The dockyard 160-ton hydraulic crane, guns, and an unlikely connection with Venice

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Abstract: Since its demolition at Somerset Wharf, at the Malta Dockyard, half a century age, there is nothing left to remind one of an outstanding Victorian engineering artifact – the 160 ton Armstrong Mitchell Hydraulic Crane. Armstrongs manufactured huge guns for pre-Dreadnought battleships and then provided the means for hoisting them ashore for overhaul. The Armstrong Mitchell crane worked by hydraulic water pressure; old timers recalled being spattered with water when working in the vicinity. In the 1966, Swan Hunter & Wigham Richardson, who managed Malta Drydocks, replaced the huge, static structure, which was visible from the Upper Barracca Gardens, with modern, travelling cranes. Similar cranes at foreign naval dockyards met the same fate but the one at the Arsenale di Venezia escaped the breakers' torches. The Venice crane is in dire need of attention, and a British charity, the Venice in Peril Fund has stepped in to raise money for its restoration and conservation.

Keywords: Armstrong Mitchell, Malta Dockyard, Somerset Wharf, hydraulic cranes, Arsenale di Venezia

For the world of warships, harbours, and armaments, the second half of the 19th century was an exciting chicken-and-egg time. Iron, and later steel, replaced wood, steam replaced sail, and old and new nations vied with each other for command of the seas with warships of increasing size and gun power. While the old wooden walls that had defined naval supremacy for centuries were dying out,

marine architects experimented with designs, learning along the way, sometimes at tragic cost to human lives. Guns in turrets were installed in central batteries on steam-powered ships; they also carried sail that made them unstable and interfered with the firing of the guns. On 6 September 1870, HMS *Captain* capsized and sank off Cape Finisterre with the loss of all but eighteen of her crew. It was not long after that the mastless battleship with heavy guns fore and aft of the superstructure appeared on the scene; in the Mediterranean it heralded a race between traditional rivals Britain and France and newcomer Italy.

On Malta and its primary asset, the Grand Harbour, the winds of change blew, as always, from abroad. The Admiralty transferred the mercantile community from French Creek to Marsa and, between 1865 and 1871, built Somerset Graving Dock (No. 3), the first of four that would eventually alter the topography of the entire creek. In 1885, a huge factory building, called the Iron Ship Repairing Shop, was built between the dock and the eponymous wharf. Both dock and repair shop were political signals to France and Italy; what the island lacked in shipbuilding (only the sloop HMS *Melita* and two gun schooners *Azov* and *Kertch* were built locally for the Royal Navy) would be offset by extensive in-house repair facilities that did away with the need for warships of the Mediterranean Fleet to return home for refit and repair.

In 1846 William George Armstrong, a solicitor turned engineer, used water pressure to power a hydraulic dockside crane; it was a world first. Four years later, on a flat site, Armstrong solved the problem of low water pressure by inventing an accumulator tower. The mechanism was ideal for lifting heavy loads; it consisted of a high cast-iron cylinder fitted with a plunger supporting a very heavy weight. When the plunger was slowly raised, it drew in the water until the downward force of the weight was sufficient to create pressure on the water below.

Armstrong has been called ‘the Bill Gates of his time’. He created a huge industrial empire, building ships, and manufacturing armaments and hydraulic equipment. The company merged with Charles Mitchell in 1867 and subsequently with Joseph Whitworth in 1897 and Vickers in 1927. These mergers added to the company’s portfolio aeroplanes, automobiles, and aircraft. The hydraulic principle was also applied for the firing of heavy-calibre guns; Armstrong sold armaments and ships all over the world, indirectly helping Japan to beat the Russian Fleet at

the Battle of Tsushima during the Russo-Japanese War in 1905. Earlier, Armstrong guns had been used by both sides during the American Civil War.

However, it was his special relationship with Italy and Venice that changed the balance of power in the Mediterranean. The 100-ton gun at Fort Rinella is testimony to Armstrong's initiation of one of the most expensive upheavals in naval architecture of the century when the company offered to sell to Italy massive guns for warships. When the Italian Navy mounted his breech-loading 100-ton guns on its pre-Dreadnought battleships, the balance of power was so altered that guns of similar calibre, albeit muzzle loaders, were commissioned for Malta and Gibraltar, from, unsurprisingly, Armstrong.

