'KARTERIA' THE FIRST STEAM WARSHIP IN WAR (1826)

Dimitri G. CAPAITZIS

SUMMARY

The Greeks, then fighting for Independence, were pioneers in steam warships. In 1825 they ordered 'Perseverance' from Brent, Deptford and steam engines from Galloway, Smithfield.

Completed in May 1826 she sailed, reaching Greece in September, and was renamed 'Karteria'. Built at the instigation of the great English Philhellene Frank Abney Hastings, who inspired the design, helped in the construction and commanded the ship on her passage and in war, the 'Karteria' was in many successful battles at Phaleron, Oropos, Volos, Salona, Vasilathi, and was the first ever steam warship in war action.

A 125ft long, 25 wide, 400 ton, 4-masted schooner with two engines run on steam from coal-fired boilers, 16 rpm, 84 horse, driving port/starboard paddle wheels and 6 knots. Originally she was to have one 32 pound gun forward and one aft, and two 68 pounders in the middle, fired in turn with the ship rotating by her paddle wheels. Red hot shot was to be used, which was lethal for enemy sail and wood ships. She traveled under sail and the steam engines were used only in action.

1. INTRODUCTION

The 'Fighting Temeraire' towed by a steam tug to her last berth to be broken up is an oil painting by the English artist J.M. Turner and hangs in the National Gallery, London. It depicts one of the last ships of the line, which played a distinguished role in the battle of Trafalgar in 1805, the 98 – gun ship HMS 'Temeraire', being towed towards her final berth in East London in 1838 to be broken up. It symbolizes the ending of an era of great wood and sail ships and the beginning of iron and steam in the building of ships.

The early 19th century saw some revolutionary changes in shipbuilding. These were early days of discovery, invention and engineering. With the tools of science and materials developing with the industrial revolution new things were designed and made. In ships these new monsters or wild beasts, as many called them at the time, gradually developed into workable and efficient machines and vehicles that were to change the world.

Progress is achieved with new ideas. New ideas come from a miscellany of sources. Some in house, some from the market, some from research, from universities, learned societies, accidents, changing economies, war, politics, geography, scientific and technical innovation, new rules and regulations, some from other industries. Some take a long time to be assimilated and established, some less, while their relative benefits can be subject to controversy. Individuals with knowledge and experience, vision and tenacity and with the tools of science and engineering, took it upon themselves to invent, coordinate and build new things.

Frank Abney Hastings was one of them. He was also a man of ideals, courage and leadership and with Byron one of the great Philhellenes and heroes of the Greek War of Independence (1821-1829). He instigated the ordering of the steamer warship 'Karteria', inspired the design, helped in the construction and commanded her on her passage from England to Greece and in the War.

Hastings' and the 'Karteria's' were positive and critical contributions at a turning point in the development of steamships, iron ships and naval guns, that was followed by quick progress and spectacular achievements in all these areas. Theirs is a great story that had a significant influence on in the transition from wood and sail to iron and steam in shipbuilding, on the development of naval gunnery as well as the politics and history of the age.

This paper also covers developments in ships, propulsion and guns before and after the 'Karteria'. Furthermore it covers design, ordering, contracting, finance, supervision of construction and thence organization for delivery, crewing, training and operations and, in this case, successful and effective combat.

2. EARLY STEAMSHIPS, IRON SHIPS AND NAVAL GUNS

Use of steam goes well back in time to Heron of Alexandria, about 20 centuries ago, and his mechanism to open and close Ptolemaic Gates. It was however with Watt in 1769 that a practical machine was built, which was followed by Stephenson's Rocket locomotive and later by steam engines for ships.

Some of the early successes were the 'Charlotte Dundas', a wooden stern-wheeler tugboat with a Symington steam engine on the Clyde in 1801, Fulton's 'Clermont', a steam ferry on the Hudson River in 1807, Bell's 'Comet' ferryboat on the Firth of the Forth and Marc Brunel's 'Regent' on the London to Margate run, both in 1812. The American 'Demologos', a steam warship built in 1814, with a paddle wheel on the inside between two wooden hulls and 26-32 pound guns, never

saw action in war. The steam warship 'Rising Star' built in London for the Chileans reached Valparaiso in 1822, when their War of Independence had ended. The American 'Savannah' in 24 days in 1819 and the Dutch 'Curacao' in 28 days in 1824 both crossed the Atlantic with part sail and part steam propulsion. The 'Diana' built in India in 1823 for British East India with two steam engines 25 hp each from Maudslay, London (100' length – 16' – 8" breadth – 89 tons) was an armed transport and may have been the first steamer to fire shots in anger in the 1822 – 28 Burma War.

The Greeks, then fighting for Independence, were among the pioneers in the use of steam warships. In 1825 they ordered the 'Karteria' to be built by Brent at Deptford on the Thames and her steam engines by Galloway at Smithfield. She was completed in May 1826 and reached Nafplion in September 1826. Frank Abney Hasting was 'Karteria's' creator and her heroic commander.

Wood was used to build boats from the dawn of history. In late 18th Century however new and longer routes, larger sizes and new ship types and possibly the scarcity and price of good wood, made the use of iron a virtual necessity. Iron bolts and nails of old were followed by clamps, brackets and knees and eventually riveted frames, beams and plates. Pig iron production in England rose from 17,000 tons in 1740 to 45,000 tons in 1785. Progress with Darby's and Cort's methods converted pig iron to malleable iron, that was not brittle and easy to fracture. In 1800 Dockyards used only about 1500 tons of iron annually. In 1809 patents were taken for the use of wrought iron plates and tubes for ships and use of iron increased significantly. In 1815 a small iron pleasure boat was launched on the Mersey and in 1818 the 'Vulkan', an iron ferry, was built for use on the Forth and Clyde Canal. In 1821 the 'Aaron Manby', the first iron steamboat, was completed at Rotherhithe (120 ft long, 116 tons) for service on the River Seine, as a pleasure boat (bateau mouche). Her flat bottomed hull was quarter inch thick iron plate fastened to angle – iron ribs and there was one deck of wood. In 1825 Horseley of Liverpool built a small iron steamer (10 hp) for the Shannon and in 1827 Napier built the 'Anglia' steamer, with an iron bottom and wooden sides above water (62.8" long to 13' – 0"breadth, 4' – 6" depth tonnage 49/36/94).

Lepanto on the 7 October 1571 was the last major naval battle between rowing galleys and an early one where guns were also used. The Holy League won and their superiority in fire power had given them an important and decisive advantage. The age of sail and guns followed.

