

The Carronade

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Cutting edge technology that placed Britain at the head of arms race, displaying innovative design and a semi-scientific approach to production. The carronades' success against the French left Britain in a dominant position in Europe; by contrast, its failure across the Atlantic played a part in the loss of the United States, changing world politics. It marks the beginning of two centuries of ironfounding in the Falkirk district.



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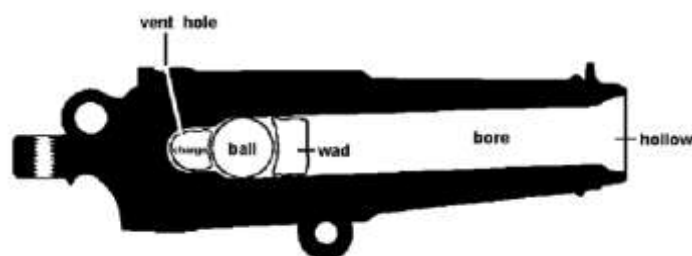
Appendix 3 – Listing the current known location of over 170 pieces of ordnance made at either the Carron Iron Works or at the Falkirk Iron Works. There will be many more out there and we would appreciate it if you could please [respond to this page](#) to let us know the presence of any others – or to provide us with photographs.

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The carronade was a short, stubby, thin-walled cannon with a relatively high calibre intended for use at short range. It was not the invention of one man but the result of the input of many learned and experienced people.

Robert Melville was stationed with the 25th Regiment of Foot in Cork, Ireland, in 1753 when he had the original idea for the carronade. He probably saw a naval howitzer there, experiencing its tremendous power, but also its problematic recoil that greatly shook its frame. This weapon was essentially a mortar with a uniform-sized bore and a slightly smaller curved chamber at the bottom end.



Illus: Section through a late carronade showing the charge in the chamber.

This arrangement allowed large diameter projectiles to be fired using less gunpowder than a normal gun and allowed projectiles to be lobbed over fort walls. The difference between a howitzer and a mortar was essentially that the former was fired more or less horizontally like a gun. These early howitzers were made of brass and it is possible that

Melville realised that if they were made of iron they would necessarily be heavier and this would dampen the amount of vibration on the recoil. This germ of an idea evidently stuck with him, but he served as a governor in the West Indies until 1771 and it was only in 1774 that he was able to gain the receptive ear of an ironfounder in his native Scotland; Charles Gascoigne was the manager of the Carron Company and in charge of gun production there.

Carron Company had been having trouble with its manufacture of ordnance and its early attempts to sell the defective products met with failure. The new type of gun would have appealed to the company as, being of lighter construction than a conventional gun, it was easier to obtain a quality casting. Always innovative and with little to lose, the company experimented with Gascoigne directing the work. For a short period the new weapon was known as a

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Gasconade. This would have been a good name as it obviously played upon the term cannonade, and it was an existing word in the English language meaning to bluster or show off like someone from Gascony. And that is what the weapon did – it projected a large missile but at a low velocity. Then there was the obvious resemblance to Gascoigne's name. There were teething problems but the company had already realised the need to carefully analyse the grade of iron used. The various iron ores were carefully blended using local supplies augmented by ore from Cumbria and a record was kept of the results. It was also found that cold blast produced more suitable grey iron for cannon than did the new hot blast technique. Excessive vibration remained and early trials at the company's firing range at Greenbrae Reach near Skinflats would have highlighted this problem. This is where Gascoigne's input seems to have been greatest and the gun truck had to be completely redesigned to provide a more stable platform.

Melville originally envisaged a 68-pounder gun which could be used by the Royal Navy against the country's many adversaries, but the Board of Ordnance had already rejected Carron Company's ordnance in 1773. It must have been obvious to Gascoigne that Carron Company's future lay in the production of the smaller calibres of the new weapon. His commercial acumen told him that sales to the mercantile navies of various countries would be lucrative enough to produce a good profit. If the production could be got right and the design proved successful then contracts from the Royal Navy might follow in due course.

International events were moving fast and in 1777 the French joined the Americans in the war against Britain and before long the east coast was infested with privateers and French warships. Francis Garbett and Co, which had hitherto transported the bulk of Carron Company's products to London, evidently felt that the financial risk was too great and put its four brigs up for sale, keeping an attenuated service going with the *Carron* and the *Falkirk*. In this they were helped by the *King of Spain* which that year had been acquired by the Carron Company and was run directly by it. The four brigs, *Glasgow*, *Paisley*, *Stirling* and *Forth*, were bought by the Hon. William Elphinstone who happened to be Gascoigne's cousin, probably on the understanding that the Carron Company contract would be passed on to him. Elphinstone was keen to experiment with the new light weight guns to defend his ships. The lighter weight was a huge advantage at sea as it would have less impact on the balance and trim of the vessel. It also meant that an armed ship could carry more cargo or have more guns than would have been the case with a conventional gun. In autumn 1778 his vessels were supplied with the new guns as part of the payment for carriage. As well as the four brigs named above, these included his two large ships, described as frigates, the *Lady Charlotte* and the *Paisley* (confusingly bearing the same name as one of the brigs). This small fleet sailed under the name of the Carron Shipping Company.

News of the new guns spread rapidly. Requests for supplies were made by Glasgow merchants as early as November 1778. Gascoigne replied to one that he was not ready to supply the new guns until they had been fully tried. Another enquirer about the gasconade was told that "*tho' the appearances of its utility are very promising, yet an adventure, such as yours, we would by no means recommend your total dependence thereon*". The time was almost ripe

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and when Gilbert Hamilton, who later on became Carron Company's agent in Glasgow, was spreading the news to potential buyers of the new light gun he was reproved, but told to "suspend their curiosity for a fortnight", after which samples would be sent for inspection.

After four years of research and design, in December 1778, at the monthly committee of the Carron Company *"Mr. Gascoigne informed the Meeting that he had constructed a very light species of guns, resembling Cohorns, and which were made on purpose to arm Captain Elphinstone's Ships in the true spirit and meaning of this Contract, and were much approved of by many people who had come on purpose to inspect them, and if it met with the approbation of the Committee, he could receive a great many orders for them, which the Meeting having considered RESOLVED to authorise Mr. Gascoigne to accept orders for as many of these new species of guns as he can receive, and which guns shall in future be called "Carronades"."*

Within days the first sales were being made. Notable amongst these is that to Zuill and Co, Carron Company's agents in Liverpool, an account of which follows:

Carron, 31 st December, 1778. Messrs John Zuill & Co. Liverpool and the other Owners of the "Spitfire" Privateer of Liverpool, per the "Fly", William Ward, from Greenock.		
BOUGHT OF CARRON COMPANY.		
No. 24255; 24230; 24200; 24148; 24251; 24281; 24310; 24449; 24481; 24480; 24512; 24413; 24414; 24448; 24280; 24209		
16 Carronades 18 prs, as above proved at the		
medium weight of 7.2.0. each ...	6.0.0.0. @ £13.10/- ea.	£216.0.0
1280 Round Shot for 18 prs.	10.5.2.24)	
320 Double headed do. for do.	2.12.2. 0)	
	12.18.0.24. @ 14/-	180.15. 0
480 Grape Shot for 18 prs.	5.1.0.2. @ 28/-	141. 8. 6
4 Casks @ 4/6d and 1 Cask @ 1/6d for grape shot.		0.19. 6
3 Boxes for do. @ 3/- each		0.15. 0
		£539.18.0

To this account Gascoigne attached a letter: *"We will now trouble you with this to request the favour that you will prevent any person whatsoever from taking a pattern, model, drawing, or dimension of the Gasconades we are now about sending you. As you are the first gentlemen we have sold them to, excepting those on board our own vessels, we would think it hard to be robbed of our scheme in its infancy."* (the letter was written before the committee meeting but only sent after it gave permission for the sale). Just how the privateering company had heard of the new weapon is uncertain, but in later years it was claimed that this sale was facilitated by Patrick Miller of Dalswinton. Miller was a businessman and successful banker and was keen to promote the interests of any Scottish manufacturing producer. He was particularly interested in cutting edge technology and in the following years was involved in the development of steam ships, in which Carron Company was also concerned. Miller was related to John Zuill.

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Vessel Name	Type	Master	Armament	Date of Reference
<i>Carron</i>	brig	Robert Paterson	22 (18pdrs)	Jan 1780
<i>Carron</i>	brig	Robert Paterson	20 (18pdrs)	Sep 1780
<i>Stirling</i>	brig	John Dick	14 (12pdrs)	Mar 1780
<i>Paisley</i>	brig	Walter Duncan	16 (12pdrs)	May 1779
<i>Paisley</i>	brig	Walter Duncan	16 (12pdrs)	Mar 1780
<i>Paisley</i>	brig	Walter Duncan	20 (18pdrs)	May 1780
<i>Paisley</i>	brig	Walter Duncan	16 (18pdrs)	Jan 1780
<i>Paisley</i>		J Gardiner	20 (18pdrs)	Feb 1782
<i>King of Spain</i>		James Laing	20 (18pdrs)	Feb 1780
<i>Forth</i>	brig	James Lang	14 (12pdrs)	Aug 1780
<i>Forth</i>	brig	John Henderson	14 (12pdrs)	Aug 1780
<i>Forth</i>	brig	John Henderson	12 (12pdrs)	Feb 1782
<i>Glasgow</i>	brig	George Walker	16 (12pdr)	April 1780

Table showing the armament of Carron ship as given by the Edinburgh Evening Courant.

The Carron Shipping Company possessed a belligerent attitude and adopted a defiant posture. In January 1779 it advertised its services with the added note: "NB. *The Carron vessels are fitted out in the most compleat manner for defence, at a very considerable expence, and are well provided with small arms – all mariners, recruiting parties, soldiers upon furlow, and all other steerage passengers, who have been accustomed to the use of fire-arms, and will engage to assist in defending themselves, shall be accommodated with their passage to or from London, upon satisfying the matters for their provisions, which in no instance shall exceed ten shillings and sixpence Sterling. The Carron vessels sail regularly as usual, without waiting for convoy.*" (EEC 8.1.1779).

It was not long before the ships were in action. In February 1779 the *Stirling*, John Dick, master, was attacked by a French privateer. The *Stirling* beat her off in an hour-long engagement, during which Dick noted that for every broadside fired by the Frenchman he could fire two with his carronades. Inevitably this was reported in the Edinburgh newspapers (EEC 24.2.1779). It was to be the first of many such pieces.

In April 1779 the *Spitfire*, armed with sixteen 18-pdr carronades as shown on the invoice, with her crew of 88, engaged the much larger French national frigate *Surveillante* of 32 guns. The outcome was inevitable and the *Spitfire* was forced to surrender, but only after she almost succeeded in sinking the French vessel! Sales of the carronade had already been going well and in March 1779 another privateer, the *Sharp* of Glasgow, with 8 guns and 6 carronades and a

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crew of only 26, was brought to a fight by the *Sky Rocket*, a privateer from New England, with a crew of 80. The *Sharp* beat off her antagonist and ascribed her success entirely to carronade fire.

In the "Edinburgh Evening Courant" of 26th May 1779 appeared the following account of another engagement in which a Carron vessel was concerned: "*The Paisley, Captain Duncan, is arrived safe at Carron. On 23rd curt., early in the morning, after passing through a fleet of colliers, about 5 miles south of Tinmouth-bar, Captain Duncan saw a frigate and cutter privateer. The cutter, which mounted 18 guns came alongside of the Paisley and ordered the captain to hoist out his boat and come aboard, which he refused to do, and stood on his defence. After exchanging two broadsides, the privateers sheered off, and stood towards the fleet of colliers, and while the Paisley was in sight took several of them. Captain Duncan had several ships under his convoy, which he brought off safe. The Paisley mounted 16 twelve-pounder Carronades.*" (EEC 26.5.1779).

The following letter was addressed from Carron to the Company's agents for the sale of ordnance at Liverpool:

Carron, 25th July, 1779.	Messrs J Zuill & Co., Liverpool.
This serves to enclose you copy of a letter we had last post from the master of one of our smacks, who on her passage from here to London fell in with, and beat off, a French privateer after an engagement off 55 minutes, off Cromer. We hear that he has since arrived in the Thames. This being the first engagement we have heard of with these guns (carronades), we thought it our duty to advise you thereof.	

An instance of subtle sales propaganda.

Armed conflicts with privateers were numerous. It is recorded that Messrs McKenzie & Lindsay of Dundee remitted Carron Company two per cent of the value of the oats cargo of the sloop *David and Jean* as a gratuity to the master and crew of the Carron armed brig *Stirling* for having retaken the sloop after her capture off the Yorkshire coast in July 1799. It was to be a momentous year, for in September 1779 the *Hawke*, privateer of Glasgow, armed with 16 guns and 6 carronades, was engaged by the French national frigate *L'Aimable* of 32 guns. The outcome should have been inevitable, but the *Hawke* beat the Frenchman off.

The three cases involving the privateers *Spitfire*, *Sharp* and *Hawke* appeared in an anonymous pamphlet published in Edinburgh in December 1779 extolling the new weapon. It was entitled "A Description of the new invented Gun called a Carronade; and its Uses" and its authorship is often ascribed to Patrick Miller. It was mentioned in a letter written by Samuel Garbertt, one of the original founders of Carron Company, to Lord Shelborne in March 1780: "*Mr Miller, a most ingenious trader of the first rank and influence in this country... by his connections occasioned many to be sold to privateers, and in December last he*

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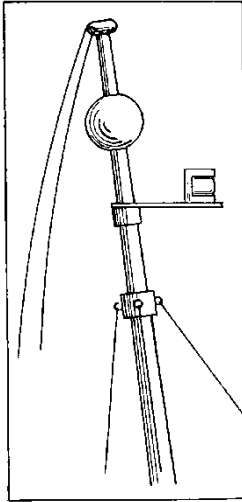
wrote and printed a few copies of a description of the Gun and its uses." (Campbell 1961, 100).

