meat during the passage included 133 sheep, 38 pigs, 2 bullocks, a milking cow, 420 fowl, 300 ducks, 400 geese and 30 turkeys. Passenger accounts from other journeys describe the dramas that inevitably attended hundreds of strangers being shut up together for months, smallpox scares, insanity and outbreaks of fights amongst passengers and seamen alike. *The Cabinet*, produced on the 1861 outward voyage and published in Melbourne in 1862, is full of valuable information about life on board and inludes a contribution from a member of the All England cricket team[23] [73]. This was the first of many cricket tours of Australia that, by the 1880s, came to be seen as :'instances of the ample manner in which the importance of the colonies and their solidarity with ourselves have recently been recognised (Ward, 1887). The ship was popular, fast and reliable and voyages to Australia continued until 1876.



[73] *The first English cricket eleven to go to Australia on board in December 1861, reproduced from Turnbull, 1965, 101. © State Library of Victoria.*

[71] *Tracings off the drawings produced by the Liverpool Compass Committee (omitting non-structural detail). The drawings were designed to show compass deviation but incidentally show the changes to the ship's profile and the extension of the deckhouse in the 1856/7 refit. 'Second Report of Liverpool Compass Committee' (1857).*



[72] *The 1857 rudder & lifting frame removed from the ship since 1970 but surviving in the dock.*

Later refits for the Australia Run, 1858-1871 - Phases 8 - 10

These refits are known from the account of the ship by the Liverpool surveyors in Lloyds Register archives, when she was examined in 1872. Unfortunately, apart from a couple of sketches, the drawings that accompanied the inspection have not survived.

The Lloyds report, presumably on information from her owners, records that the poop deck houses and foesle were added in 1856. The 'main deck' (this is assumed to be the existing upper deck, which is now a post 1970 feature) was doubled in 1858 with 4 inch pine.

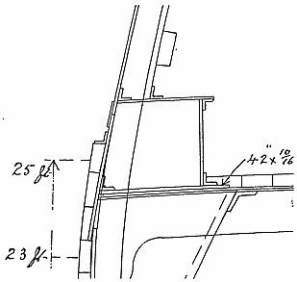
Phase 8. In 1861 'the flat of the bottom amidships or under the boiler was mostly renewed' This was then a second renewal, following the repairs in 1851/52.

Phase 9. In December 1866: 'the Box side stringer on the lower deck [assumed to be the existing promenade deck] was introduced, likewise the bulb beams to Main Deck [assumed to be the upper deck]' [74, 75].

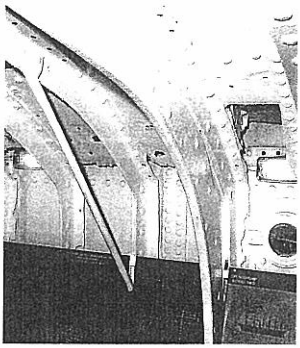
Lloyds records that the spar deck was doubled in 1869 with 4 inch pine.

Phase 10. The Lloyds report states that in July 1871, 'the fore and aft webs for about forty feet in length in way of the Fore Mast were renewed, as also the Iron deck on them' and a new main mast fitted. This might be the main mast of the ship that survived *in situ* until 1970 and is now stored on the dockyard site.

By the time of the 1872 survey there were standards set for iron ships and, unsurprisingly, the *Great Britain* did not conform to all the required particulars. The Lloyds' surveyors were impressed by the craftsmanship of her plating, but thought it light and were clearly nervous about her age and so did not recommend her for a class A classification. This affected her insurance and made it unlikely that she would have continued as a passenger ship, even had the Australia run continued to be profitable. The caution of the Lloyd's assessment is confirmed by a Board of Trade survey of the hull in 1873. This included holes drilled in