At the end of the 18th century there was a surge towards gun development and improvement. Carron's of Falkirk, Scotland, produced a new lightweight short barreled weapon that threw a greater weight of shot that the conventional long guns of the same weight. They remained popular till the 1820's. In 1822 Paixhans, a French artilleryman, proposed guns firing explosive shells – canons obusiers - for a fleet of cheap, expandable iron steamships. The French Navy rejected the idea.

3. FRANK ABNEY HASTINGS

Frank Abney-Hastings was born in 1794, the younger son of Lieutenant General Sir Charles Hastings and grandson of Frances Hastings, 10th Earl of Huntington. In 1805 he joined the Royal Navy aged 11, and was on the "Neptune" in Trafalgar. He served worldwide with distinction and rose to the rank of commander. In 1820 however after an unfortunate incident and argument with a senior officer in Port Royal, Jamaica, he was unjustly compelled to leave the service. He went to France to study gunnery and learned French. In 1822 he went to Greece to fight for her liberation. He volunteered to serve on the Tombazis' ship "Themistocles" and quickly won the respect of the Greeks for his courage, seamanship, naval tactics and the clever and innovative use of guns. He participated with distinction in many a naval and military engagement.

His major and memorable contribution was with the "Karteria". In a Memorandum to the great Philhellene Lord Byron, in 1823, and later presented to the Greek Government, he advocated the use of steamers instead of sailing ships and guns firing hot shot. These were to prove a revolutionary innovation and advance over the armed merchantmen and fire ships then used against the mighty Ottoman and Egyptian fleets. Steamships would manoeuvre quickly and efficiently with or against the wind and hot shot would bring havoc and fire to the sails and wooden hulls and decks of their traditional sailing ships.

4. BUILDERS, FINANCE AND COSTS

In the autumn 1824 Hastings went to England. He promoted his ideas for steamships and naval guns and, when the second Greek loan of £2,000,000 was floated in February 1825, he managed to obtain £10,000 from it and authorization for the building of his steamship the 'Perseverance', in March 1825. He offered to pay for her guns himself.

The order went to the Brent family shipyard at Deptford for the hull and outfit. The Brents were old established shipbuilders and enjoyed a fine reputation. Between 1770 and 1803, they had built at least 64 ships, light merchantmen (East India and Hudson Bay Companies) of 800 – 1200 tons and the remainder were warships of 74 guns and smaller (Royal Navy). In the early 1800's warship orders declined and the Brents turned to innovation and technology. They designed and built

three steam powered paddle wheel packet ships, including the 'London Engineer' that shuttled passengers between London and Margate. Later the Brents contracted with the famous radical Thomas Cochrane, later Earl of Dundonald, to build a steam warship, the 'Rising Star ' to be used in the Chilean revolution. It arrived in Valpariso in July 1822, too late to be of use to the rebels, but it was the first steamship to cross the Atlantic, and was the first steamship in the Pacific Ocean.

The steam machinery was ordered from Alexander Galloway's, an important engineering firm in London, Smithfiield. Alexander Galloway was considered one of England's leading engineers. Well before 1824, they had exported minting machinery to Algiers and a large cotton press to Egypt. They had also built the steam engines of the 'Rising Star' and a new steam engine for the 'London Engineer'. The latter had been bought by Mohamed Ali, the Pacha of Egypt, and sailed to Alexandria, to be there converted to a warship. Galloway's son Thomas went to Egypt in 1824 to help and stayed on to become the Pacha's Chief Engineer and named Galloway Bey. After his death in 1836, his brother John Alexander continued his project for a railroad and canal Alexandria, Cairo, Suez, that preceded the Suez Canal for the passage to India.

The hull was quickly and efficiently built, but the steam machinery, promised for August 1825, was subject to continuous postponements and delays. Engine building was then still in its infancy and the "series / mass production" with the order of five more steamships must have had an adverse effect. Influences from other clients are not unusual. In the circumstances Hastings was certainly not happy, but managed quite well. 'Perseverance' was finally completed and sailed from London in end May 1826, bound for Greece and under the command of Hastings.

She was rigged as a four-masted schooner, and made way mostly under sail. Her engines, were noisy and slow – sixteen revolutions per minute. For her time, she was however a great success. Design of engines and boilers then was empirical, and nobody could be sure that a new ship would raise enough steam to make any headway. The 'Perseverance' did, but with a good share of trouble. In the Mediterranean, her iron riveted boiler burst and there were problems with the engines and paddle wheels. Hastings put into Cagliari, Sardinia, where repairs took three months. It was September before he reached Nauplia and a great welcome from the locals. Some thought the ship would start her paddle wheels and climb to the top of Palamidi, the town's hill fortress. She was officially delivered to the Greek Government and renamed 'Karteria', greek for 'Perseverance'.

5. 'PERSEVERANCE' / 'KARTERIA'

The following are taken from:

A. Brent's General Arrangement Plan (National Maritime Museum)
B. Other sources:

	A	B
Length between Perpendiculars	130'- 2"	125'- 0"
Length of the keel for Tonnage	111'- 6"	
Breadth Extreme	25'- 0"	25'- 0"
Breadth Moulded	24'- 6"	
Height between Decks	6'- 4"	
Length of Engine Room	43'- 0"	
Burthen in Tons	350	400
Tonnage		233
Breadth two Paddles	41'- 6"	
Diameter Paddles	13'- 10"	
Width Paddles	6' 3"	
Horse Power		2 x 42
Revolutions / minute		16
Speed (Knots)		6
Consumption (tons / day coal)		7

It is possible that we have here 'design' and 'as built' data. Here and elsewhere in this paper particulars come from a miscellany of sources, many of them on history, and may differ on the technical data.

The ship was built as a 4 – mast schooner. She had raised forecastle and poop decks and a raised deck midships. The fore and aft well – decks in between had a high bulwarks port and starboard and the ship's 8 guns were located within, 2 fore and 2 aft, port and starboard. The raised deck midships was in way of the port and starboard paddle wheels and above the engine and boiler rooms. The tall funnel was above the boilers aft, with the engines forward.

