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Identification of the Parameters of Naval Artillery

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This book deals with the problems of reconstructing ballistic performance, based on eclectic source material. Included are some concrete examples of the identification of the parameters of naval artillery. Also included is a database of naval artillery from the Ironclad Era through World War 2.

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CAVALLI, WAHRENDORFF AND THE MAKING OF KRUPP

The decade of the 1860s was a period of technical transition in naval warfare. Wood was giving way to iron for shipbuilding and armor protection. Smooth bore guns were giving way to rifles, both muzzle- and breech-loading. And the leading gun makers were graduating from cast iron to steel barrels. And the firm of W.G. Armstrong in Britain was rapidly rising to prominence in the field. But there is another story; the story of two obscure inventors and an obscure Prussian company known as Krupp. This paper seeks to explore this other story, and shed some light on the beginnings of Krupp's rise to prominence.

1860-е годы стали периодом технической революции в военно-морском деле. Дерево уступило место железу, как в судостроении, так и в защите; гладкоствольные орудия – нарезным, как дульнозарядным, так и казнозарядным. А ведущие производители орудий начали выпуск стволов из чугуна и стали. Британская фирма WG Armstrong в этот период быстро пошла в гору и вскоре заняла видное место в этой области. Но есть и другая история, оставшаяся в тени исследователей. Это история двух непонятных изобретателей и не получившей тогда широкой известности компания Круппа из Пруссии. Эта статья направлена на изучение этой малоизвестной страницы, чтобы выявить роль Круппа и поставить его на видное место в истории этой эпохи.

The 1850s and 1860s were a time of transition in the development of artillery, characterized by the work of several individuals of extraordinary insight and determination. In Britain, the pioneering work of W. G. Armstrong produced an array of breech loading guns in numerous calibers, suitable for the field artillery, the siege train and fortresses, and even the Royal Navy. Whitworth made advances in the production of steel for gun making, though his designs did not have the acceptance of Armstrong's. Blakely designed muzzle loading rifles of great quality, with the same variety of applications as the Armstrong guns had, though not with the same wide acceptance. In the United States, Dahlgren and Rodman brought the smooth bore muzzle loader to its ultimate state of development. Parrott and Brooke produced rifled muzzle loaders of good performance.

There is, however, another line of development that has been virtually ignored. Almost all British and American historians mention the pioneering work of Cavalli and Wahrendorff, if they are mentioned at all, either as talented experimenters whose work led nowhere, or with degrees of inaccuracy that obscure their contributions[1]. And Krupp is mentioned as if its designs and products appeared fully developed and perfect, with a time distortion that condenses the fifty years prior to 1914 with passing comment. Yet much is made of how Armstrong grew and expanded as a successful commercial enterprise, in spite of the virtual boycott by the British armed services.

To be direct, there is another story in the development of modern artillery, one whose revelation is long overdue. It is sincerely hoped that this small effort will

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[1] See Hogg and Bachelor, Naval Gun, p. 67 for the perfect example in point. Some of the description of the Cavalli gun is correct. Nothing mentioned of Wahrendorff is.

encourage other more knowledgeable historians to fill in the gaps and correct any errors.

I. Cavalli

Giovanni Cavalli was a Sardinian artillery officer of considerable talent and reputation. He had a successful career in the service of Piedmont-Sardinia and later of Italy, demonstrating considerable influence and foresight. In 1845, then Major Cavalli was involved with experimental firing against armored targets at Turin. In 1856, following the Crimean War, he advocated the construction of armored floating batteries of 1500 Tons, and larger ironclad warships of 1600 Tons and 24 guns or 2400 Tons and 36 guns, all with iron hulls and inclined armor, and fitted with rams. His case was sufficiently persuasive that they influenced Cavour to adopt such ships for the new Italian Navy.

He realized, as did many others, and perhaps as a result of the 1845 firings at armored targets, that the greater weight and explosive content of cylindrical conical shells would be advantageous for nearly all artillery applications. Yet the smooth bore guns of the time were hardly an effective delivery system, as the projectiles tended to tumble in flight, and the necessary windage combined with the greater projectile weight reduced gun performance.

What was needed was a system of rifling that would impart spin to the shells, thus restoring accuracy. So he examined the promising work of a Bavarian captain of artillery named M. Reichenbach. This talented officer experimented with a muzzle loading bronze rifled gun in 1816. By cutting seven grooves into the bore, he successfully fired conical projectiles, though deviation (deflection) in the trajectory was very great at first, but by reducing the angle of the rifling, the results were quite remarkable. But the work was curtailed in the face of lack of interest in military development so soon after the fall of Napoleon[2].

In 1845, three experimental cannon were manufactured by the West Point Foundry, at the behest of the British government. They were highly unusual for the time, in that they were breech loading rifles. Hence, the detailed descriptions deserve to be quoted at length: "*The chase of this gun does not differ essentially from the usual form of cannon; but at the breech the piece, instead of being round, has the four sides planed off so as to present from the rear an appearance of a square with the corners rounded off. It is bored throughout its length, and rifled with two flat grooves with rounded edges. The rear of the chamber is enlarged, and these grooves being continued through it, although shallower than in the chase, are deep enough to receive the wings or projections on the shop and hold it up till it reaches its seat in the gun.*

Crossing the bore at right angles, with its front face perpendicular to the axis of the piece, a wedge-shaped opening with a rectangular cross-section is cut. It is

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[2] "Breech Loading Rifled Artillery," in www.globalsecurity.org/ military, and Baxter, The Introduction of the Ironclad Warship, pp. 56, 90, 91 and 198. For a very interesting discussion regarding a connection between Cavalli and the CSS *Virginia,* see Greene and Massignani, Ironclads at War.

for a 32-pdr. 24cm deep, 13,7cm wide at the large end, and 9,4cm at the small. This opening receives the quoin or wedge destined to close the breech in rear of the charge. The wedge is made of hardened iron or steel, and of the same shape as the part of the opening which it is to fit. The wedge shape enables the bottom of the bore to be more perfectly closed, and prevents the escape of gas, whilst it also enables the breech-piece to be more easily moved after firing. The front face of the breech-piece is perpendicular to the axis of the piece, whilst the rear face makes with it an angle whose tangent is 18th [sic.1/8th], the co-efficient of friction of the hardened iron wedge against the cast iron of the piece. By means of this disposition and keeping the surfaces in contact well greased or moistened according as required, the breech-piece is found after firing to be more or less moved, at the same time that there is no danger of its being pushed too far or thrown out of place.

The breech-piece is provided with two handles, which serve to handle it in pushing in and withdrawing it from its position. The large handle placed on the right, is of such a size that, when the breech is open and ready for the charge, the projectile can be passed through it, the lower part of the handle part of the handle supporting the projectile, and guiding it through the breech opening into the chamber. To the large handle is attached a small chain and hook, the latter fitting into an eye screwed into the top of the opening on the right. This chain, when the breech is being opened, arrests the quoin when the opening in the large handle comes opposite the bore. When the charge is introduced, the cannoneer on the left pushes, and the one on the right pulls each by his handle, and the quoin comes back to the proper position for firing. In case any forcing is necessary, either for this or to move it after the piece is fired, a mortise is formed in the rear face of the quoin to receive the square end of a large iron handspike. It is not generally found necessary to use this lever except for the last-named purpose. In order to diminish the adhesion of the parts, three points are placed under the lower face of the quoin, which keep the quoin at the proper height in the cut.

To cut off the escape of gas, a ring of hammered copper is used, similar to the one in Armstrong's gun. The cross-section of this ring is about one inch square. A recess for it is cut out of the gun at the rear part of the bore, the inner diameter of it being greater than the outer one, in order to retain it in position. The ring projects about 6,4mm behind the bore, and is pressed against by the quoin when in position. The interior diameter is the same as that of the chamber, and corresponding recesses are cut in it to allow the passage of the shot-flanges."[3]

Speaking of the same guns, General Sir Howard Douglas gives an even more contemporaneous description: *"…In these guns the mechanical contrivances for securing the breech are very superior to the rude process of earlier times… The length of the Cavalli gun is 2,7 meters; it weighs 2,994 tones, and its caliber is 16,5 cm. Two grooves are cut spirally along the bore, each of them making about half a turn in the length, which is 2,057 meters. The chamber, which is cylindrical, is 30cm long and 18cm diameter…*

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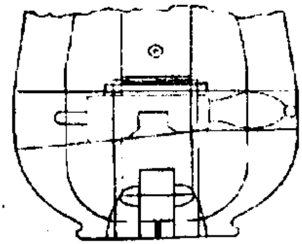
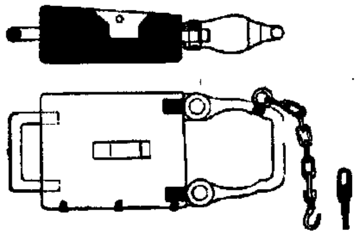
[3] See "Chapter IV. Rifles" in Gibbon's Artillery Manual, in www. usregulars. com/ gibbons. Note that this gun pre-dates Armstrong by several years.

Immediately behind the chamber there is a rectangular perforation in a horizontal direction and perpendicular to the axis of the bore; its breadth vertically is 24cm, while horizontally, it is 13,3cm on the left side and 9,6cm on the right side. This perforation is to receive a wrought-iron case-hardened quoin or wedge which, when in its place, covers the extremity of the chamber which is nearest the breech. The projectile…being introduced through the breech and chamber into the bore of the gun, and the cartridge placed behind it, a culot or false breech of cast iron is made to enter 6,35cm into the bottom of the chamber behind the cartridge; and a copper ring, which also enters the chamber, is placed over it. The iron wedge is then drawn towards the right hand till it completely covers the chamber. After being fired, the gun can be reloaded without entirely taking out the wedge; for the latter, which is shorter than the rectangular cavity in which it moves, can be withdrawn far enough to allow the new load to be introduced."[4]



Cavalli's Breech Mechanism



Wedge of Cavalli Breech

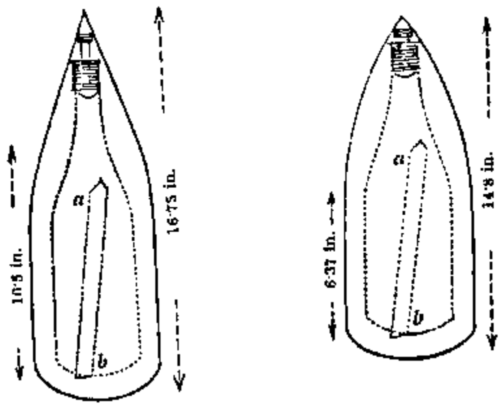
The projectiles were especially interesting. As described by General Douglas, *"…the first [see below] is designated cylindro-conical, and the other cylindro-conoidal; their entire lengths are 425mm and 375mm, respectively, and their greatest diameter is 16,5cm: each has two projections, a b, directly opposite t one another, and 6,35mm deep, which enter the grooves in the rifled bore. (These projections make an angle of 7 deg 8 min with the axis of the shot.) Each shot, if hollow, weighs about 31,3 kilos.; and if solid, about 46 kilos…*"[5] The ballistic shape of these projectiles is quite good, especially for that time! The blunter shape corresponds well with the more familiar 2 crh of the late 19th and early 20th centuries, while the longer resembles the 4 crh projectiles of the dreadnought era. The rounded base, however, would contribute to instability in flight.

In 1846, Cavalli was sent to Akers, Sweden, to oversee the production of some cannon being manufactured there for the Sardinia. This gave him an opportunity to meet and compare information with Baron Martin von Wahrendorff, the owner of the foundry and also an artillery designer of some repute. The Baron had been producing breech loading smooth bore guns since 1841.

A comparative trial was arranged for September of that year. The Cavalli gun produced interesting results, summarized in the Table below.

[4] General Sir Howard Douglas. A Treatise on Naval Gunnery – 1855. London: John Murray, 1855. pp. 213-14.

[5] Ibid., pp. 150-51.



Common Shells used by Cavalli

Table 1.

Shell, kg	Charge, kg	Elevation	Muzzle velocity, m/sec	Range, m	Drift, m
31,3	3	14.75°	272	3044	77,7
31,3	4	13.00°	313	3354	91,4
46,0	3	14.50°	230	2370	25,6
31,7	4	13.00°	315	3491	90,5

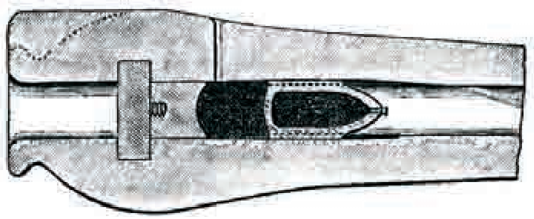
The first two shots were using the nominal 2 crh shell, filled with black powder. The third was the same shell, but filled with lead, and the fourth was the nominal 4 crh shell, filled with black powder. The amount of drift/deflection in the trajectory was considered excessive, and the muzzle velocities were quite low.

Unfortunately, the gun was disabled after the fourth shot, when the breech blew off, a problem Cavalli attributed to weakness of the cast iron.

Another of the three guns was tested at Shoebury Ness, in 1850. The results were very much the same as previously at Akers. Comments were that the deviations (deflection/drift) “were so variable in amount that no allowance could be made for them in laying the gun with respect to the” target[6]. A modern artillery expert, Edward Rudnicki, believes the excessive drift was the result of two factors: first, “The erratic nature of the drift with the splined shells could be a result of the projectile's balloting as it traveled down the tube, as two splines would not be enough to properly center and support the projectile,” and second, that the rifling, one turn in 25 calibers, was excessive, as “…spin is a factor in Magnus Effect and thus drift. An excessive spin rate will over stabilize the projectile; as a result it will more greatly resist aerodynamic forces tending to cause it to nose over, with much resultant Magnus drift.”[7]

[6] Ibid., pp. 217-18. M V from Table 1 are calculated values working from the known data, using exterior ballistics software written by W. J. Jurens.

[7] Letter to the author, dated January 11, 2007.



Representation of the Cavalli breech loading system.
(Holley, A Treatise on Naval Gunnery)

The last of the three guns was tested at Turin in 1854. But in the interim between the embarrassing failures at Akers and Shoebury Ness, Cavalli had made some changes. We know that during subsequent work in Belgium, he cut the splines to form two "buttons," which he found to be strong enough under the pressures of firing. From the data given in Table 2 below, it would also appear that he adjusted the pitch of the rifling, to avoid the over stabilization and drift demonstrated in the previous tests[8].

The third gun, modified and firing a modified shell, was tested in 1854 in Turin. Unlike the previous tests, only one charge weight was used, 2,3 kilos, and only the long nosed shell was fired. The weight was reduced to about 31 kilos with the conversion of the two splines into four "buttons."

Table 2.

Shell, kg	Charge, kg	Elevation	Muzzle velocity, m/sec	Range, m	Drift, m
31	2,3	10°	305	2805	2,80
31	2,3	15°	305	3784	3,20
31	2,3	20°	305	4510	3,75
31	2,3	25°	305	5103	4,75

A new 8-pdr gun tested at the same time was reported to have performed quite well, achieving a range of 2423 meters at 25-deg elevation[9].

Following the unsuccessful trials at Shoebury Ness, the Belgians became interested in Cavalli's work. They had an 18-pdr cast, with Cavalli's breech mechanism, but some modifications to the rifling. The two grooves were rounded with a width of 5,2cm and a depth of 3,2cm. The two splines were replaced with two rounded buttons of virtually identical width, but allowing windage of 2mm. But the shot moved freely in the bore, and so did not produce good results. A Captain Gillion of the Belgian artillery suggested that a pair of buttons/studs for each groove of the rifling would produce better results[10].

With the successful trials in Turin, Col. Cavalli passes into history. His enduring legacy, however, is the wedge form of breech mechanism, which will appear again in this story.

[8] Gibbon's, op.cit.
[9] Engels, "On Rifled Cannon," New York Daily Tribune. April 7, 1860.
[10] Gibbon's, op.cit.

One brief sideline remains to be examined. As Cavalli had used a form of "shunt" rifling first invented by Col. Treuille de Beaulieu, the highly capable French artillerist, in 1842, an examination of French developments is in order.

While the trials in Akers and Shoebury Ness were not completely successful, they did spur the French to begin serious development at the Arsenal at Vincennes, in 1851. De Beaulieu used a 22 cm gun re-bored to a 30-pdr. The first experiment was much the same as the Belgian gun already mentioned, or perhaps worse, save that they were testing a Muzzle Loading Rifle. Using the single stud/button allowed considerable "play" of the shell within the bore. Careful measurements demonstrated a variance of 1 deg 7 minutes in the angle of the shot leaving the muzzle[11].

The French quickly adopted the two studs suggested by Cap't. Gillion, and the first serviceable gun, the M1855, was quickly put into production. The gun tube would have been virtually the same as that of Cavalli, though a MLR. With a caliber of 16,5cm (30-pdr) it fired an oblong projectile weighing 26,4 kilos at a MV of 347 m/sec. Some of the first from the foundry were rushed to the Crimea, but arrived too late to see any service in that war. The gun did give good service in China and Cochin China (Indo-China), and were very effective against the Austrians in the 1859 war.

Col. de Beaulieu, however regarded the M1855 as a starting point only. Development continued, altering the rifling system from two grooves to three, at a varying pitch, and the introduction of a "gas check" attached to the rear of the projectile. This design was tested successfully, and became the M1858/60 MLR, and comprised the original armament of *Gloire*. Modified versions of this gun were also used to arm the first Italian ironclads, but that is beyond the scope of this tale.