Gascoigne and Melville maintained a correspondence on the ordnance and possible improvements. The carronade continued to be developed and tested; now with more confidence than before. Government officials began to be lobbied and were invited to Carron Company's range at Greenbrae as is shown from this entry in the Scots Magazine:

"On the 4th and 5th of August were exhibited at Carron, under the direction of Charles Gascoigne, Esq: a variety of trials of his new invented guns, called Carronades, of the calibres of three, twelve and twenty three pounders, which worked with great ease and dispatch, and discharged their shot with much force and accuracy; after which a considerable number of experiments were made with hollow or shell shot, intended to perform the double effect of shot and shells against ships; and, lately sundry trials were made with shot perforated through the centre, and spirally fluted on the surface, suggested by Professor Anderson of Glasgow, in order to prevent the common aberration in the flight of shot. All the experiments were made in the presence of Adolphus Oughton, Commander in Chief, Lt. General Melvill, Capt. Fraser, Chief Engineer and many other gentlemen, who expressed the greatest satisfaction on the occasion." [Scots Magazine, August 1779, 452.]

From very early on there was a conscious decision to adopt a reduced windage in the design of the carronade. Windage is the difference between the diameter of the bore and the diameter of the projectile. The tighter fit meant that when the gunpowder in the chamber was ignited and expanded at an exponential rate with great energy, less of the force-giving gas went around the projectile and what remained was very efficiently used to propel it. This also reduced the amount of powder required. It is mentioned in the Board of Ordnance trials in July 1780 at Landguard Fort in Harwich. Mr Sinclair, the agent for Carron Company, stated that they produced shot with just sufficient size to allow them to fit in the bore. According to Frazer in 1824 the shot was cast in spherical iron moulds of the same diameter as the bore, and the windage was formed by the shrinkage of the metal as it cooled (see also Caruana 1997, 163; Rees 1819). At the time the general rule for conventional cannon was that the diameter of the bore should be one twentieth greater than that of the shot. Thus a 24-pounder had a solid ball of that weight and the shot had a diameter of 5.547 inches, the calibre of the gun was 5.824 inches, leaving a windage of 0.277 inches – approximately twice that of a carronade.

The Carron Shipping Company's ships were made available as escorts to ships carrying Carron cargoes. The great delay and hence financial penalties that occurred whilst vessels waited for an official Royal Naval escort were crippling and there must have been a subsidy from these ship owners. According to a tradition in the Carron Company these escort ships were the first to carry the cannon ball emblem at the masthead. This was an unobtrusive means of identifying the escort vessel, as well as being a good advertisement for the products of the company. The custom continued long after the cessation of hostilities made it unnecessary and it became a feature of all Carron Line ships until the last one was sold in 1948.



Illus: Drawing of a Carron Line masthead with a sheet copper sphere or cannon ball.

Naturally Carron Company exploited their success. In the *Edinburgh Evening Courant* the following anonymous question was raised: "*How long did the last London fleet that arrived in Leith wait in the Thames and at the Nore for convoy?*"

Did they not arrive in London from Leith about the beginning of May, and not return to Leith till the end of August?

Did not the Carron ships make two or three voyages in the time; and would not the Leith ships have made two at least, could they have obtained convoy, without writing so many letters to the Admiralty... Might not the Carron Company, with greater propriety, transmit a letter of thanks to the

Admiralty, because not one of their ships has been captured during the war, although they did not wait for convoy?" (EEC, 1 November 1780).

One suspects that Carron Company may have planted the question.

AT CARRON,—FOR LONDON,
To sail FEBRUARY 5, 1782,
The Carron Shipping Company's VESSEL
THE PAISLEY,
J. GARDINER Master,
mounting twenty 18 pounders, and men answerable.—For freight or passage apply to Mr G. Hamilton, Glasgow; Mr John Brown, Leith; or to the Carron Shipping Company, at Carron Wharf.

N. B. The Carron vessels are fitted out in the most complete manner for defence, at a very considerable expence, and are well provided with small arms.—Able-bodied landmen, who are desirous to serve on board those vessels for three years certain, will meet with the best encouragement, and be protected; and all Mariners; Recruiting Parties, Soldiers upon Furlough, and all other steerage passengers who have been accustomed to the use of fire arms, and will engage to assist in defending themselves, shall be accommodated with their passage to or from London, upon satisfying the Master for their provisions, which in no instance shall exceed Ten Shillings and Sixpence Sterling.

*. * The Carron vessels sail regularly, as usual, without waiting for convoy.

Illus: Advertisement in the *Edinburgh Evening Courant*, February 1782.

For privateers it seems that the carronade was the weapon of choice and its fame soon spread, though reports were often vague. "*On Wednesday last, two vessels arrived at Stromness, from the westward; one of them mounted 22 24-pounders, Carronades, but pierced for 28 guns. The commander of her gave out, that she was the Resolution privateer of Dover, and that the other vessel, which mounted 18 guns, was his prize, which had come from Virginia, loaded with tobacco, bound for North Faro. Their true identities was questioned.*" (EEC, 2 Feb 1780).

In 1780 the brig *Paisley*, John Gardiner master, beat off an attack by two French ships while protecting a convoy of colliers; and soon after she captured another enemy ship, which she brought into the Forth as a prize (Bowman 1979, 159). William Elphinstone was so delighted by the possibilities of the carronade that he gave up his control of the Carron Shipping Company and took to privateering in the frigate *Paisley*, erroneously referred to as a brig in this notice:

"As the brig Paisley, belonging to Carron Shipping Company, is completely fitted out for a cruise, and provided with a letter of marque against the Dutch. All able-bodied seamen and landmen that are willing to engage on board said vessel will meet with the best encouragement, by applying to Mr John Balfour at Pilrig. The vessel will sail upon Monday next. As only a few hands are wanted to complete her complement, it is hoped that those who intend engaging will apply immediately that they may not be disappointed of so fine an opportunity." (EEC 30 Dec 1780).

The other ships continued to serve the Carron Company, some under its direct control and some under the brothers D and A Gordon, who had been Elphinstone's partners. The masthead symbol being retained, wise Frenchmen soon learned to steer clear of the Carron vessels.

Sales of carronades must have been at a fever pitch for almost every account of an engagement with the enemy at this time makes mention of them. Samuel Garbett had complained in his letter to Lord Shelburne that he had objected to the production of these light guns at Carron because they used less metal and therefore smaller profits. He was clearly out of touch with what was going on. Not only was the company selling vast quantities of the carronades, but most sales were accompanied by a wooden mounting, a variety of projectiles, and even gunpowder.

One of the carronade's great advantages was that it required smaller amounts of explosive than a conventional gun. When they were first placed on sale it was advised that a weight of powder one eighth of the weight of the ball was appropriate, though even this was soon found to be too much. By contrast a conventional gun would take powder of about one third of the weight of the ball. For undisciplined seamen familiar with the long gun this could be confusing and led to expensive mistakes. An overcharged carronade could wrench its mountings and render it inoperable in a battle, losing valuable discharges and endangering its crew. As it happened flannel cartridges had just been introduced when the carronade was launched on the market, though they were not in general use. Captain Charles Douglas of HMS *Duke* was a great advocate for their adoption by the Royal Navy. He recognised their superiority to previous practice and developed priming tubes of quill filled with an economical explosive composition which was safer, tidier and more certain than loose powder from a powder-horn. The use of a flannel cartridge also meant that all of the powder was discharged leaving no burning embers and obviating the need to worm the guns. By cutting out this procedure the guns could be fired even more rapidly as Douglas demonstrated by the superior rate of fire that he achieved with HMS *Formidable* in the victory over the French at The Saints in April 1782. Carron Company had adopted these cartridges and advertised them in 1780:

"As nothing is more dangerous on board a ship than the spilling of loose powder upon deck, in loading and priming of guns during action, the charges of powder for the Carronades ought to be filled in flannel cartridges, made suitable to the bore of the gun, which saves the powder, without the risk of retaining fire in the chamber after discharge, and which require no worming; and the gun should be primed with the Carron primers, which are more certain, much quicker, and less dangerous, than powder.

These primers are threaded with a quick match, and are put (20 for each gun) in a tin-case, slung like a cartouch, so as to be readily used; and, when used, are thrust into the vent till the head is pressed down to the bottom of the pan, and then lighted with a match in the common way...

The flannel cartridges and primers of all sorts, for great guns and small arms, are made at Carron, and forwarded with the guns; also shell-shot, carcasses, and hand-grenades, are charged and primed ready for use." (EEC, 5 February 1780).

This went hand in glove with the development of the projectiles. John Anderson was the professor of Natural Philosophy at Glasgow University (and later founder of Strathclyde University); he advised on the development of shot. It is evident from the trials in August 1779 that hollow shot was intended for use with the carronade. This shot weighed less and this reduced resistance to the expanding gases on the ignition of the gunpowder producing less back pressure, while the decreased windage sustained the pressure for longer. That may be one of the reasons why the rear part of the carronade (the distance from the base ring to the first reinforce) was proportionately longer in relation to the length of the piece than was the case in a long gun. Shells are also mentioned at the trials, and these would have been even more suitable since the proportion of the gasses which escape past the projectile is in part a function of its weight. That is to say, the heavier the projectile the greater the pressure behind it and the more gasses escape before the inertia is overcome. General Melville may also take credit for the development of such shells which seem to have comprised a bursting charge inside a hollow shot (Secretary 1917, 121; Caruana 1997, 163). John Robison, the professor of Natural Philosophy at Edinburgh University was soon involved, and later so was Henry Shrapnel. John Smeaton advised on the production methods for the shot moulds and the carriages.

Professor Robison stated that it was the original intention for all carronades to use hollow shot (Lefroy Papers), but the Navy did not favour them as they were difficult to store safely in wooden ships. Robison noted that the hollow shot was "cast over the core". This meant that hollow shot for the 68-pdr carronade weighed about 48lbs, that is 70% of the solid shot – and the same proportion would have applied for other calibres (Caruana 1997, 168).

"John Spottiswood, at his Carron Warehouse, foot of the West Bow, Edinburgh, begs leave to inform all those gentlemen who are fitting out privateers to cruise against the enemies of this country, that he will engage to furnish them with long guns, carronades, ball, chain, canister, long rig'd shot and hand grenados; primers and cast iron ballast; likewise musquets with or without bayonets, - flints and ball for ditto; hangars, spears & c upon a reasonable commission, and deliver them at Leith, or ship them for any other port in Scotland as expeditiously as possible." (EEC, 1 January 1781)

One of the reasons that Carron Company's early attempts at casting cannon had produced poor results was because of flaws on the internal surface of the bore. It was an old joke that to make a cannon the company merely took a long round hole and poured metal around it. That was not quite true, the metal had in fact been poured around an iron bar or newel coated with clay. Thereafter the sides of the resultant central channel or chase were cut with a boring machine to remove the gas pockets. Carron Company was therefore one of the first ordnance manufacturers in Britain to experiment with the new concept of casting the guns solid and then boring out the entire centre. This small band of manufacturers was adamant that this method produced higher quality results, but it took the establishment a long time to be convinced. However, tests at Woolwich showed that guns made this way had a more compact grain of metal and were therefore stronger (Watters 2010, 70; Nimmo 1777, 464). Gascoigne reacted quickly. In April 1775 he sent an appeal to John Smeaton for advice: *"We have no experience of Boring from the Solid or how the Guns may answer but if you would write us that a Machine and Apparatus can be constructed to bore from the Solid with any tolerable degree of expedition and of that simplicity as to make a straight and fair Bore, with a Scots workman, we will certainly make a trial of it and put your design in execution as soon as possible after we receive it."* (Campbell 1961, 88). A makeshift boring machine was set up *"with machinery done in a hurry, and not quite as it should be; but that notwithstanding, the first gun that he bored was perfect."* (Watters 2010, 71). Its success led the Company to adopt this method wholesale and in December Gascoigne arranged *"to make the proper alterations on the boring mills for boring the guns out of the solid"* – these were the existing mills which had used the old procedure. A new boring machine was assembled on the principles already established by John Wilkinson in England. The increased demand for guns meant that the operations had to be up-scaled and in February 1776 Gascoigne reported that *"he had begun to arrange the Works, so as to be enabled to bore more solid guns; and that, on receiving the last Spanish order, he had enlarged the plan, so as to bore out of the solid all the guns the Works are capable of casting."* (Watters 2010, 71). It was probably one of these new machines that was described in 1815: *"the gun is placed in a horizontal position; the borer lies on a carriage, which is advanced towards the cannon; the latter turns round its axis without advancing."* It was modified by John Smeaton in 1779 for the carronades and was described as *"An apparatus for moving forward the Boring Bars for the Carronades made at Carron without a carriage."* (Watters 2010, 75). By a series of linkages attached to a weighted pulley the point of the screw was forced against the casting with whatever force was required. This caused pressure to be applied to the turnbuckle screw which advanced the cutting bar into the gun. Smeaton was one of the best engineers of his day and his prolific output included several projects at Carron. The carronades were cast solid in the upright position (Gillespie 1868, 152).