Materials used for construction are described by Hastings, in his Memoir of 1828:

The 'Karteria' was built with her timbers close and caulked together, and would therefore, have floated without planking. I had several opportunities of remarking the advantage of building thus, to resist shot; nothing less than a eighteen pounder ever came through us; this, 'tis true, might be partly attributed to Turkish bad powder, but those shot that did come through, always made a nice clean round hole without a splinter. However, against shells it would have a disadvantage, as they would be more likely to stick in it. Perhaps if shells became generally used, it will be proper to make the upper works of a ship as slight as is consistent with strength, and iron ribs might perhaps be good. The 'Karteria' had another peculiarity in her build – two solid bulkheads enclosing the engine room, and caulked and lined, so as to be water tight, the intention of this was, in the event of one part of the ship being leaky from

any cause whatever, the water could not flow into another part of the ship. This arrangement, which is due to the ingenuity of Mr Brent, the builder, once saved this ship from fire, which broke out with great force in the after-part of the engine room, and would have communicated to the shell room very quickly. But for this bulkhead, which kept the fire forward, and gave us time to subdue it. I see no reason why all men of war should not be furnished with similar partitions. The same builder saved another ship (the Rising Star) from sinking, by this contrivance.

The Midship Section shows a carvel build, about 3" thick, on the lower sides, which also corresponds to the difference between the Breadth Extreme (25' – 0") and the Breadth Moulded (24' – 6") given, and the material is obviously wood. The upper sides are about 4" thick and bottom about 3.5", while frames on the sides are 10" wide and bottom transverses about 11" wide and apparently wood. The bottom brackets and bottom / side gussets are apparently iron, while the iron ribs mentioned are for the future. This was a limited use of iron and there was no sufficient precedent or experience to do more for the 'Karteria'.

The 'Amie McKim' built in Baltimore in 1833 was the first archetypal clipper. Composite construction was adopted for the early clippers with internal iron frames, beams and pillars, wood for stem and sern posts and planking to which copper plating was fixed. This avoided galvanic action and protected the hull from fouling. Paixhans had advocated iron steamships and his shell cannons in 1822 without success. Hastings must have had similar ideas and while his steamship and his guns went ahead, full iron construction for ships came later. Another interesting feature on the 'Karteria' was her two solid bulkheads, enclosing the engine room, and caulked and lined, so as to be watertight and to prevent any possible leak of water from flowing from one part of the ship to another. Transverse watertight bulkheads in wooden ships were introduced by Shanks on the 'Trial' in 1790 and used by Bentham on seven experimental vessels in 1794. He had also introduced longitudinal bulkheads. Transverse watertight iron bulkheads in iron steamships were first introduced by Williams on the 'Garryowen' in 1833.

The steam engine started as a practical machine with James Watt with his introduction of condensers, double-acting pistons and translation into rotary motion. These were covered by his 4 patents between 1769 and 1785. More than 250 patents were filed by others up to 1825 and covered boilers, furnaces, valves, regulators, fuels and generally progress and development for application in pumps, locomotives and some in ships. A typical steam engine for a ship at the time was low pressure 20lb /in^2 at about 15 revolutions per minute and driving paddle wheels on the ship's sides, middle or aft Boilers were single iron boxes with internal stays, a furnace for burning coal and a tall flue.

The 'Karteria' had two steam engines, one port and one starboard, that ran independently. Each was connected to its corresponding paddle wheel and this system gave exceptional manoeuvrability. The engines ran on steam from the boilers burning coal. The engines were located forward of the boilers. Power from each steam engine was 42 horse and with a total of 84 horse speed in calm water was about 6 knots on a consumption rated at about 7 tons/day.

These were early days however and making steam engines for ships and running them had not been generally established. The 'Karteria' sailed well, but her machinery and paddle wheels gave constant trouble.. The necessary diversion to Cagliari for repairs was bad for morale and Hastings wanted to dismiss the two Galloway engineers onboard. Running, maintenance and repairs in Greece afterwards was a serious headache for Hastings. Coal was also problem with high consumption. He had chartered the 'Tiber' in London and had one of his officers bring a cargo of coal and other supplies to Greece. Local wood and other fuels were not adequate. It was lucky the ship moved mostly under sail. His skills and perseverance however kept things running when they were needed most, in battle.

Guns, steam and possibly iron, were central in Hastings's thinking. In his Memorandum to Byron in 1823 his ideas were for two long 32 – pounders fore and aft and two 68 – pounder guns of seven inches bore, one on each side. These were later changed to 4 - 68 pound Carronades (Carron Ironworks, Scotland) of the Government pattern and 4 – 68 pound guns of a new form, seven foot four inch long, fifty eight hundred weight (about three tons)and based on a model prepared by Hastings. They were apparently ordered at the same time as 'Perseverance' in March 1825 and sent to Greece via the USA, as the ship had to leave England unarmed. In fact they arrived in Greece on frigate 'Hellas' in December 1826. For the 'Karteria', that had arrived in September 1826, Hastings had to borrow temporarily guns from the Nafplion fortress and used this time usefully to organize and train his crew.

The original ideas for action were to start with red hot shot, heated by the ship's furnace coal, and which, while less destructive than shells, had a longer range. Explosive or incendiary shells would follow. These combined with the steamship's movements, independent of the wind, would be lethal against sailers depending on the wind and with vulnerable sails and wooden hulls. All this was based on variety of innovations of equipment and methods to heat and transfer the shot, to carry and fuse the shells, good locks, protection from recoil and gunners' good training and discipline, all of which were Hastings specialities.

Samuel Gridley Howe, the 'Karteria' American doctor had recorded in his November, 1826 journal:

We have two Englishmen (officers), one German, one Frenchman, and one Greek; The Greek is the eldest son of Tombazi, Captain Hastings is a man who deserves the deepest gratitude and respect from the Greek nation. It is only through his exertion, his activity, and generosity, that this ship was ever got out. She was built under his own eye in London, and carries as much weight of metal as a thirty-six gun frigate; her engine, however, is not the best. Captain Hastings, having on board about forty English and forty Greek sailors, is all ready to join the Greek fleet and engage the enemy.

Elsewhere crew numbers are given as 17 Officers, 22 Petty Officers, 32 Gunners, 110 Seamen and 4 Cooks/Servants, a total of 185. With the ship running partly on sail and partly on steam, it is obvious that specialties were needed and used accordingly. Hastings spoke English, French and Greek and with some effort achieved their respect, loyalty and love. He got the best out of them.

6. 'HELLAS', 'ENTERPRISE', 'MERCURY' ETC

With the engagement of Thomas Cochrane to command the Greek Navy, orders were placed in mid1825 for two 64 gun frigates for an estimated £ 75,000 each from New York naval contractors Bayard and Howland and for five further steamships for £ 25,000 each from London's Brent and Galloway..