The *Navy and Army Illustrated* of 12 June 1896 featured the hoisting out of one of the 67-ton guns from the aft turret of the pre-Dreadnought HMS *Trafalgar*. The ship served with the Mediterranean Fleet between 1890 and 1897. Her main armament was four 13.5″ guns mounted in two turrets, fore and aft. For the uninitiated there was this explanation for such a laborious, dangerous, time-consuming, and necessary procedure:

> The disembarkation of a battleship's big guns is a proceeding that takes place in all men-of-war at varying intervals for the purpose of replacing worn or damaged pieces by new. After a limited number of rounds, a gun loses its accuracy through the effect of corrosion caused by the powder gases, and requires re-lining or re-fitting with a fresh inner tube. A 67-ton gun for instance, such as we see here being hoisted out of the after turret of the 'Trafalgar' in the Malta Dockyard, has a 'life', as it is termed, of 120 rounds with full charges or of 400 rounds with half-charges and of 200 rounds with three-quarters charges. After firing this number of rounds, the gun goes back to the arsenal for inspection and, if necessary, for renewal. By regulation, in peace practice half-charges only are used, with an occasional three-quarters charge to test the proper working of the gun mounting; the full charge being reserved for employment in war.

After landing on the wharf the gun would be transported to the Iron Ship Repairing Shop. None of this would have been possible without the Armstrong Mitchell crane. Steel wire and winch drums were a few years away; wrought-iron chains on cranes were liable to break if overloaded. Armstrong filled the need for heavy lift dockside cranes using his hydraulic cylinder invention. Between 1876 and 1905, the

firm manufactured 160-ton fixed hydraulic cranes for La Spezia (1876), Bombay (1877), Liverpool (1881), Malta (1883), Taranto and Venice (1885), Pozzuoli (1887), and Japan (1892 and 1905). Most of them were destroyed during the last war. The La Spezia crane was demolished in 1969, that of Taranto in 1992. Only the Venice crane survives. This is the story of the Malta Dockyard crane.

The crane built for Malta was Works No. 2983, date of manufacture 1883. The crane is first shown in 1888, in images of the launching of HMS *Melita* on 20 March. For the intervening years, the esoteric world of the Dockyard is of little help. Until the construction of the docks at Għajn Dwieli, which were extremely well documented, images of Dockyard expansion during the nineteenth century are scarce and generally cover inaugurations; hardly any photographs being taken of the works themselves.

A photographic record of the installation of the Armstrong Mitchell crane is scarce and probably inexistent (none likely exist of its demolition in 1965–66). However, the actual works have been excellently documented by the contracting engineers, Charles Colson and Charles Henry Colson in Paper No. 2631, *The 160-Ton Hydraulic Crane at Malta Dockyard Extension Works*, Sect. II-Other Selected Papers, *Minutes of the Proceedings*, Part 4, Volume 114, Issue 1893 (January 1893), 284–8, Institute of Civil Engineers. The paper describes the workings of the crane itself and the rebuilding of a section of Somerset Wharf to take the weight of the new structure. Crane and wharf would have been of little use to the navy before the Iron Ship Repairing Shop was completed in 1886. Whether this date refers to the building and/or its machinery (which had to be procured from England) is not known. However, a photo of French Creek from the Upper Barracca Gardens shows the newly completed factory (freshly quarried white stone standing out) and, probably, the platform of the new crane. This image may be dated with some accuracy because the Colsons refer to problems caused to the works during engine trials of HMS *Alexandra* which was undergoing refit just off the wharf. The flagship of the Mediterranean Fleet emerged with a white hull in 1866 after the refit. It is therefore likely that 1883 is the date of manufacture of the crane but the actual erection following shipment to Malta in a knocked down state, had to wait for the revamped quay and completion

of the new factory.

For the Colsons, father and son, civil engineers with Admiralty, the major job in hand, apart from the hydraulic crane, was the building of a second dry dock in French Creek on a site north of Somerset Dock. As originally planned, neither dock was to disturb the fortifications; indeed, intervention at Somerset was limited, the dock being built on War Department land and extending into the sea with the use of caissons or temporary dams during construction. Further to the north Senglea and Corradino Bastions intruded on the second projected dock. The Admiralty must have accepted Lt. Col. Andrew Clarke's (the director of works at the Admiralty) dictum that the fortifications were obsolete and therefore redundant. The second dock necessitated a lot of rock-cutting. At Somerset traditional Maltese methods of quarrying were largely used; for No. 2 Dock (Hamilton) the Colsons brought a Lobnitz rock-cutter from England to speed the works. Charles Colson (1839–1915) joined the Admiralty Department of Civil Engineering in 1866. His son Charles Henry Colson (1864–1939) followed in his father's footsteps in 1883.