Meanwhile Carron Company had not neglected what was potentially its largest single customer – the Royal Navy. It was fortunate in being able to draw upon the lobbying power of quite a number of influential friends. One of these was John Murray, the fourth Earl of Dunmore. He was governor of New York from 1769 to 1770, and then of Virginia until 1775, at a time when the Americans were fighting for their independence. He then returned to Scotland where he helped to promote the carronade before eventually, in 1787, becoming governor of the Bahamas for nine years. Helped by the early successes of the carronade

in battle he was able to persuade the King to order a trial of one at Woolwich. It was probably a 12-pdr, though it was merely referred to as "Lord Dunmore's" (Caruana 1997, 164; Blackmore 1976, 145). The trial took place on 13 March 1779, but the results were not good. Despite this, more trials were held on 6 and 7 July comparing the performances of a 12-pdr carronade with a 12-pdr gun using round shot, case, grape and langridge. The case consisted of 23 shot of 8oz, the grape of 9 shot of 1lb each, and the langridge of 15 pieces of iron one inch square and three inches long. On the basis of the firing it was shown that the carronade was the ultimate deck sweeper at 25-50 yards. At that close a range it could not miss, its spread of projectiles was excellent, and the calibre was large enough to produce a hail of shot with multiple loads which could clear any enemy deck with a few rounds and probably half unrig the enemy vessel into the bargain. Charles Middleton, the Controller of the Navy, was present and was enthusiastic.

Fortune was on Carron Company's side. The Navy was struggling to fully re-arm for the struggle against the French and had prioritised the copper sheathing of its ships to make them fit for continued service, leaving an urgent gap to fill in the armament of those ships. At the same time the Navy was trying to expand, but was faced with an arms industry beset by production difficulties. At a time of increased demand and diminished supply the carronade had two cardinal virtues – it was easy to cast and it was cheap. Ordnance was paid for by weight and a 24-pdr carronade weighed only 12cwt, whereas a 24-pdr gun weighed 50cwt. Even though Carron Company charged £22 per ton compared with the going-rate of £18 per ton paid by the Board of Ordnance this still put the comparative prices at £13 and £45. Although offset by the fact that the slide carriage was between £5 and £10 more expensive when bought from Carron, this still left a substantial saving.

Within a week of the trials in July 1779 the Admiralty had produced a scale for arming its various types of ships with carronades on their quarterdecks and forecastles; these included 18-pdr and 24-pdr carronades as well as the 12-pdr trialled. The matter was much discussed by ships' captains. On 12 July 1779 Captain Charles Douglas of the *Duke*, then in Torbay, wrote to Middleton "*I do thoroughly agree with you... in being of opinion that twelve-pounders of the Carron make would answer very well on this ship's poop... Admirably, too, would 24's do for her quarter deck, three of a side, where rigging is not in the way.*"

"The substance of the experiments made at Woolwich on the short pieces of cannon, though not so complete as I wish, yet were sufficiently decisive in proving that such guns may be used to great advantage on the round-houses of all ships and on the quarterdecks of others whose present establishment of guns admits of spare places clear of the rigging. By using them in this way and allowing them in addition to the present establishment, it will considerably increase the force of our ships in general, but more particularly those of the smaller classes. The lightness of the guns makes them a great object to the three-decked ships, whose construction is not calculated to carry a heavy weight on their quarterdecks and yet ought not to be deprived of the advantages of artillery on so commanding a height if a proper kind can be found to answer the purpose. The poops or roundhouses of all ships should be supplied with cannon on the same principle; and as frigates from 44 guns downwards have a large space unoccupied on their quarterdecks clear of their rigging, I am of opinion the

Carron ones are suitable to all these purposes and far superior to small arms in naval engagements. Their weight is so small and the guns placed on their beds in such a way as to require but two men to work them, whereas common ones of the same bore are allowed ten or twelve. From the shortness of the piece, they never heat, and may be easily fired twice in the same space of time another is fired once. But notwithstanding these advantages, their velocity is not equal to the guns now in use; and though they appear to me the best improvement yet invented for rendering our ships superior in strength to any of the enemy's of the same classes, yet I should be sorry to see them trusted wholly to for their defence."

[Middleton – Sandwich Papers]

The sizeable order for carronades went to Carron and it took several months for them to be made and dispatched. Middleton had recommended that the carronades would be particularly useful for the Navy's smaller vessels, such as the frigates. Aptly the first issue, at the end of October 1779 was of two 18-pdrs and eight 12-pdrs for HMS *Romney*, eight 18-pdrs for the *Brilliant*, and eight 12-pdrs for the *Cormorant* and the same for the *Rattlesnake*. *Romney* was a 50-gun ship, *Brilliant* a 28-gun frigate, *Cormorant* a 14-gun sloop, and *Rattlesnake* a 10-gun cutter. They were part of Captain Johnston's Squadron which was about to put to sea and the variety of sizes of vessels indicates that this was a trial. Carronades, carriages and stores seem to have been bought as a package from Carron. In December the following year when Captain Roddam Home of the *Romney* was asked how they answered in service he wrote "*I found them to answer as they now are, very well and am of opinion they are of excellent service when properly fitted...*" (Caruana 1997, 166). His letter continues with a description of suggestions for the better fitting of the carriages and proposed changes to them necessitated by the violence of the recoil.

Captains of Navy ships were given a fair degree of latitude as to whether or not their vessel should be fitted with carronades, as indeed had been the case with copper sheathing. Middleton wrote in March 1780 that "*by making carronades a favour instead of forcing them on board the line of battle ships, they will, like copper, make their own way.*" (Sandwich Papers).

Some of the captains were enthusiastic about having the carronades about which they had heard so much from their civilian counterparts. Slowly they were rolled out over a select number of ships. Before long they were called upon to perform and did so with panache. In July 1780 HMS *Romney* captured the bigger French frigate *Etat d'Artois* and carronades were a major factor in this success. When the Board of Ordnance criticised the carronades John McBride of the *Romney* wrote "*I can assure the Board that the carronades were fired upwards of thirty times, and though by no means fitted to that advantage that they may be, yet neither bed, carriage, nor breaching gave way, nor was the ship in any way endangered by fire... I am clearly of opinion that no musquetry on the poop, gangways, or tops, can withstand them in close action, & even out of musquet shot*" (Caruana 1997, 172). This was precisely what Middleton had been arguing.

The following month HMS *Flora* engaged a French frigate called *Nymphe*. *Flora* was armed with four 18-pdr carronades as well as 36 long guns. The ships closed for action and considerable credit was given to the carronades for the

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prompt surrender of the French ship. By way of promotion McBride was made captain of his prize which was now called simply *Artois*. She too was fitted with carronades. Following a successful encounter with two Dutch privateers in the late summer of 1781 he wrote to the Admiralty that December to emphasise his support for the new ordnance: *"You will please to represent that our carronades were worked with great ease & effect, one case shot from the large carronade almost entirely unriggered one of the privateers & brought down every sail but his jib; from three trials I have had of them, I am fully convinced of their great importance... I have only to add, that our seamen's prejudices are removed and they prefer much being quartered at a carronade to a great gun. I beg to observe that if they were one or two calibres longer and mounted as the great carronades are, it would be a very great improvement. We only put twenty eight ounces of powder in the eighteen pounder carronades, which is four ounces less than the proportion given, I think that perfectly sufficient."* (ibid, 173).

The names of McBride of the *Artois* and Williams of the *Flora* were cited by Carron Company, through James Baird its London agent, in support of the greater use of carronades. Also named by them were Charles Douglas, Carteret and several others (Caruana 1997, 173). Over the next year carronades became widespread throughout the fleet as an augmentation of their existing firepower. According to the Navy list of 9th January 1781 some 429 ships in the Royal Navy then had carronades mounted. Carron Works had become one of the principal arsenals in the world. By July 1782 over 1,000 carronades had been supplied and fitted. Carron Company was casting and finishing between 60 and 80 carronades a week! Perhaps it was because sales to the Admiralty represented a bulk order, or because Carron Company knew that the Admiralty would order them from its other ordnance suppliers if the price was too high, but the price paid by the government was lower than that offered to privateers. When quizzed about this Gascoigne simply stated *"there cannot be a better excuse as our anxiety to serve our Country, and to be favourable to Government in her present exigencies"* (Campbell 1961, 94).

Date	12-pdr	18-pdr	24-pdr	32-pdr	42-pdr	68-pdr	Total
January 1781	286	306	4	8	--	---	604
July 1782	404	478	36	18	44	22	1002

Table showing the number of the various calibres of carronades provided to the Royal Navy.

When Rodney won his famous victory over de Grasse in the Battle of the Saintes off Dominica, in the West Indies, on 12 April 1782, his leading ships were equipped with carronades. Whether by accident or design the battle saw the British breaking the French line, a tactic later repeated at Trafalgar and one that suited the carronade perfectly. At the close ranges involved this antipersonnel weapon inflicted huge casualties on the soldiers aboard the enemy ships as well as on their crews. It also performed the task of de-rigging and incapacitating the ships, producing sitting ducks for further action. The scale of the casualties can be judged from the fact that the whole British fleet of 36 ships had 243 killed and 816 wounded, whilst the *Ville de Paris*, the French flagship alone suffered 400 dead and 700 wounded.

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The Admiralty had carronades placed on receiving ships to train new recruits.

Carron Company did not neglect any market and in 1781 targeted those living in coastal areas with this advert: *"Carron June 6, 1781. In order to prevent the depredations that generally are occasioned by the landing of the enemies privateers, Carron Company will furnish any town, village, nobleman or gentleman's seat on the sea coast with Carronades, ready for service, and which may be mounted upon a common cart, and transported on the shortest notice. The calibres most suited are 4, 6 and 9 pounders, which are sold, with carriages complete, at 20s for each pound weight of their respective shot; a 4 pounder with carriages, rammers, & c 4L, and 20 rounds of shot 20s in all 5L; a 6 pounder, with ditto, 6L, 20 rounds of shot 30s, in all 7l 10s; a 9 pounder, with ditto, 9L, 20 rounds of shot 45s, in all 11L 5s."* (EEC, 9 June 1781).

From the outset Melville had been keen to develop the 68-pdr carronade which he considered would become part of the main armament of a Navy ship rather than an augmentation mainly for use as an antipersonnel weapon as was the case with the smaller calibres. Middleton too considered that they would fulfil an urgent role.

On 20 December 1779 the Comptroller wrote: *"All I mean in favour of the large carronades is that we may have something to look to in case the enemy should outnumber us next summer in the Channel. Under these circumstances our forty-gun ships, and even India ones, fitted to carry 68- and 42-pounders may not only prove the means of saving us from disgrace but gaining a victory. Such a measure, however, will not be practicable unless it is considered and digested before the season for action approaches. Our class of fiftys are sufficiently strong with their proper guns, and therefore I cannot agree with Mr Frazier in wishing them exchanged for carronades. But your Lordship must not expect to see large ships furnished with these cannons next summer, as the fitting them for that purpose will interfere too much with coppering, and which must supersede every other object till there is a sufficient number completed for the use of the Western squadron."*

He was still fighting his case in March 1780: *"It will be of no consequence, My Lord, to His majesty's service to find out some years hence that the large carronades and shell shot might have been used in the present war to great advantage in naval engagements; but at this time, when no other Power is possessed of the invention and we are attacked by a formidable enemy, it is surely of consequence to seize the present moment. It will be time enough to consider the application of these guns when their merit has been comparatively proved, but as the season for action is advancing no time ought to be lost in making the experiments."*

The success of the small carronades emboldened Melville and Gascoigne and it would seem that the Earl of Dunmore was again involved as a sponsor. The Royal Armouries has a carronade with a bore of 7 ¼ ins which is ¼ ins larger than the 42-pdr, but less than that of a 68-pdr. It bears the Earl's crest on the reinforce – a demi-savage wreathed about the head and loins with oak, holding in the dexter hand a sword erect proper, pommel and hilt or, and in the sinister a key of the last. Above this are an earl's coronet and the motto "FURTH FORTUNE" (Blackmore 1976, 145). Such grandiose embellishment suited a trial

gun. However, it also has a deeply incised broad arrow showing that it was proofed by the Board of Ordnance. Before long the new calibre was ready for this market. On 5 May 1780 an Admiralty minute noted that the Carron Company had invented a carronade to carry a 68-pound ball or a shell of 56 pounds; and that the master-general of the ordnance was desired to make experiments with it. In fact these trials had taken place that March at Woolwich (Caruana 1997, 168). On 15 August 1781 Commodore Keith Stewart wrote to the Admiralty setting forth the good qualities of the carronade and begging that HMS *Berwick* might be supplied with two 68-pdrs and two 32-pdrs (Com. Stewart's Journal). On 21 January 1782 the Admiralty desired the Ordnance to supply 68-pdrs "for the Forecastle of all ships capable of supporting them". Their introduction was slow, but by July 1782 there were 44 42-pdr carronades and 22 68-pdr carronades in service.

68-pdr carronades were certainly being produced by the time of Jacob Pattisson's visit late in 1780. Carron was a veritable arsenal.