With the M1858/60 in production, de Beaulieu turned his attention to developing a breech loader, and began experimenting in 1859. He took the M1858/60 as a starting point, but rejected the Cavalli wedge and the vent piece used by Armstrong. He finally settled on the interrupted screw, which had been patented in the United States in 1853 by John P. Schenkl and Adolph S. Saroni. Test firing was successful, and the design entered production as the M1860.

Performance of both the M1858/60 and the M1860 was the same. With the same 69 lb. projectile, MV was 317 m/sec. and a range of 6438 meters was achieved at an elevation of 40 deg. Deviation for range was 107,9 meters, and drift was 14,9 meters[12].

II. Wahrendorff

Baron Martin von Wahrendorff (1789 – 1861) was without a doubt one of the most talented gun designers of the 19th century. He inherited the Akers *styckebruk* [foundry] and became one of its chief designers. He also sought to market the guns made from the high quality and plentiful iron ore available in his native Sweden.

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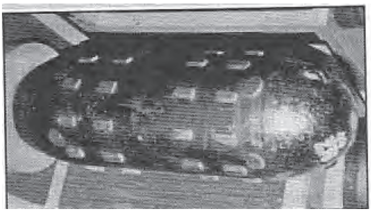
[11] Ibid. And "Ordnance," Classic Encyclopedia. And Spencer Tucker, Arming the Fleet, p. 226.

[12] "Ordance," op. cit. and Gibbon's, op.cit. and Whipple, "The Progress in Naval Artillery From 1855 to 1880." Ordnance Notes, -- No. 203, Washington, June 19, 1882. And Baxter, op.cit. p. 209.

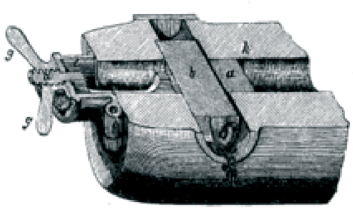
Certainly Akers could and did manufacture the standard smooth bore muzzle loaders of the day. In 1836, they manufactured thirty 30-pdr M/35 guns for foreign sale. And in 1844 they completed forty similar but lighter versions of the same gun for the Swedish Navy[13].

The Baron, however, felt that such guns, and the standard carriage that was used to mount them, were really inefficient for the tasks, and wasted space in circumstances where space was at a premium. This included both on board ship, and in fortress casemates. In short, he saw breech loading as the solution[14].

In 1837, Baron Wahrendorff obtained a patent for the design of his breech mechanism. General Sir Howard Douglas provides a description of the 30-pdr (6.37 inch) used for the Akers test in 1846, which deserves to be quoted at length:



Studded projectile with gas check from Shirokorad's Encyclopedia of Russian Artillery



As depicted in "Baron Martin von Wahrendorff"

"A rectangular wedge, 31cm long, 20,5cm broad, and 10,8cm thick, is made to slide, towards the right or left hand, in a perforation, formed transversely through the breech, for the purpose of covering, after the gun is loaded, the aperture by which the charge is admitted into the bore. A notch 18,3cm long and 1,8cm broad is made longitudinally in the wedge, and through this passes the stem, or bar, of a cylindrical plug, by which the charge is kept in its place [a]. This plug is 18,8cm diameter and 12cm long, and it is provided with a stem or bar, 40cm long, at the extremity of which is a screw nut having two handles [g]. The plug is introduced in a direction parallel to the axis of the gun, through an orifice in the breech; and its stem passes through a perforation made in an iron door which closes the orifice. When the gun is loaded the door is closed; the plug is pushed forward, to the rear of the charge, by means of its stem. [Then cylinder 'b' is inserted behind the plug, as the main source of strength to withstand the force of the propellant explosion] And the wedge is made to slide into its place: a turn of the screw nut at the end of the stem is then taken, when the whole is drawn tightly together and is ready for firing."[15]

The first gun, a 12-pdr (about 12 cm) was cast in 1840. It was an unchambered smooth bore, which was dubbed the m/41 after testing and adjustments.

[13] Lars Ahlberg. Documents e-mailed to the author on November 6 and 7, 2006. And "Breech-loaded Guns…used by the Swedish Armed Forces," www.tfd.chalmers.se.

[14] Herbert Jager, German Artillery of World War One, p. 7.

[15] Douglas, op.cit., p. 216. and Ahlberg, op.cit.

It was submitted for trials at Vaxholm the next year. Further trials were conducted in 1845 aboard the ship-of-the-line *Manligheten.*

These trials were not entirely satisfactory, and development continued[16].

The projectile used was the normal solid ball or hollow shell, all spherical. However, to avoid the problem of windage, Wahrendorff coated his projectiles with lead, which provided the seal. The effect was to increase the weight of the projectile on the one hand, and to take full advantage of the propellant gasses on the other[17]. Regrettably, no performance data is to hand for these breech loading smooth bores. But it seems reasonable to conclude that it would have been approximately equal to that of the usual smooth bore muzzle loaders of the time.

Even while the development of his smooth bore guns continued, the Baron began experimenting with a rifled gun tube. He did not, however, adopt the 'shunt' system of rifling that de Beaulieu had invented the previous year. Rather, he used the polygroove form first used by Reichenbach back in 1816, and used successfully in rifled muskets and small arms. But he retained the lead coated shot, as the coating would adhere to the rifle grooves and center the shot in the bore, while retaining the seal.

As already mentioned, Major Cavalli arrived at Akers in 1846, to oversee the manufacture of some smooth bore guns for the Sardinian government. The meeting of two such talented and creative men was bound to produce many exchanges of ideas and lively discussions. In the absence of comments concerning any hostility between them, we can only assume their interaction was congenial. General Douglas hints at this by noting that the trials in that September were "experiments for the purpose of testing the merits of their shot…"[18]

Cavalli seems to have convinced the Baron of the merits of conical projectiles, and even to test the same rifling scheme. Wahrendorff had a 30-pdr prepared with the tube rifled according to Cavalli's specifications, and had some projectiles made for it, using the same splines to grip the grooves. General Douglas comments that the performance of the Wahrendorff guns was virtually identical to that of the Cavalli guns. But this is only to be expected, for by duplicating the conceptual flaws, he also duplicated the less than successful results.

However, the Baron also lad some lead coated conical projectiles made for his poly-groove rifling. Douglas notes that fact, but without detailed comment. He merely states that, "It must be admitted that the Wahrendorff gun has considerable advantage, in respect to range, over the English 32-pounder at a high elevation…[and] stood well, the wedge [sic] resisting more effectually the force of the discharge than that of the Cavalli gun."[19]

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[16] Ibid., p. 212. and Jager, op.cit., p. 7.

[17] "Ordnance," op. cit. And "Breech Loading Rifled Artillery," op. cit.

[18] Douglas, op.cit., p. 150.

[19] Ibid., pp. 218 & 219. Douglas means the 'cylinder' rather than a 'wedge.' This is also confirmation that the breech of the Cavalli gun failed, as he comments further that, "*If the latter, when it failed, had been on board a ship, the breech would have passed through, or have made a prodigious fracture in the opposite side; and consequently, besides the physical injury, it must have produced the worst moral effect on the crew.*"

Wahrendorff Breech Loading Smooth Bore M. 1855 (compliments of Lars Ahlberg)

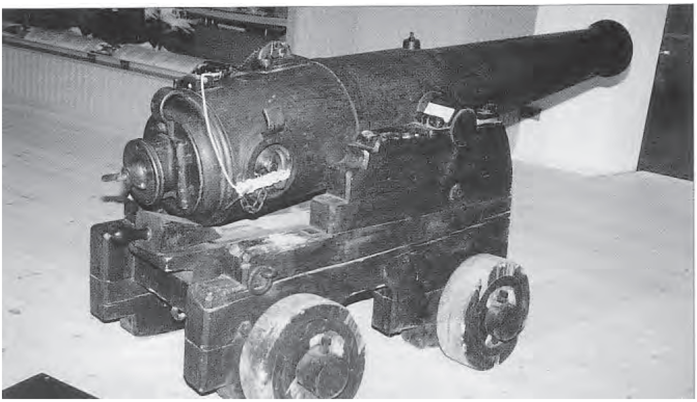


Photo of m/41 gun from Hans Mehl's Naval Guns, manufactured in 1845. Note the naval truck carriage.

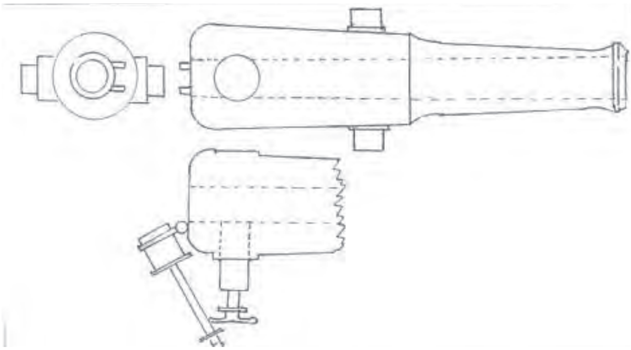


Diagram courtesy of Lars Ahlberg. Note the lack of a chamber.

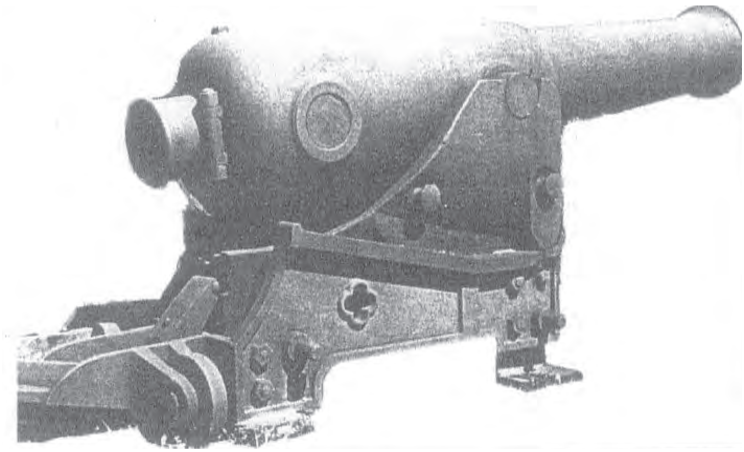
Douglas continues, probably more contemporaneously with the publication of his manuscript, and referring to the m/54, that: "*Baron Wahrendorff has invented a 24-pounder gun, which is also to be loaded at the breech. It is mounted on a cast-iron traversing carriage; and, taking little room, it appears to be very fit for casemates. The upper part of the carriage has, on each side, the form of an inclined plane, which rises towards the breech, and terminates near either extremity in a curve whose concavity is upwards. Previously to the gun being fired the trunnions rest near the lower extremity; and on the discharge taking place, the gun recoils on the trunnions, along the ascending plane, when its motion is presently stopped. After the recoil, the gun descends on the plane to its former position, where it rests after a few short vibrations. The axis of the gun constantly retains a parallel position, so that the pointing does not require readjustment after each round…The gun was worked easily by eight men, apparently without any strain on the carriage. With a charge of 3,63 kilos and with solid shot, the recoil was about one meter,* *and the trunnions did not reach the upper extremity of the inclined plane, though the surface was greased.*”[20]

Trials In 1848, perhaps with the 12-pdr type in the photo above, and the sales of all types of Wahrendorff guns followed. Complete data is not available at this time, but below is listed what is known:

1845: part of an order given to Finspong for 108 82-pdrs standard smooth bores caliber 226.2mm (c. 8.9”). The entire order was manufactured in three installments: 1843 by Finspong, 1845 by Akers, and 1853-55 by Finspong. Thirty of these guns were aboard the Swedish warships *Stockholm, Skandinavien*, and *Forsiktigheten*.

1844 – 53: Nineteen 60-pdr m/44 for foreign sale.

1852: An unknown number of 24-pdr m/52 (155mm) were manufactured for the Coast Defence, These guns had a bore length of 11 calibers.



Courtesy of Lars Ahlberg. Note the carriage.

1853: Seventy 30-pdr m/53 mounted aboard the Swedish warships *Forsiktigheten* (22), *Stockholm* (22) and *Skandinavien* (22). Some of this order was manufactured by Finspong in 1853, and Stafsjo in 1856.

1853: It appears that a lighter version of the m/53 30-pdr was also manufactured, all by Akers. They were mounted on the Swedish warships *Norrkoping* (18) and *Stockholm* (20).

1854: Two versions of the m/54 82-pdr were manufactured for Coast Defence. While the number is not known, the lighter version had a bore length of 9.5 calibers, and the heavier 11 calibers[21].

Information on the sale of Wahrendorff rifled guns is even less precise, and perhaps even controversial. For example, one of the Swedish documents states that

[20] Ibid., p. 219.

[21] Ahlberg, op.cit. And “Breech-loaded Guns…” op.cit.

no Wahrendorff guns were in Swedish service, while the documents from which the above list was taken disproves that in detail. Yet no reference is made in them to any of the Wahrendorff rifled guns being in Swedish service. Indeed, the entry for the 16.7cm m/69 (30-pdr) gun manufactured by Finspong specifically states that it was mounted on the screw frigate *Vanadis*, which was launched in 1862. Other sources, however, including Conway's, note that she carried eight 6.6" BL guns as part of her armament. So either we must believe that the ship sat idle for seven years, or the guns were Wahrendorff BLs. Whether rifled or smooth bore is difficult to say, but the timing argues in favor of rifled guns[22].

Foreign sales are difficult to determine and quantify. But below is a list of what is known and suspected:

1843: The Prussian Army bought three of the smooth bore breech loaders for tests: 6-, 12-, and 24-pdrs.

1851: The Prussian Army bought a 12-pdr (12cm) BLR for tests. Over the next two years, guns of several other calibers were purchased for additional trials. And in 1854, the APK (*ArtilleriePrufungsKommission*) of the Prussian Army actually recommended that the 12-pdr be adopted[23].

Austria-Hungary purchased Wahrendorff guns in large quantities. At the Battle of Heligoland in 1864, the frigate *Schwarzenberg* carried 6 smooth bore 60-pdrs, 40 smooth bore 30-pdrs, and 4 rifled 24-pdr BLs, while *Radetzky* mounted 4, 24 and 3 respectively. The rifled 24-pdrs were definitely Wahrendorff guns, m/61. How many of the smooth bores were also is a question.

But the most famous use occurred two years later, at the Battle of Lissa. The Austrian fleet mounted at least 115 Wahrendorff 24-pdr (15cm) BLRs. There is also reference to a number of rifled 48-pdrs taken from fortresses to arm the *Ferdinand Max* and *Habsburg*. From the after action reports, the breech loaders fired faster and more accurately than the Italian rifled muzzle loaders.

In addition, guns were exported to Bavaria, Brazil, Egypt, Britain, France, The Netherlands, Norway, Portugal, Spain, The Ottoman Empire, and the USA. The Danes also purchased a number of 4-pdrs (8.33cm) as both field guns and light guns for naval use. The barrel was 20 calibers, and fired a 4,7 kilo Common Shell with a 0,2 kilo black powder bursting charge, as a muzzle velocity of 370 m/sec[24].

1859: Russia ordered twenty 30-pdr BLs, which were delivered in 1862. However, these were 'blanks' so they could experiment with various systems of rifling. In one barrel, they tried the Armstrong system of small grooves and lead coated projectiles, but the shells broke up in the barrel and accuracy was bad. In another the shunt type developed by de Beaulieu, and in the third the "Prussian" [Krupp] system. All were tried at Volkov in September, and the decision was made to rifle all using the Prussian system. This work was done at the St. Petersburg Ar-

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[22] Ahlberg, op.cit. And Gardiner, Conway's All the World's Fishting Ships, 1860 – 1905, p. 362.

[23] Jager, op.cit., pp. 7 & 9.

[24] Conway's, op.cit., pp. 267 – 276. And Jack Greene and Alessandro Massignani, Ironclads at War, Conshohocken: Combined Publishing, 1998., pp. 196 – 241and p. 254. And Lars Ahlberg, e-mail dated December 20, 2006. And Brassey, The Naval Annual, 1886, p. 386.

senal. Then the guns were used in the fortresses of Kronstadt and around St. Petersburg. This rifling system was considered as the forerunners/prototype for their M1867 family of guns[25].

1858: The Prussian Navy ordered ninety guns for the *Gefion*, *Arcona* and *Gazelle*[26]. These were probably rifled breech loaders.

The Wahrendorff rifled breech loaders were very successful, and well designed, the larger calibers being chambered. The overall length of the 24-pdr was 21 calibers, and the bore was 18.4 calibers. The Russian 30-pdrs were proportionately the same. The rifling was also very gentle, at the rate of one turn in 63.2 calibers.

There is little information on the performance of these guns. The Table below gives the information for the Austrian and Russian guns, and it may be assumed that the guns in other navies would be similar.

Table 3.

Gun	Shell, kg	Charge, kg	Elevation	Muzzle velocity, m/sec	Range, m
24-pdr	27,7	2,15	14	310	3068
30-pdr	36,6	2,75	24	292	4867

For the 24-pdr, the data applies to the lighter Common explosive shell. A heavier armor piercing shell was available, as were so-called ‘battering’ charges. For the 30-pdr, the data applies to the armor piercing shell but with the ‘light’ charge. Common explosive shell was available[27].