The frigates were delayed and costs escalated. In August 1826 one of the frigates was sold to the US Navy for £48,000, (while £88,000 had been spent on her) to pay for the other (apparently £200,000). The 'Hope' was delivered in November 1826 and reached Greece in December, renamed 'Hellas'.

The steamships were also delayed. The 'Enterprise' reached Greece in September 1827 and was renamed 'Epiheirisis'. The 'Mercury' was even later, when the War was nearly over and was renamed 'Hermis'. Of the other three, one blew up during trials and two were never completed, but left to rot on the Thames.

7. OPERATIONS

In end January 1827 the 'Karteria' proceeded to Phaleron, in the vicinity of Athens and saw action in both sea and land engagements. She was accompanied by three brigs and five gunboats.

In February she was ordered to Oropos in the Gulf of Evoia, where with the frigate 'Hellas' commanded by Miaoulis and the brig 'Nelson' commanded by Papanikolis they brought havoc to enemy coastal defences, stores and ships and disrupted their traffic of troops and supplies. Two transports loaded with equipment and supplies were captured and taken to Poros.

In March Cochrane took over as Commander of the Greek Navy and ordered the 'Karteria' to lead with schooner 'Themistoclis', brigs 'Ares' and 'Panaghia' and sloop 'Aspasia' and proceed to Volos for a similar operation. Shore installations and guns were destroyed, five loaded transports were captured, two were destroyed by fire and one ran aground.

Immediately after at Trikeri they attacked a large warship at anchor and mounting fourteen long 24-pound guns and two mortars and four beached captured schooners. All were destroyed by firing from a distance.

That type of operation was where the Greeks were most effective. Armed merchantmen and fireboats at sea and quick movements and strategic positioning of forces on land, were a relative match for the large Ottoman Navy and Army. Their movements of troops and supplies were seriously disrupted, while their fortified cities fell one after the other.

The balance however could not be kept forever. The Ottomans, with their Egyptian allies, were gaining both at sea and on land. Cochrane with the 'Hellas' and 22 ships and 6 fire ships, attempted to surprise and burn the Egyptian fleet in Alexandria in June 1827, but had no success. In early September with the 'Hellas' and 'Karteria', two schooners, twelve brigs and three gunships he proceeded to Vasiladhi and Mesolonghi to take part in the Greek land offensive in the area. They had limited success and the fleet was split.

Hastings with 'Karteria', 'Sauveur' and gunboats 'Bavarois' and 'Philhelleic' remained, ran the gauntlet of the two opposite castles at Rio Straits, near Patras, passed into the Gulf of Corinth and entered the Gulf of Salona, below Delphoi, where there was one Algereen brig of 14 guns, the Admiral's 16 gun brig, three small schooners, two armed transport brigs and two large boats with guns, shore batteries and three loaded Austrian transport ships. Hasting' attack with the 'Karteria' and others, was devastating. The Admiral's Brig was set on fire, as well as one schooner and one transport brig, the Algereen brig was abandoned and out of their nine ships only two were spared. The three Austrians were taken as prizes. Finlay later wrote:

'The battle of Salona afforded the most satisfactory proofs of the efficiency of armament of steam-boats, with heavy guns, which Captain Hastings had so long and warmly advocated. 'The terrific and rapid manner in which a force so greatly superior to his own was utterly annihilated by the hot shot and shells of the 'Karteria' silenced the opponents of Captain Hastings's plan throughout all Europe. From that day it became evident to all who studied the progress of naval warfare, that every nation in Europe must adopt his principles of

marine artillery, and arm some vessels in their fleets on the model he had given them'

Salona infuriated Egypt's Ibrahim Pacha, the Ottomans' ally. Their fleets at Navarino were facing England's under Codrington, France's under De Rigny and Russia's under Heyden, there to persuade them to make peace and go home. They refused and on 20 October 1827 a battle was sparked off and they were quickly defeated. Navarino was the last major naval battle with sail. A new era had been started with Hastings and the 'Karteria'.

The fighting went on. Hastings with the 'Karteria' saw action off Patras, at Karavostasi, Vasilathi, tragically at Aetoliko he was wounded and died on 1 June 1828. He was given a state funeral with full military honours and he was hailed as a great hero and a great philhellene by the leaders of the Greek State, that was about to be born, and deeply mourned by all. Thomas Gordon wrote of him:

No one served Greece more selflessly. No other foreigner could match his record of achievement.

Frank Abney Hastings is buried in Poros and his heart is immured at St. Paul, Anglican Church, Athens

In September 1829 the Treaty of Adrianople was signed and in February 1830 Britain, France and Russia recognized a free Greek State.

8. LATER STEAMSHIPS, BRUNEL AND FROUDE

In 1827 Napier built the 'Anglia' (62'-8" long 13' beam) with an iron bottom and wood sides. In 1828 the French built the 'Sphinx' (62.25m long 8.15m beam 910 tons 60hp). In 1830 she had some war action in Algiers. In 1833 she towed from Egypt the Obelisk, now placed in Concorde Square, Paris. In 1830 the 'Dee' was built for the Royal Navy with 2 – 36 pounders and 4 carronades. In 1833 the 'Royal William' was the first ship to cross the Atlantic on steam and paddle wheels alone, while the 'Archimedes' in 1838 was the first steamer driven by a propeller, which showed a gain on efficiency over paddle wheels.

Isambard Kingdom Brunel, whose bronze statue stands on the Thames Embankment next to the old Shell building, is the designer and builder of underwater tunnels, railways, bridges and ultimately the three great ships of the age.

The first in 1838, the 'Great Western', wooden built, 236 feet long, 1321 tons, 2300 tons displacement, with four boilers and one 750 horsepower steam engine driving 28 foot diameter paddle wheels, crossed the Atlantic on her maiden voyage from Bristol to New York in 14.5 days, an average 8 knots and with 24 first class passengers. She arrived only hours after the 'Sirius', 700 tons, 320 horsepower, that crossed from Cork to New York in 18.5 days, an average of 6.7 knots with forty passenger onboard.

The second in 1845 the 'Great Britain', an iron ship, 322 feet long, 3443 tons 2,284 tons displacement, with a 1500 horse power steam engine driving one propeller crossed at an average 12 knots with 60 first class passengers in state rooms and a full complement of steerage passengers and 600 tons of cargo. Later she was used as a cargo and passenger ship to Australia, carrying on one voyage 600 passengers. She had five watertight bulkheads.