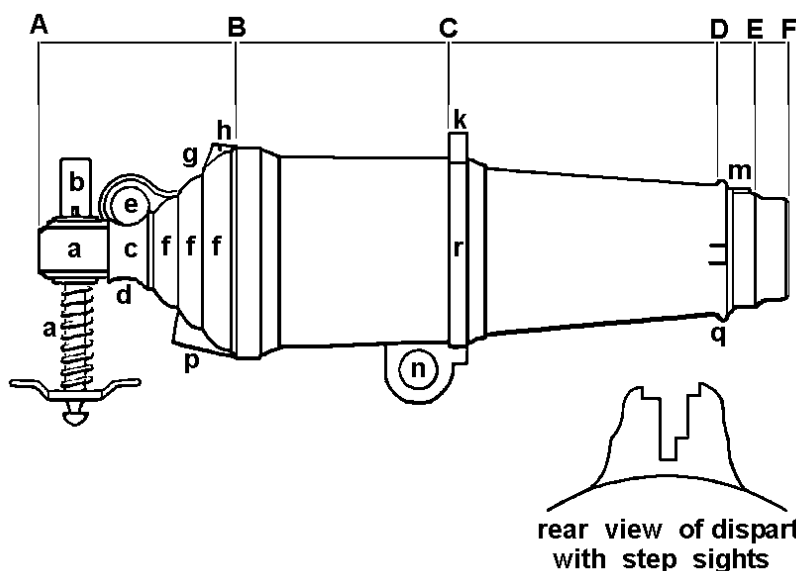
"You are next conducted to view the stores of Ball, Grape shot, Cannister shot which are so numerous & well arranged & of so many horrid forms, that you insensibly withdraw shuddering from a sight so pregnant with future Woe... What they call Cannister shot are a great number of Balls, or pieces of Nails, fastened tightly in a thin plate of Iron, & which immediately breaks either when discharged from a Cannon, or the first thing it strikes against. There are another kind of Shot composed of eight short bars of Iron fitted slightly tied together which upon being discharged separates as the above. These are of different forms & are said to be much in use for cutting the Rigging of Vessels. The most shocking of all is that to which they gave the name of Starshot. It consists of eight pieces of Iron adapted to each Star, fastened at one end with a strong single & having knobs at the other, slightly connected by a fillet of thin Iron – each of these pieces is about 12 or 14 inches long. The knobs are closed and first put into the Cannon – as soon as they are discharged they separate, yet held by the single, they whizz along & I think would rarely fail of doing execution. We are told that they are now coming into Fashion and are charitably supposed to be used for destroying the Rigging... We saw some balls of 68lb each, which were made for some Carronades lately cast here – it is said a few of these are at present in the Navy, as they are not near so long as the Cannon formerly in use, their weight is not so great... we were fortunate to see some 32lb balls cast. The iron is first melted & then pored into moulds, a composition of sand and clay. When the ball is cool it is taken out and finished up...

We afterwards walked into another office & saw several moulds in which Cannon are cast. We were here likewise singularly fortunate, in seeing a six pounder gun. The mould is placed perpendicular in sand with the mouth just appearing above the surface & at about three yards distance from the Cauldron. A groove is then made in the sand which leads to it, into which liquid iron is poured, runs along and fills the mould – it was filled up in two minutes. We stood as near the operation as we dare & as bold as we were we did not feel ourselves altogether free of anxiety & dread. All the Cannon are at first cast solid, & the bore is afterwards made by means of a water engine, which last operation no person is permitted to see. A twenty four pounder is said to be done in 10 or 12

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hours. This boring hath not been long in practice it was formerly the custom to cast them hollow, by which means they not infrequently burst, this is said now to be very rarely the case."

The very early carronades up to this point seem to have been swivelled on conventional trunnions and these are shown as late as December 1781 on the Admiralty drawing for mounting them on board the *Artois* (PRO ADM 106/3472). By this date the release of hot gases, often with flames, from the muzzle had been shown to be a major fire risk to the vessel on which they were placed. Many complaints were made on this point from the captains of the Navy's ships. It may have been partly to resolve this problem that in 1782 the trunnions were largely replaced by a loop in the form of two perforated lugs, cast integrally with the gun, on the underside. A substantial locking pin then passed through the holes in order to secure the gun to the carriage. These loops are variously called "carronade loops", "trunnion loops", or "joints", and by removing the need for brackets at the sides they supposedly allowed the carronade to project further from the ship's side than was previously the case (Frazer 1824). This may have been so when the carriage was mounted externally as they were at this time, but the carronade loop was retained even after the barrel had been lengthened and then mounted internally, which indicates that there must have been another reason. That may have been connected with the fierce vibration on recoil. The pin and loop were stronger than the trunnion in a bracket which the carronade often shook free. Ironically, being underneath, the loop imparted a turning moment that accentuated the downward pressure on the breach (Caruana 1997, 185). It is unlikely that the loop was introduced to all the different calibres at the same time and it may have been phased in over a year or two. Apart from a few carronades ordered with the first batch all of the carronades purchased by the Royal Navy had the carronade loop. They should also have a broad arrow to show that they had been proofed by the Navy. Very few had the royal cypher.



Illus: The parts of a carronade (based on R.W. Adye's *The Bombardier and Pocket Gunner of 1802*).

AB – cascable

BC – reinforce

CD – chase

DE muzzle

EF – flash rim

a – elevating screw box;

b – elevating screw cap; c – neck;

d – neck fillet;

e – breeching loop; f

– breech mouldings; g – base patch; h – vent patch, pan & vent;

k – dispart & step sights; m – muzzle patch dovetail to receive dispart; n –

carronade loop; p – quoin patch or shoe; q – muzzle mouldings or astragal.

The switch to the loop system with its attendant slide carriage meant that the normal method of elevating the barrel was no longer possible as this relied upon the stepped sides of the traditional carriage truck to provide a fulcrum for a handspike, then resting the breech on a triangular wedge of wood called a quoin or coin. There was already an alternative available in the form of an elevating screw – and this was adopted. It required a change in the pattern of the rear of the cascable mouldings to incorporate a screw thread in the button. However, cast iron is relatively brittle and because of the violent motions of the carronade the quoin had to be retained, whereas on other guns it was not necessary. To provide even greater stability a quoin patch was added to the casting. This was a small square section added to the underside of the breech which spread the pressure on the quoin more evenly. Hitherto the Carron Company had placed its name, the year, calibre and serial number of the gun on the ends of the trunnions, now it placed them on the quoin patch. The fragility of the cast iron thread in the button was partially overcome at a later date by inserting a bronze bush in the cascable to take the thread.

A further modification was introduced at almost the same time as the loop which helped with the same problem of the muzzle flash. In 1782 the 68-pdr carronade was introduced and with it the difficulty of loading increased. By adding a cup-shaped extension to the muzzle the solid shot could be more easily guided into the bore. The muzzle cup was relatively thin-walled and did not count as part of the length of the carronade, though it did add fractionally to the weight of the gun.

Just when sights for pointing the weapon in the right direction were introduced on the carronade is uncertain. They were not used on the long guns at this time and it seems curious that they should have been first adopted for a short range weapon. It was probably with the advent of the large calibres that Gascoigne, advised by his experts, incorporated them into the design. On 6 May 1782 he wrote to the Admiralty "*I now beg the liberty to inclose you a Sketch, and Explanation of the Views or Sights upon the Carronades, which it is necessary to be generally known.*" The sketch is missing.

The carronade went through many patterns and it is the sum of many elements that defines the weapon. The chamber for the charge of powder was the initial defining feature and was usually one calibre less than that of the bore, and the muzzle cup one calibre more. Unlike conventional ordnance the chamber extended the bore back to the rear of the base ring. From the beginning it was a single reinforce weapon which was unusual for British ordnance, but not for other nations and which, though not appreciated at the time, was actually sounder. The cascable of the carronade was formed by three diminishing arcs ending in a diameter of one calibre at the neck fillet. At the other end the muzzle only has a vestigial swelling to protect it from physical contact with the side of the ship. One characteristic of the pieces produced at Carron was that they had four small reinforcements running back from the swell.

Middleton had written on 24 February 1782 that: "*The carronades will not be wanted all together, neither do I believe any other alteration in the construction necessary than adding two calibres to their length – but if it is thought right to adopt the measure proposed, why should the Board of Ordnance confine themselves to the Carron foundry when there are so many capital ones in this country?*"

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The number of 68- and 42-pounders wanted for the old ships will not exceed 500, and the 24- may amount to 80 in number: 580 therefore, instead of 1200, will be the whole that is required for this service and which cannot surely be attended with the delay mentioned in the memorandum sent to Lord Ashurst [Lieutenant-General of the Ordnance]. The best way however is to try what can be done, by sending an express to the Carron Company as soon as the measure is approved, and order them to undertake what has been proposed, and to inform the Board of Ordnance how soon the remaining part can be completed. The facility of making the carriages seems to be admitted; but in order to save time, I would propose some part of them to be undertaken on the spot where the ships are, and the Ordnance to complete the whole."

The old ships referred to were vessels in a poor state of repair which would normally have been retired. The Navy was overstretched and desperately needed these extra ships. Two days after that letter Middleton wrote that the old ships were no longer able to bear the weight of their traditional armament but that reducing their calibre would render them impotent. Instead, he again proposed the lighter carronades, particularly the 68-pdr. *"The stress I lay upon carronades is the size of their shot, and which will carry away the largest mast as well as sink the largest ship whereas 18-pounders will do no more than wound either. The former is a formidable force and the latter only apparent"*.

The lower velocity of the ball fired from a carronade meant that instead of punching a clean hole through the side of a wooden ship, as was the case with a conventional gun, it created a larger more jagged hole and sent splinters off in all directions. These sharp fragments of wood then created havoc amongst the enemy crew. It was probably for this reason that Melville nicknamed his invention "the smasher", though he may have preferred the name "Melvillade".



Illus: The model presented to Lieutenant-General Melville by the Carron Company, c1790.

At a later date Carron Company presented Melville with a well-executed model of a carronade mounted on the side of a ship. The brass inscription reads: "Gift of the Carron Company to Lieutenant-General Melville, inventor of the smashers and lesser Carronades for solid, ship shell, and carcass shot, etc., first used against the French ships in 1779."

The old ships included the *Fame*, *Egmont* and

Hercules. These were 74-gun ships with a normal establishment of 32-pdrs on the lower and 18-pdrs on the upper deck. The *Fame* was noted as being in poor condition even in 1780 and the *Egmont* had suffered in the great hurricane of that year in the Leeward Islands. Consequently the *Fame* had been downgraded and in January 1782 carried 550 men instead of 600; her armament was reduced with 24-pdrs instead of 32-pdrs and 12-pdrs for her 18-pdrs. The *Hercules* had been re-armed in that manner in April 1781. However, in February 1782 the *Egmont* was reduced to 68 guns and 500 men but was armed throughout with carronades of 68, 42 and 24 pounds. Two smaller ships, *Belleisle* and *Rippon*, were re-armed with heavy carronades throughout at the same time. Old ships armed with carronades were also proposed at harbour entrances for home protection.

The introduction of the 68-pdr carronade brought with it the possibility that a ship of the Royal Navy might be completely armed with this weapon. HMS *Alfred* had been fully armed with carronades of a small calibre in 1780 for only a short period before reverting back to more conventional armament. In 1782 the 44-gun ship *Rainbow* was armed experimentally with twenty 68-pdr carronades on the lower deck, twenty 42-pdrs on the upper deck, and six 32-pdrs in the upperworks. It is said that the Carron Company being very concerned about the way in which the Navy fitted its guns sent men from Carron to mount them. A trial was conducted on 31 July and was witnessed by several officers. James Baird of Carron Company produced a glowing report, as might have been expected, which was sent to the Admiralty. It is possible that the so-called trial was sponsored by the Carron Company. Although short on measurable facts, such as the distance of the shot, the report includes such statements as "most of the gentlemen present were astonished" to find that a 68-pdr carronade was perfectly cool after firing six rounds (the carronade file, National Maritime Museum).

Just a few weeks later Master Charles Duncan of the *Rainbow* wrote to Baird from Plymouth on 11 September 1782 saying: "*I am happy to acquaint you, that the Rainbow has taken and brought in here, the French Frigate of 40 guns & 380 Men, without any action more than firing the Starboard Carronade on the Fore Castle, it was fired 26 times. The Carriage gave way the third shot, in the same manner as the starboard Gun on the quarter deck did at the Nore, but was in 10 minutes lash'd & stood firm during its being fired 23 times, and was not so hot as might be expected; the French were surprised to see a 32 lb Shot from our Fore Castle lying upon their Q. deck, it kill'd the second Captain and the man at the wheel, several other shot struck the Ship; after a short Chace she struck. I hope this will give your Carronades credit. I do assure you Captain Trollope is much prejudiced in their favour, & every Officer on board the same.*" (Caruana 1997, 177). Despite being out-gunned during the chase, the *Hebe* should have been able to outrun the *Rainbow* and it seems that the killing of the helmsman and some of the crew may have been the critical factor – but that is what the carronade was good at.

Patrick Miller was utterly convinced by these large calibres and believed that even bigger guns would be even better. He seems to have financed experiments in this direction (perhaps taking on the role previously undertaken by the Earl of Dunmore) and in September 1781 the Edinburgh Courant reported that "*On Wednesday last one of the largest carronades ever made was tried at Carron. It*

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carries a ball of a hundred pounds weight. The power of this great instrument of destruction is immense, and it is as easily worked as a long twenty-four pounder. It answered extremely well all the trials and experiments that were made." (EEC, 8 September 1781).

"Experiments made at Carron River mouth with one Hundred Pounder Carronade being 9 Inches in the Calliber and six Calibers in Length inclusive of a chamber of 8 Inches in diameter containing 11 pounds of Powder and weighing about 48 Cwt made 14th September 1781.

No of Expt	Nature of shot	Charges of powder	Elevation deg min	Distance or 1st graze, yds	Remarks
1					The gun sealed with 2lb of Powder.
2	shot 100lb	11lb	10 30	2400	
3	do	do	30	500	or first graze & grazed a second Time at 850 yards & lost in the water at a great distance.
4	do	do	1	600	or first graze & grazed 4 or 5 times afterwards & lost as above.
5	do	6lb 8oz	1	500	or first graze & grazed a second time at 900 yards & grazed frequently afterwards till lost in the water.
6	cannister shot 11lb		2	240	or first graze & then continued scattering in a straight line for 800 yards. NB this Cannister.
7	do	11lb	2	270	or first graze & continued scattering in a straight line for 1300yds. NB this Cannister contained 32 of 2lb shot 27 of 1lb and, including the Cannister, weighed 97 lb.
8	do	11lb	2	230	or first graze scattered and spread a good deal some grape going 1500yds. NB This Cannister contained 90 of 1lb 4 of 1/2 lb & with the Cannister weighed 98lb.
9	hollow shot	11lb	10	1400	NB This shot weighed 82lb.
10	do	11lb	30	500	grazed frequently afterwards & went in all 2200 yards.
11	do	6lb 8oz	1	440	or first graze, 2nd graze 560 & went about 1700 yards.
12	shot	11lb	2	540	or first graze 970 & was lost in the River. NB This last shot was pointed at a flag staff 500 yards distant from the Gun and went within a few inches of the staff.
13	shot	11lb	13 40	2750	
14	loaded shell	11lb	13 40		Burst in the air at a great height (supposed about 200 yards) and the fractures fell about 1000 yards from the gun.