When Martin von Wahrendorff died on January 20, 1861, the Akers *styckrbruk* was taken over by A. von Stockenstrom and M.L. Berg, his illegitimate son. Gun production ceased in 1866, though the foundry continued to manufacture projectiles for some years. But the Baron had made several significant contributions to the field of artillery. He developed a workable breech mechanism, and an advanced traversing carriage. He proved the superiority of poly-groove rifling, and his lead coated projectiles demonstrated the importance of a good gas seal. Guns of his design and manufacture participated effectively in two naval battles. In short, he left a legacy of innovation and scientific development[28].

But his greatest and lasting contribution occurred in 1859, when his latest models were tried by the Prussian War Ministry, and the design was selected for production! For the Prussians, however, the main question was of what material should the new guns be made: bronze, cast iron, or the very expensive cast steel[29]. And therein lies the rub…

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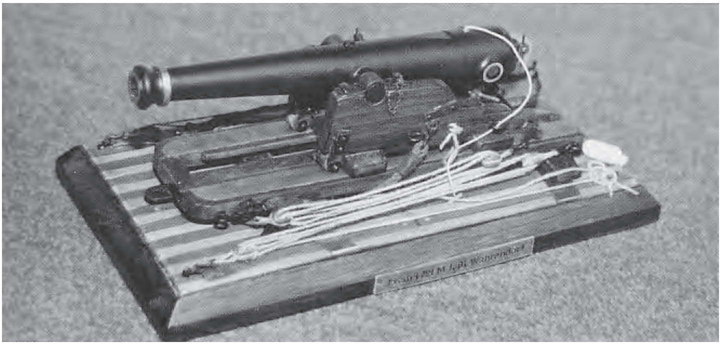
[25] A. Shirokorad, Encyclopedia [of] Fatherland [Russian] Artillery. [Russian language] Minsk: Karvest, 2000, pp. 258-260.

[26] Lawrence Sondhaus, Preparing for *Weltpolitik*, Annapolis: Naval Institute Press, 1997, p. 59.

[27] Shirokorad, op.cit. pp. 259-260. And Hans Mehl, Naval Guns, op. cit. p. 47.And Thomas Allnutt Brassey, The Naval Annual, 1886. Portsmouth: J. Griffin and Co.: 1886, p. 386.

[28] “Baron Martin von Wahrendorff,” op.cit.

[29] Jager, op.cit. p. 9. Jager says 6-pdr, but the C/64 and Krupp’s own system referred to guns as 4-pdrs, and the corresponding gun in Russian service, based on a Krupp design, is also a



Model of the 24-pdr from Hans Mehl's Naval Guns.

III. Krupp

At the beginning of 1859, Alfred Krupp was not a happy man. Oh, his steel products were in great demand, for everything from railroads to fortresses to building material. But he had had almost no success in breaking into the lucrative market for artillery.

In 1841 the Krupp *Werke* had received some orders for 23cm and 28cm cannon for the Coast Defence. And they had participated in re-arming the Artillery with system C/42 smooth bore guns[30].

Sometime around 1845 the French Army had purchased a single cannon for tests, which were duly conducted at the Arsenal at Vincennes.

In 1855, the Khedive of Egypt purchased a number of guns. These were most likely the 30-pdr smooth bores that were still in use in 1882 in the fortifications at Alexandria[31].

But the Navy shunned his overtures. Their reasoning seems to have been that foreign sales bestowed a "legitimacy," or perhaps acceptability, to the gun maker, and Herr Krupp had few such sales and therefore little to recommend his product. So they purchased their ship borne artillery from foreign suppliers.

In June of 1853, the newly commissioned *Danzig* had its armament of twelve guns shipped in Britain. Two years later, the Swedish firm of Finspong received an order for 48 guns, to be fitted in *Thetis, Frauenlob,* and *Hela.* And as previously mentioned, Akers received an order for 90 guns in 1858. Even small rifled guns for the new warships were ordered from Spandau[32].

4-pdr, though the caliber identical. See E. Monthaye, Krupp and De Bange, p. 208, and Shirokorad, op.cit. NOTE: The 'pounder' system for denoting gun calibers was very imprecise. Bore sizes for a 30-pdr were 16.72cm, 16.66cm, 16.47cm 16.3cm and 16.18cm. The 24-pdr could be 15.53cm, 15.32cm, 15.24cm or 14.91cm. And 12-pdrs could be 12.19cm or 12cm. To some degree, nationality was a factor, but not necessarily.

[30] Baxter, op.cit. p. 259. And Jager, op.cit. p. 7.

[31] "Breech Loading Rifled Artillery," op.cit. And "History of Rifled Cannon," op.cit.

[32] Sondhaus, op.cit. pp. 53 & 73.

It would not be an understatement to claim that the decision facing the War Ministry following the trials of the Wahrendorff guns in 1859 was a “make or break” situation for Krupp. If the Ministry came down in favor of iron, then much of the work would go to Swedish foundries, probably Akers and Finspong. If they decided in favor of bronze, a traditional favorite of gunners, then Krupp would be unlikely to participate at all. Then the consequences could be a Krupp *Werke* on the fringes of the armaments industry, with the Prussian/German Army and Navy purchasing their artillery from foreign suppliers. So to understand the decision, it is first necessary to understand something of the materials involved.

Bronze suitable for cannon is composed of 90 parts copper and 10 parts tin. Increase the proportion of tin makes the bronze harder, but more brittle and hence liable to catastrophic failure. Decrease the proportion of tin, and the bronze is too soft for cannon, and loses some of its elasticity. But properly made, the Tensile Strength is about 45,500 pounds per square inch[33].

The French Army went to war in 1859 with bronze 4- and 12-pdr guns. But this was just an expediency, as their order to Krupp for steel castings could not be filled in time. When hostilities ended, the French Emperor ordered all of the bronze guns melted down and the metal sold; the proceeds to be used to buy cast steel[34].

As a material for cannon, bronze did have some critical disadvantages. It was subject to slight corrosion from general atmospheric causes, and more so from the gasses created by the burning of the black powder propellant. And the tin is liable to melt away at corners by the heat generated from rapid firing, in addition to that caused by the propellant. Being “soft” it is also liable to serious injury from the projectile bouncing around inside the bore; such impact also creating small corners[35].

The characteristics of iron were well known, given that wrought iron was state of the art. Good wrought iron had a Tensile Strength of about 60,000 pounds per squire inch, about twice that of cast gun-iron. Iron had been the preferred material for heavy cannon for 300 years, popular with the gunners and the Generals[36].

Steel was another matter entirely. There was a general suspicion on the part of gunners that it was likely to burst/fracture catastrophically and with no warning. Several steel guns had burst explosively during proof, causing causalities. This was because the margin between the elastic limit and rupture was very small.

The Tensile Strength of steel suitable for cannon is about 90,000 pounds per square inch. Bessemer, working at the Woolwich Arsenal, developed a process of hammering the steel to remove bubbles and imperfections, which would increase the Tensile Strength to about 145,000 pounds per square inch. But Friedrich Krupp believed that the Bessemer process was insufficient, and developed his own.

The Krupp guns were made of “crucible” steel. But the word “crucible” is not used in the original sense, but rather signifies that the ingredients are melted together in crucibles before being cast. The crucibles used were rather small, and each con-

[33] Col. J. C. Benton. Ordnance and Gunnery. Ordnance Department, 1867. p. 138.

[34] “History of Rifled Cannon,” op.cit. The author does not know if the order to Krupp was eventually filled, or if the French firm of Schneider was able to provide the steel castings.

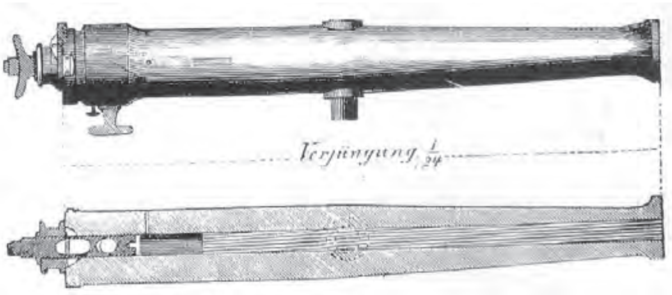
[35] Benton, op.cit. pp. 138-9.

[36] Ibid., p. 143.

tained a different recipe depending upon what portion of the gun was being poured; the material being tailored to give the most desirable characteristics for each portion. The goal was to create a large margin of safety between the elastic limit and the fracture limit. Early proof of his success was the trial at the Arsenal at Vincennes, when 3000 shot were fired from the smooth bore without degradation of the barrel. It has been claimed that Krupp steel had twice the strength of wrought-iron, without the bubbles or other imperfections that plagued other steels[37].

The APK had tested Krupp cast steel in 1855, so on their advice, the contracts were let to the Krupp *Werke*. It was also decided that the first priority should be the field artillery. Production commenced promptly, turning out guns of 6-, 12- and 24-pdrs (roughly 9, 12 and 15cm)[38].

But from this point, the story becomes rather convoluted, and is best broken down into separate lines of development.



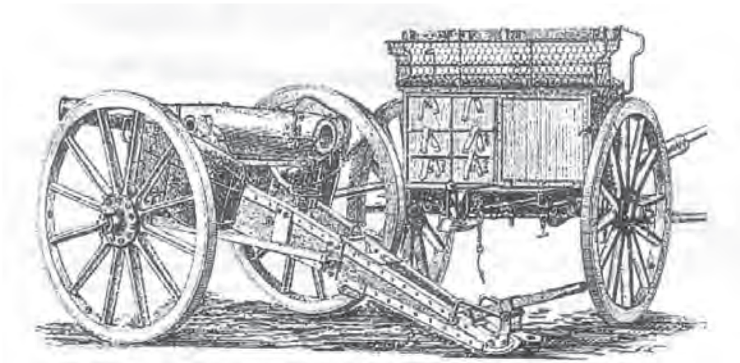
Prussian C/61

Austrian 12cm (12-pdr) Cannon M1861, shown with an old smooth bore 8-pdr.

C/61 Ammunition. Pictured are nose fuzed Common shell,
Schrapnel, Timed fuze explosive, and Case shot.

[37] Ibid., 142. And King, The War-Ships and Navies of the World, 1880. Annapolis: Naval Institute Press, 1982 edition, pp. 465-6. And Tucker, Arming the Fleet, Annapolis: Naval Institute Press, 1989, p. 239.

[38] Jager, op.cit., p. 9.



C/61 and M1861 with Ammunition Carriage

Prussian Artillery

The order for the first 100 steel blank tubes was signed by the Prinzregent, Wilhelm I, who personally increased the amount to 300 tubes. Krupp was to cast the tube according to specifications, and then ship the blanks to the Konigliche Geschutzfabrik, the Royal Arsenal, at Spandau, to be finished. From the point of view of the Prussian government, this arrangement made good financial sense. Steel was a very expensive commodity. Given that the Spandau Arsenal was already supported by the government, their work did not represent a great increase in expense beyond the monies paid to Krupp[39].

This arrangement presents an important distinction. While Krupp was responsible for the steel gun tube, Spandau was responsible for the breech mechanism. So as often happens when dealing with a government agency under mandate to save money, Spandau tinkered with the design. Most of the “improvements” over the original Wahrendorff design were harmless, but one deserves comment. Spandau replaced the brass obturator pad with one made from wood shavings! As wood tends to smolder, the seal weakened, allowing gases and soot to escape, to the dismay of the gunners[40].

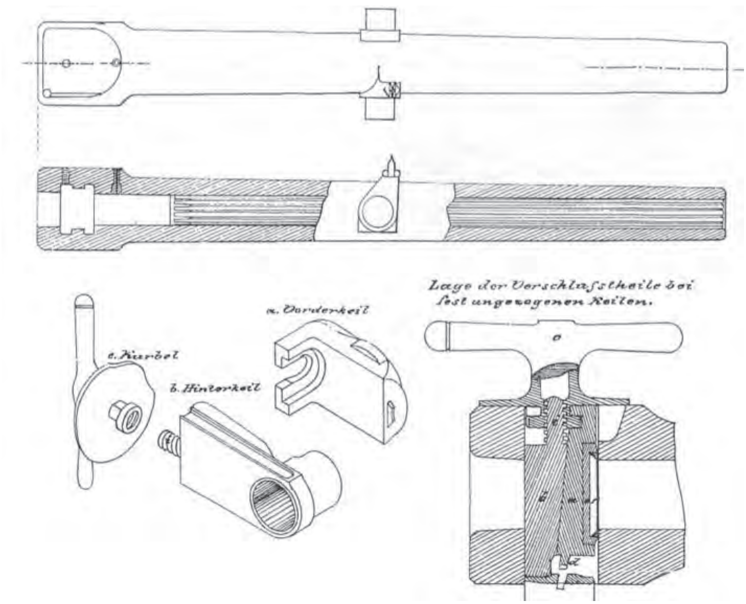
Complaints from the Artillery caused Spandau to provide an “improved” breech mechanism. Known as the Kreiner Breech after the designer, it proved an expensive failure! The resulting guns were known as the C/64.

Production of the C/61 and subsequent C/64 had been steady, but no doubt for financial reasons, at a moderate rate. Hence, fully one third of the artillery of the Prussian Army during the war against Austria in 1866 was the smooth bore C/42! These old short ranged guns were at the mercy of the more modern Austrian artillery, composed mostly of the M1861! But the performance of the C/64 was a repeat of the experience two years earlier during the Danish War!

Nathan Okun, perhaps the leading expert on the phenomenon of naval ferrous armor penetration, comments that “the two-piece design is somewhat weaker than

[39] Jager, op.cit. p. 11. And “Breech Loading Rifled Artillery,” op.cit.
[40] Jager, Ibid.

a single piece design…the reduction in strength is due to the inability of the two pieces to prevent each other from spreading **sideways** under the blast force near the crack between them, something that cannot happen in a single solid piece of steel. Thus, they can deform/crack separately in different directions, especially the front [inner] plate being hit directly by the powder blast, eventually resulting in the support from the back plate no longer being uniform or strong enough and the front plate will bend or break, allowing blast gasses to get around it and…making the gun unusable or…blowing the breech off.” The result was that over time the Kreiner wedge plates would bend, or the inner plate would break, under the stress of firing. Also, the square breech opening, without any taper or rounding, offered a convenient corner for the concentration of forces, resulting in cracks in the breech block which could lead to structural failure[41].



Kreiner Breech of the Prussian C/64

The reaction by the Prussian Ordnance Corps was to halt production of the C/64, and revert to the C/61. The existing C/64 guns were to be returned to Spandau, as convenient, to be repaired. These repairs amounted to drilling the square breech blocks, which they had forged onto the Krupp tube, for an insert suitable for the Wahrendorff cylinder and retainer pin; in other words, converting the C/64 into C/61. However, given the number of guns involved, the work was not completed in

[41] Jager, Ibid. And E. Monthaye, Krupp and De Bange, p. 208. And Geoffrey Wawro, The Austro-Prussian War, p. 220. Dr. Wawro errs in referring to the Prussian artillery as a whole as “outmoded.” Indeed, the Austrian M1861 and the Prussian C/61 were virtually identical, coming as they did from the same Wahrendorff design. Also, Nathan Okun, e-mail to the author, February 20, 2007.

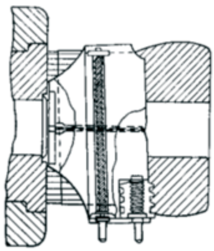
time for the French War of 1870, though at least the old C/42 guns had been recycled[42].

Krupp's Own Production

At about the same time that Krupp was given the first order for the field artillery blanks that became the C/61, the War Ministry also ordered 24-pdrs for the Coast Defence. But this was a low priority order, given that few suitable positions existed at the time. Great impetus was provided during the Danish War of 1864, when their ironclad *Rolf Krake* threatened to sail into Flensburg harbor. It took several 24-pdr C/61 guns from the siege train to drive her off[43].

The Navy also ordered 24-pdrs at about the same time. They had an immediate need to arm nineteen gunboats of the *Jager* and *Chamaleon* classes. Each carried one 24-pdr and two 12-pdrs of the C/61 type[44].

These two orders seem to be the last of the Wahrendorff C/61 design manufactured for Krupp's own customers. The Krupp engineers had carefully and completely examined the strengths and weaknesses of both the Cavalli wedge and the Wahrendorff cylinder, and reached some conclusions. Cavalli's wedge was a good starting point. When combined with a Broadwell ring, it provided good obturation, but lacked strength to resist the pressure of large propellant charges, only being supported by the structure of the gun tube around the periphery. What was needed was the additional strength provided by the Wahrendorff cylinder, but without the complexity of his system of obturation. By removing a portion of the cylinder to provide a flat face, and attaching that to the Cavalli Wedge, they retained the advantages of each component. The finished design resembled a rounded "D" and became known as the Krupp System., or cylindro-prismatic wedge[45].



Krupp wedge. Compare with C/72 in the Conclusion.

Available evidence indicates that the Krupp System was in place in 1860–61. The 4-pdr Field guns ordered by the Saxon Army were so constructed. So too were the guns sold to foreign countries.

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[42] Ibid.

[43] Ibid., p. 104. And Greene, Ironclads at War, p. 259.

[44] Greene, op.cit., p. 259. And Erich Groner, German Warships, 1815 – 1945, pp. 132 – 134.

[45] Brassey, The British Navy. P. 62. And "Ordnance," op.cit. And "Breech Loading Rifled Artillery," op.cit.