The lesser job at the Dockyard extension works was the erection of the 160-ton hydraulic crane; it was a work in reverse in that it had to be erected on an extant wharf that had been completed just over a decade earlier. Wharf walls are extremely strong but the intervening space, above which the deck is laid, is generally filled with loose quarry refuse and mud. Clearly this could not take the weight of the huge crane with its tons of wrought iron, ballast, and the weight of the guns being hoisted out of the ships. New foundations had to be laid.

The section of the quay on which the crane would rest was sectioned off with a temporary timber (fir) caisson, 26 feet deep, laid on a sloping bottom, and the quay was dug out until the rock bottom was reached. The foundations, 56 X 53 feet, were made from a solid mass of Portland cement concrete, consisting of six parts of hard limestone, three of sand, and one of cement. The process of filling this huge hole must have taken months; Portland cement was imported in barrels and concrete was mixed by hand on site. The Colsons describe problems and solutions; a leaking caisson from an underwater trench and engine trials by HMS *Alexandra*, moored abreast of the works, whose turning screws churned the mud and exposed the fissure. Pumps kept the interior of the caisson

reasonably dry while the fissure was filled. After the foundations up to the coping were completed, the new wharf wall was lined with hardstone.

Above the level of the deck was the column, 50 feet in diameter and 20 feet high to the top, where the roller path was laid. Outside the form work, the column was lined with local limestone slabs, but the curb carrying the roller path was made of Cornish granite dowelled at the top with metal cramps. In the central pivot, also made of granite, and reaching down to deck level, was the chamber for the hydraulic pipes. The pipes were connected, via a covered trench on the wharf to the boiler and engine house at the rear of the Iron Ship Repairing Shop.

The Colsons describe the crane in detail: the maximum working load of 160 tons can be lifted 50 feet at a radius of 70 feet by means of a direct acting cylinder suspended in gymbals from the jib. Lesser loads up to 35 tons can be lifted 90 feet at a radius of 75 feet, via an additional chain purchase provided outside the main lifting cylinder. This is the main ram for lifting and lowering with a high capacity, smooth and controllable operation for delicately placing heavy loads like gun barrels, boilers, and engines; no chains to suddenly jump or break, no gears to break. There is a smallish chain attached to the ram to draw it back towards the jib, bringing the access platform with it, on which stands the operator who controls the inlet and outlet valves.

The crane revolves on 96 linked rollers. The wrought-iron counter-balance box is loaded with 480 tons of old iron and stone, enough to balance 320 tons, twice the working load. Timber scaffolding was used for the erection of the crane, whose parts were riveted together. The total cost of crane and foundations was £23, 221. The crane itself, including the ironwork, machinery, chains, pumps, and delivery, but excluding erection, cost £14,550.

The crane continued to be used long after the big gun ship had passed into history. It lifted tugs, torpedo boats, and barges; a photograph taken in 1945 shows a motor fishing vessel (MFV) being hoisted for maintenance on a cradle on the wharf. For most of the time it was painted in red oxide; the men knew it as the 'Red Crane'. The Dockyard was partly privatized in 1959, the lease being granted to Bailey (Malta) Ltd., a Welsh ship-repairing firm. In 1963, Swan Hunter & Wigham Richardson was appointed manager. The crane was a hindrance and a