The third in 1858 the 'Great Eastern', an iron ship, 692 feet long, 82 feet beam, about 18,900 tons lightweight, and about 27,000 tons displacement, with two steam engines each driving port and starboard paddle wheels and one driving one propeller aft, she could reach a top speed of 15 knots on 300 tons of coal a day and carry 3000 tons of cargo and 4000 passengers or 10,000 troops. The ship was double skin, with cellular double bottoms, transverse subdivision bulkheads, great longitudinal strength and excellent manoeuvrability. All features that were adopted in shipbuilding ever since. She was by far bigger than any ship built to that date and it is only about 50 years later, in 1906, that she was surpassed by Cunard's 'Lusitania', 31,500 tons with four propellers and a speed of 24 knots.

The basic principle behind these spectacular increases in size was that power to propel a ship does not so much depend on size, weight and displacement, as on resistance to a ship's motion in water, caused by her hull surface or skin friction, eddies and wavemaking. William Froude had worked with Brunel and later developed his famous theories. It is in this new world of science and mathematics, combined with the use of iron and steam, that naval architecture came to relate size and shape of hull, engine power, efficiency of propulsion, quantity of fuel and cargo to the design of ships that had been traditional, empirical and with a cautious and conservative outlook.

In warships progress was different. France, Russia, United States, Spain, even the Ottomans, Naples and Sardinia, went into warships, where steam, iron and new artillery, in different stages of development, were used in many combinations. The Royal Navy ordered at some stage iron frigates, but later turned them into transports. In the Crimean War (1853-1856) steam propelled gun platforms were used. In 1859 'La Gloire', wood/ironclad steam warship was built by France and in 1861 'Warrior' steam, 938 ton displacement, the first complete iron warship, albeit with internal wood cladding 24 inch thick, was built by England. The propeller, turret guns, steel and ultimately Parsons' 1897 steam turbine, closed

the century that had seen spectacular development and innovation in ships.

The steam engine had a slower development. Low pressure engines in the first half of the 19th century were followed by compounds of 60 lb/in2 in the 1860's and triple expansion engines of 120 lb/in2 in the 1870's. Drastic change only came about at the end of the 19th century, when Parson's 'Turbinia', the first steam turbine boat, was presented in a spectacular manner to Queen Victoria and the Royal Navy at Spithead in 1897.

In the second half of the 19th century the industrial revolution, with ship technology as a spearhead, was ready for export. Engineering, metallurgy, propulsion, science and ballistics gave the West the tools to straddle the world, move the people and carry the goods fast and efficiently. Associated with all this is the opening of the Suez Canal in 1869. The London to Bombay sea miles were reduced to about half and the whole pattern of sea trade changed drastically. This was the age of European expansion worldwide and the emergence of global economy.

These years saw the consolidation of iron over wood and steam over sail. In the 1880's Bessemer steel started replacing iron. By 1900 it was nearly all steel, which was lighter and easier for construction. Steel benefited all ships. Warships and passenger ships benefited from both steel and steam turbines and went on to larger sizes and greater speeds, and in line with the commercial and military requirements of the times. The great transatlantic passenger liners and the dreadnoughts are legends of the age.

9. CONCLUSION

Hastings and 'Karteria' make a fascinating story, that places them at a crossroad of both technology and history. The 19th Century saw a fascinating transition from the proud sailers to the steam and iron ships, that started progress and development towards the giant ships of to-day.

Steam propulsion would give more and more power, be independent of wind and weather and less labour intensive than sail. Cost and availability of fuel would be a problem, but organizing stocks worldwide and increasing efficiency of boilers and engines would alleviate it in time. Paddle wheels were bulky and slow, in way of guns on the sides and vulnerable to enemy fire. They were later replaced by propellers. Wood construction of ships had limits in supply and strength. With part and then full iron construction hulls would be lighter and size of ships would increase dramatically. Wood and sails were an easy target for fire ships, explosive and incendiary shells. Iron cladding, then iron hulls and steam engines deep inside the hull gave better protection. Naval artillery also benefited from stronger ships, better iron and innovative design.

Many contributed with their knowledge, science, experience and hard work. It can be said that Hastings and 'Karteria' were among the catalysts in the start of one of the most important creations of these times. Creation involves discovery, invention, enthusiasm, leadership, getting things done, construction, operation, struggle, achievement. In most cases it has to go uphill and by-pass the established and conventional wisdom of the time. The biographies of these many creators make for a great inspiration to us all.

For those involved in shipbuilding, operations, the innumerable associated activities, the many personalities they meet worldwide, the exotic places they go to with ships, the struggles of Hastings and 'Karteria' mirror their own activities and routines in the exercise of their profession.

10. ILLUSTRATIONS

FRANK ABNEY HASTINGS
THE FIGHTING TEMERAIRE
DEMOLOGOS
KARTERIA FIGUREHEAD
KARTERIA AND HELLAS
KARTERIA MODEL
KARTERIA BRENT PLAN
KARTERIA FINLAY PLAN
KARTERIA MIDSHIP SECTION
CLIPPER PLAN

11. ACKNOWLEDGEMENTS

Maurice Abney Hastings and Dianne Williams, from Ashby de La Zouche, Telemaque Maratos and Spyro Nicolaou from the Society of Study of Greek History, John Paloumbis from the Piraeus Maritime Museum, Harry Tzallas from Alexandria and my colleagues Sam Biggs and Yanna Vrettou have given me great help and inspiration in the preparation of this paper. I am very grateful to them all and convey to them my sincere thanks.