The orders from the Prussian government bestowed the “legitimacy” that Krupp has so long sought. As a result, foreign orders flowed into Essen, and Krupp’s reputation increased accordingly.

Russia became one of Krupp’s largest and best customers. Beginning in 1863, she ordered hundreds of guns and blanks of all sizes. The list below is a sample only:

1863 100 4-pdrs, 68 8-inch and 30 8-inch blanks, 24 9-inch blanks, and at least one 11-inch.

1865 250 9-pdrs.

1866 an undetermined number of 9-inch.

1867 4 11-inch.

1871 at least one 12-inch[46].

Austria also began purchasing heavy guns from Krupp. Their first order was placed in 1864 or 1865, for at least 28 8-inch (68-pdr) guns for the ironclads *Erzherzog Ferdinand Max* and *Habsburg*, then under construction. Delivery of these guns was delayed at the behest of the Prussian government as war approached. They were finally delivered, probably in 1867, and they were definitely on board the intended ships by 1869. But over the next eight years, Krupp supplied 12 9-inch (23.54cm) for the ironclad *Lissa*, 8 26cm for the ironclad *Custoza*, 8 24cm for the ironclad *Erzherzog Albrecht*, 10 9-inch (23.54cm) for the converted ironclad *Kaiser*, 6 28cm for the ironclad *Tegetthoff*, 30 15cm/26 for the frigates *Radetzky* and *Laudon*, and two 21cm for the sloop *Fasana*[47].

In around 1864, Spain purchased four 24-pdrs for the frigate *Gerona*, and around 1866, the Netherlands began purchasing 12-pdrs for the light guns on their ironclads. And for an element of mystery, the Egyptian frigate *Mehemet Ali* was armed with a mixture of twenty Krupp 12-pdr and ten Armstrong 40-pdr BLRs. These were virtually the same caliber (12cm and 12,1cm)! The Ottoman Empire purchased ten 24-pdrs and several 6-pdrs for their frigate *Selimieh*[48].

There are a series of minor mysteries involving foreign sales during the 1860s, mostly created by inaccurate primary information, and perhaps exacerbated by typographical errors. Below is a discussion of several samples.

In 1864, A. Hall of Aberdeen launched a small ironclad sloop in speculation of selling her to the Confederate States of America. She was purchased in 1869 by Prince Kumamoto and arrived at Nagasaki in January 1870. By the end of the year she had been presented to the Emperor as the *Ryujo*. But sources differ regarding her armament, and its origins. It appears that she mounted two 6.5-inch and ten 5.5-inch Breech Loaders. That the 6.5-inch guns are breech loaders limits the potential manufacturers to the French (16.5cm) or Krupp (16.7cm 30-pdr). And for the 5.5-inch, the field includes the French (13.9cm), Krupp (18-pdr, roughly

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[46] Monthaye, op.cit. p. 208. And Shirokorad, op.cit., pp. 161, 274, 287, 303, 392, 410, 420, & 424. The Russians experimented with the Kreiner Breech, an interrupted screw breech, and one other, but the vast majority of the M1867 guns were the Krupp cylindro-prismatic. The experiments were most likely using Russian produced guns.

[47] Sondhaus, The Habsburg Empire and the Sea. p. 243.And Gardiner, Conway’s 1860 – 1905, pp. 268 – 276.

[48] Conway’s 1860 – 1905, op.cit., pp. 372, 383, 392 and 416.

14cm), and Armstrong (70-pdr). We can probably eliminate the French from consideration for reasons of quality and policy; to wit, French manufacturers were not allowed foreign sales for fear of giving away their "secrets." This implies that the 6.5-inch gun came from Krupp. And by inference, the 5.5-inch were probably also from Krupp.

An unknown shipbuilder (or agent?) in London provided three ships that eventually became part of the Imperial Japanese Navy. One was the *Monshun,*launched in 1865 as the British steamer *Eugenie* but sold to the Hizen Clan in February 1868. Sources agree that she carried a 7-inch Forbes smooth bore, and that the second heavy gun was 5.5-inch caliber. But one source, Watts and Gordon, state that it was an Armstrong muzzle loader, while another that it was a Krupp breech loader. The latter seems more likely, given the information below.

Launched in 1867 as the British steamer *Hinda* but sold to the Choshu Clan, *Dai Ichi Teibo* was armed only in March 1869. She received two guns, the larger given variously as a 6-inch MLR, a 5.9-inch MLR, and a 5.9-inch BLR. There is agreement that the other gun was a 5.5-inch (18-pdr) Krupp BLR. It therefore seems likely that the larger gun was also a Krupp 24-pdr BLR.

The last ship, launched in 1866 as the British steamer *Assunta,* was also sold to the Choshu Clan and became the *Dai Ni Teibo.* She was armed with two guns of the same caliber, given variously as 6.7-inch Armstrong BLR, or as 6.5-inch Krupp BLR. While Armstrong surely could have produced such an "unusual" caliber gun as a 6.7-inch (17cm) gun, it seems quite unlikely. So it is more reasonable to believe that the guns were Krupp 30-pdrs.

J.S. White of Cowes built a wooden paddle frigate in 1863, nominally for China as the *Chiangtsu.* Curiously, the Chinese government refused to ratify the purchase. Given the timing, it is quite possible the ship was originally ordered by the Confederacy who then could not pay, or that she was built on speculation for sale to the Confederacy, potentially as a blockade runner. The ship was sold to the Prefect of Satsuma in 1867, and became part of the Imperial Navy in 1869, as *Kasuga.* Sources agree that she carried one 7-inch Forbes smooth bore muzzle loader and two 30-pdr smooth bore muzzle loaders. But there is no agreement about the other four heavy guns. One source states that they were 5.1-inch BLRs, and another 4.5-inch BLRs. Both are odd and unlikely calibers! It therefore seems more reasonable to infer that the original manuscript documentation was virtually unreadable. So if the "1" and "4" were actually another number, then it is possible, or even likely, that the guns in question were really 5.5-inch, which would be in line with the armament of *Monshun* noted above, and by inference, that J.S. White may also have build that ship.

The firm of Denny in Glasgow built a composite screw corvette under the name *Pampero* as a commerce raider for the Confederacy. She was acquired by Chile, but captured by the Spanish during their 1864-66 War, while on the passage from the builders. Re-named *Tornado* in Spanish service, her reported armament was one 20cm MLR, which was a Palliser conversion of their 20cm No. 1 modello smoothbore. Also listed are two 6.4-inch BL and two 4.7-inch MLR. At that time, only France and Krupp manufactured 30-pdr BLRs, and as mentioned above, the

French were not exporting their guns. So it is reasonable to infer that those two guns were from Krupp. The 4.7-inch were most likely Armstrong 40-pdrs.

Chile acquired a wooden screw frigate *Chacabuco* in 1866, from an unknown British source, which may have been built on speculation for sale to the Confederacy. Her reported armament was three 8.2-inch, two 70-pdrs, and four 40-pdrs, supposed all Armstrong BLRs. But the three big guns were not a standard Armstrong caliber (21cm), though it was a standard Krupp caliber. While it is possible that Armstrong could manufacture three non-standard guns to order, it is more likely they were purchased from Krupp.

And finally, there is the mystery of the *Fujijama*, also listed as the *Fuji*. Information about her is full of contradictions. She is listed as a wooden paddle frigate, though drawings do not show a paddle, unless it is internal, which is not mentioned. And at 1000 tons, she is really too small to be a frigate. Supposedly she was built in New York for the Union Navy between 1863 and 1865, and strongly resembles the *Resaca* class. There are indications that she was ordered by the Shogun, who did acquire her in 1866, and so would not appear on the U.S. Navy lists. Her original planned armament was to have been 24 guns, but her hull was pierced for only five guns on each broadside, for unidentified smaller guns. Her heavy guns comprised one 6.3-inch (30-pdr) MLR, and two 5.9-inch, type and manufacturer unknown. It is possible that the 5.9-inch guns were Krupp 24-pdrs, at the behest of the Shogun[49].

Naval Guns

The road to success with the Prussian Navy was still full of pot holes and obstacles. The War Ministry had observed that the 24-pdr would be insufficient against armor, knowing the results of the French experiments in 1858 and 1861. They were aware that larger gun calibers would be necessary in the battle between armor and gun power.

In 1862 they ordered a few **iron** 17cm guns from Krupp, probably motivated by parsimony. They were tried in 1864, and not surprisingly, found to be unsatisfactory[50].

In the fall of 1864, the Navy decided to accept steel guns, and ordered 17cm and 21cm guns. But the Prussian Ordnance Corps had not yet lost faith in the Kreiner breech, so Krupp was required to use it with the new guns.

In 1865, Krupp received a Contract with the navy for over 100 guns, to replace the various Swedish guns on the unarmored screw ships. Also, toward the end of the year, the eight ships of the *Camaleon* class were fitted with a rifled 68-pdr in addition to their 24- and 12-pdrs. These guns were most likely the short 21cm L/12.25 guns similar to those ordered by the Austrian Navy.

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[49] Ibid., pp. 219, 231, 235 and 413. And Watts and Gordon, The Imperial Japanese Navy, pp. 77 – 82. And Jentschura, Jung and Mickel, Warships of the Imperial Japanese Navy, 1869 – 1945, pp. 12, 89, and 113-4.

[50] Hovgaard, op.cit, p. 397.

Firing trials the next year, possibly using one of the 8-inch guns not delivered to Austria, indicated that the 21cm caliber was only marginally effective against the thicker armor being applied to ironclads, so 9-inch (23,54cm actual) guns were ordered, also with the Kreiner Breech[51].

1867 and 1868 were the absolutely critical period for Krupp and the Prussian Navy. Part was obviously technological, but the rest was pure politics. The Navy wanted the most modern and powerful guns for their new ironclads. Krupp desperately wanted that business. And the Prussian government did not want to be dependent upon a foreign supplier for the heavy guns needed by the Navy. To make everybody happy, Krupp guns must show well in a series of trials.

The second of these took place in May 1867, in two parts. The first involved one of the 21cm L/19 guns ordered in 1864. Along side of it was a 21cm L/19 gun provided by Krupp, with the cylindro-prismatic wedge. During the endurance test, the inner plate of the Kreiner wedge split. A new wedge replaced the broken one, and the firing continued without interruption. But the incident did have serious consequences. First, the Ordnance Corps abandoned the Kreiner wedge, and in July ordered 20 new 21cm guns with the Krupp wedge. But they also refused to accept the guns with the Kreiner wedge, now considering them unfit to meet the requirements of naval service. This action, correct though it may have been, caused a considerable delay in providing the armament for *Kronprinz* and *Friedrich Karl*, which had been delivered from the builders in August 1867, and forced to sit idle at Kiel. The new guns could not be delivered before July 1869[52].

The first trial pitted the new Krupp 9-inch (23,54cm) gun against an Armstrong 9-inch [22,9cm] MLR. Three targets were prepared for the trial, representing the side of an armored ship. The first had a 6-inch plate on 10-inches of teak on a 1-inch skin. The second was a 7-inch plate on 30-inches of backing. The third duplicated that of the *Konig Wilhelm* with 8-inches of armor with 10-inches backing and a 0,75-inch skin. The guns were put in position 950 meters from No. 1, 750 meters from No. 2 and 500 meters from No. 3.

The Armstrong gun was fired four times at target No. 1, twice at No. 2 and once at No. 3, but each shot pierced the target. The first shot from the Krupp gun at No. 3 pierced the 8-inch plate but only 7,5-inches of the backing. The second shot at No. 2 pierced the target but the Gruson shot broke up passing through. The Armstrong gun had produced an initial velocity of 400 m/s, while the Krupp gun only 348 m/s. This showed a clear superiority of the Armstrong gun. Krupp argued that the shell was defective, and the gun had the Kreiner wedge, which leaked gas and limited the size of the propellant charge, and asked for a new trial. For the above mentioned political reasons, the matter of selecting heavy guns for the Navy was tabled[53].

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[51] Sondhaus, Weltpolitik, op.cit., p. 82. Jager, op.cit., p. 62. Hovgaard, op.cit. p. 398. And Monthaye, op.cit., p. 112. And Groner, op.cit., p. 134.

[52] Sondhaus, Weltpolitik, op.cit, pp. 90-91. And Greene, op.cit., p. 258. And Monthaye, op.cit., pp. 112-113.

[53] Hovgaard, op.cit., p. 398. And Very, “Development of Armor for Naval Use,”pp. 441 – 442.

The next trial was in March 1868. Krupp brought a new gun with his cylindro-prismatic wedge, and hooped for additional strength. Gruson had provided new chilled shell. The results were better than the previous May, but were still not satisfactory. The gun could not produce enough muzzle velocity. Krupp blamed the “corned powder” that had been mandated by the APK, pointing out that the Armstrong gun was using prismatic black powder [sic. actually pebble], and asked for another postponement.

Politics being what they are, another delay was granted. But many of the officers in the navy could not understand why Krupp could not produce effective naval guns when Armstrong could. Some even felt that the Navy should buy guns from Armstrong. Fortunately, both the Ordnance Corps and the War Ministry felt that muzzle loading rifles would be a technical leap backwards.

The next trial commenced on July 2nd, with Krupp bringing the same gun, and also a supply of Prismatic powder obtained from Russia. But again they were disappointed, though the results were better than in March. The Gruson chilled shell did penetrate into the plate, but not nearly as well as the chilled Palliser shot from the Armstrong gun. Krupp again asked for a postponement to study the results, which was granted.

The next month, Krupp returned, bringing new **steel** armor piercing shell. The first shot from his gun shattered the target plate!

After this success, both guns were subjected to the endurance test. The Armstrong gun developed a fissure after round 138, and was a ruin after the 300th round. But the Krupp gun was still in working order after 676 rounds, even though one of the chilled AP shells had burst in and injured the bore after the 640th shot! Following this success, a new model 21cm L/22 was tried at the medium range with the prismatic black powder, which performed better than had the Armstrong gun. [54] It was readily apparent that the future of naval artillery was long barreled steel breech loading guns!

Conclusion and Discussion

The lengthy delay in resolving the competitive trials between the Krupp 9-inch (23.54cm) and the Armstrong 9-inch MLR were not without cost. The guns intended for *Konig Wilhelm* were delayed, and not delivered until late 1869. Between 1867 and 1869, the Austrian ironclads *Drache*, *Salamander*, *Kaiser Max*, *Prinz Eugen*, and *Juan de Austria*, which had fought so valiantly at Lissa, were all re-armed with 7-inch Armstrong guns, and the old steam line-of-battle ship *Kaiser*, re-constructed as an ironclad between 1871 and 1873, mounted the Armstrong 9-inch MLR, for a total of 66 guns. But this brief interlude was the only incursion Armstrong enjoyed with the Austrians. In 1874, the *Kaiser Max* class were “re-constructed” [a political fiction for obtaining new construction under the guise of improving obsolescent/obsolete ships, The U.S. Navy used the same process on some Civil War vintage monitors at about the same time.] and their MLRs landed.

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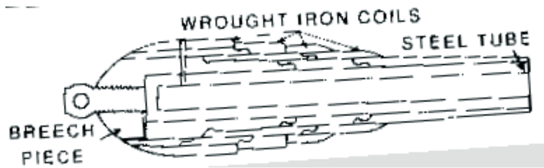
[54] Sondhaus, Weltpolitik, op.cit, pp. 90-91. And Greene, op.cit., p. 258. And Monthaye, op.cit., pp. 112-113. And Very, op.cit.

28 of these guns were used to re-arm the *Erzherzog Ferdinand Max* and *Habsburg*. The "re-built" ships, and all other new construction for the Austrian Navy, were armed with Krupp guns, at least until the turn of the century[55].

Proponents of Armstrong, both contemporary and modern, cast the 1867-68 competitive trials as primarily a political matter, only obliquely referring to the technology involved, and then mainly citing the "poor performance" of the Krupp guns. Their intention is to infer that the Krupp guns were inferior and undependable products. When the technical matters are mentioned, it is in the context of implying that much of it was acquired from others. For example, the process of shrinking hoops or rings around the breech and chamber for additional strength was invented by Armstrong or Blakely, and the carriage used by Krupp by Vavasseur[56]. Each should be examined in some detail.

In a sense, both contestants in the first competitive trial suffered from the same malady; government interference. In the case of Krupp, as already mentioned, it was the mandated Kreiner Breech and the 'corned powder.' In the case of Armstrong, it was the short-sightedness of the British armed services which rejected his breech loading rifled guns. This denied Armstrong the opportunity for further development of the concept by reverting to rifled muzzle loaders.



Armstrong Muzzle Loading Rifle

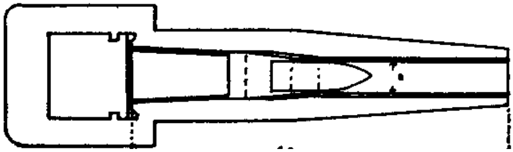
The Armstrong MLR probably represented the limit of the technology possible. The construction was a steel 'A' tube, with a number of wrought iron hoops or rings shrunk around it for strength. Designed for black powder, the barrel length was rather short. In other words, the interior ballistics was rather fixed, in that the physical structure could not be altered easily. The short barrel could not efficiently use any version of a slower burning propellant. While later versions did have a chamber, it could not be altered once the gun was completed. In short, the propellant charge weight and the projectile weight could be altered, but the gun itself could not. These same objections would cause the Royal Navy to recant their decision ten years later.