[GD58/8/25]

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From there the great carronade was taken to Leith and when Lord Townshend, Master General, visited the battery he was saluted by a full round of guns, among which was a carronade that carried a ball of 102 pounds weight (EEC, 1 October 1781). The following Monday *"some trials were made of the hundred pounder carronade lately mounted on the battery at Leith; a gentleman who was present informs us, that the gun, being loaded with 11 pounds of powder, and elevated to 15 degrees, threw its shot about two miles into the sea; and, by way of comparative trial with one of the 24 pounder guns belonging to the battery, a shot was fired at the same time from one of them with the same quantity of powder and elevation, and by the observation of the guard and others at the end of the pier, the 100 pound shot went further than the 24 pounder by about 30 yards. Another trial was made at an elevation of 4 degrees, when the 24 pounder shot ranged between 3 and 400 yards farther than the 100 pounder carronade. Several other experiments were made on this gun, by firing at a mark, and throwing shells and grape shot, all of which seemed to succeed perfectly well. There was a number of spectators upon this occasion, amongst who was the Duke of Buccleugh, the Lord Advocate, Captain James Ferguson of the navy, who all seemed much satisfied with the performance of the gun."* (EEC, 6 October 1781). The gentleman noted was, presumably, Miller. It was also recorded by the Carron Company:

Experiments made the 1st Octr 1781 at the New Battery at Leith.			
103 11lb 45			This shot fired into the sea & from observation made at the pier head went about
			3000 yds. There was at the same time fired from the Battery a Shot from the governments 24 pounder.
89 shell	1		49 Cwt charged also with 11 pounds of powder & fell short of the other 20 yards.
82 shell 11lb	12 45		plunged into the water at a great distance supposed about 2500 yards but did not
Shell 11lb	12 30		burst.
yards from the			burst in the air at a great height & splinters spread about 1500
100 shot 7lb	12 30		Battery.
Cannister 7lb			plunged into the water about a mile distance.
fell 400 yards distant.			pointed upon the Cask 600 yards distant - the bulk of the shot
100 11lb	41		at the time this shot was fired another shot was fired from the
24 pounder at the			same elevation and with 9lbs of powder. NB It was conjectured that the 100lb ball went 1600 yards and the 24 pound Ball 1900 yards.
From the time taken to load and fire sundry of the above shot, it is evident that ten men can work the 100 pr Carronade and fire in 3 minutes."			

A. Fraser wrote to Professor J Robison of St John's Hill, Edinburgh: *"Allow me to ask you, for my friend Mr . Gascoigne, if you have had time to peruse the printed papers he used the freedom to put into your hands on the Carronades and if you have made any remarks on the Principles he has laid down. He submits likewise the enclosed paper for your consideration, which is meant to be added to the former if approved of.*

If it is not encroaching too much on your time, Mr Gascoigne would also have been happy to see the calculation you made relative to the difference of the

velocities of the 100 pr. and 24 pr. Shot, when they fell in the water, as it makes a material argument in favour of the Carronades, which we find with the same initial velocities."

John Robison had been born in Baldernock, Stirlingshire and attended Glasgow Grammar School and the University of Glasgow. After a brief stay in London in 1758 he became the tutor to the midshipman son of Admiral Knowles, sailing with the Royal Navy on General Wolfe's expedition to Quebec and Portugal (1756–62). His mathematical skills were employed in navigation and surveying. Returning to Britain in 1762, he joined the Board of Longitude — a team of scientists who tested John Harrison's marine chronometer on a voyage to Jamaica. He subsequently settled in Glasgow and in 1766 succeeded Joseph Black as Professor of Chemistry at the University of Glasgow. In 1770 he travelled to Saint Petersburg as the secretary of Admiral Charles Knowles, where he taught mathematics to the cadets at the Naval Academy at Kronstadt, obtaining a double salary and the rank of lieutenant colonel. Robison moved back to Scotland in 1773 and took up the post of Professor of Natural Philosophy at the University of Edinburgh. In Scotland this was the Age of Reason and Robison is typical of the many people who worked on the carronade.

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Account:		
Patrick Miller Esq., of Dalswinton.		
Bt. of Carron Company.		
1781		
Sept. 29	1 Carronade 100 pr. No.38281 proved with Carriage complete Ball, Shot & c., as detailed	2T.11C.2Qrs.0lbs £100. 0. 0 4.11.2
<u>N.B.</u> Half the value of the Shot only to be placed to the debit of Mr. Miller, because they were used at the Greenbrae trying experiments.		
	Magazine Articles	4.13. 0
	For one half of the expenses of experiments made at the Greenbrae with the 100 pr. Carronade. The Company pay The other half of said expenses, amount per said note £3.19.6d, his half is	1.19. 9
1782		
June 6	1 Carronade 132 pr. No.38403 proved with a carriage skead, Stool, platform and trucks (weight adjusted)	126.17.10
	1 Carronade 32 pr. No.38360 proved (weight adjusted)	21. 5. 9
	1 Carronade 12 pr. No.38830 do	7. 4. 0
	1 Carronade 6 pr. No. 38389 proved	4.10.0
	1 Carronade skead, stool, platform and trucks for do.	1.10. 0
	Balls	17.14. 0
	Shot	8. 6. 9
	6 Boxes	0. 4. 6
	24 Ganister shot	4. 5. 6
	Fitting above	0. 5. 0
	Balls	4.19. 0
June 29	Balls	10. 9. 7
	Shell and Shot	3. 7. 2
	Fitting	0. 7.10
	Boxes	0. 4. 0
	Shell Shot	1.13. 0
	Fitting above	0. 6. 0
	Case Shot	5.17. 6
To 1784		
April 17.....		£449. 0. 3

A History of Falkirk in 10 ½ Objects: Object 9

The 102-pdr carronade was not to be the upper limit of these weapons. Trials of "Patrick Miller's 132-pounder carronade" took place at Greenbrae Reach on 24 January 1782. The ball carried 2,000 yards at 15 degrees of elevation and 3,300 yards at 31 degrees (Com. Stewart's Journal).

Miller was soon lobbying the Navy about these too. He had a meeting with Middleton who subsequently wrote (undated but late 1781 or early 1782): *"Mr Miller, the inventor of the great carronade, is now in London. I have had two interviews with him in company with Admiral Kempenfelt and other sea officers on the subject of this piece of ordnance for sea use, and we are so convinced that his reasoning is not visionary that I shall be very glad to have it tried on board Commodore Stewart's ship."*

Mr Miller is a modest, sensible man, and having no other view in urging his improvements than what proceeds from zeal to his King and country, he is deserving of notice from Ministers. His discoveries in artillery and the effects of powder on ball are of real moment, and so very extraordinary in their nature that I am convinced from his Majesty's great penetration in such subjects he would receive satisfaction from the experiments in Mr. Miller's possession, which he does not choose to make public in the present moment...

Mr Miller returns to Scotland next week. He is a banker in great repute in Edinburgh, and no interest whatever to promote by the present business.

P.S. – Mr Miller, I am told, had an intention of presenting this gun to his Majesty; but dropping a hint last night of sending it through the Russian Ambassador to the Empress, if no such opportunity offered, I think it of consequence to mention it to your Lordship."

Kempenfelt subsequently wrote to Middleton on 11 March 1782: *"Carriages to work on a bed were used before carronades were invented. The advantage is that few men are required to manage them; but though this method may answer with the smaller carronades, I doubt whether they will do so well with the larger; and this appears to be Mr. Miller's opinion, for he said he proposed his large carronades to be mounted upon a carriage only..."*

P.S. The 130-pdr carronade, Mr. Gascoyne says, is too large for any ship's port."

Miller's 132-pdr carronade does not seem to have been accepted by the Government bodies and he accordingly presented it to the King of Sweden, Gustavus III, who acknowledged the gift. Knowing that Miller was an enterprising agriculturalist he sent him a small package of turnip seed in return (Heston 1906).

The 12-pdr (No. 38830) paid for by Miller is also of unusual interest. Ordinary 12-pdr carronades at the time weighed 5cwt 1qr 12lb, but 38830 weighed only 2cwt 3qr 4lb. This extra-lightweight construction seems to have been a one off requested by Miller as part of his experiments. In a paper attributed to Miller he states *"I caused a light gun, a 12-pounder, to be cast at Carron. This gun was tried in the neighbourhood of Leith; it was charged with powder, one-twelfth of the weight of the ball; it answered everything I expected from it"* (Woodcroft Papers, 1813). The amount of powder used is also unusually small at this time and would have been part of the 'effects of powder on ball' referred to above. Like so many avenues of research on ordnance at the time this extra lightweight gun seems to have led to a dead-end. However, charges generally for

A History of Falkirk in 10 ½ Objects: Object 9

carronades were gradually reduced. Initially it had been set at one eighth of the weight of the ball, but this was quickly altered to one ninth. By 1798 it was indeed one twelfth and even sometimes as low as one sixteenth, depending upon the pattern of use and how it was being used.

In 1784 St. Fond visited Carron Iron Works and was shown around by a guide under careful conditions: *"He conducted us at first into an immense court, surrounded with high walls and vast sheds. This place was covered with cannons, mortars, bombs, balls, and those large pieces, short and expanded at the breach, which bear the name of carronades."* He also noted that the cannon were covered with a thin varnish of a steel colour to prevent rust, the ingredients of which were kept a secret, but which he thought might include lead. Pattison implied that the balls were treated with a boiling hot metal – clearly it was important with the reduced windage that they should not rust.

Over the years of peace and war carronades were sold to Russia, Denmark, Spain, Holland and Sardinia.

In the Navy's ships of the line carronades were used to augment the traditional armament. They played a greater role when a ship was structurally incapable of taking the larger weights of long guns. The area where they were undisputedly dominant was on launches, bomb-vessels or gun boats where they replaced the howitzers. Their use became a standard tactic familiar to Nelson. On 20 December 1798 he wrote the following memorandum respecting the evacuation of Naples by the Neapolitan Court: *"Three barges and the small cutter of the Alcmena armed with cutlasses only to be at the Victoria at half-past 7 o'clock precisely – only one barge to be at the Wharf the others to lie on their oars at the outside of the rocks. Grapnels to be in the boats. All other boats to be armed with cutlasses and the launches with Carronades."*

Whilst the 68-pdr carronade was undoubtedly a formidable weapon as Middleton had reported, it was also expensive. This is how it compared with the 32-pdr in June 1804 (Aden 1/4016):

	32-pdr	68-pdr
carronade	£27. 6. 0	54. 6. 0
carriage	15.17. 0	34. 0. 0
Side arms & c	3.12. 9	3.15.11
Ammunition & stores	36.12. 5	74.17. 6

Carronade Mountings



Illus: Model carronade based on GD58/8/85 in the Carron archive, showing the sliding carriage.

The carronade was inseparable from its mounting and this evolved with the design of the gun and practical experience. Input came not only from John Smeaton, John

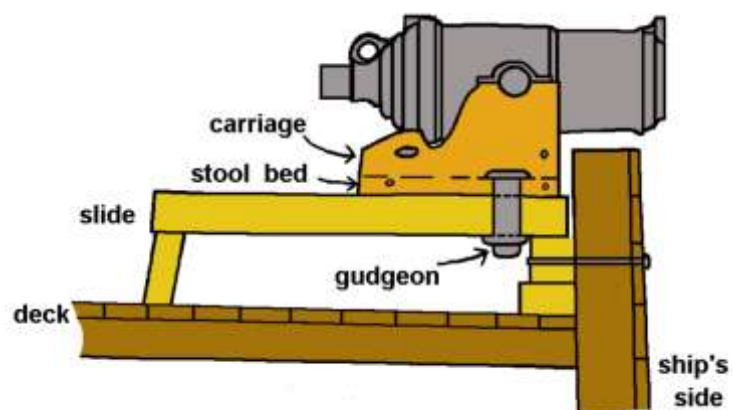
Anderson and other Carron men, but also from the Admiralty's carpenters and ships' captains.

In a pamphlet published by Carron Company at the end of 1778 mention was made of the carronade "*possessing some advantages for naval defence that cannot be given to any gun now in use on the common method of mounting and working them, and this gun, upon trial having been found to answer*" (Campbell 1961, 91). From this it is clear that the Company had prepared a new type of mounting for the carronade when it was first launched, presumably in order to alleviate the problems with excessive vibrations when it recoiled. At the Woolwich trial in July 1779 the conventional 12-pdr gun was mounted on a ship's carriage, but the carronade was "*mounted on a new constructed sliding carriage*"

Illus: Suggested type of mounting of a carronade in 1779.

The first sliding carriages supplied by Carron Company had in fact been designed with merchant ships in mind, the Royal Navy having refused to take Carron ordnance. Few of these ships had decks with gun ports below the main deck and the

carronade, being much lighter than conventional cannon, was normally placed on the main deck. Here they required to be solidly fixed to the wooden side by two bolts so that they did not roll about when not in use, and there was less travel during the recoil. They had an upper and a lower section – the upper being simply a smaller version of the standard sea service carriage stripped of its axletrees and wheel (trucks); the lower was little more than a fixed stool with



a slot along its centre. The two sections were connected by a large bolt (the gudgeon) which was fixed to the upper section, but free to slide backwards and forwards in the slot in the lower section. The upper section could be rotated about the gudgeon to allow the carronade to be pointed in different directions, called traversing. This was somewhat problematic as whenever it was fired obliquely it attempted to recoil sideways rather than longitudinally, placing enormous strain on the gudgeon and often oversetting the mounting entirely.