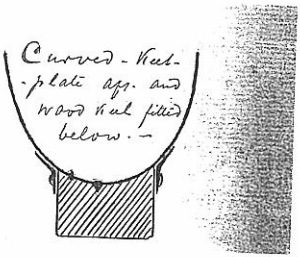
[74] *Phase 8. The 1866 box stringer from an extract from an 1887 cross section, BRO, 11562(4). The box stringer survives. © Bristol Record Office.*

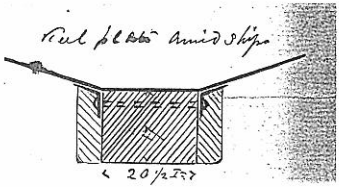


[75] *Phase 8. One of the 1866 bulb beams supporting the upper deck, seen adjacent to a Phase One angle iron beam & strut. The bulb beam probably makes use of one Phase One angle iron beam, to which it is riveted.*

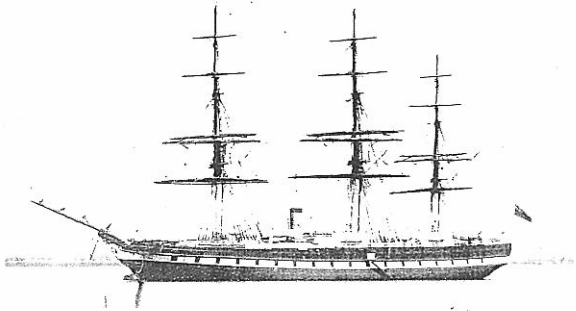
parts of the hull 'and, more especially where deterioration usually occurs'. William Bisset, who undertook the survey concluded 'Having carefully examined this vessel, I beg to state that I consider her to be in first rate condition; her plating is perfectly sound, and she is in every way seaworthy'[24].

In spite of this confidence in her fabric, the *Great Britain* was laid up at Birkenhead. She had carried more than 12,000 passengers to and from Australia.



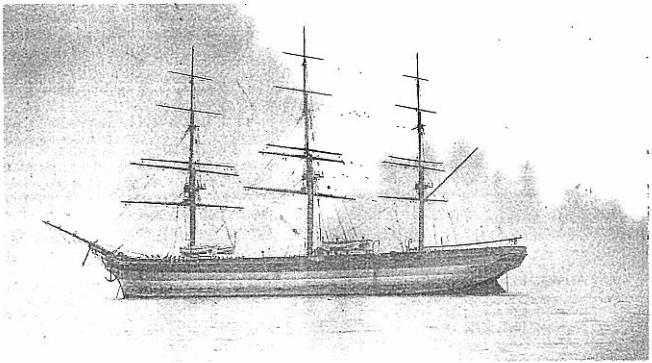


[76] *Sketches of the keel plate from the Lloyds 1872 report.*
© Lloyds Register Archives



[77] *The 'Great Britain' at Gravesend, 14 August 1975, before her last Australian voyage.*
© The National Maritime Museum, London

4.3 - The *Great Britain* as a sailing ship



[78] *The Great Britain as a sailing ship, the elegance of her lines disguised by wood casing.*
© San Francisco Maritime Museum.