The original Krupp barrels were cast solid, then rifled and 'finished' for their breech mechanisms. Being of crucible steel, which as noted above allowed each section of the gun to be cast with a recipe tailored to provide the optimum qualities for that section, Krupp did not originally see the need for hoops or rings.

However, when the need was realized in 1867, Krupp did indeed shrink high **steel** rings around the low **steel** barrel. But it is disingenuous to claim that the con-

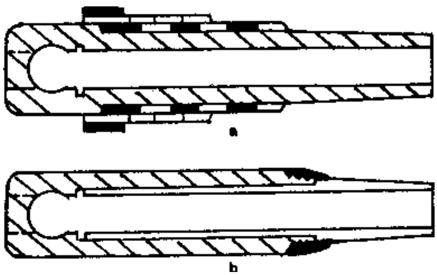
[55] Gardiner, Comway's All the World's Fighting Ships, pp. 267-270.
[56] Marshall Bastable, Arms and the State, pp. 135 – 142.

cept was taken from Armstrong. Indeed, it was already in the public domain! Brooke, Parrott, and Blakely (who also had a claim as the original inventor) all used hoops in their designs. The Italians spend some months prior to the 1866 War installing hoops on their cast iron 16cm guns, most of which were purchased in Britain and France, both of whom used hoops for their guns[57].



Krupp gun cast for a Kreiner Breech

The comment that Krupp borrowed the gun carriage design from Vavaseur may indeed have some merit. On the other hand, Vavaseur may very well have borrowed the idea from Wahrendorff! The idea of using gravity and mass to absorb recoil was hardly new. In those days, there was no international protection of intellectual property. In consequence, inventions often had several inventors, and it is extremely difficult to determine whose came first. For example, Vavasseur is credited with inventing the copper driving bands for projectiles in 1874. However, Krupp was using them in 1872[58]!



Later Krupp guns. Above: hooped design C/68 Below: mantel design of C/72

With regard to the alleged poor performance of Krupp guns during the Franco-Prussian War, Alfred Krupp's letter to *Engineering* published on June 18, 1875, adequately addresses the question. "*With regard to the 200 guns stated to be disabled in the…war, I would offer the following remarks…There were three systems of breech-loading used in the war…my system, which was confined entirely to the 4-pounder guns supplied to Saxony, while all the other 4-pounders were upon Kreiner's double-wedge system, and the 6-pounders were constructed upon the Wahrendorff plan. The 24-pounders had all the double Kreiner wedge. They all*

[57] See Greene, Ironclads at War.
[58] M.L. Ruffell, "Breech Mechanisms." And Mehl, Naval Guns, p. 183.

were, however, with the exception of some other guns supplied by another firm, made of steel taken from my Works…not one of the guns from here burst…and also that not one of the guns fitted on my system of breech-loading was disabled…That a large number of guns on the Kreiner and Wahrendorff system were disabled (not burst), is quite true…"[59]

Another analysis provides some interesting details. Prior to 1868, sixteen guns failed. Seven of these were Prussian field guns with Kreiner breeches. The other nine were larger guns, many of which had Kreiner breeches. Of the nine guns after 1868, two were damaged by premature ammunition explosions, and the other seven from the effects of overstraining due to overly large propellant charges, which blew the breech[60]. Note that disabled guns can be rather easily repaired, as evidenced by the 1867 trial with 21cm guns noted above. The twenty five mentioned here were damaged so severely that they were returned to the foundry, and hence were out of service.

The 'poor performance' of the Krupp gun in the first two competitive trials was the result of the government mandates, in these cases, the Ordnance Corps. The other two were more directly related to the technology. In the third, the volume of the chamber was insufficient to get full advantage of the slower burning Prismatic powder. Hence, the length of the chamber was increased by 0.1 caliber, at the expense of the rifled portion of the barrel, from 16,9 to 16,8 calibers, and the charge weight increased. The Table below gives a reconstruction of the gun in its condition for Trial 3 and Trial 4. Subsequent tests in 1869 demonstrated that the gun could take the stress of an even larger charge, so its service performance is included for comparison[61].

Table 4. Armstrong vs Krupp 9-inch Guns

Gun	Shell, kg	Charge, kg	Muzzle velocity, m/sec	Note
Armstrong 9-in MLR	116,10	22,70	438,90	Elswick designed
	116,00	23,00	454,15	Austrian service
	113,50	19,50	426,40	Danish service
	113,00	23,00	450,00	Dutch service
Krupp 9-in BLR	139,00	20,00	410,00	Test 3 w/ Gruson shell
	132,50	24,00	435,00	Test 4 w/ steel AP shell
	139,00	30,50	455,00	Service as C/68

There is no question that politics were involved. What must be determined are the degree and the effect of such political intervention. To a great degree, both Armstrong and Krupp were in the same position; to continue to be viable and profitable, both needed a large portion of the business from their respective governments. Armstrong reverted to rifled muzzle loaders when his government left him with little market for his breech loaders, though fortunately his ship building busi-

[59] Monthaye, op.cit. p. 208.
[60] Ibid., p. 106.
[61] Brassey, The Naval Annual 1886, pp. 386-391. The Trial 4 MV is a calculated value.

ness more than made up the difference. Krupp had no ship building business at that time , and therefore imperatively needed the ordnance business from both the Prussian Army and Navy, small though the Navy was at that time.[62]

Many of the officer corps of the Navy did not care who supplied their guns, but that they needed guns promptly. The technical questions mattered less than having something to fire! The Ordnance Corps wanted a domestic provider, and at least rationalized that if the government could not afford to build their own facilities, Krupp would have to do. Likewise, the relative failure of the Kreiner breech, and the success of Krupp's own system, had discredited the Royal Arsenal at Spandau, so there was probably an element of chagrin in their support for Krupp. They also brought some technical expertise to the question, and felt that MLRs had little or no room for development, and were actually obsolescent. Hence, they were inclined to give breech loading technology a chance to develop. And in the background was the King, Wilhelm I, who was a personal friend of Alfred Krupp. The King may or may not have understood the technical matters involved, but he did believe that steel breech loaders were the best for the future. In the event, the coalition who supported Krupp, or at least did not oppose his technology, could do no more than to give him as much latitude as possible to prove the performance of his guns. In effect, the four competitive trials **forced** Krupp to advance his technology. So he probably was given two more chances to perform than might be the norm in other circumstances. After all, even an order from the King would not change the results of the trials, which were physical and technical, not political.

The trial result vindicated Krupp, and he became the major supplier of Prussian, and later German, ordnance. But not the type to rest on his laurels, he promptly set about improving the C/68.

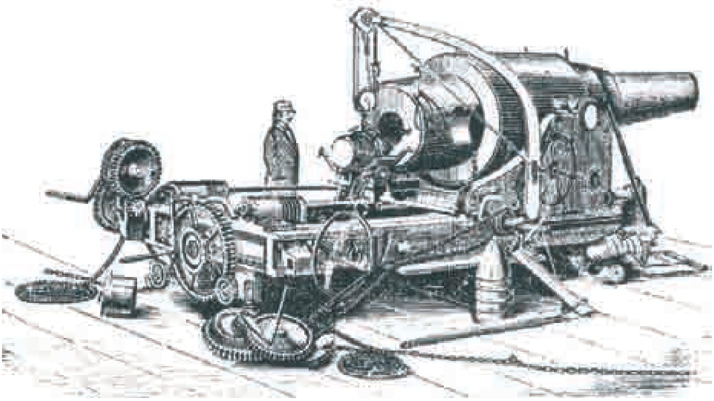
The result, known as the C/72, and including the C/73 field guns, was the direct ancestor of modern Krupp ordnance. The construction of the gun was changed. Instead of rings/hoops shrunk onto the barrel, the barrel was thinned and covered with a thick steel mantel where the strength was needed, though rings were still used in heavier guns for local strength. The chamber was designed for the slower burning Prismatic powder. The projectiles were no longer covered with lead, but now featured copper driving bands, and were made of **steel**. And the wedge was altered. Note in the figure below that it now featured two parts that lined up with the bore; the normal Broadwell Ring, and now also a tube through which the shell and charge can pass. The original design required that the wedge be moved far enough to expose the bore, and then moved back into position. The new model did not need to be withdrawn as far to allow loading. This simplified and accelerated the loading process, and allowed a higher rate of fire. And last, but not least, the barrels were longer! The slow burning Prismatic powder allowed the barrels to be lengthened, which increased propellant efficiency and produced higher muzzle velocities.

And finally, the old adage is that "Imitation is the sincerest form of flattery." "*As late as 1880 a proposal was made to convert the [Armstrong] RBL 40 pr (4.75-in) and 7-inch into 'side-closing' guns by rotating the piece 90-deg within*

[62] Brassey, The Naval Annual 1886, pp. 386-391. The Trial 4 MV is a calculated value.

the trunnion ring, thus making the vent piece a horizontal sliding block. As well as making handling more convenient the conversion saved much labour, as the vent piece no longer had to be completely removed for loading. Experimental guns were prepared, other systems of obturation tried, as well as projectiles with copper driving bands. The modified guns were said to have 'answered extremely well' but the expense involved, especially for new ammunition, ruled out further action."[63]

Krupp 21cm C/72 guns in open coast defence emplacement.

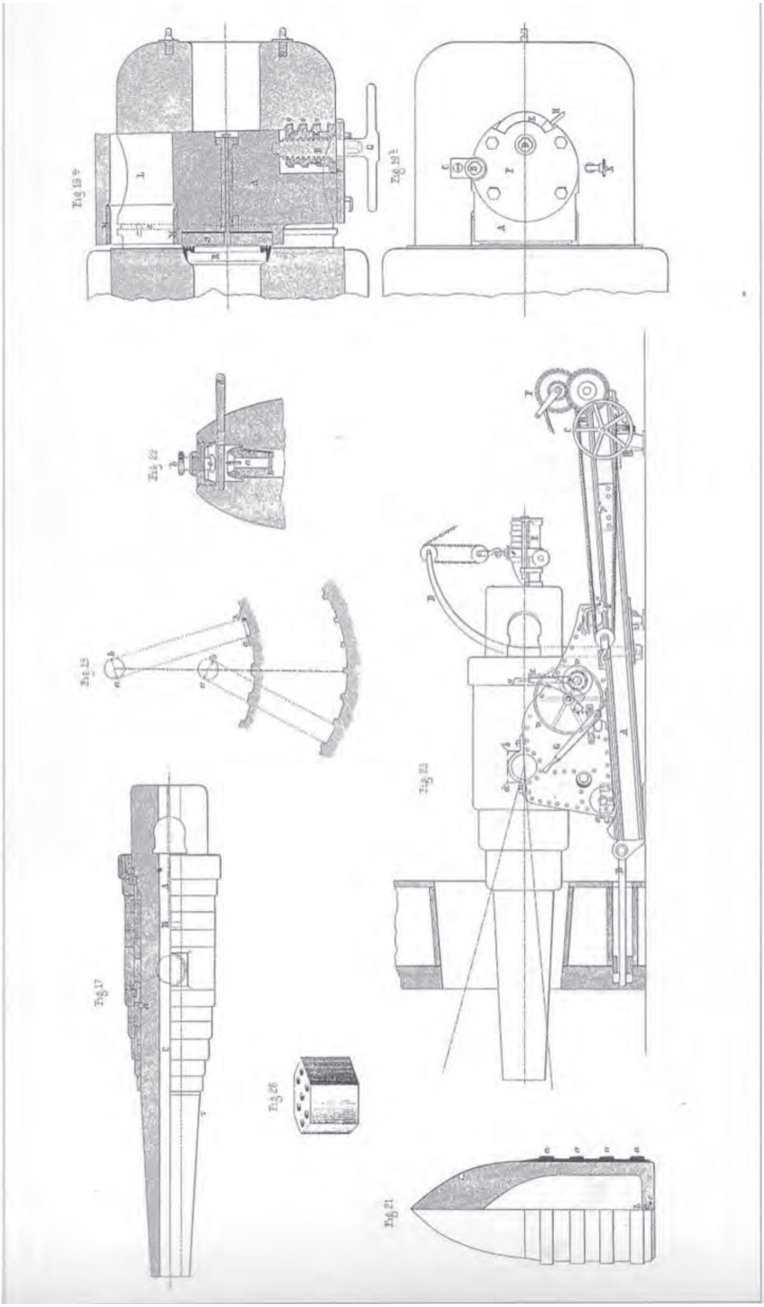


The Krupp 9-inch (23,54cm) gun on a swivel carriage.
(Appleton's Cyclopedia of Applied Mechanics, 1880)

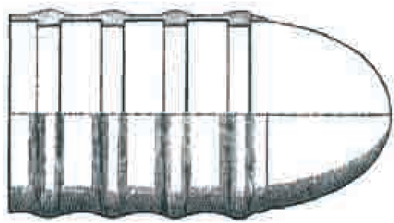
Every success story has a beginning, a point of origin. For Alfred Krupp, there were three essential factors, all of which contributed greatly and were indispensable. First, he developed high quality [by the standards of the time] steel suitable for gun making.

Second was the pioneering work of General of Artillery Giovanni Cavalli and Baron Martin von Wahrendorff. One could argue that Wahrendorff's contribution was greater, as his success enabled Krupp to begin breaking into the Prussian ordnance market, and there is some merit to that circumstance. However, exclusive of Prussian interest, both of those ingenious men focused attention on breech loading, and provided viable systems to prove breech loading was possible and practical.

[63] Ruffell, op.cit.



Krupp 28cm C/72



An early Prussian lead coated shot, typical form
of the Gruson Chilled Shot. (Holley, A Treatise on Naval Gunnery)

Krupp 30.5cm/C80

And third, Krupp realized that by combining the best features from both the Cavalli and Wahrendorff guns, a much more effective system could be developed. Modern Krupp artillery is the combination of Krupp steel, the Cavalli wedge, and the Wahrendorff cylinder. .And the rest, as they say, is history.

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HITTING THE TARGET. NAVAL FIRE CONTROL 1860 TO 1900

It is a common misconception that modern Naval Fire Control and gunnery was a XX century development, solely beholding to Sir Percy Scott and William Sims and the 'Gunnery Revolution' they launched, and that the 'art' of gunnery had changed little since the Battle of Trafalgar in 1805. Thus, the pioneering work of Bradley A. Fiske, A.P. Davydov and Sir George Elliot, amongst others, is discounted and ignored. This article seeks to look at the progress of the last 30 years of the XIX century to place the 'Gunnery Revolution' in its proper context.

Существует распространенное заблуждение, что современные системы управления артиллерийским огнем появились лишь в XX веке и представляли собой развитие идей "Артиллерийской революции" сэра Перси Скотта и Уильяма Симса, а более раннее искусство стрельбы оставалось практически неизменным со времен Трафальгара в 1805 г. В результате вклад таких пионерских работ как работы Бредли Фиске, А.П. Давыдова и сэра Джорджа Элликота полностью игнорируется. Предлагаемая работа – попытка рассмотреть прогресс последних тридцати лет XIX века и рассмотрение "Артиллерийской революции" в контексте этих событий.

It is a common misconception, even among Naval Historians, that until Percy Scott and William Sims began the so-called Gunnery Revolution in the Royal and U.S Navies at the beginning of the twentieth century, the "art" of gunnery had changed little since the time of Trafalgar. This view overlooks the fact that Scott did not invent the Director, but resurrected the device and applied modern technology to the pre-existing concept and equipments [1] It also pre-supposes that such problems as deflection and roll were beyond comprehension, and completely discounts the scientific work of Bradley A. Fiske and A.P. Davydov, two of the prolific inventors of the age.

Nothing could be further from the truth. Hans Busk, writing in 1859, describes the gunnery problem as follows:

"…in firing at a moving object as at a steamer passing, we will suppose at twelve knots per hour, allowance must be made for her speed, and a point must be aimed at a-head of her, to be determined by her distance and rate of motion. But this is not all: an 8-inch shell takes two seconds to travel 450 yards, to that the gunner having in the first place made the closest approximate estimate of the distance of the vessel to be struck, has to calculate her rate and then to fix upon an imaginary point in her line of course at which she and the shell may arrive simultaneously, taking heed, moreover, if there be much sea on, to fire when the deck of his own vessel is horizontal, or at any rate with a falling in preference to a rising side" [2]

Indeed, "The first recorded system…is probably Philip Broke's 1807 – 13 method of laying the broadside guns to an ordered elevation…and…angle of training so that their fire could be directed on a target which the individual gun captains could not see." A Captain W. Moorsom, RN, had introduced a "director" in the early 1850s to address the issues noted above. Located in a convenient position and manned by an officer, the target bearing, heel, and range were determined, and the guns laid accordingly. The officer gave the order to fire when the target came into his sights. [3] The entire process was verbal. One can imagine the designated officer asking the master Gunner for the range, estimated by eye and perhaps with the benefit of experience, then performing some quick calculations, after which instructions were shouted to the Lieutenants in charge of the batteries for the laying of the guns. After an appreciable interval, the shouted order to fire is given, and within seconds, each battery discharges. So far, so good, but can the process be repeated in the din of readying the guns for subsequent rounds? One suspects that, given the communications technology of the period, effectiveness of the system was limited to the first salvo/broadside only.

