Bristol's *Ruby* on Trial

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Introduction

Iron canal barges were introduced from about 1787 and proved successful since the hull was lighter than a wooden one, permitting a bigger payload. A later, but similar, barge may be seen at the Blists Hill Museum, Ironbridge. During the 1820s and early 1830s a number of sizeable ships were built for river and coastal service but they were unable to go out of sight of land since there was no way of using a magnetic compass in an iron ship.[1]

An increasing amount of iron was being used in traditional wooden warships for brackets and straps - and even masts - and this, too, affected the compass. The Admiralty began experiments on compass correction in 1835 and a solution was published by the Astronomer Royal, Sir George Airy, in 1838. His solution, using small magnets to compensate for the effect of the hull was time consuming and, initially, not entirely reliable but it was good enough. I.K. Brunel changed the design of the *Great Britain* to iron, the East India Company acquired an iron gunboat, *Nemesis*, and the Admiralty ordered an iron mail packet, *Dover.*

Iron hulls were some 25 per cent lighter than those of wood and were far more able than wooden hulls to support the concentrated weight and the vibration of early steam engines. These aspects were particularly important for shallow draught ships and in 1840-41 the Admiralty ordered several small iron steamers for exploration of the Niger river and for service on the Great Lakes. In September 1841 two more small tenders were ordered, probably intended for use in exploration, possibly also for the Niger, but which were used for harbour service in home waters. These were the *Rocket*, ordered from Fairbairn on the Thames and *Ruby* from Acraman, Morgan & Co of Bristol.

Acraman, Morgan & Co of Bristol

The early history of the Acraman business is complicated but their shipbuilding interest dates formally from 1839 when William Morgan joined the company.[2] Morgan, born in 1791 was one of many brilliant graduates of the Admiralty School of Naval Architecture at Portsmouth[3], later becoming co-editor of the influential 'Papers on Naval Architecture'. He left the Admiralty when the reactionary Symonds was made Surveyor and worked briefly for the Austrian Lloyd steamship company at Trieste. Morgan bought, and improved on, Galloway's patent for feathering paddle wheels which were appreciably more efficient than those with fixed floats and such wheels were fitted to Acraman, Morgan ships.[4] A new shipyard was established in Bedminster, near Clift House, but the company was short lived, filing for bankruptcy in 1842, soon after Ruby was launched.

Particulars of Ruby

Tonnage 73 (Builders Measurement), Length 90ft, beam, 12ft-9½ in, depth 7ft-1 in. Two cylinder engine of 20 nominal horse power. The wheels of *Rocket* were 10ft-2in diameter, 3ft-9in wide with floats 9in deep, turning at 36 rpm and *Ruby* was probably similar.

They were an unsatisfactory pair; *Rocket* was broken up in 1850[5] and the files were full of complaints about *Ruby.* She was used as a tender, first at Chatham and then at Portsmouth but was said to be too small to tow a lighter, her accommodation was inadequate even for harbour service and her machinery was unreliable. In later years she was used to take shipwrights from Portsmouth to ships at anchor in Spithead.

By 1846 this four year old ship was worn out. A survey report read:

> *Her state was very bad; the iron of which she was constructed was originally very thin, not thicker than a half crown [Actually 1/ 8in], the seams of rivets were many of them quite gone; the ribs were very far apart - I should consider it likely that they were about 4ft apart, instead of being 10 inches or afoot, the heads of her rivets were quite gone, especially internally, the deck was also partially removed for the purpose of lifting the machinery out previous to the experiment, and this made the vessel still weaker*[6]

Iron Warships

In the meantime, the Admiralty's iron ship programme was running into trouble. A considerable number of iron ships had been ordered by the Tory government including some very large frigates, second only to the Great Britain in size. The Whigs were opposed, led by their naval spokesman Admiral Sir Charles Napier, pointing out that insufficient attention had been paid to the effect of gunfire on iron structures.[7] At first sight this was unfair, the *Nemesis* had served in the China War and suffered several hits, none of which caused serious damage and all were easily repaired. The British built (and officered) Mexican frigate *Guadeloupe* had similar experiences in the war with Texas.

However, the First Naval Lord, Admiral Sir George Cockburn, arranged for tests at Woolwich Arsenal in 1845-46.[8] These tests were carried out in unusual secrecy but remaining reports show that they were carried out with great care and were impartial. They showed that under some conditions a gunshot and a piece of plate could shatter, throwing lethal splinters for a great distance. A high velocity shot would make a small hole, easily patched but a spent shot, such as one piercing the near side and going on to hit the far side at reduced velocity would tear seams and joints over a considerable distance. Though inconclusive, these tests suggested that there were unsolved problems. There was also a problem with the rapid fouling of iron ships.

Firing Trials

In July 1846 it was decided to use the hulk of the *Ruby* for firing trials. She was placed 450 yards on the broadside of the gunnery training ship *Excellent* (Ex battleship) and 8in and 32lb shot were fired into her. Chad's report says:

> *All the shot passed through both sides, the holes made on the first side being of the size of the shot, and generally smooth even when striking upon a rib, but the damage done to the opposite side of the ship was very different as in the case when the shot struck on a rib the damage was very great. The iron sheets were torn off and injured to a considerable extent, and even when the shot passed clean through between the ribs, the holes made were of a difficult nature to stop, from their edges being turned outward. The splinters from the first side were few, but very severe.*

The Ruby was then placed end on to the guns but the shot fired at her so tore the ribs and plates that it was evident that a similar vessel so situated would be in danger of being instantly sunk by one well-aimed shot.