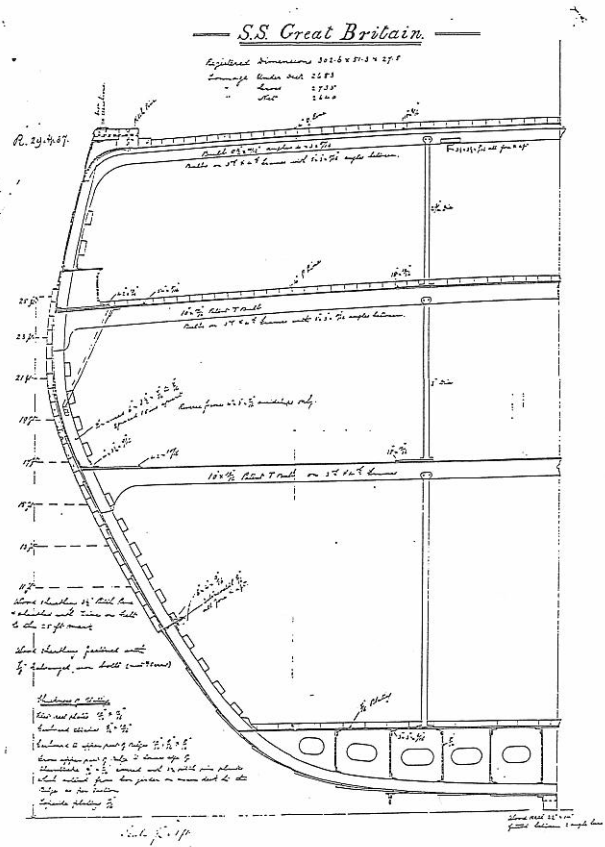
Phase 11

In 1881 an attempt to auction the ship resulted in her being withdrawn at £6,000, and in 1882 ownership was transferred to Vicary Gibbs (connected with the former part-owner) and the ship was – as Patterson had suggested in 1848 – converted into a sailing ship [78]. This was undertaken for the business of exporting coal and importing saltpetre, nitrates and wheat by Graysons (Corlett, 190, 154). This final and most drastic transformation of the ship into a large cargo-carrying windjammer is known from an 1880s cross section amidships [79], photographs, and her appearance when she was rescued in 1970.

She only undertook two complete voyages in this form, between Liverpool and San Francisco. On her third voyage, which started at Penarth, bad weather and shifting cargo forced her into Port Stanley in May 1886. Repairs estimated at £5,500 forced her sale. In 1887 her Registry was closed and she was officially converted to a hulk for wool storage, having been sold the previous year to the Corporation of the Falkland Islands Company.

The 1882 work removed all the passenger accommodation, including the new spar deck added in the 1850s. The engine and boiler space became a cargo hold, and the foremast was moved forward. Timber planking was added to the hull above the water-line, disguising her original construction. This may have been intended to protect her from damage by lighters (Corlett, 1990, 155) or may have been perceived as playing a structural role. Although this was a downgrading of the great steamer, the physical intervention this last conversion required must have been expensive, suggesting that a long life in this form was anticipated.

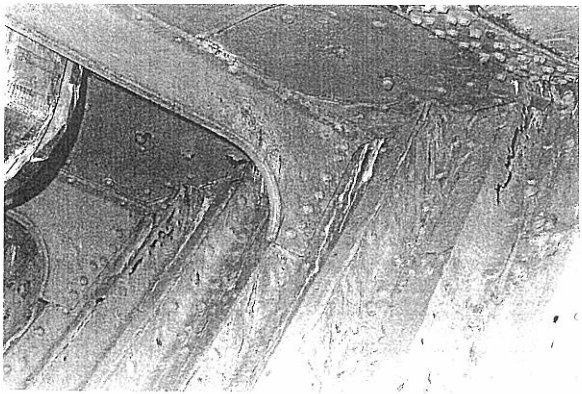
The loss of the engines and boilers had to be made up with additional structural members and this involved the introduction of Butterley patent bulb beams (patent stamp on beam in the present Hayward Saloon on the ship),



[79] *Cross section of 1887 showing the use of Butterley beams (shown as 'patent T bulb') and wrought iron stanchions to provide open spaces for cargo and to replace the structural elements lost when the boilers and engines were removed, BRO, 11562(4). © Bristol Record Office.*

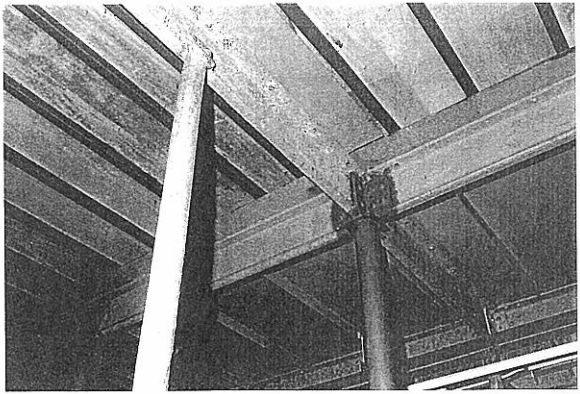
supported on wrought iron stanchions [80-82]. These survive extensively in the space between the focsle bulkhead and the existing after engine room bulkhead, below the level of the promenade deck.