Poor communications was, however, only part of the problem. The guns themselves tended to be quite heavy and bulky. In broadside mounts, this mattered little as their traverse was limited, though this required the ship to maneuver to line up the guns with their target. For fire at other angles, pivot guns were common. Their carriages were mounted on a system of tracks or races, which enabled them to be moved from one side of the ship to the other, or cover the angles in between. But even in 1877, "…the crews of both [of *Shah*'s] 9" guns had trouble moving their massive weapons from one broadside to the other over the races."[4]

Mounting guns in turrets or on turntables *en barbette* was less of a solution than commonly thought at the time. The early turrets were traversed by hand. In the case of the *Huascar*, for example, "it took sixteen men fifteen minutes to turn it through 360 degrees."[5] Later, and larger, turrets and turntables were steam powered, though *Inflexible*'s were powered by Rendel's hydraulic system, which had been experimentally used in the *Thunderer*, which allowed "a complete rotation …in just over a minute."[6]

But the problem was one of tracking the target. Obviously, the hand operated turrets were much too slow, while the steam and hydraulic powered turrets and turntables lacked the necessary control, especially given their fixed loading position requirements. Like communications, the available technology was not sufficient for the task.

At any kind of range, gunnery was exceedingly bad, and the existing fire control system, such as it was, proved inadequate. In 1870, the ironclads *Monarch*, *Captain*, and *Hercules* took part in gunnery experiments off Vigo. Each ship was to fire for five minutes at a rock 600 feet long and 60 feet high, "or twice as long and four times as high as a ship." At a range of about 1,000 yards, "*Hercules* fired seventeen shot, of which ten hit; *Captain* fired eleven shot, and made four hits; *Monarch* fired twelve shot, and made nine hits." But according to Captain Philip Colomb, had the rock been moving, none of the shots would have hit![7]

New technologies, however, promised at least partial solutions. In the British Royal Navy, the implementation of electric ignition of the firing charge, around 1868 or so, provided a tactic that would enhance effectiveness. It required that the guns be laid on a pre-determined angle, and then the ship would maneuver to bring the guns in line. At that point, the firing circuit would be closed. Oscar Parkes described this gunnery tactic as used in conjunction with ramming:

"It was intended to withdraw the [gun crews] from these [broadside 9"] guns to the armoured forecastle [in *Shannon*] after they had been laid, and then fire them by electricity when passing the enemy if an attempt to ram failed.

"As in the *Shannon* salvo firing was to be the special form of attack, the guns being loaded and laid under cover of the end bulkheads [of *Northampton*] and fired electrically without the crews being exposed in a close engagement. The broadside having been discharged, she was then to turn bows on, reload, and again maneuver for another broadside."[8]

It should be noted that *Shannon* was completed in 1877, and *Northampton* in 1878. There also may be some question as to how important ramming was as a viable tactic. *Monarch*'s 12" 25-Ton guns were sighted to 7,000 yards, through she had been completed in 1869. *Alexandra*, completed in 1877, had her 11" 25-Ton guns sighted to 10,000 yards.[9] At sea, this was at best wishful thinking, though it implies that gunnery action at ranges greater than 1,000 yards was considered reasonable. Indeed, in May, 1877, *Shah*'s action with the monitor *Huascar* provides an example of the Royal Navy's capabilities, and Andrew Smith's account deserves to be quoted at length:

"*Shah*'s port guns opened fire at 1,900 yards… DeHorsey chose to use the *Shah*'s speed to fight at long range, mainly 1,500 to 2,000 yards, although ranges (estimated by eye) varied from 300 to 3,000 yards. The *Amethyst*… kept at 1,500 to 2,500 yards, although Able Seaman Patrick Riley records a minimum range of 1,000 yards in his memoirs…Fire control was extremely primitive. Ranges were estimated by officer's eye, shouted at the gunners through the noise of battle, sights set accordingly, and guns mostly laid and fired individually. However, the *Shah* also fired several broadsides from her 7" guns, including three by electric firing, mostly aimed by the director sight at *Huascar*'s turret…The action had lasted about 2 hours 40 minutes. The *Shah* fired 32 rounds 9" (2 common shell, 11 Palliser shell, 19 Palliser shot), 149 rounds 7" (4 common shell, 145 Palliser shot), and 56 rounds 64-pounder shell, total 237 rounds. The *Amethyst* fired 190 rounds 64-pounder shell. Total… 427 rounds… We may safely conclude that the *Huascar* received at least 50 hits."[10]

From the above account, several points of some importance bear emphasis. There was a 'director sight' that could and was used for aiming at a specific target, the guns could be fired electrically when under 'director control', but information/instructions were still passed verbally. But the overall gunnery performance of the two British ships was rather good, considering the constantly changing range and bearing at which they were firing, the sea state, and that the monitor did not present much of a target above water; a minimum of 11.7% hits, though some sources claim sixty to seventy hits for 14.05 to 16.39%.

In the mid 1870s, Admiral Sir George Elliot took advantage of another advance in technology to re-work the director system, which was subsequently fitted to most of the large warships in the Royal Navy. The 'director' was moved to the 'conning tower', or to a purpose-built ‘Director tower’ if no conning tower had been fitted, which was fitted with the new voice pipes to the various gun positions, as well as the existing electric firing circuits.[11] The intent was obviously to solve the communications problems, as well as further centralize gunnery control. But the test of combat brought mixed reviews.

An excerpt from the report of Captain H. Fairfax of the turret ironclad *Monarch* illustrates the chronic problems of fire control. *Monarch* was one of the ships participating in the bombardment of Alexandria, Egypt, in 1882:

"The sighting arrangements and methods of laying the guns for elevation are in this ship particularly bad. After the Captain of the turret has ascertained and communicated the heel to the number laying the gun the time necessary to work the elevating gear, lay the guns by means of the crude wooden scales, and make ready is so great that probably another gun or turret will have fired in the interim, and consequently the heel of the ship be so affected that a re-lay of the gun is necessary unless a bad or chance shot is purposely delivered…[the Elliot director gear] proved so untrustworthy that the turrets were fired independently. The voice pipes to the turrets proved useless in the din of action, and orders had to be passed verbally by specially stationed officers."[12]

Captain John Fisher of the *Inflexible*, and A.K. Wilson, filed reports to the effect that the voice pipes were not an effective means of communications with the various guns, that the 'conning towers' restricted the vision of the gunnery officer considerably, and that some effective method of finding the correct range was needed. The Captain of *Superb* "…had noted that he had a clearer view of the action [from his conning tower] than the individual gun captains stationed at each firing gun…[and]…suggested that an electric telegraph should be installed between the tower and the guns so that the bearing and elevation could be passed down…Other captains of ships not fitted with conning towers suggested that a similar connection should be made between the fighting tops and the guns… [13]

But only a few weeks later, on 18 August, the Elliot director gave sterling service during the landings at Port Said. *Orion* and *Carysfort*, in a slow bombardment of an Egyptian Army camp, fired effectively at a range of about 4,200 yards. Admiral Hoskins, who commanded that area of operations, praised the action in his official dispatch: "I draw particular attention to the effective fire maintained by the *Orion* and *Carysfort* on <u>a position which could only be seen from the masthead of the latter vessel</u> at over 4,000 yards -- a fire by which a train standing on the rails at Nefiche station was twice hit and the carriages and trucks secured for our own use." [14] In our modern parlance, the range and bearing were estimated from the masthead 'crows nest', and the information passed to the gunnery officer in the 'conning tower.' The correct bearing and the range was passed to the guns, which were then laid accordingly. The guns were then fired electrically, and corrections made upon spotting reports from the crows nest. In these circumstances, effective fire could have been accomplished at ranges of 7,000 or 10,000 yards, so long as direct observation of the fall of shot was practical.

In 1885, a Lt. R.H. Peirse took up the task of improving the 'director', and reportedly greatly improved the device and concept. A further set of modifications was made in the early 1890s, but within a few years the Director was overtaken by technology. The advent of a secondary battery of Quick Firing mounted in casemates on each broadside proved to be a complication, due to the different ballistics, and so they were fired independently.[15] All-round loading of the heavy guns greatly increased their rate of fire, comparatively. And the new Barr & Stroud range-finders more than doubled the effective combat range. As the old style slow firing MLRs and BLRs fell out of use, so too did the Director system that enhanced their performance.

In the late 1870s, about the same time that the RN was working with the Elliot Director, the Russian Navy deployed a fire control system of great interest. Designed by A. P. Davydov and accepted in 1876, it laid the guns at pre-determined angles ahead or abaft the beam, and directly abeam. The choice of which line to use was made by the gunnery officer, who would anticipate what the relative positions of his own and the target ships would be. Once the guns had been laid, the gunnery officer had but to wait for own ship's motion to bring his sight on, at which point he could fire the guns electrically.[16] This imminently practical system was probably deployed on the ironclad turret ship *Petr Veliki* and the armored cruisers of the *General Admiral* class, and subsequent ships, until replaced by the much superior Geisler system of 1894. [17]

The French Navy seems to have lagged well behind the British and Russian Navies. On 23 June 1884, the armored cruiser *La Galissioniere*, anchored at Chefoo, China, fired at targets up to 4,000 meters range, in an effort of over-awe Li Hung-chang.[18] While this sounds impressive, it only required a rudimentary range table and a skilled gunner, even using the open sights of the time, to fire from an anchored ship at a stationary target clearly visible. *Carysfort*'s feat two years before required a fire control system, crude by modern standards, to hit a target not even visible from the guns or the bridge, even though the range was similar. Theodore Ropp confirms, in his Development of a Modern Navy, that the French only became interest in fire control in 1891, on which more later.

On March 3, 1883, the bill that created the "New" U.S. Navy was signed into law by President Arthur. This was a momentous event in the history of fire control because it unleashed the genius of Bradley A. Fiske upon the field of naval technology. So at this point, it seems germain to examine some of his inventions, as much as they influenced future developments as for their application within the context of this paper.

In 1883, Fiske designed electric primers to fire heavy guns, and suggested that the Plans for the *Chicago* be altered to include dynamo rooms to provide plenty of electric power. In December 1885, he suggested that heavy guns should be trained, elevated, and fired by electric motors, under the control of a single gun captain, and prepared a sketch of the necessary wiring. Two years later, he wrote a paper "detailing his plans for 'pointing and firing guns with automatic mechanisms.'" This also detailed a device for automatically firing the guns at the proper point in the roll cycle of the ship. He proposed using a spirit level set at the same height as the guns, on the horizontal plane. When the bubble in the level was at the proper angle due to the roll, the liquid would drain away, which would break the electric circuit and fire the guns. [19]

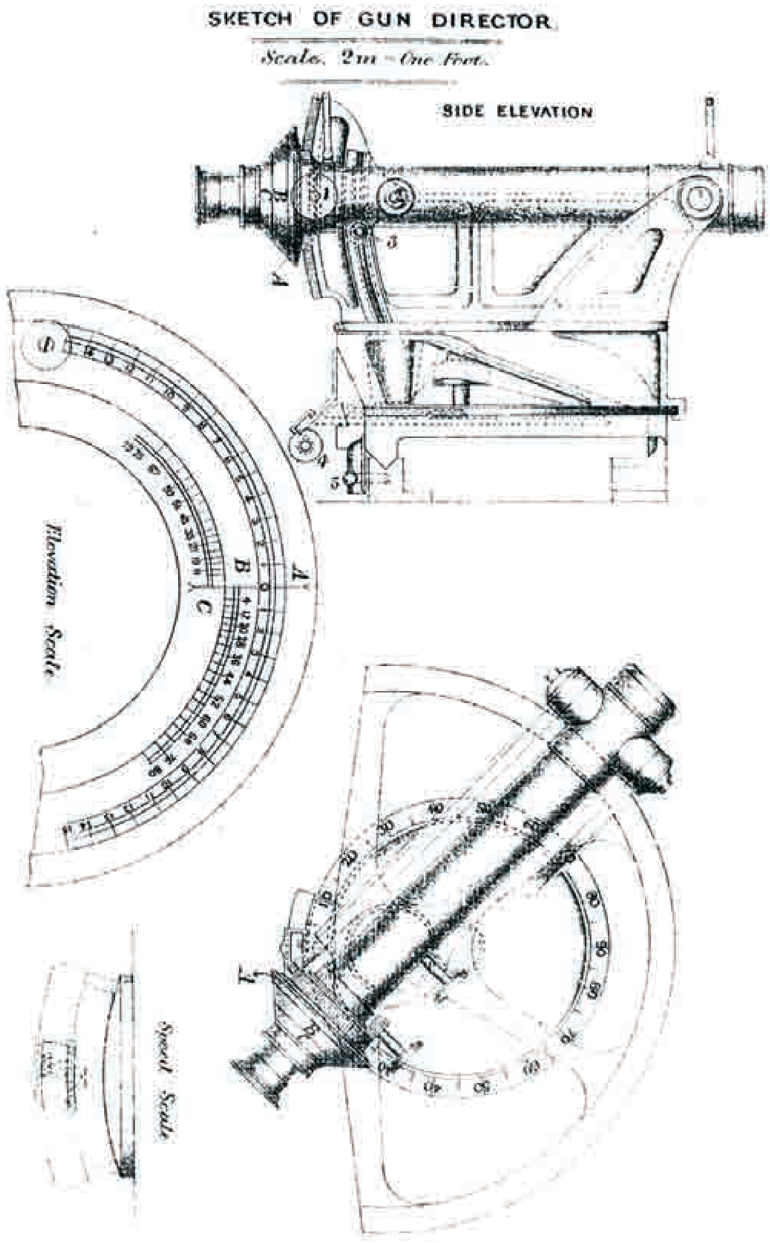
One of the most significant of Fiske's inventions was a workable range-finder. Unlike the optical instruments with which we are familiar, this was a two-station two observer device based on trigonometry, the principle being "to find the sum of two angles included between two observers and lines drawn from those two observers to the target." The two stations, one fore and the other aft, each equipped with a telescopic sight, formed the base of the triangle, a known distance from each other. Each observer would focus his sight at the same location of the target ship, such as the foremast. A wire was attached to each telescope. As the telescopes were moved onto the target, the wires moved. The distance these wires moved was proportionate to the range to the target, and a galvanometer dial, using the same principles as on the Wheatstone Bridge, then pointed an arrow along a scale calibrated in yards to indicate the range to the target. And the two stations were connected to the conning tower by electric telephones, the first such devices ever used at sea. [20]

Without a reliable range-finder, "firing at ranges greater than three thousand yards was considered useless because the errors of sighting were so great that ammunition would be wasted. In fact, in 1890 two thousand yards was considered to be about the limit of accurate range." The Navy was impressed with the device: "It is the opinion of the board that the experiments [with the range-finder] show that the instruments are in good order and the pointing accurate, that they will give reliable results within 3% in ranges less than 5,000 yards, or at greater ranges when adjusted skillfully." Two sets were to be placed aboard ship, one for each side.[21]

Several of the new warships for the U.S. Navy were fitted with the electric range-finder, as well as several other of his inventions, such as an electric range transmitter, electric range indicators, and telescopic sights. These included the battleships *Maine*, *Texas*, *Indiana*, and *Massachusetts*, as well as the cruisers *Baltimore*, *San Francisco*, *Cincinnati* and *Minneapolis*.[22]

In October 1890, Fiske began a year long trip to Europe to market his range-finder. He was warmly received in Paris, and invited by the Minister of Marine to have his device installed aboard the ironclad battleship *Formidable* at Toulon. The test was successful, and the French Navy accepted the instrument aboard *Formidable*, and another for the coast defence battery at Cap Brun. It is unknown how widespread the use of the range-finder was in the French Navy, but there is no doubt that they had been very favorably impressed. It was also installed in the Chilean battleship *Capitan Prat*, then building at La Seyne.[23]

But the two-observer range-finder came to a bad end. The American Asiatic Squadron contained only one ship equipped with the device, the cruiser *Baltimore*. At Manila Bay, "…the … electrical range finder … failed after the first round was fired and because the topmasts of the Spanish ships were housed, it was very difficult to obtain masthead heights with either a sextant or stadimeter. Firing ranges therefore were set at the distance to the beach, with corrections made by spotting." Those units aboard the ships at Santiago fared no better.[24] No matter how technically accurate the Fiske instruments were, and even after the U.S.N. accepted optical range-finders he expectantly awaited the Navy changing its mind, they were too fragile for the rigors of combat. One is reminded of the Henderson Gyro and the *Abferungs Gerat* at Jutland in a later war, and cannot help but think that development was abandoned prematurely.