12. REFERENCES

1. DAVID HOWARTH / Collins – 1976
   The Greek Adventure
2. DAVID CRANE / Harper– 2009
   Men of War
3. DAVID CORDINGHY / Bloomsbury – 2007
   Cochrane
4. DAVID BREWER / John Murray – 2002
   Flame of Freedom

5. DOUGLAS DAKIN / - 1955
British and American Philhellenes – 1955
6. A.J.B. WACE / British School, Athens – 1918
Hastings and Finlay
7. BLACKWOOD / Ballantyne & Hughes – 1845
Biography of Frank Abney Hastings
8. JOHN GALLOWAY / J. Weal – 1844
Overland Route to India
9. ANTOINE ZAHLAN
19th century Arab Technology
10. FRANK ABNEY HASTINGS / British School – 1828 Memoir
11. C. YOUNG / London Drawing – 1867
Fouling and Corrosion of Iron Ships
12. P. GOODWIN / San Francisco – 1997
Iron in Ship Construction 1660 – 1830
13. BRIAN LAVERY / Dorling Kindersley – 2004
Ship
14. K. AMIANTOS / Athens Academy – 1928
Hastings
15. S. TRIKOUPIS / Athens – 1862
Speeches
16. GEORGE FINLAY / Zeno – 1971
History of Greek Revolution

13. AUTHOR'S BIOGRAPHY

Dimitri G. CAPAITZIS
BSc ACGI CEng FRINA FIMarEST FSCMESS MIMechE

1955 Graduate City & Guilds, Imperial College. University of London.

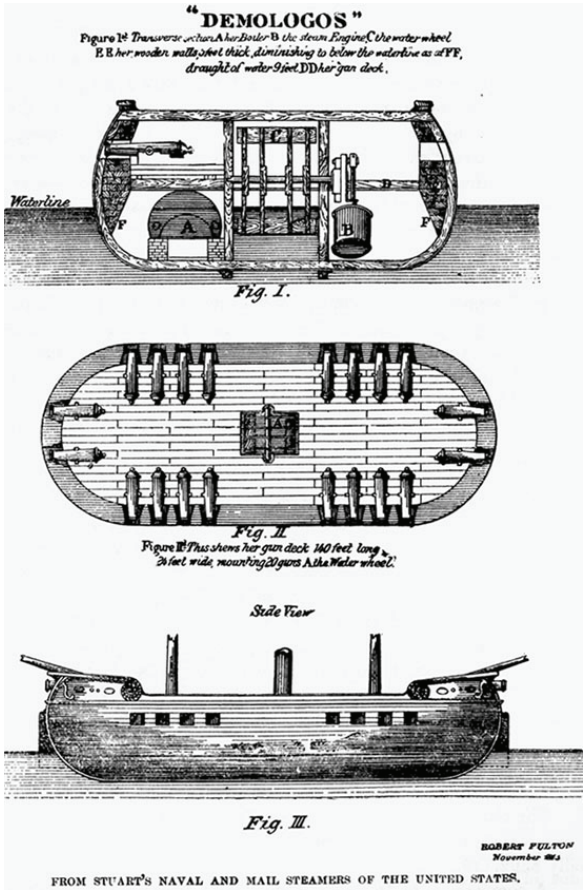
1956/7 Apprentice at British Shipyards and at sea.

1958/75 Superintendent Engineer - newbuildings and repairs - with Rethymnis & Kulukundis, then C.M. Lemos, then Manager with M. Marcou, all in London.

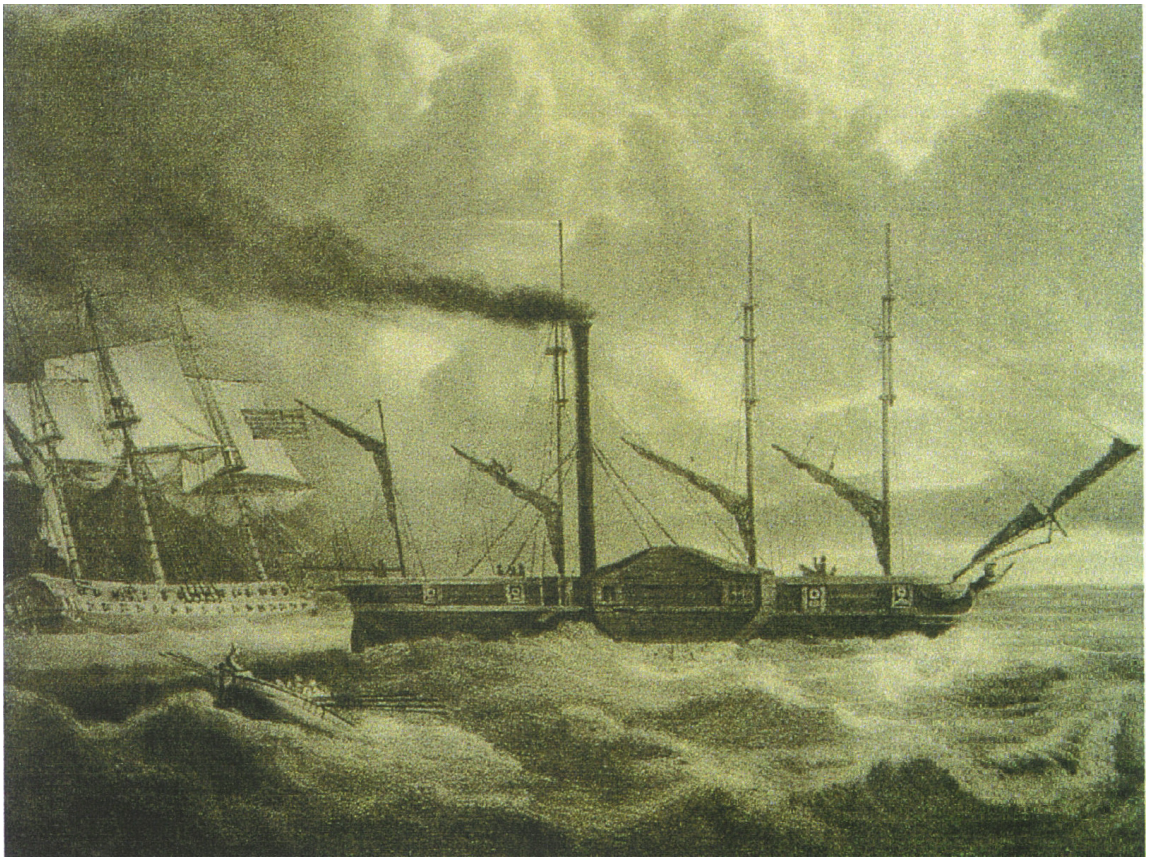
1976/2008 Consultant, in both London and Piraeus, acting for clients in general shipping technical, management and legal work, also in contracting, specifications, planning and supervision of 160 newbuildings and 7 conversions worldwide.