Butterley beams, sometimes known as a 'tee bulb' were patented by Mr Alleyne in 1859 and recommended for the support of wooden decks in Reed's *Shipbuilding in Iron and Steel* (1869, 139) and Thearle's *The Modern Practice of Shipbuilding in Iron and Steel* (1886, 49-51). The T part of the beam and the bulb part were rolled separately and welded together along the neutral axis of the beam. After 1869 the form of bulb-iron in general use for deck beams was rolled in one piece, with angle irons riveted on either side of the top edge after the round-up had been performed. This is similar in appearance to the tripartite 1866 beams which support the present upper deck. The Butterley Beams are noted as 'patent tee bulbs' in the 1882 cross section of the ship. The ship was ceiled with widely-spaced planking in the cargo areas.



[80] *A Butterley beam in situ, fixed to a Phase One angle iron frame.*

[81] *Loose stanchions in the ship in 1998 clearly show the design of the stanchion base (although there are variations to the stanchions in situ) and the curved lapped design of the top which curves over the bulb to support the Butterley beams.*



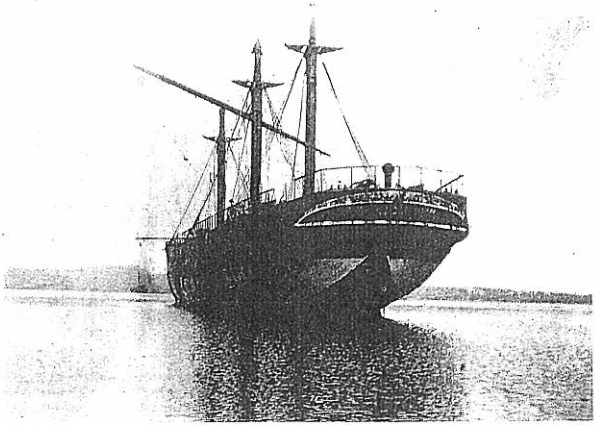
[82] *A Butterley beam and stanchion (front) in situ in the former boiler space. The stanchion to rear is post 1970.*

4.4 - The Hulk

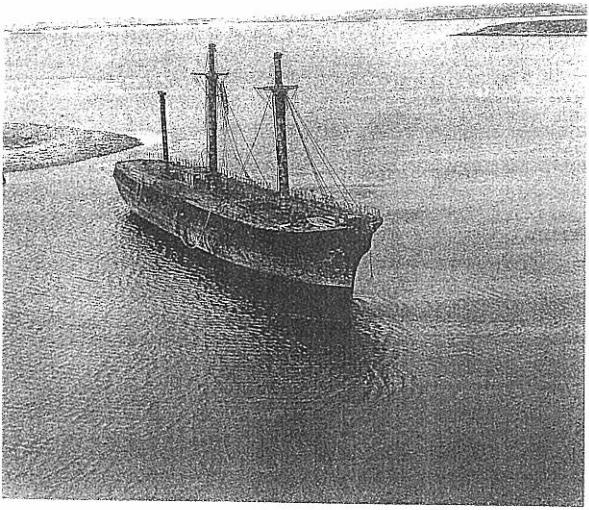
Phase 12

As was to be expected, conversion to a hulk involved the minimum of alterations. The rigging was stripped to the lower masts and mainyard. A winch house and donkey engine were provided for loading and unloading. Two cargo doors were cut in the side of the ship, the forward door removing the top corner of the hull. The focsle deck was raised. By 1933 the upper deck was leaking and there was a risk of her sinking and blocking the entrance to Port Stanley.