"Collingwood" Pattern Director

But the failure of Fiske's electrical two-observer system cleared the way for the major competitor, Barr & Stroud. This Scottish firm was manufacturing optical single observer instruments that used the coincidence principle, to wit, prisms show the observer a split image, and adjusting screw to align each image into a single complete image by moving one prism. This was mounted on a calibrated scale, which translated the distance the prism moved into the range to the target.[25]

After trials and tests, the British Admiralty ordered five models at the end of 1892, the first of which was mounted aboard the cruiser *Blenheim* on July 22, 1893. From then on, the Admiralty presented the firm with an increasing number of orders as the instruments were mounted on the ships of the Royal Navy. But foreign orders also made up a large portion of the company's business. Through their connection with Armstrongs, the Japanese cruiser *Yoshino* received the eighth production model [which no doubt explains in part how the IJN's "Flying Squadron", of which she was the flagship, could so speedily overwhelm the Chinese cruisers *Ch'ao Yung* and *Yang Wei* at a range of 3,000 yards during the Battle of the Yalu the next year], while the Chilean *Blanco Encalada* and the Argentine *Buenos Aires* received later production. In addition, the navies of Germany, Sweden, the Ottoman Empire, Italy, and Brazil all purchased instruments for trials.[26]

Perhaps Bradley Fiske's most enduring contribution to the field of fire control was his invention of the telescopic sight., patented on September 5, 1893. Perfection of the instrument, however, was not accomplished without incident. In its first test, aboard the gunboat *Yorktown* during a voyage from Chile north in early 1892, the telescope had been attached to the gun! It promptly gave the ship's Executive Officer a black eye when the gun recoiled. But on September 22, when *Yorktown* held her required semi-annual target practice, the sight was given a second trial. "During the morning, eighteen shots were fired, using the regular open sights, with the customary dismal results." But in the afternoon, using the telescopic sight now attached to the gun shield, "…four shots hit the target, wrecking it…Several days later, a shot fired successfully at a moving target confirmed…" the importance of his invention.[27]

The above occurred a full five years before Percy Scott attached a telescope to one of the 4.7" guns aboard HMS *Scylla*. It should also be noted that Fiske's sight included fine cross-hairs, whilst Scott's initially did not. In March of 1897, the Secretary of the Navy directed that telescopic sights should be fitted to all of the 4-, 5-, and 6-inch guns in the fleet, and the new Mk. 5 mounting for 5" guns to be installed in the new armored cruiser *Brooklyn* were so equipped from the outset.[28]

Karl Lautenschlager, in his article "A Majestic Revolution", considers the telescopic sight to have been not merely important, but a revolutionary piece of technology, and his comments deserve to be quoted at length:

"Using an open sight, the gunner had to line up a rear sight, front sight and the target. Since the human eye cannot focus on objects at different distances at one time, a compromise had to be made by focusing more or less on the front sight and attempting to keep target and rear sight in line. This meant that a target the size of a ship had to be inside 2000 yds. if it was to be hit consistently… The change from open sights to telescopic fire control gave pre-dreadnought battleships the capability to shoot accurately out to about 7000 yards. The telescope's optics…and fine cross hairs, allowed accurate aiming and thus consistent hitting out to 7000 yds."[29]

It is, perhaps, unfortunate that Mr. Lautenschlager over-looked the beneficial effects of range-finders to the increase in effective gun range. Still, his intent is valid; the telescopic sight was a milestone in the development of fire control.

Impossible as it may seem, the French Navy seems to have been absolutely quiescent in the fire control field. They had spent the thirty years since 1860 dealing with the technical issues involved with naval artillery and propellants, which resulted, with the nitrocellulose propellant for the long M.1887 guns, in first class artillery. But ranging was still accomplished using either sextants or Lugeol’s Stadimeter, which dated to the late 1850s. It was a split image device with an attached Table for converting angles into ranges. In 1892 L V Fleuriai presented a much improved Statimeter, and C F Guyon provided a calculating circle for quick conversion to ranges That they did not adopt the Fiske rangefinder may be due to the ‘not invented here’ syndrome, which led to various proposals from French firms failing trials through the remainder of the decade.

However, the nature of warship armament had changed. A.P. Davydov foresaw this in 1881 and had designed a gun mount with greater training and possibly ‘follow the pointer’ gear for control. In 1884 Vavasseur developed the first Central Pivot type mounting, which greatly increased lateral training speed. And the development of Quick Firing guns created an inseparable divide between the heavy slow firing main guns and the secondary battery. Fiske foresaw this n 1893 and had changed his emphasis from Central/Director Control to the individual guns. The final Director in the British Royal Navy, installed in the *Royal Soveriegn* class, was intended only for the heavy main guns. And within a few years, ‘all around’ loading, introduced after the first two units of the *Majestic* class, so increased their rate of fire that the Director was no longer considered necessary or advantageous. The primary consideration became the best means of communicating target bearing, target range, deflection and firing orders to the guns..[30]

The system that developed in the French Navy over the next several years called for the observer [spotting officer] in the masthead obtaining a range and communicating it to the gunnery control center. The gunnery staff then estimated the target speed, calculated the deflection, and passed this information to the guns by the new Range and Order devices. The medium caliber guns then fired several broadsides, the first to a range less than that reported, and each subsequent one to a greater range until the target was hit or straddled. [Basically, this was a ladder-type system] Once the range had been established, the main guns would open fire.

This method was tested in 1897 by the battleships *Brennus*, *Neptune*, and *Marceau*, but the results were mixed. The 'short-shot' method was considered too slow in finding the target. But once the range had been found, the results were favorable. The battleships scored 26% hits at ranges of 3,000 to 4,000 meters.

In 1898 the Ministry of Marine issued instructions for fire control methodology. The 'ladder' system was discarded in favor of requiring the medium caliber guns to use the displayed range. The range figure was to be corrected by spotting.

Interestingly, salvo firing was not used, opinion being that as long as the guns were using the same range figure, their gunnery would be effective.[31]

But the Imperial Russian Navy may very well have been ahead of all other navies in the mid-1890s. Their Geisler 1894 system involved electronic indicators to not only transmit range data from the observer positions on the masts to the gunnery center, but also the sight settings, for both deflection and elevation, from the gunnery center to the gun positions. As soon as the guns had been laid, the gunnery officer could fire them electrically at the proper moment in the roll cycle. Since elevation and deflection were calculated values from the gunnery officer, the guns only needed to be kept on target by continuous aim in train. There were only two short-comings; the lack of a reliable and accurate range-finder, and the time lost to the manual processing of the elevation and deflection. The time and accuracy gained with the Geisler electronic indicators was to a considerable degree lost to the manual work involved. That being said, the Russians had the best system available before the 'gunnery revolution'.[32]

Dr. Ropp made an interesting statement which deserves some attention. He stated that "in 1902 the state of gunnery in all the major navies was about the same [as the French Navy], except in the Italian, which used the British system of individual fire [but] without the sea-training of the gunners. The Russians and the Germans (the only navy on whose methods of fire the French had no information whatever and which may have discovered the principles of fire control independently) were using the French system."[33] With regard to the two Imperial navies, one wonders to what he was referring, given that the Franco-Russian Entente was ten years old at that time, and the degree of technical exchange between the two was considerable, and that French yards were even building ships for the Russian Navy. And the Geisler 1894 system was well in advance of the French 'system' of 1898. However, one of the hallmarks of German gunnery in a later period was the use of the ladder system for rapid target acquisition. So with "reverse engineering" type reasoning, it would appear that the Germans picked up the latter from the French, and then refined it to tactical usefulness.

The young Imperial German Navy (*Kaiserliche Marine*) did, in part, advance well ahead of the major navies, this being in long range gunnery. Between October 11[th] and 15[th], 1885, the ironclad battleship *Bayern* fired at a target off the Courland coast, at ranges from 1500 to 5000 meters, scoring 33 hits out of 133 shots, an impressive 24.8%. At a time when their normal practice firing range was only 2,500 meters, *Bayern*'s long range shooting was sufficiently accurate to impress the naval leadership. As a result, it was decided to prepare range tables for every gun, so they could be fired to maximum range. At this time, however, maximum ranges for the heavy guns were between 7,400 and 10,000 meters. [33]

But there is a considerable difference between firing at long range, and being able to control the fire in order to obtain hits. In 1890, Admiral Thomsen, of the ordnance department, clarified the situation by pointing out that deflection would be a considerable problem at long range, and that target movement could be observed and measured with modern equipment. This led to two developments; the first of which, in 1892, was to commission Dr. August Raps to work with the firm of Siemens-Halske to develop fire control equipment. Initially, this project was for the benefit of the Coast Defense artillery, but after the turn of the century, the Fleet began receiving the equipments. The second development was the issue of firing training regulations in 1893, using the new fire control known *Gabelverfahren* system, which allowed observation of changes in target movement in both range and bearing when compared to a scale. Once the target range had been determined, its movements could be tracked, and adjustments made for gun range and deflection, which could be communicated to the guns using the 'direct current 3-roller system,' one of the first range and order equipments. It is very possible that the Germans were the first to actively pursue accurate fire at long range. [34]

Conclusions

A. The test of combat

Unfortunately, there were few ship-to-ship actions in the period covered, that demonstrated fire control to any great extent. Discounting the Battle of Lissa, the field is limited to the *Shah* and the *Huascar* in 1877, the Sino-French War of 1884-5, the Sino-Japanese War of 1894-5, and the Spanish-American War of 1898. Of these, the first has been covered above, and the second offers little. The French squadron made short work of the vastly inferior Chinese ships, mostly in enclosed and calm waters of harbor and river.

The Battle of the Yalu, however, provides some points of interest, one of which has been cited above, to wit, the Barr & Stoud range-finder aboard *Yoshino* encouraged effective fire at 3,000 yards. In addition, at ranges of 2,000 to 3,000 yards, the Chinese battleships were hit a hundred times, though the number of rounds fired is unknown. In the realm of the heavy guns, both *Itsukushima* and *Matsushima* were hit by two 30.5cm shells from the Chinese ironclads, but these may be attributable to the large number of European and American officers serving aboard. On the other hand, the Japanese fired only thirteen 32cm rounds from their big guns, and obtained no hits for their efforts. Both the Chinese and Japanese heavy guns were mounted on turn-tables, so part of the different success rate may be attributable to the basic engineering; Krupp and Armstrongs for the Chinese, and Canet for the Japanese. It is interesting, and perhaps indicative, that the Chinese ironclads opened fire at 6,000 yards, though they could hardly have been effective.[34] They fired a total of 197 rounds from the 30.5cm guns, and obtained a total of five hits (2.54%), and 484 rounds from the guns from 30.5cm down to 4.7-inch, making 48 hits (9.92%), though many of these had been on the old ironclads *Hiei* and *Akagi*, at ranges of only a few hundred yards.[35]

The Spanish-American War was the acid test for the "New Navy", the ships of which carried many of Fiske's inventions. While the failure of Fiske's range-finder has been noted above, as have the subsequent ranging problems, the gunnery statistics are illustrative. The American squadron fired 157 8-inch, 635 6-inch, and 622 5-inch shells, for a total of 77 hits (5.45%), of which the largest portion belonged to the 8-inch guns. But it should be remembered that the targets were at anchor, and the range relatively short, so this performance was considered abysmal.

Of the ships that participated in the Battle of Santiago, the ones equipped with the Fiske range-finder, which should have given them a considerable advantage, also suffered the failure of the instrument. Fortunately, many of the ships in the fleet were also equipped with Fiske's telescopic sight. But since the battle was in the nature of a stern chase at speed, the gunnery conditions were far from ideal anyway. Again, the gunnery statistics paint an interesting picture. Of the forty seven 13-inch shells fired by the *Indiana* class battleships, none hit. *Iowa* managed to get two hits from the 39 12-inch shells she fired (5.13%). But taking the heavy gun performance as a whole, the hit percentage is only 2.33%. Given the reasonably short ranges, the obvious conclusion is that the technology to track a target with those heavy turrets did not yet exist. Of the medium caliber guns, the USN fired 1,208 shells for 40 known hits (3.31%). Though many hits could not be documented, making the actual percentage higher, the gunnery performance was still considered abysmal.[36]

B. Effectiveness

So what does all of this mean? I believe the data supports several conclusions:

1) Based on the performance of the ironclads off Vigo in 1870, 1,000 yards was too great a range for un-assisted fire, which explains why Hans Brusk considered 450 yards an example of long range in 1859. It seems safe to say that effective fire at 1,000 yards was unlikely.

2) Based on *Shah*'s performance, 'director' firing at targets larger than *Huascar* could be effective at a range of 3,000 yards. This would include the Russian Davydov system, and most probably the Elliot Director, mostly due to the lack of effective communications.

3) With big guns and no more technical assistance than a sextant-type range-finder, effective gunnery was probably limited to 2,000 yards [meters], as maintained by Bradley Fiske, and detailed by Karl Lautenschlager.

4) Based on the U.S. Navy's appreciation of the Fiske range-finder, it seems reasonable to conclude that a viable range-finder could extend effective firing out to 5,000 yards. Add telescopic sights, and effective range could be extended to 7,000 yards. This presumes other technical support, such as electronic range indicators, and a central control to calculate deflection.

5) Based on the U.S. Navy's performance in the Spanish American War, viable range with only telescopic sights was probably not greater than 4,000 yards, and more likely 3,000.

6) With a range-finder alone, based on the Japanese performance at the Yalu, effective firing was limited to around 3,000 yards, with open sights.

7) And finally, with a viable technique, in spite of open sights and the lack of an effective range-finder, 3,000 meters could be a practical combat range, based on the French trials.

But the bottom line conclusion, however, is that the fire control developments were effective, and definitely increased the combat range of those navies that applied the technology.

Notes

[1] John Brooks, "Percy Scott and the Director," Warship 1996 (London: Conway Maritime Press, 1996), p. 150 & 155. And Peter Padfield, Aim Straight: A Biography of Sir Percy Scott, the father of modern naval gunnery (London: Hodder and Stoughton Limited, 1966), pp. 189–190. This is confirmed also by the "…stealing a master sight and other fittings from [old] ships in reserve…" on which more below.

[2] Hans Busk, The Navies of the World (London: Rutledge, Warnes, and Rutledge, 1859), p. 239.

[3] Brooks, op.cit., p. 155.

[4] Jack Greene and Alessandro Massignani, Ironclads at War (Philadelphia: Combined Publishing, 1998), p.288.

[5] Ibid., pp.289–290.

[6] Oscar parkes, British Battleships (London: Seeley Service & Co. Ltd., 1957), p.254.

[7] Sir Thomas Brassey, The British Navy: Its Strength, Resources, and Administration, 5 Vols. (London: Longman, Green, and Co., 1882), Vol. III, p.418.

[8] Parkes, op.cit., pp. 236 & 241.

[9] Ibid., pp. 132 & 219.

[10] Greene and Massignani, op.cit., pp. 287 – 291.

[11] Captain H. Garbett, R.N., Naval Gunnery ((London: George Bell and Sons, 1897), pp. 209 – 211. Gunnery in this period operated generally in one of two modes: independent firing or Director controlled salvo firing. Of the two, independent fire was the more common.

Shooting still involved open sights mounted on the gun, though they had become rather sophisticated, allowing adjustments for both shell "drift" and target speed across [deflection]. Elevation was accomplished most likely using a scale graduated in 100 yard increments. Firing the guns was done electronically on the roll when the sight came on the target, and ranges were provided by the Gunnery Officer via voice pipe.

The Elliot Director system was built around a telescope fitted with cross hairs. This telescopic sight, one for each side of the conning tower, was fitted in a vertical frame, which was pivoted on a graduated arc matching the arcs provided for each gun. This frame moved over racers in the same manner as the guns, and allowed the telescope to be elevated or depressed as necessary. It was also the mount for the electronic firing key, and several scales with verniers to display the ranges and corrections. Mounted on the bulkhead of the conning tower, in easy view, were various Tables that included, but not limited to, Range Tables for the guns, the 'speed across [deflection] based on target speed, the 'dip' correction for range, and the elevation/roll effect caused by the 'dip' correction.

The general procedure would be:

1) The Gunnery Officer decides the bearing in train to lay the guns, which was then passed to the guns via voice tube;

2) The range for firing was selected and passed to the guns;

3) The speed across correction is made and the sight set slightly in advance of the gun bearing;

4) The 'dip' correction – an allowance for the greater height of the Director above the guns, larger for close range or smaller for longer ranges – is identified from the appropriate Table and the telescope is depressed from the horizontal accordingly, and then locked in place;

5) When the telescopic sight moved onto the target, the Gunnery Officer depressed the firing key which fired the guns electrically.

If the target should be at a slightly different range than anticipated, the system was sufficiently flexible to quickly compensate. By changing the scale and 'dip correction' for the correct range, and setting the 'dip correction' to the telescopic sight for the correct range, the sight would be on target at a slightly different point in the roll. The effect would be allowing the roll to alter the elevation from the horizontal of the guns at the time of firing, lower for a closer range or higher for a greater range.

The tactic previously described for *Shannon* and *Northampton,* as examples, was a variation of this broadside mode of Director firing, though the guns would be laid for the short range expected during a melee in connection with ramming, as occurred at the Battle of Lissa in 1866.

However, the main purpose of the Director, and no doubt the most common usage by the heavy ironclads, was to deliver converging fire on the target. To accomplish this, converging stops were fitted to the races of the guns so that each gun was aimed at the same point at a range of 600 yards. The stops were set up for three specific lines of bearing – bow, beam or quarter. The procedure was much the same, though instead of being given a specific bearing, the gun captains were told to prepare for "converged firing by director" and which of the three set lines was to be used.

[Special thanks to Dr. John Brooks for his valuable assistance]

[12] Peter Padfield, Aim Straight, A Biography of Sir Percy Scott, (London: Hodder and Stoughton Limited, 1966), p. 55.

[13] Ibid. And Greene and Massignani, op.cit., p. 376.

[14] Lord Charles Beresford, Charlie B. A Biography of Admiral Lord Beresford of Metemmeh and Curraghmore (Boston: Little, Brown, & Company, 1914), Vol. I, p. 182. And Marjorie E. Moore, Adventures in the Royal Navy: The Life and Letters of Admiral Sir Arthur William Moore (Liverpool: C. Tinling & Co. Ltd., 1964), pp. 48 & 49. And Lt. Colonel W. H. Green, "Tel-El-Kabir, 1882," Army Quarterly and Defence Journal, Vol. 88, No. 2, 1964, p.222.