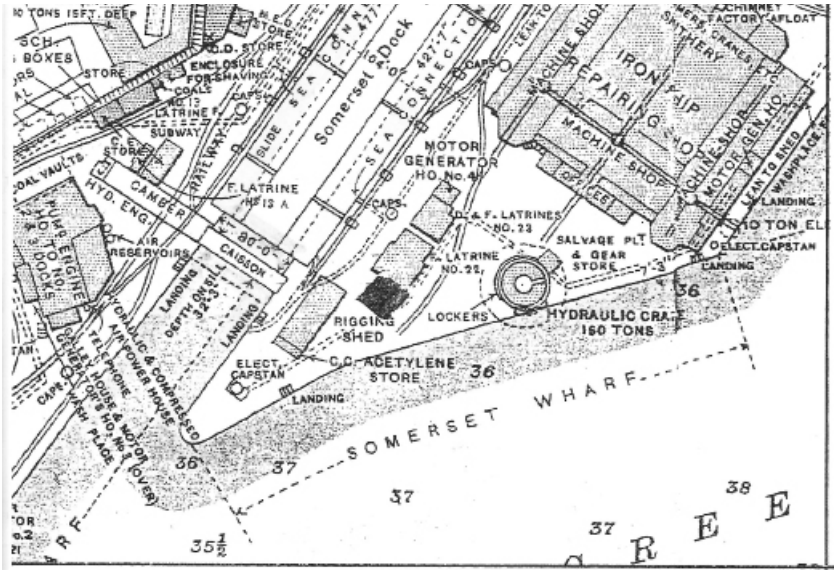
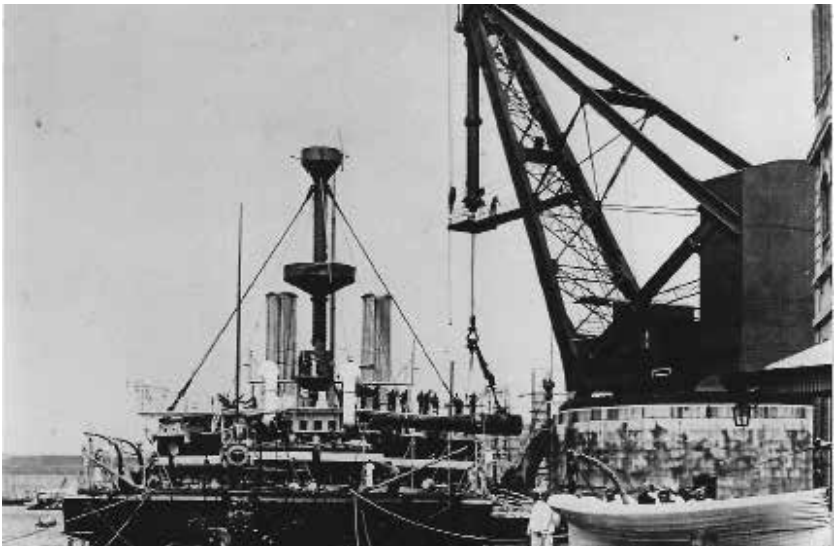
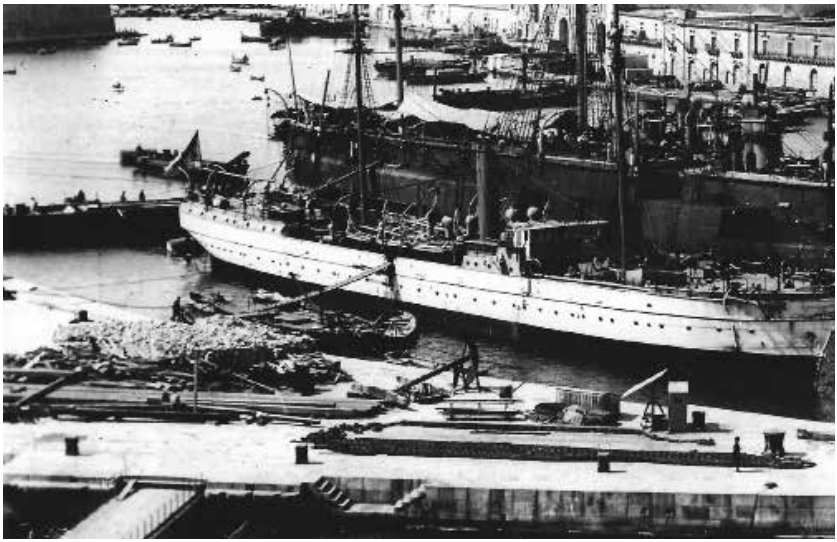


Fig. 1. Site of the hydraulic crane on Somerset Wharf, close to the eponymous dock (No. 3) and the Iron Ship Repairing Shop