In 1936 a fund was launched for her preservation and the Falkland islands Company offered to present her to the government. Predicted costs meant that the project was abandoned and she was removed to Sparrow Cove in April 1937, holes driven in her sides with crowbars, and beached [84].



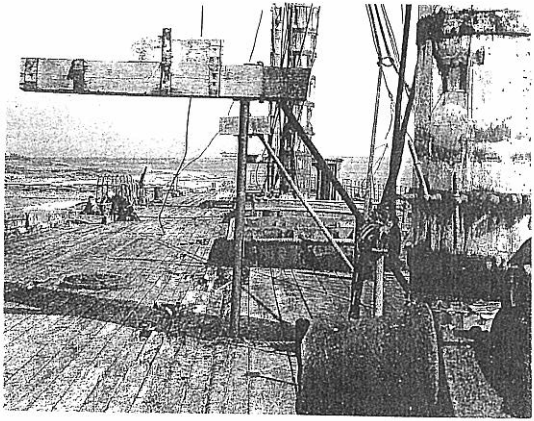
[83] *The 'Great Britain' as a hulk c.1900, reproduced from Corlett, 1990, 158. © Ray Sutcliffe*



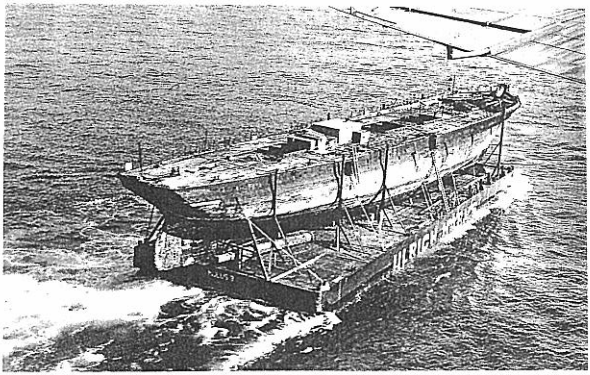
[84] *The 'Great Britain' at Sparrow Cove in 1967, reproduced from Corlett, 1990, 160. © Karl Kortum.*

4.5 - Rescue and Restoration, 1970-1998

In 1967 Dr Ewan Corlett mustered renewed interest in the fate of the *Great Britain* with a letter to *The Times*. An inaugural meeting of the *ss Great Britain* Project was held in Bristol in May 1968. Dr Corlett went out to the Falkland Islands to assess the condition of the ship and the prospects of rescue. This was another risk-taking enterprise with success by no means assured, but on 13 April 1970, the ship was floated onto a pontoon, *Mulus III* and brought back to Bristol. Formal ownership was transferred to the *ss Great Britain* Project from the Falkland Islands. On 1 July 1970, she was floated out from the pontoon in Avonmouth Docks. At that stage the ship was effectively a huge sieve with a great crack, full height on the starboard side. The journey up the Avon to the Floating Harbour was a perilous one but she made her way, towed up the Avon to the Floating Harbour on her own bottom on 4 July to a celebration parallel to that of her floating out in 1843. She re-entered the dock in which she had been constructed on July 19 1970, 127 years to the day since her leaving.