FRANK ABNEY HASTINGS

THE FIGHTING TEMERAIRE

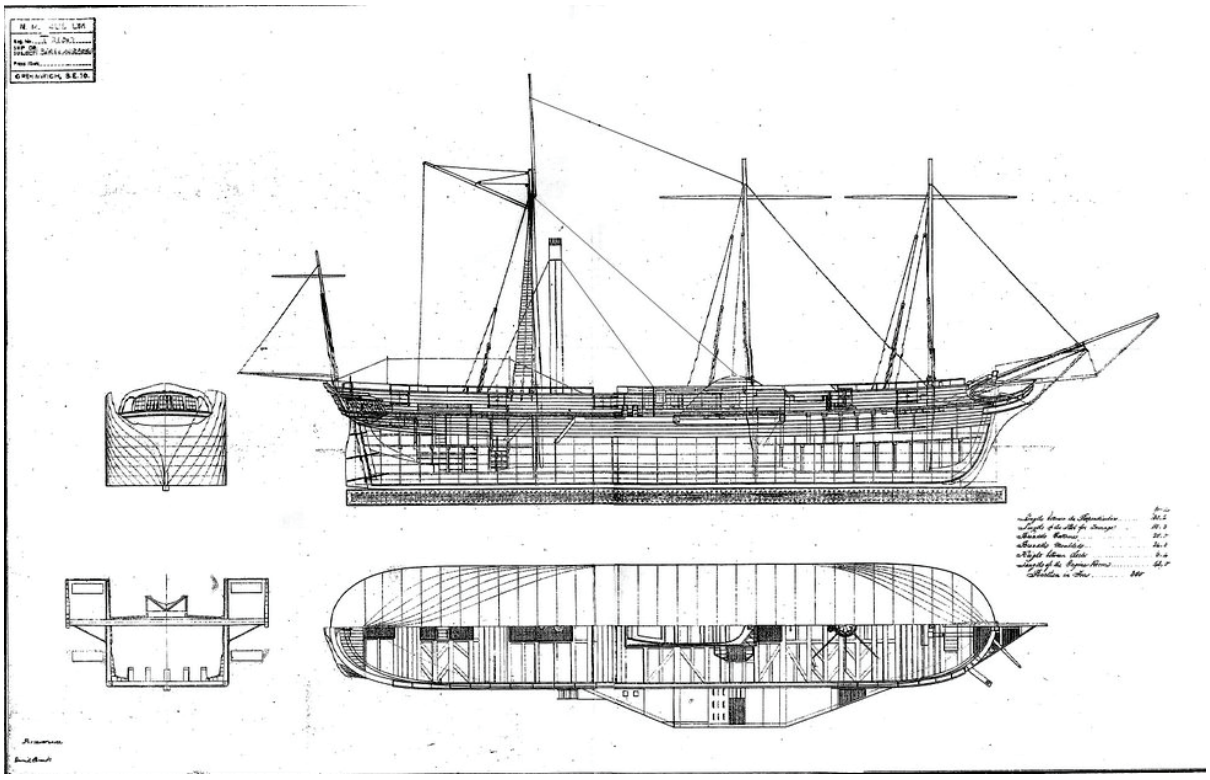


KARTERIA FIGUREHEAD

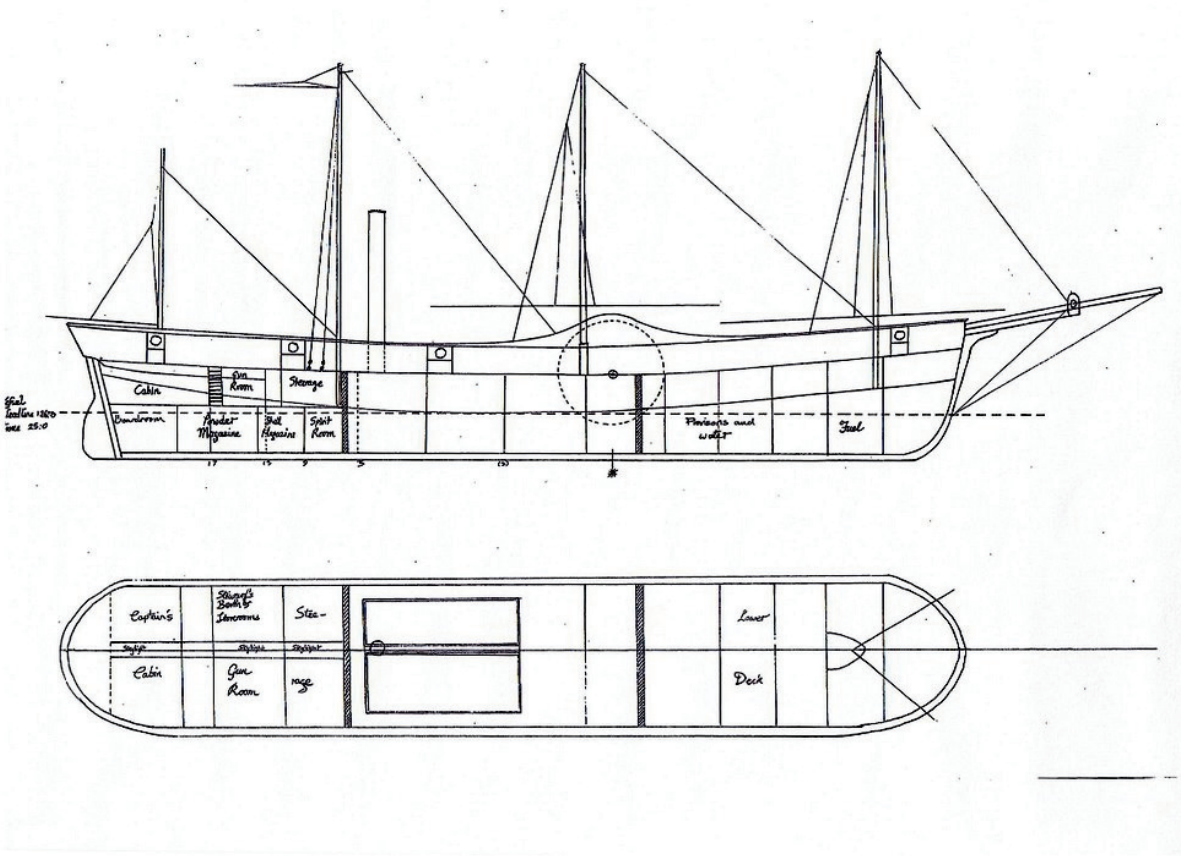


KARTERIA AND HELLAS