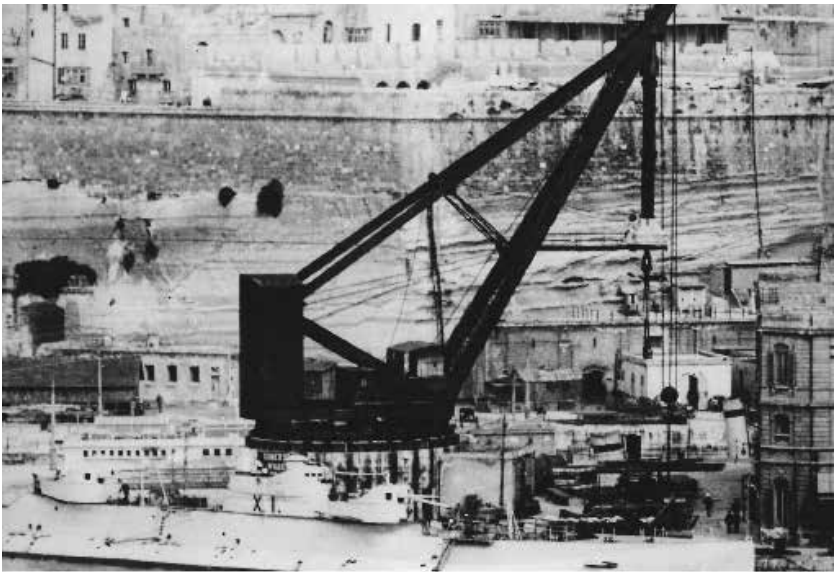


The valve operator on the platform of the 160-ton Armstrong Mitchell Hydraulic Crane hoists out one of the 13.5-inch guns of HMS *Trafalgar*. Photo published in The Navy and Army Illustrated, 12 June 1896



Engine trials on HMS *Alexandra* (black hull, beyond HMS Humber) hampered reinforcement work on Somerset Wharf to take the weight of the new crane

The crane survived war damage that partly destroyed the Iron Ship Repairing Shop. At right is the Melita Slip where the famous eponymous sloop was launched in 1888



The 35-ton hoist working on HM Submarine *XI c.*1926–28.The unique cruiser submarine carried four 5.2-inch guns. In the background is construction work on Senglea Primary Sc[oo] on St Michael Bastion

The only surviving Armstrong Mitchell 160-ton Hydraulic Crane is at the Arsenale di Venezia

throwback from another time. Unlike modern travelling cranes, ships had to be moored exactly beneath its jib. In 1965 the axe fell on the Victorian artefact; the jib was dismantled, the counter-ballast box emptied. An August 1966 photograph shows the huge concrete column. The Portland cement must have taken months to demolish. That was 50 years ago; the crane passed into industrial heritage oblivion without as much as a record.

When in Venice try to visit the Arsenal di Venezia during the Biennale or on Italian Navy Arsenale Open Days. Even if this is not possible, the crane is as much a landmark was it was in French Creek. The ballast box needs attention; if it breaks the crane will topple into the water; since the crane does not function, enough of the ballast can be removed to balance the structure. In 2013 the straps holding the ballast box were reinforced. It might sound incongruous that La Serenissima, with its millennial heritage should worry too much about a Victorian crane, which Lord Foster describes as 'a priceless part of the industrial heritage of Venice'. Nevertheless the crane, an 'iconic structure' is part of the history of the arsenal, which dates from the twelfth century and was once the hidden part of the city where its ships were built. Restoration of the unique crane was the first industrial heritage project undertaken by the British Venice in Peril Fund in association with The Superintendency of the Cultural Heritage of Venice and the University Institute of Architecture of Venice, Padua University and Turin Polytechnic. Lord Foster has said, 'it would be an unforgivable act of negligence' to leave the crane to deteriorate further as it is 'not only aesthetically inseparable from its historic context, but it is a priceless part of the industrial heritage of Venice'.

It is understandable that the Malta crane had no future at Malta Drydocks with its different business model. This article is a flight of fancy of what could have been and a cautionary tale against further destruction of what little industrial heritage is left.

Sources: The need to change gun barrels ever so often is taken from *The Navy and Army Illustrated*, date quoted in the text. The installation of the crane by the Colsons, father and son Admiralty engineers, is taken from a paper read at the Institute of Civil Engineers; the source is similarly quoted. The Venice in Peril Fund is a British registered charity (www.venicein peril.org/projects/armstron-mitchell-crane) which

raises funds for the restoration and conservation of the city's works of art and buildings. The hydraulic crane is an interesting, albeit vastly different challenge. (Venice in Peril Fund: timesofmalta.com, Sunday, 5 June 2016, 'Rise and Fall of Malta's Armstrong Mitchell 160-ton hydraulic crane' by Michael Cassar.)