[85] *At Sparrow Cove in 1969 before her masts were removed for the rescue. Her fore and main masts are currently stored by the ss Great Britain Project on site, her mizzen mast was left in Port Stanley as a memorial to the period she spent in the Falkland Islands, BIM 7329.*



[86] *The ship on her way home, 1970, reproduced from Corlett, 1990, 171. © Daily Express*

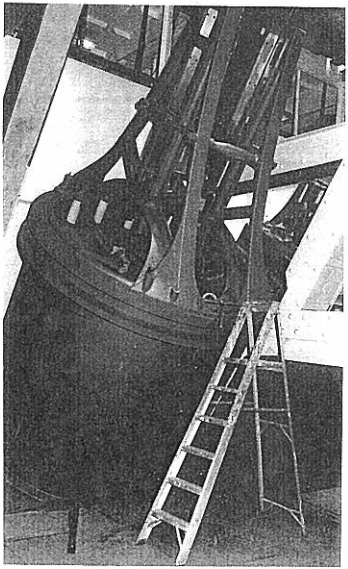
The success of the heroic salvage operation was succeeded by an equally heroic, if less glamorous, period. The task was to restore a ship that, as Joe Blake records in *Restoring the Great Britain*, would have been classified as 'beyond economical repair' by any shipyard (1989, 31) in a context of uncertain funding, and the uncertainty of whether the ship would remain in Bristol. A restoration philosophy had to be established, research undertaken, specifications written and work begun. Preserving a decayed wrought iron ship that was also acknowledged to be a national treasure, put the *ss Great Britain* Project in a position similar to that of her original building committee, without textbooks and having to undertake experiment and research to establish the best way forward. Visitors were welcomed from the outset.

As anyone responsible for a large, complex, historic site will understand, good systems established at the outset - for example for recording and careful storage, can and do get left behind as other priorities come to the fore.

The physical impact of nearly 30 years of restoration and recreation work has been substantial. Much of the work has been undertaken by volunteers and firms who have given their services *gratis* or at unprofitable prices. Only the outlines of the work can be indicated here, the pre 1990 works are described in more detail in Corlett, 1990, 177-193.

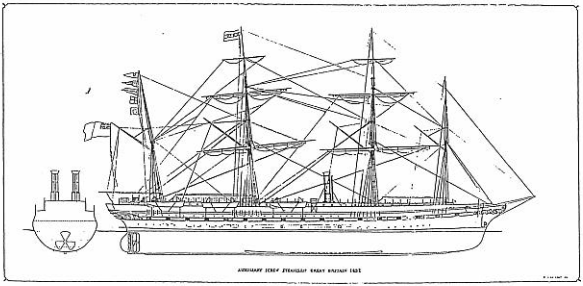
Interest in phase 1 of the ship - the Brunel era - has, to date, dominated the process of restoration, along with the need to make the ship accessible to visitors. Steel decks, upper (throughout) saloon (after) and promenade (amidships), have been introduced and a mixture of repair, restoration and re-creation have produced her 3 major first phase bulkheads. The re-creation of her original machinery, intended to turn in due course, involved the removal of some of the 1882 elements to make room for it. Re-created engines, incomplete at the time of writing, have been installed on the basis of original images of them. Re-creating the original rudder involved the removal of the 1857 rudder and extensive alterations to her stern, which revealed that her original stern post had survived intact. The plating has been patched, and in some places replaced, with fibreglass or steel. Fittings have been introduced into the aft promenade and saloon on the basis of historic descriptions and images. A room has been created in the upper area of her original boiler space. The refitted saloon and this room, the Hayward Saloon, have generated income and local links by being hired out for functions.

Nearly 30 years later, the restoration process was halted in 1997 for thorough review and a reconsideration of all aspects of the ship's conservation, management and presentation to the public. This Conservation Plan (1999) is part of that review.



[87] *One of the cylinders of the re-created Phase One engines in 1998*

[88] *The re-created upper deck in 1998.*



[89] *One of Dr Ewan Corlett's reconstruction drawings of the 'Great Britain' based on documentation and fabric analysis. This shows the form of the ship in 1852, reproduced from Corlett, 1990, 128.* © *Dr Ewan Corlett.*

5 -Tabulated Analysis of Surviving Fabric

This section identifies fabric of different phases in each of the surviving elements. It is based on observation allied to documentation. It does not claim to be completely comprehensive. It will need amendments as different elements are better-understood. Question marks indicate more than normal doubt about whether the fabric does in fact come from a particular phase. The 'uncertain' category means that at this stage it has not been possible to put the fabric into a known phase.