"Sliding carriages for carronades" are included in the list of stores and ammunition sent to Captain Johnstone's squadron at Portsmouth in October 1779. That squadron included the *Romney* and in December 1780 Captain Home wrote from it giving one of the first full descriptions that we have of the sliding carriage and which is worth quoting at length:

"I had the honour of receiving your letter dated the 23rd, desiring to know how the Carronades of His Majesty's Ship under my Command, answered in Service, and if I could point out any improvement that could be made in fitting the Beds and Carriages. The Carronades of the Romney were fitted on board our own Ship, and differ in some respects from those done in His Maj.^{ty} Yards; I found them to answer as they now are, very well and am of opinion they are of excellent service when properly fitted, the Observations I have made of them are as follows. The Neck of the Carriage that travels on the Bed is too short, & the Ring that forelocks it below too thin, and also too narrow, therefore we found it necessary to double the Ring both in breadth and thickness. Instead of having the Bed bolted down to the side, we have eyebolts both in the Bed and side, & so lash it by which means it gives way a little when the Gun is fired, enough to save both the Iron Work and Bed. Whereas when the Bed is bolted down and consequently has no play (and especially when the Gun is pointed at an Angle) it rises with such violence that before the Gun is brought up by the breeching it either breaks the Carriage or the Iron Work; with Us the Ring below gave way or bent, so as to prevent the Carriage from Travelling on the Bed, and very often the Bed itself broke, indeed as long as the Bed was bolted down nothing could withhold it. By lengthening the neck of the carriage it gives room for the Ring to be thicker and the Bed also which is a great improvement and the thicker the Plate is under the Bed the better; the Iron Plate & the Ring likewise cannot be too smooth, that the Carriage may meet no Resistance."

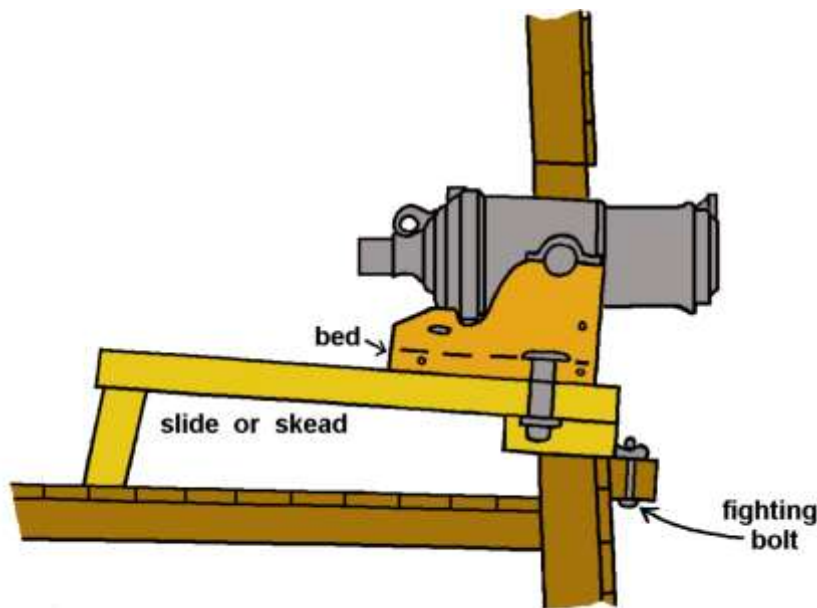
The report gives a clear indication of the strength of the kick on the recoil and rightly points out that restraining the lower section of the carriage (here called the bed) exacerbated the problem – though it was tried again later. The "ring" or gudgeon was almost double in size. However, he was wrong to try to make the sliding motion as smooth as possible as the friction absorbed some of the force out of the recoil.

The sliding carriage on the *Romney* had been supplied by Carron Company to its standard pattern. At this time one made at Carron was charged at 20 shillings per pound weight of calibre. A carriage for an 18-pdr would therefore cost £18; far more than the £8.17.4 for those subsequently supplied by the Board of Ordnance.

John McBride's comments are also of interest as he used carronades in combat. Writing in December 1781 *"I shall mention to the Board the necessity of the breeching bolts being strong & well secured without, the recoil is sharp and*

sudden, but if the coin is used to elevate the train of the bed, this occasions the carronade to recoil upon an inclined plain, which not only eases it, but the resistance sends the shot with more velocity." (Caruana 1997, 172).

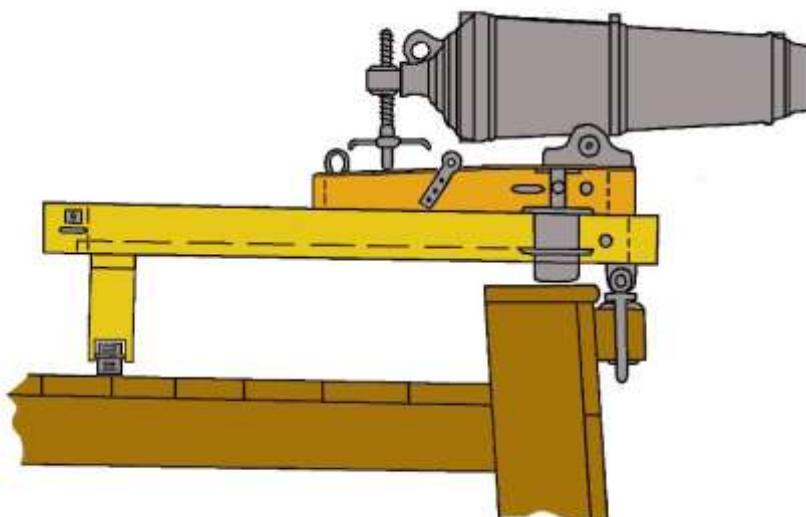
Raising the back of the mounting to create this inclined plain soon became normal practice. The Navy's shipyards and captains all had their own ideas on how best to fit this troublesome gun and so a multiplicity of methods developed. The rigid fixture of the slide, or skead as the Carron Company called it, was slackened to allow it to play more as the gun recoiled. Initially this was done by replacing one of the two fixing bolts with an eye and shackle; then by placing a strong vertical pin through the centre of the front of the slide so that the entire



Illus: The suggested type of mounting of a carronade in 1782.

mounting could pivot about that point. This became known as the "fighting bolt". The new arrangement also overcame the problem of the sideways thrust of the reactionary forces from firing. The front of the slide became first more rounded, and then more pointed, to accommodate the traversing. By late 1781 the fighting bolt had been transferred outboard of the ship's side on the "outside principle", as is shown on a drawing of the carronade mountings on the *Artois* (Caruana 1997, 199). This allowed the carronade to protrude beyond the gun port for firing and kept the muzzle flash clear of the ship.

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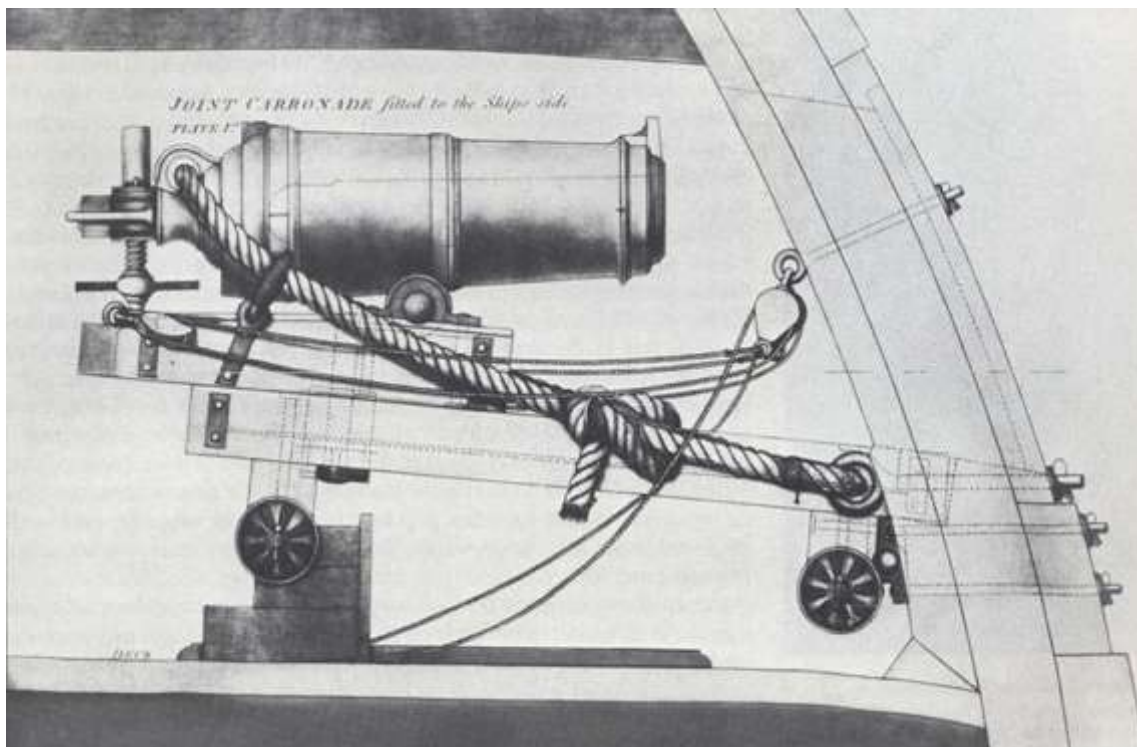
Illus: A carronade mounting for the upper decks, c1790, with traversing wheels.

The introduction of the carronade loop in 1782 meant that the cheeks of the carriage could be removed and the carriage was greatly

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simplified becoming little more than a plank anchoring ever stronger ironwork. Rather confusingly it became known as the "bed". With this development the whole ensemble could be made narrow enough to fit through even the smaller gun ports on the outboard principle. However, up until this point the carronades were mostly mounted on forecastles, quarterdecks and gangways. In some cases trucks were placed on the bottom of the slide so that the carronades could be moved around the open decks to cover blind spots. A stepped stool was then provided to support the rear leg to provide an anchor point and to allow the side to be raised using a bar to change the inclined plain to whatever angle was desired.

As carronades became more widely used as part of the main armament of the Navy's ships they were moved into the main gun decks where the ports had hatch covers and for this it was necessary to change the fitting to the inboard principle. It was no coincidence that the carronade was incrementally lengthened and the muzzle cup of 1782 reduced the risk of fire from the flash, though it still remained a problem.



Illus: The fitting of a carronade c1810 from the Carron archive (reproduced in Campbell 1961).

The following letter dating to 1804 illustrates some of the continuing difficulties: "Agreeable to your directions I have sent you a drawing of a 32-pdr Carronade as fitted on board His Majesty's Sloop Helena. The Chock you will observe is fitted close down on the Flat of the Deck, which is not in General approved of but we followed this method in order to cut as little as possible up into the Sheer Strakes. And by keeping the Chock close down on the Deck, we were obliged to score up into it, the depth of the Key or Forelock; when a Carronade is fitted as above described it will require a height of 3ft 11ins from the upper part of the Deck to the lower part of the upper port sills, but should you wish to preserve the depth of the Key or Forelock under the Chock a height of 4ft 1 ½ ins will be

necessary. This latter way I beg to say is generally approved of as it gives an opportunity of cleaning under the Chock and also preserve the Deck." (Caruana 1997, 202). Here the "chock" is in essence the front leg of the slide. The drawing that accompanies this letter shows traversing wheels on the rear leg.

The illustration produced by Campbell in 1961 shows a similar arrangement, but with a stepped stool instead of rear traversing wheels. The elevation screw is covered by a protective cap suggesting a date of around 1805. It is fitted on the inboard principle and the sill of the gun port has been partly cut back to receive the front of the slide. This is also the case on the model presented to General Melville around 1790.



Illus: Side and rear view of the model presented to Robert Melville by Carron Company. The brass place bearing the inscription can be seen on the top.

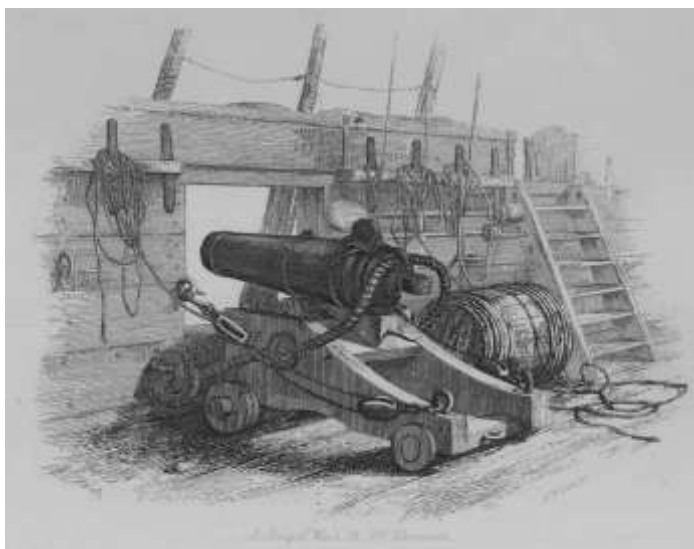
On the model the sill of the gun port has a curved cut-away at the height of the carriage, but is square for the slide. That this is not the model maker's error is shown by drawings in the Carron collection (GD58/8/85). The model is not dated, but its maker, William Winlow died in 1796. He was a prolific inventor of new machinery for agriculture as well as a fire extinguisher. At the time of his death he was "engine-maker to the Prince of Wales". Melville became a full

general in 1793 and died in 1809. It would seem that the designs of the mountings for the Carron Company and the Navy had diverged. Carron still relied upon the gudgeon for traversing.

Falconer's Dictionary of 1815 shows a carronade mounted on the inboard principle with traversing trucks at both ends of the slide. By then there was a multiplicity of mounts.