A 10in shot with a 12lb charge passed through the bottom plates on one side, struck a rib on the other, and made a hole 4ft x 3ft. Chads reached the only possible conclusion saying that 'the above experiment clearly proved vessels of the *Ruby* class unfit for war purposes' after all, she was not designed to fight! No other conclusion was drawn at the time but later writers attach too much importance to this rather silly test. The reason for the trial remains obscure; firing trials against obsolete ships are still popular and sometimes useful. The end came for poor *Ruby* when her remains were sold for £20.

There were further trials against replica sections of the big frigate *Simoom* and variations thereof in 1850 which confirmed that the resistance of wrought iron to shot was variable and often poor. Chads' final conclusion was that 'iron vessels are utterly unfit for war.' He has been denigrated as reactionary ever since but with the benefit of hindsight, it is clear that he was right.

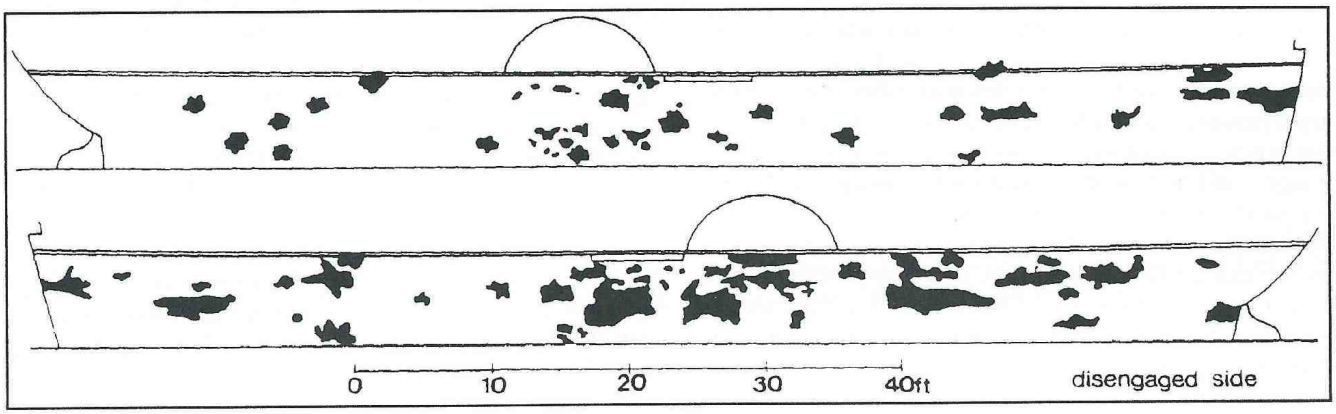
Wrought Iron and Temperature

The reason remained a mystery until *HMS Warrior* was being restored. The author was suspicious about the strength of wrought iron through the thickness and arrangements were made for John Bird at the Naval Constructional Research Establishment, Dunfermline, to test sample of *Warrior's* iron. He found that while the ultimate tensile strength was 220 N/mm^2 in the longitudinal direction but only some 150 and very variable perpendicular to the plane of the plate.9 More important, he found that the impact strength was temperature-dependent with a rapid fall off below 20°C, explaining the inconsistency of the original material - *Nemesis & Guadeloupe* fought in warm water; the Woolwich tests were in the winter. More recent tests[10] by Dr J .E. Morgan of Bristol University on iron from *Great Britain* show even higher temperatures for transition to brittle behaviour with little impact strength below 40°C. Failures in wrought iron (and other ferrous materials) are very often associated with low, even not so low, temperatures and this should always be investigated.

The Admiralty are often accused of being reactionary in the introduction of iron ships. In fact, they were over-ambitious; wrought iron was not a suitable material for ships of war.

Notes and References

1. Brown, D.K., *Before the Ironclad*, (1990).
2. H.S. Torrens, H.S., *Men of Iron*, (Bristol, 1984).
3. Brown, note l.
4. Feathering wheels were rarely used on warships as it was thought that the mechanism might jam if hit by gunshot. *Ruby* was hardly a warship and may have had Morgan's wheels.
5. Fairbairn's wrought iron ships seemed prone to early corrosion.
6. Chads, D. *Experiments at HMS Excellent on Iron Built Ships* (1846).
7. Napier had lost a great deal of money on an early iron ship, the *Aaron Manby.*
8. Cockbum had an outstanding war record. was an excellent administrator and was progressive in action. He has been badly served by earlier writers but a new biography does him justice.
   Morriss, R., *Cockburn and the British Navy in Transition*, (Exeter, 1997).
9. Brown, D.K., and Wells, .J.G., . '*HMS Warrior* - the Design Aspects', *Transactions of the Royal Institution of Naval Architects* (RINA) 128 (1986).
10. Morgan, J.E., 'The Wrought Iron of *SS Great Britain*'. RINA Historic Ships Conference, Bristol (On board the *Great Britain*), 1996.



***HMS Ruby*: hull damage received 6-7 August 1846 from 40 shots fired by *HMS Excellent*.**