5.1 - The ss Great Britain

Phase 1 (1839-1843) GWSSC	Plating of hull (excluding later repair) Lower hawse holes in plating Frames of hull (excluding later repair) Stern post; stem post Some original plating to forecastle, forward boiler room and after engine room bulkheads Docking keels Angle iron deck beams (including carling evidence for Phase 1 companionways & cargo hatch) Diagonal struts between angle iron deck beams and hull (some may be later but those to upper deck and forward of the forecastle bulkhead are Phase 1) Iron web stringers above angle iron deck beams (may be later versions of known Phase 1 design) Timber stanchions Transverse timber to forecastle deck Transverse timbers to tank top aft of the after engine room bulkhead Timber stringers? (might be 1852) Timber and wrought iron mounting under tank top floor, aft of after engine room bulkhead Lower hawse holes Base of circular skylight Windlass? WC pipes? Hammock hooks
1845 following trials	Iron stanchions to forecastle and lower forecastle? (the continuous stanchions are 1852) Baulks of wood lining the bow (forecastle)?
Phase 3 1851-52	Keelsons Continuous iron stanchions rising through decks forward of the forecastle bulkhead Remains of continuous iron stanchions in lower cargo deck Some fabric (some is restored) of plate stringers forward of the forecastle bulkhead including diagonal struts between stringers and hull Surviving iron fabric of tanktops (assume 1852 because of deepened keelsons) Cast iron brackets for missing wood breasthook to forecastle WC bulkhead?

Phase 4 1853	Double row of wrought iron stanchions to lower cargo deck (forward)? Timber mast partner in lower cargo deck? (possibly moved in 1882?)
Phase 6 1856-57	[*ex situ* lifting screw frame] [*ex situ* figurehead] [*ex situ* foremast?] (date needs confirming) *ex situ* mainyard Propeller lifting trunk
Phase 9 1866	Box stringer to saloon deck Tripartite bulb beams to upper deck
Phase 10 1871	Intercostal frames round existing wood mast partner in forward lower cargo deck Sections of plated deck located as above [*ex situ* main mast?] (date needs confirming)
Phase 11 1882	Ubiquitous wrought iron stanchions mostly directly supporting Butterley patent tee bulb beams Butterley patent tee bulb beams Large cargo hatches - carlings and coamings Hawsepipe housings in focsle. [*ex situ* foremast and mainmast?] (dates needs confirming)
Phase 12 1886-7	Doorways cut in
Phase 13 1970-1998	Steel deck beams Steel and fibreglass plating replacement Restoration fabric of major transverse bulkheads Deck timbers to saloon, promenade and upper decks Timberwork of companionways Re-created propeller; rudder & engines Re-created six mast rig Re-created funnel and pre-heater tank After boiler room bulkhead Steel shoes welded to some stanchions at decks Re-created cabins and saloon Replacement timber (e.g. some king beams forward of the forecastle bulkhead)

5.2 - The Great Western Dock

Phase 1 (1839) GWSSC	Cradle-Shaped profile at W end, coursed Pennant masonry and apron of ashlar Pennant masonry. Slots for timbers 2 flights of steps on S side Transverse timbers to dock floor at W end
Phase 2 (after 1855, before 1870) Patterson ?	Kink in S side associated with battered walls and flat floor Battered walls on N & S sides as far as E end extension?
Phase 3 (c.1903) Bristol Corporation	Walling, flooring & steps of E end extension, which gave the dock a blunter nose
Phase 4 (?)	Concrete facing on part of N side of dock wall

Phase 5 (post 1970) SS Great Britain Project	Concrete-lined recess for metal stair into dock on N side Metal stairways introduced on each side of the dock
Uncertain	Complex changes to flooring material, e.g. brick flooring and sections of concrete