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The famous etching by E.W. Cooke of a brig of war's 12-pdr carronade printed in 1829 shows a truck carriage rather than a sliding carriage. These tended to be favoured by the merchant fleet as they could be moved around more easily. It also shows a flintlock for firing the gun, covered by a leather apron to protect it from the elements. It is a joint carronade, but carronades with trunnions continued to be made available throughout this period.



Illus: 1829 print of a carronade by Cooke.

"Oct 8th 1824

Cost of a 12 pr C'ade Carriage made for Lord Glenorchy.

Wood	£1.-.-
W J M/ge 56lb @ 9d	2.2.-
Joint bolt 11lb	- 9.-
Crow Bar	- 5.-
Cast iron cheeks}	-15.8
Patches & trucks}	3.10
Carpenters wages	- 7.6
Painting	- 1.6

	£5.-.8

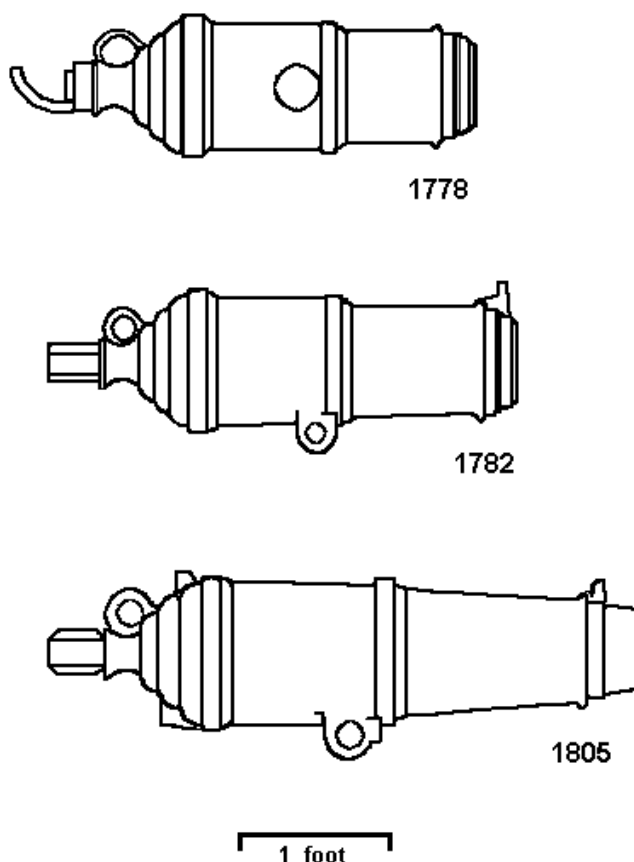
NB 8 C'ade carriages 12 prs were made & sent to Lord Glenorchy Ashmore, charged at the rate of £5.5.- ea.

Sponges & rammers	7/6 ea
Scoop & screws	7/6 ea"

GD58/14/51.

In 1778 the carronade had been rushed into launch for maritime service as a new weapon at a time of major international strife. It is not therefore surprising that it underwent a number of changes in design between then and 1783 when the American War was over. Changes still continued thereafter at a slower pace, brought about by technological advancements as well as practical experience. In 1795 Joseph Stainton, who had taken over from Gascoigne at Carron, stated that "the guns have been much changed since the last war" (Watters 2010, 289). In explosive charges, for example, cylinder powder became standard in 1801. In foundry practice the use of more a powerful blast meant that furnaces were able to achieve higher temperatures resulting in the greater fluidity of the metal and a denser casting.

Illus: Changes in the design and length of the 18-pdr carronade.



The most noticeable change was that to the length of the carronades. Caruana compiled the following table which summarises the variation that occurred in the various calibres. Increases of 4ins occurred to some calibres in late 1779, early 1780 and in 1782. The main reason for this was, as is explained elsewhere, to have the carronade protruding sufficiently far through the ship's side to reduce the fire risk from the fireball that was ejected from the muzzle upon discharge. It would also have produced a narrower cone of projectiles.

	1778	1779	1780	1781	1782	1783	1793	1794	1795	1796	1798	1815
100				56								
68pdr			48	54	62					62		62/48
42pdr									52	52		52
32pdr					40/48			48	48		48	48
24pdr	28	32	36		36/40	40	44	44	44		44	44/36
18pdr	24	28	28	28/30			40	40	40		40	39/28
12pdr	20	24	26					26	26	32	33	26

Table showing the lengths of carronades between 1778 and 1815.

In some models the diameter of the chamber at the end of the bore was also changed. Around 1780 the chamber of the 68-pdr carronade was changed from 7ins to 6ins. Consequently it was possible to reduce the diameter of the breech and even though the gun was larger it weighed less (Caruana 1997, 180).

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In the French Revolutionary War carronades continued to augment the armament of the ships of the Royal Navy just as they had in the American War. This is reflected in the establishment of carronades issued in 1794:

Rates	Guns	Quarterdeck No. pdrs	Forecastle No. pdrs	Roundhouse No. pdrs	Total
1st	100		2 32	6 24	8
2nd	90		2 32	6 18	8
3rd	74-80		2 32	6 18	8
3rd	64		2 24	6 18	8
4th	50	4 24	2 24	6 12	12
5th	44	6 18	2 18		8
5th	38	6 32	2 32		8
5th	36	6 32	2 32		8
5th	32	4 24	2 24		6
6th	28	4 24	2 24		6
6th	24	6 18	2 18		8
6th	20	6 12	2 12		8
sloops		6 12	2 12		8
brigs		6 12			6
cutters		4 12			4

Table: Establishment of carronades for the Admiralty November 1794 (PRO ADM 160/150).

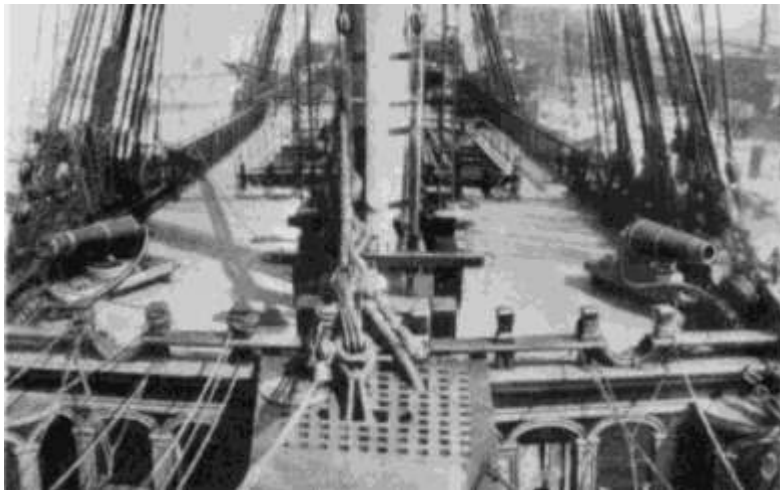
Carronades continued to be at the centre of encounters. On 15 July 1796 an action was fought between the converted East Indiaman *Glatton* and a French squadron of eight ships. The *Glatton* had been built in 1792 as an ordinary East Indiaman, although rather more than the usual size, and when the Navy was particularly short of frigates, they took her over, in spite of the fact that such vessels were seldom satisfactory. The *Glatton* was armed entirely with carronades, twenty eight 68-pdrs on the lower deck and twenty eight 32-pdrs on the upper deck. The French squadron mounted nearly 200 guns and, closing round her, expected to make her an easy prize, but when 68 pound shots began to crash through their sides instead of the 12 pounders which were the biggest they expected from such a ship, they were glad to sheer off in haste.

On 2 April 1801 Peter Fyers was a captain of the Royal Artillery in command of a detachment in the seven boom vessels at Copenhagen. Before the action began, he so worried Lord Nelson as to succeed in gaining his consent to his sending 8ins shells on board the *Elephant* and *Glatton* for use in their 68 pounder carronades. It was one of those fired from the latter vessel which destroyed the Danish Commodore's ship *Dannebrog* and called forth later from Nelson the generous remark "I'll tell you what, Fyers, it would have been anything but a victory if it had not been for your shells". The victory at Copenhagen had important effects. Had Nelson not won all Europe would probably have followed Napoleon.

Trafalgar

From 1798 Nelson kept two 68-pdr carronades on whichever flagship he was on, transferring carronades from ship to ship. They suited his preferred battle strategy of close-range fighting. It was only on 17 August 1804 east of Minorca that HMS *Kent* supplied the *Victory* with two 68-pdr carronades with carriages.

At Trafalgar on 21 October 1805 Collingwood's column was the first to engage the enemy. Captain Hargood of the *Belleisle*, the second ship in that column, held his fire until he could give effective salvos. She carried thirty 32-pdr guns, thirty 24-pdr guns, and two 9-pdr guns, plus fourteen 32-pdr carronades, eight 24-pdr carronades, and two 9-pdr carronades. She thus probably carried more carronades than any other ship in the battle. Her first broadsides were very effective, but after breaking the enemy line she was surrounded by five French ships and was soon completely de-masted. Her fallen sails impeded her firing and it was 45 minutes before the next British ship arrived in support.



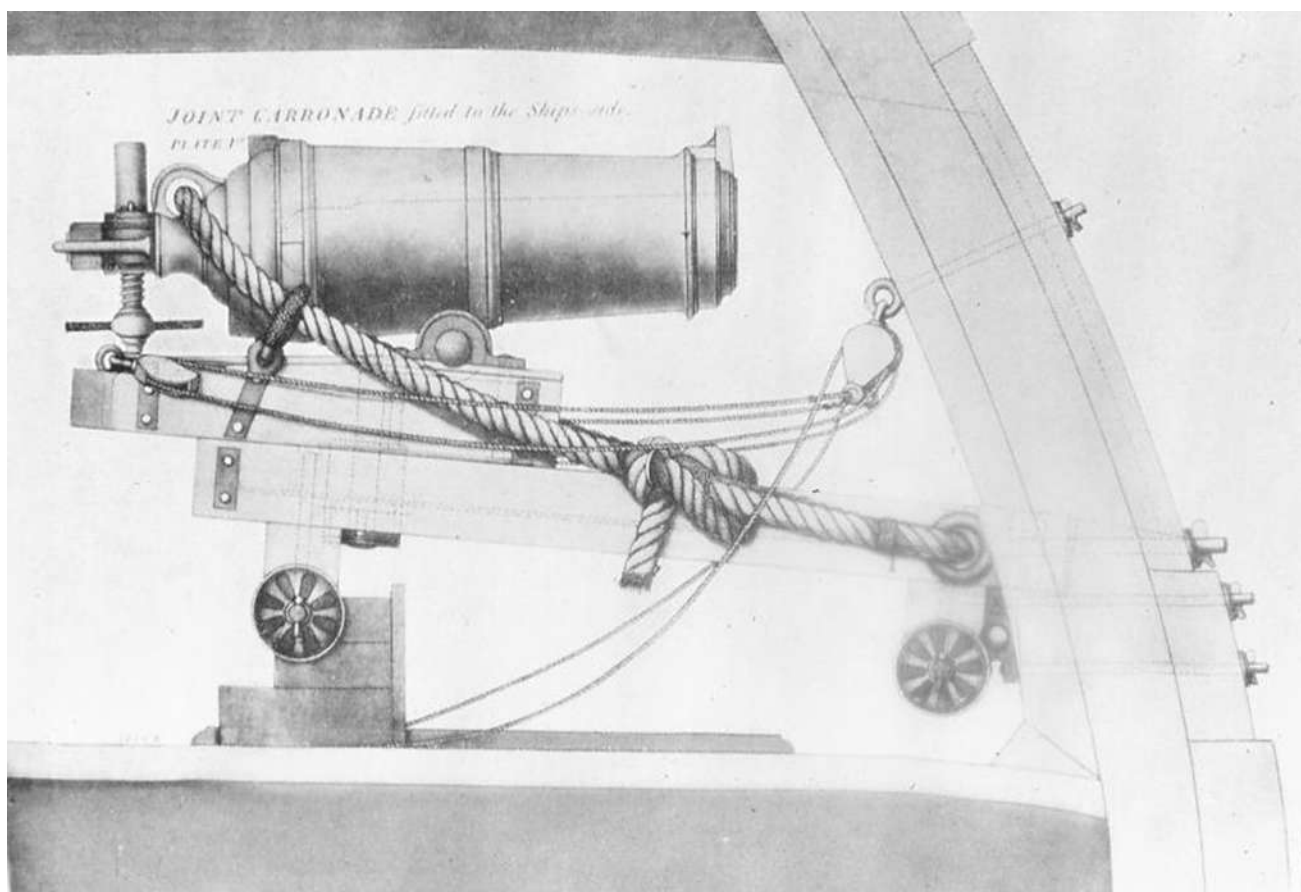
Illus: The two 68-pdr carronades on the forecastle of HMS *Victory*.

The *Victory* at the head of the second column headed for the slender gap between the French ships *Bucentaure* and *Redoubtable* in order to break the enemy's line of battle there. This was a difficult manoeuvre and

meant that as she approached ever closer the French were able to fire at the *Victory* without much opportunity for a reply. Relentlessly the *Victory* continued on her course until she was almost abaft the ornate highly decorated stern of the *Bucentaure*, Villeneuve's flagship. The 68-pdr on *Victory*'s forecastle had been loaded with a keg of 500 musket balls and a solid ball and a charge of 6.5lb (3kg) of powder. As she passed within six yards or so the trigger on the flintlock firing mechanism on the larboard carronade was pulled. The round shot smashed the frame of the stern and was followed by the musket balls that fanned out in all directions as though from a massive shot gun causing a swath of death. This was one of the most famous shots in history. The devastation and carnage was continued as gun after gun on that side of the *Victory* came to bear killing most of the men on her gun decks. The French had been training for months to board the enemy's ships and soldiers on the open deck of the *Bucentaure* moved to board the *Victory*, but she pulled away to deal with the *Redoubtable*.