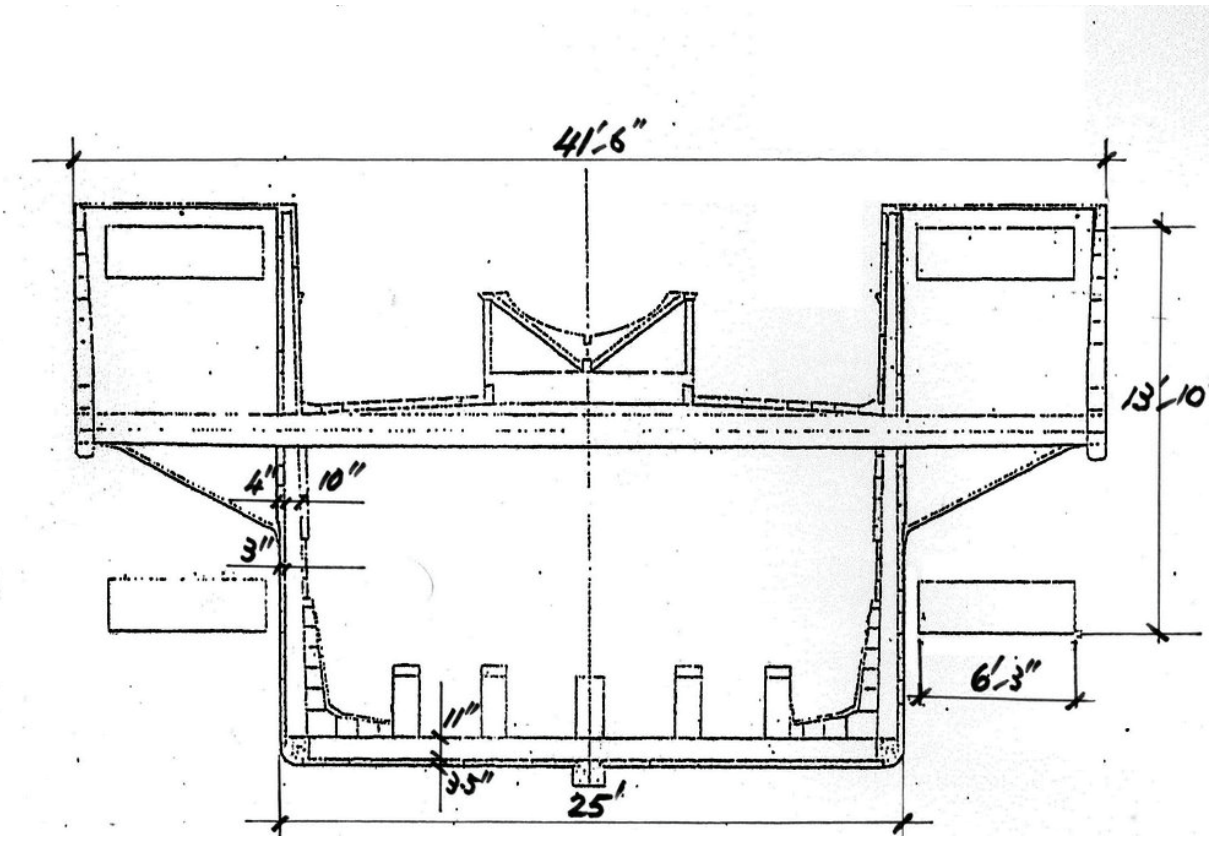
KARTERIA MODEL



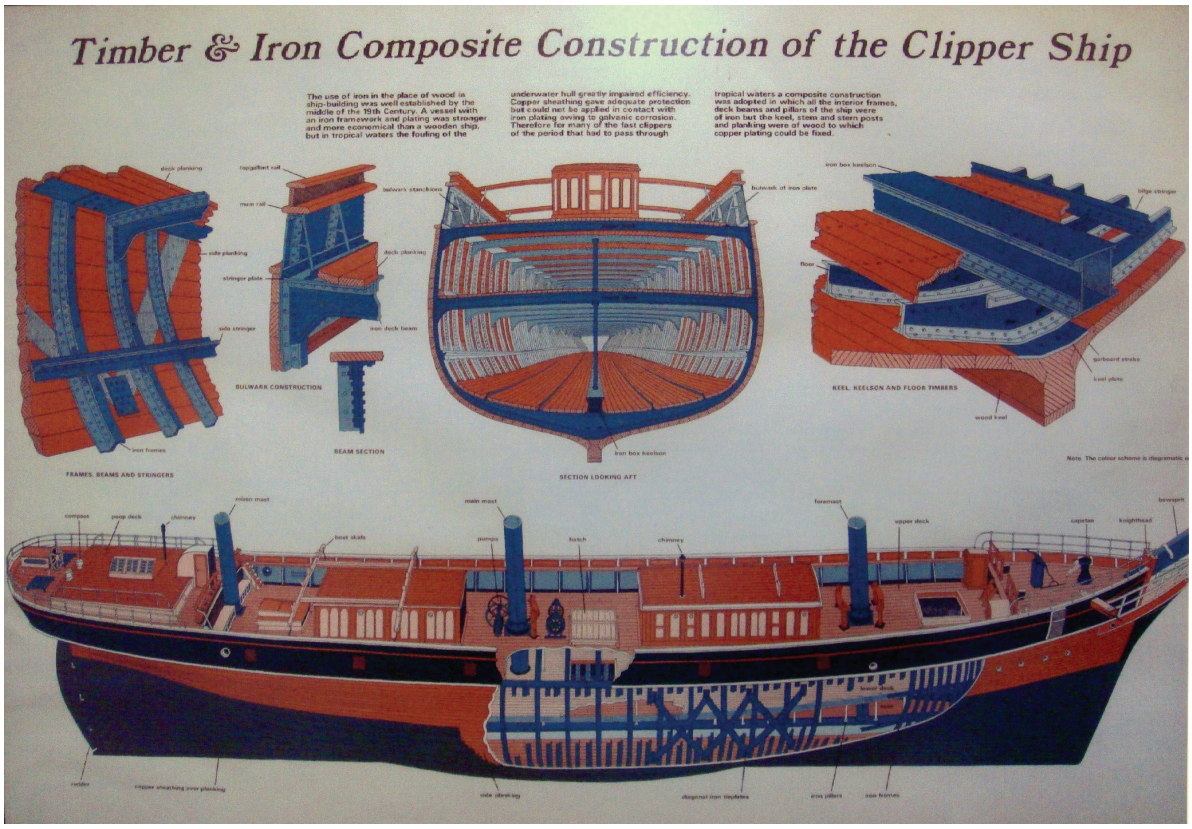
KARTERIA BRENT PLAN



KARTERIA FINLAY PLAN



KARTERIA MIDSHIP SECTION



CLIPPER PLAN