5.3 - The GWSSC Factory

Phase 1 (1839-1840) GWSSC	Pennant masonry external walling (with later patching) Thick internal crosswall at N end Brick flooring N of internal crosswall? (the flooring N of the crosswall post-dates the tithe map but is probably GWSSC phase)
Phase 2 (tannery use c.1855-1886)	Assumed tanpits built up on earlier floor level, S of crosswall
Phase 3 (? 1886 or after, for warehouse use) Possibly GWR	Floor covering over tanpits Bullnose brick cills to former windows on E side? Ventilation grilles at floor level?
Phase 4 (c.1945) Wickham and Norris	Stanchions, Belfast roof trusses and roof covering to all but N end
Phase 5 (after 1962) Wickham & Norris	Stanchions, Belfast roof trusses and roof covering to N end
Uncertain	Blocking of N end doorways

5.4 - The Dock Office

Phase 1 (?before 1855) Either GWSSC or Patterson	External envelope of E block Drawing office cupboards Drawing office chimneypiece Doors with Gk ogee mouldings Chimneys on W side Cast iron columns and axial beam on ground floor?
Phase 2 (c.1905) Wickham and Norris	Art Nouveau chimneypieces, ground and first floor Parquet floor to E block, ground floor Heated lobby to E block, ground floor Part-glazed screen, E block, ground floor Stair Single-storey lean-to to S
Phase 3 (?) ? Wickham & Norris	W Block Plate-glass high-transomed windows Joinery of W block First floor corridor cut through E block for access to W block Amendment to E block roof for top-lighting to middle first floor room
Phase 4 (c.1940-45) Wickham & Norris	Repairs following bomb damage? Possible re-building of E block S gable end wall Window repairs

5.5 - The Jefferies Range

Phase 1 (c.1914-1919) Jefferies & Son	Basic envelope of range of: Office but rear (S) wall probably rebuilt after 1940/41) Former fitting shop Former smith's & boilermakers' shop E building in range (now Bristol Blue Glass workshop) may be slightly later & has renewed roof covering.
Phase 2 (c.1940-45)	Repair following bomb damage Brick S wall of office? Refenestration of office Conversion of upper floor of former fitting shop to office
Phase 3 (after 1962) ?Charles Hill	Ground plan & possibly some walling of corrugated iron shed at E end of range
Phase 4 (after 1970) SS *Great Britain* Project)	Lavatory block added at W end of range

5.6 - The Range North of the Dock

Phase 1 (? 1945-1952?)	External envelope (excluding post 1970 re-cladding)
Phase 2 (post 1970) SS *Great Britain* Project)	N canopy to entrance-cum shop Re-cladding of walling of entrance-cum-shop Re-cladding and conversion of ground floor of cafeteria

5.7 - Timber yard Buildings

Phase 1 (pre 1852?) GWSSC	Masonry & brick wall containing stone arch projecting off S boundary wall
Phase 2 (? pre 1945) Wickham & Norris	Store No 2? Incinerator?
Phase 3 (pre 1952 probably with later alterations) Wickham & Norris	Timber stores 1, 3, 4 & 5
Phase 4 (post 1952) Wickham & Norris	Timber stores against S boundary wall
Uncertain	Brick paving in yard rear of Jefferies range

5.8 - Boundaries

Phase 1 (pre 1848) GWSSC or Charles Hill	Pennant rubble walling of timber yard S boundary wall E of the kink
Phase 2 (c.1872) Wapping Dock Co.	Pennant rubble walling of timber yard S boundary wall W of the kink, following a boundary change
Phase 3 (c.1903)	Brick wall round nose of dock
Uncertain, c.post 1945	Fabric of S boundary of dock area, re-using probably late C19 rails & incorporating one brick pier (c.1903?) from pre-war covered hauling way in timber yard. Horizontal planking probably c.1960s