The French copy of a 32-pdr carronade on the forecastle of the *Redoubtable* burst, killing many of the crew. Its captain, Jean Lucas, believed that his best chance of success was to abandon the gunnery battle and board the *Victory*. Sharpshooters were told to pick off the crew of the carronades as well as the

officers and it was one of these that fatally wounded Nelson. Lucas deployed his men with small arms accordingly. On the *Victory* it was noticed that a number of the *Redoubtable's* crew had assembled in her larboard chains, as if with the intention of boarding and so the other 68-pdr carronade came into play. The gun crew on the *Victory* had to stop firing in order to deal with the remainder of the boarding party, but were driven below deck by enemy grenades. At this point the second ship in Nelson's column, the *Temeraire*, arrived and fired its carronade putting paid to any chance of a boarding. After he had been taken prisoner on the *Victory*, Lucas said that the carronade had killed or wounded between 400 and 500 of his men (Duffy 2005, 165).



Beyond Trafalgar

It is a common misconception that all carronades were produced by the Carron Company, but that was not the case. It is not even true to say that the Navy got all of its carronades from Carron. In 1779 Charles Gascoigne had tried to patent the new gun, but it was not considered to be a new concept and he failed. Consequently anyone could copy it. Up until 1783 it appears that Carron Company was the Navy's sole supplier. Its adherence to this monopoly may have been connected with the design and development period of the new weapon. With the end of the American War the Board of Ordnance decided to end its reliance on one source. Before long another Scottish foundry belonging to the Clyde Company was supplying it with carronades and by 1808 only around 45% of those taken by the Board were manufactured at Carron (Caruana 1997, 188).

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The carronade fell into enemy hands as early as 1779 when the *Spitfire* was captured. It was soon copied by the French. However, this was during a period of rapid development when considerable changes were made and to many the real secret was in the quality and type of iron used. In Rye on the south coast of England is an 8-pdr carronade bearing the letter "F" with serifs on the left trunnion as the foundry mark of Finspong, south of Stockholm. The foundry was the main supplier of armaments to the Danish Navy throughout the 18th century and it is possible that the carronade was taken at the Battle of Copenhagen in 1801. Ironically, the King of Denmark got ten 30-pdr carronades from Carron in 1821.

Carronade-type guns were also used by the United States Navy. These were not of Carron manufacture and indeed the Company had passed a resolution not to send guns to America as early as October 1775 (Watters 2010, 70). Twenty replica 32-pdr carronades can still be seen at Boston on the decks of the USS *Constitution*, built in 1797. She received her first carronades in 1804, manufactured by Henry Foxall at the Columbia Works in Georgetown, Maryland. There is even a gun on display at the Alamo, Texas, with a sign that reads: "This type of cannon was made in Carron, Scotland, in the 1790s." That one probably was not!

Despite its own advice the British navy occasionally placed too much reliance upon the carronade. In the battles of the Lakes on the Canadian border during the war of 1812-13 the carronades lack of accuracy at long range was telling. Captain Barclay's dispatch reads: "*The other Brig of the enemy, apparently destined to engage the Queen Charlotte... kept so far to windward as to render the Queen Charlotte's 24 pounder Carronade useless, whilst she and the Lady Provost were exposed to a heavy and destructive fire from the Caledonian and four other schooners armed with long heavy guns.*"

Just to confuse matters different navies used different calibres. Indeed, the reduction in the windage of carronades meant that its bore was marginally smaller than that of a conventional long gun of the time. The 12-pdr, 18-pdr, 24-pdr, 42-pdr and 68-pdr were all calibres with which the Navy was already familiar. It may be noted that Melville's original concept had been for 8ins shot which was the 68-pdr. The 9ins (100-pdr) and 10ins (130-pdr) calibres, although developed and produced by Patrick Miller, were rarely requested. 8-pdrs were common on Danish ships and for Britain Thomas Blomefield of the Navy developed a 6-pdr, though it seems to have been sparsely, if ever, used. A goods list of around 1800 also advertised 3-pdr, 4-pdr and 9-pdr carronades! Carronades commissioned for civilians might be different again.

The carronade continued in use and racked up more battle honours. Space restricts us to just a few examples. The first relates to the privateers of New Brunswick which were harrying American shipping in the war between the Loyalists and the Americans in 1812. The most successful of the privateers for 1813 was the *Matilda*; although a small schooner of fifty tons, armed with five guns and carrying forty men, she had the good fortune to send in twelve prize vessels after an absence of three months. Next in order of success come the *Dart*, with eleven prizes, the *Wolverine* with eight, and the *Shannon*, *Retrieve* and *Fly* with seven each. As an example of the armament of these privateers the schooner *Wolverine* of 143 tons carried:

A History of Falkirk in 10 ½ Objects: Object 9

1 carronade, 9 lbs.	37 muskets.
4 long guns, 9 lbs.	40 boarding pikes.
2 long guns, 6 lbs.	10 pair pistols.
3 long guns, 4 lbs.	4 swivels.

The *Dart* was carrying two 6-pdr carronades on 22 May 1813 when she cut out a prize, the *Union*, from almost inside Boston Harbour in sight the United States Navy. The *Union* had sailed from Cadiz for Boston with a cargo of salt, fruit and block tin and was taken before the prize court in Saint John.

Carronades were not counted in the nominal armament of Navy ships until 1817. Even as late as 1827 at the Battle of Navarino 32-pdr carronades were used to good effect at close range, this time against the Turks. By 1832 the Ordnance Board List of Ships shows that 68-pdr carronades were only to be found on HMS *Tigre* and six new bomb-vessels.

According to Gillespie the last carronade was cast at Carron in 1852, by which time it was already more or less obsolete (1868, 152). Metcalfe, the assistant manager of the works in the 1930s, stated that 22,591 carronades had been dispatched since 1778, and that did not include those which failed the proof. The patterns for the carronades were kept until 1877 when the Carron Works was modernised and thousands of old patterns were instructed to be destroyed by George Heggie, the foreman of the pattern works (Gibson 1908, 201).

The existing carronades continued to be used for various purposes, including bollards. One curiosity was a "locomotive battery for field of battle with steam engine" patented by James Cowen in 1855 (No.747). It held 14-pdr carronades and the framing had strong powerful scythes, hinged when not in use, to mow down any troops that came into contact with it! (Ffoulkes 1945).

Carronades were perhaps the most famous weapon of the late eighteenth and early nineteenth centuries. Even figures such as Robert Burns and James Boswell were familiar with them.

In 1768 James Boswell raised £800 to have thirty carronades and the requisite munitions sent from Carron to Corsica to aid General Pasquale Paoli in his effort to resist the French invasion which was part of their European strategy. Corsica had been owned by the Republic of Genoa for five centuries until the Corsican Republic was established in 1755. Unable to regain control the Genoese sold the island to the French in 1764 in a secret treaty. Boswell had visited in 1765 and had struck up a friendship with Paoli, which continued after the latter's exile to Britain. They toured Scotland together "*They then viewed the iron-works at Carron, which are carried on at so prodigious an expence, and have diffused such opulence, and such a spirit of improvement, in that part of the country. General Paoli had a peculiar pleasure in viewing the forge where were formed the cannon and warlike stores, which a society of gentlemen in Scotland sent to the aid of the brave Corsicans*" (Boswell 1785).

Robert Burns's connection was a few years later, in 1792. He had been promoted to the position of Excise Officer for the Dumfries Port Division in February of that year with a salary of £70 per annum and for the first time in his life was financially comfortable. Just a few weeks later a smuggling brig named

Rosamund of Plymouth with Alexander Patty as the master was suspected of smuggling and was approached by a small party of government officers. The crew fired upon them and so assistance was brought in. The next day the ship was seen to be aground off the coast, but at some distance from the shore. 44 armed men, including a large number of soldiers, searched for boats so that they could get out to the *Rosamund*, but the local people damaged such as there were before they could requisition them. Eventually the party, which included Burns, waded waist deep through the water. The shot from the vessel was poorly aimed because she was leaning over to one side. It was a dangerous approach and just as they were within reach of the ship they saw men jump off her and head across the mudflats to the English coast. Immediately before they did so the crew had taken a 6-pdr carronade and punched a huge hole in the ship's side to wreck it. The ship had to be repaired before it could be refloated and was sold on 19 April. The Excise Officers presumably benefited financially from this transaction. It is said that Burns, flushed with money, paid £4 for the four carronades that were on board her with the intention of despatching them as a gift to the French Convention to show his sympathy with their cause. At the time the two countries were not at war though it was an uneasy peace. However, it seems that they may have been seized at the port of Dover.

Appendix 1

CONCORDANCE SHEET: DATE AND SERIAL NUMBER OF CARRON ORDNANCE.

Year	Serial Number		Year	Serial Number		Year	Serial Number
1765	1-		1807	71820		1828	85420
1771	2000		1808	73950		1829	85860
1778	24000		1809	75630		1830	86150
1789	47880		1810	76890		1831	86150
1790	48120		1811	77750		1832	86345
1791	-		1812	80230		1833	86445
1792	-		1813	81930		1834	86560
1793	51120		1814	83680		1835	86680
1794	-		1815	84025		1836	-
1795	-		1816	84120		1837	-
1796	-		1817	84275		1838	-
1797	56450		1818	84340		1839	86695
1798	59530		1819	84390		1840	86710
1799	-		1820	84460		1841	86726
1800	-		1821	84515		1842	86747
1801	62460		1822	84560 (+ new series)		1843	-
1802	63320		1823	84694		1844	-
1803	64570		1824	84708		1845	86810
1804	67150		1825	85140		1846	86820
1805	69450		1826	85285		1847	86827
1806	70630		1827	85390			

According to a note by R Campbell the last guns to be made at Carron were invoiced on 26th August 1848. Replicas were made in this century but they were not usable.

The numbering of the early sequence is complicated by the fact that even swivel guns were numbered in the first decade or so of production.

Appendix 2

PRESENT LOCATION

Year	Serial No.	Calibre	Present Location
c 1790	-----	68-pdr carronade	Tower Armouries, Leeds (Lord Dunmore's) [XIX.47]
1793	50399	18-pdr carronade	private, Kamloops, Canada
1803	63991	12-pdr carronade	Carron Works
1805	68660	carronade	Parade, Fort Nelson, Portsmouth [XIX.741]
1805	68690	12-pdr carronade	National Maritime Museum, Greenwich
1808	73338	24-pdr carronade	Tower Armouries, Fort Nelson [XIX.235]
1810	75990	12-pdr carronade	Carron Works

Carronades at the Dock Park, Dumfries.

Carronades used as bollards at Burghead.

Carronade at the Alamo, Texas.

Carronade with trunnions at Fort Beausejour National Historic Park, Canada.

Two 12-pdr carronades dated 1812 with trunnions at Fort George National Historic Park, Canada.

Carronade on Stranger's Brae, Stomness, taken from the American privateer *Liberty* in 1813.

6-pdr carronade at Marina Park, Thunders Bay, Lake Superior. Ontario.

Two 32-pdr carronades from the *Cataraque* on King Island, Tasmania.

Carronade with loop and elevation screw found off West Sussex coast by fishermen on display at Littlehampton.

Carronade from HMS *Anson* at Llandudno.

Carronade with loop and elevation screw at Government House, Bermuda.

Two 6-pdr carronades at Carron Phoenix from HMS *Hercules*.

6-pdr carronade on Isle of Wight with iron garrison carriage.

Bibliography

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|-----------------|-------------|---|
| Blackmore, H.L. | 1976 | Armouries of the Tower of London, I: Ordnance. |
| Boswell, J. | 1785 | Journal of a Tour to the Hebrides. |
| Bowman, I.A. | 1979 | 'The Carron Line: Part 1. Carron Sail 1759-1850',
Transport History, 10 No. 2, 143-170. |
| Campbell, R.H. | 1961 | Carron Company |
| Carronade File | unpublished | National Maritime Museum. |
| Caruana, A.B. | 1997 | The History of English Sea Ordnance 1523-1875.
Vol. 2: 1715-1815, The Age of the System. |
| Duffy, M | 2005 | The gunnery at Trafalgar, tactics or
temperament?', Journal of Maritime research,
7.1, 140-169. |
| E.E.C. | | Edinburgh Evening Courant |
| Ffoulkes, C. | 1945 | Arms and Armament. |
| Frazer, A.S. | 1824 | Memorandum on the Recoil of Naval Ordnance. |
| Gibbs, K. | 1982 | 1982 'The Carronade', Guns, Weapons &
Militaria, Vol. 1, No 5. |
| Gibson, J.C. | 1908 | Lands and Lairds of Larbert and Dunipace
Parishes. |
| Gillespie, R. | 1868 | Round About Falkirk. |
| Heston, A. | 1906 | 'Patrick Miller, Dalswinton, Inventor,
agriculturalist and patriot,' The Gallovidian, 31 Vol
8 (Autumn 1906). |
| Lavery, B. | 1987 | The Arming and Fitting of English Ships of War
1600-1815. |
| Lefroy Papers | | Royal Artillery Library, Woolwich.. |
| Metcalfe, M.H. | unpublished | 'Carron Company as ordnance manufacturers'. |
| Munday, J. | 1987 | Naval Cannon. Shire Album 186. |
| Nimmo, R. | 1777 | A General History of Stirlingshire |
| Rees | 1819 | Rees' Cyclopaedia or Universal Dictionary of Arts,
Sciences, etc. Vol. 4 – article on cannon. |
| Secretary | 1917 | 'A biographical sketch of General Robert Melville
of Strathkinnes', Scottish Historical review. |
| Saint-Fond, F. | 1799 | Travels in England, Scotland, and the Hebrides |
| Watters, B. | 2010 | Carron. Where Iron Flows Like Water. |