[15] Garbett, op.cit., pp. 212 & 213. This improvement, known as the "Collingwood" pattern after the battleship for which it was first mounted, represented a change in emphasis. First class battleships were now fitted with a secondary armament of 6-inch BLRs which, due to the different ballistics, could not be grouped with the heavy guns of the main armament. So the modified Director was used for the main armament only, and the secondary guns fired independently.

The modifications consisted of:

- the trunnions of the telescope were moved to the outer end and mounted on a pivot. This reduced the required size of the sighting port and kept all movement inside the conning tower;
- the graduated arcs were eliminated, and replaced with graduated movable collars around the inner end of the telescope;
- the 'speed correction' was shown in knots, which eliminated two sets of reference tables, which increased the speed of operation;
- the convergence point for Director firing was increased to 800 yards.

The price for these improvements in operations, and especially the more efficient manner of handling the corrections, meant that each unit was specifically fitted and graduated for the ship in which it was mounted. In other words, there would be one set of tables and corrections for *Collingwood* and her 12-inch guns, and a different set of tables for her half-sister *Benbow,* which carried 13.5-inch guns.

The final iteration in the 19th Century was known "double dial" gun director, developed in the early 1890s for the *Royal Soveriegn* class battleships. The modifications consisted of:

- a more powerful telescope with greater magnification and better focusing;
- a graduated dial with a pointer was placed on each side of the telescope; on the right for the 'dip correction' and required elevation, and on the left for training and speed across corrections for the bow, beam or quarter convergence positions. The graduations of these dials was finer and more accurate than the scales in the previous patterns.

The voice pipes were now equipped with electric bells and indicators to alert gunnery personnel of incoming messages.

[16] Aleksei Pavelovich Dayvdov was a prodigious inventor, and single-handedly put Russia into the premier position in gunnery among the navies of the world, for a period of some ten years.

The first device, known as the 'galvanic [battery powered] electromagnetic lock,' was tested aboard *Sevastopol* in 1865. Basically, this used an electromagnet to initiate the hammer lock which fired the guns, and may be considered the first electric firing mechanism.

Other elements were tested in *Pervenets* in 1872, and the complete system was tried and accepted in 1876 and deployed the following year. By 1880 some 30 ironclads and large cruisers had been fitted with the system.

In brief, the revolved around a Director Sight arranged on a base with markers corresponding to the fixed angles to be used by the guns, and the galvanic firing key. From the bow, these angles were 45-deg, 90-deg and 135-deg. However, the firing circuit had to be closed in four distinct places to actually fire the guns.

The first step in the process was the Gunnery Officer selecting a target, fixing the Director Sight on the fixed angle most appropriate to the situation, and determining the range at which to fire. This information was communicated to the guns – choice of angle and range in 'cables' [200 yards each].

The gunners had two indicator status switches next to their gun. When set for 'aiming' the gun was not connected to the electrical circuit, and the gun was trained to the proper angle and the rear sight adjusted for the proper range. The status indicator was then changed to 'ready' and their portion of the circuit with the inclinometer was closed.

The next step was to maneuver the ship to bring the guns into line with the target. Near the helmsman was a 'steering apparatus/instrument' which showed the three fixed gun angles and a 'galvanic indicator' which was synchronized with the Director Sight. The helmsman's task was to steer the ship so that the indicator was aligned with the correct gun angle, thus closing another part of the firing circuit.

When the ship was properly aligned and all the guns reported 'ready,' and the Director Sight was aligned with the target, the Gunnery Officer closed his firing key, closing that portion of the firing circuit.

The final step was particularly ingenious. Davydov had developed a 'galvanic inclinometer' in which a pendulum swung along a graduated arc. In the 'zero' position of the roll cycle, the pendulum closed the final portion of the circuit, which initiated firing the guns.

Some thirty ships of the Baltic and Black Sea Fleets were equipped with the system by 1880, and it remained in service through the 1880s, when it was overtaken by advancing technology.

As a practical matter, the guns could certainly fire independent of the Director, on local control, with range and target bearing provided by the Gunnery Officer, but not using the galvanic firing system. In this mode of operation, they certainly would have performed as well as *Shah*, though there is an unfortunate lack of combat use to demonstrate the capabilities of the system.

A.V. Khramoi, History of Automation in Russia Before 1917 (English translation; Jerusalem: Israel Program for Scientific Translations,1969), pp. 87,134,135,179 – 181. And Captain Dr. A.V. Platonov, "Domestic Gear for Controlling Artillery Fire," Tsitadel, No. 6 (no. 1, 1998), p.94, (translated by Steve McLaughlin). And Norman Friedman, Naval Firepower, Battleship Guns and Gunnery in the Dreadnought Era (Annapolis: Naval Institute Press, 2008), p. 170.

[17] A.P. Davydov continued his work on fire control to at least 1890. While the information is very sketchy, and there is no certain if any of his subsequent inventions were actually accepted and deployed, an account of his work is indicative. It is extremely unfortunate that no drawings or specifications have survived.

1) It appears that an application of his 'steering indicator' was used with what we might call 'follow the pointer' instruments. "When the gun layer behind the gun aims at a moving target through the sights of a 'galvanic indicator,' an indicating device in front of the gun crew shows the same marks as do the sights, so that the crew, by traversing the gun mounting that carries both the gun and the layer, can always keep the gun aimed at the moving target." The wording is stilted and obscure, but 'galvanic indicator' is the term used for the Director Telescope. This seems to indicate that there was a pointer in the gun layer's sight and another in front of the mount, synchronized with the Director Telescope.

2) It also appears that in 1881 Davydov developed a means of electrical control of gun elevation. "…the gun elevating gear has special contacts connected with the range finder [sic] and so arranged that, when the elevating handwheel is turned, the gun elevation will be the correct one for the

range finder indication…the handwheel does not have to be turned continuously, but only for a few seconds.” In a report to the Russian Engineering Society, Captain L.P. Semechkin commented on this proposed design on 5 June 1991; “As regards continuous setting of guns at elevation angles corresponding to the movement of the enemy, which is followed-up by a special observer, who determines the changing range, Davydov goes very far and offers the design of a gun mount that will set the gun at the required angles, this arrangement being the only one that ensures correct azimuth and elevation at the moment of firing.” Unfortunately, there is no hard evidence what form of device this was, but the ‘special [electrical] contacts’ in the absence of powerful electric motors capable of elevating many tons of gun, and that the actual change in elevation was accomplished by the handwheel, implies something akin to a ‘follow the pointer’ set-up where a crew member turns the handwheel to match a pointer. Such an arrangement was within the technology already demonstrated by the ‘steering indicator’ that was part of his Director system, though this is speculation.

3) Davydov also worked on gun stabilization to compensate for roll. The device “linked the indicator of the inclinometer with the elevating gear contacts in such a way that the gun elevation would be increased or decreased by an angle compensating for the ship’s roll and pitch, so the gun could be fird at any time at the correct elevation.” This would certainly be an ingenuous use of the inclinometer. One is reminded of the *abferungs Gerat* used by the Imperial German Navy after Jutland which used a gyro device to stabilize the gun relative to the target, so the concept is certainly valid. It is unfortunate that the details of the design have not survived.

4) In 1877, Davydov devised a complete system for the indirect fire of coastal guns. The test shoot was done with 6-inch mortars located behind a forest where it could not see either the target or the fire control post. A target was mounted on a boat with a beam of one meter, being towed at a speed of 9 knots. The fire control post could see the target, but not the guns. Davydov tested the system off Vyborg in 1879, and direct hits were achieved at a range of about 2150 meters.

The heart of the system was some form of calculator! As Davydov wrote at the time, “The lead does not depend on man’s considerations but by the nature of things, ie., on the time taken by the shell and the speed of the enemy vessel. Prediction is done automatically and does not require any calculations or other combinational considerations by fire control personnel.” He described the device/system to the Director of the Ministry of Marine on 28 February 1890 as follows: “My automatic method of imparting the correct elevation to the guns requires that quadratic equations be solved immediately and automatically, that is, that, in accordance with the movement of the target, followed by the range finder, the guns be set immediately and automatically at the corresponding elevation angles, with an accuracy of 1-deg/40 minutes or 1/14.4 of a circle, and this in addition to being simultaneously imparted both a vertical and a horizontal lead in accordance with the movement of the said target.”

It should be noted that whatever this device was, it performed 23 years before the Dumaresq, and testifies to Davydov’s genius. Khramoi, op.cit., pp. 134 & 135, 181 & 182.

[18] Richard N.J. Wright, The Chinese Steam Navy, 1862 – 1945 (London: Chatham Publishing, 2000), p. 60.

[19] Paolo E. Coletta, Admiral Bradley A. Fiske and the American Navy (Lawrence: The Regents Press of Kansas, 1979) pp. 19, 20, 21, 30.

[20] Ibid., pp. 28 – 28.

[21] Ibid., p. 29.

[22] Ibid., p. 38.

[23] Ibid., pp. 31, 32, 35.

All Range Finders, be they sextant-type, two observer or single observer instruments operate on the same principle; to wit, a trigonometric problem. They are all based on the following reasoning; if one knows the length of one side and two angles of a triangle, the length of the other sides and the third angle can be calculated easily. From there it is a simple process to determine the linear range from the firing ship to the target.

The earliest attempts to determine the range used sextant-type devices. In this case, the object being measured was the height of the main mast above the deck. Using this figure as the 'base line' combined with the two angles – the one at the deck assumed to be 90-deg. and the other determined by the sextant representing the angle from the top of the mast to the observer – the calculations are rather simple. However, the error factor creeps into the situation in two forms; the height of the mast is not correctly known, and the roll of the observer's own ship tends to distort the results. The Russians developed an instrument to be used horizontally rather than vertically, using the length of the target ship, which produced much better results. The obvious problem was the angle of and/or the heading of the target ship, which would distort the 'base line' and produce inaccuracies.

The two observer system, as invented by Fiske and developed independently by the Imperial German Navy, was much more reliable. In this case, as described, the base line is the known distance between the two observer stations, each of which produces an angle to a prominent feature of the target, such as the fore mast or forward funnel. In this system, the base line is known and the two angles reliably acquired, It would produce accurate results from about any angle from which both observers could sight on the target.

The single observer equipment, in this period represented by Bar & Stroud, provides the known base line, in this case the length of the instrument itself, and through a system of lenses and mirrors, allows the range to be determined. But its accurate range is limited by the length of its base line; longer instruments being much more accurate over longer ranges than short base line instruments.

[24] Ibid., p. 54.

[25] Michael Moss and Iaian Russell, Range and Vision, The First Hundred Years of Barr & Stroud (Edinburgh: Mainstream Publishing Company Ltd., 1988), p. 20.

[26] Ibid, op.cit., pp. 30 – 33.

[27] Coletta, op.cit., p.36.

[28] Ibid, op.cit., p.44.

[29] Karl Lautenschlager, "A Majestic Revolution," Warship Volume VII (London: Conway Maritime Press, 1983), p. 111.

[30] John Spencer, "Conduite du Tir: the Birth of Centralized Fire Control," Warship 2010 (London: Conway Publishing, 2010), pp. 159, 165, 165.

[31] A very great technical problem was getting the information from the Gunnery Officer to the guns. As previously mentioned, the Elliot Director relied on the ew [in 1868] voice pipe technology. In 1880, Percy Scott joined HMS *Inconstant* as the Gunnery Lieutenant. This ship, the first of the large iron frigates, completed in 1869, and had neither boice pipes nor Elliot Director. Scott designed a range telegraph along the lines of the bridge to engine room telegraphs, and submitted it to the Admiralty in May 1881. Unfortunately it was not taken up until after the turn of the century.

Between 1885 and 1893, Bradley Fiske had patented a number of devices which, taken in sum, would have constituted a Director system. However, he had changed his focus to the individual guns and had perfected an electric range transmitter and the range indicator receiving unit, coupled with his speed and direction indicator passed the necessary information to the guns or battery. With his range finder, these instruments were widely used in the New Navy.

The French Navy had not developed a Director, but in the early 1890s were keenly aware of the importance of Range and Order Transmitters to get the necessary information from the Gunnery Officer to the batteries of Quick Firing guns. The first proposal for such a system to warrant trials came from L V Loncelet in 1893. This was a system of cables and lamps to transmit bearing, range and deflection. Each turret/barbette would have eight cables for eight lamps. But the system could handle only five pre-set ranges between 400 and 2200 meters, and deflection was also restricted to five values. It was tried on the *Neptune*, but was ultimately considered insufficient.

A system from L V G, Eng was tried in 1895 in *Amiral Duperre'* successfully, and by November of 1897 was aboard *Brennus, Jureguiberry, Marceau, Neptune* and *Amiral Charner.* The equipment involved six dials to be read in pairs, from right to left. The right hand dial for range was graduated in 1000 meter increments, from 1000 to 4000. The left hand dial was graduated in 100 meter increments from 0 to 900. The right hand Deflection dial was split into right and left scales, to distinguish between fore and aft direction of target movement. It showed target speed in knots in 10 knot increments from 0 to 30 on each side. And the left hand dial was denoted in knots from 0 to 9. Target bearing was handled much the same as deflection. Both sides of the Right hand dial had two increments, 0 and 100, while the left hand dial was graduated in 10 degree increments from 0 to 90.

In early 1898 a competing system appeared, having previously been tried on the cruiser *Latouche-Treville*. This was the L V Germain hydraulic system using nanometers instead of electric voltmeters as in the Eng system. It had only four dials, including one for orders. Deflection, right and left, was in 2 knot increments between 0 and 30. Range was in 100 meter increments from 1000 to 5000. And bearing was given on a single scale from 10 degrees to 180 degrees in 10 degree increments. Trials in 1899 proved so successful that it supplanted the Eng system for new construction.

Barr & Stroud had offered to develop a 'Range and Order' system, and when the British Admiralty affirmed interest in June 1892, development began in earnest. Prototypes were ready in 1894, and the device was ready for sale in July of 1898. But while the Admiralty was deciding whether to buy, the Japanese Navy began placing orders for the new 'Range and Order Indicator' before the end of that month! By February 1901, 30 transmitters and over 200 receivers had been sold; one set to the Admiralty for trials aboard *Canopus*, and another set for an Argentine coastal fort, with the balance being bought by Japan. The device was entirely electric, using electromagnets to synchronize the pointers between the transmitter and the receivers.

Padfield, op.cit., p. 48. And Coletta, op.cit., p.38. And John Spencer, "Conduite du Tir: the Birth of Centralized Fire Control," <u>Warship 2010</u> (London: Conway Publishing, 2010), pp.165 – 169. And Moss and Russel, op.cit., pp. 34 & 34.

[32] The Russian Navy also abandoned Director Control for the reasons noted above. They also saw salvo firing as too limiting, as the rate of fire was determined by the slowest gun. In the case of the slow firing heavy guns, this was an obvious conclusion. Early on, the Russian Navy had adopted a standard battery caliber of 6-inch guns which, with their M.1877 family of guns, had a rate of fire substantially quicker than the heavier guns [if contemporary US naval guns are any measure]. This led to the change to decentralized shooting, with the role of the Gunnery Officer being to supply the relevant data for sight setting. However, this produced a practical limitation insofar as spotting the fire of an individual gun was left to the layer/gun captain of that gun. Beyond a range of 10 cables [2000 yards] such spotting became confused with the fire of other guns, reducing the ability to make corrections.

The solution came in 1893/94 with the system produced by the N.K. Geisler and Co. electromechanical works. This well conceived system integrated multiple functions in the following manner:

1) The range finder positions [Stadimeters; B & S optical rangefinders for evaluation were only received in 1899], two of which were in the tops, were equipped with electric 'range transmitters;'

2) The Gunnery Officer in the conning tower had the receivers in the 'main range finder' display, and could evaluate the ranges received and enter the result in his own 'range transmitting dial' to the guns;

3) Target bearing was determined by use of a 'battle indicator' [an improved Davydov telescopic sight] and transmitted to the guns;

4) The manually calculated deflection was also transmitted to the guns in the same manner;

5) The 'battle transmitting dial' was used for basic orders: 'short alarm' [Ready for centralized salvo firing by electric firing circuit], 'Attack' [Fire! Independently], and 'Drumming' [Cease Fire].

6) With the 'shell transmitting dial' the Gunnery Officer could specify the type of ammunition to be used, be it armor piercing, Common high explosive, shrapnet [for defense against torpedo boats and destroyers] or practice [old cast iron projectiles].

Note that during independent firing, range, target bearing and deflection would be updated continually, which included spotting corrections.

As with the French system mentioned above, the main weapon of attack was the QF battery, with the heavier guns joining as they were able.

While the Geisler system was conceptually very advanced, and shared many aspects of the later Director systems, it was limited in its efficacy by the lack of optical and more accurate range finders and telescopic sights for the guns, and any form of mechanical calculstion device for solving the Fire Control problem. Still, it was the best system produced in the late XIX century. Norman Friedman, U S Naval Weapons (Annapolis: Naval Institute Press), p. 17. And Platonov, op.cit., pp. 94 – 96. And Stephen McLaughlin, Russian & Soviet Battleships (Annapolis: Naval Institute Press, 2003), pp. 35, 63, 75, 81, 88, 112.

[33] Friedman, Naval Firepower, op.cit., p. 158. And Guy Hartcup, The War of Invetion (London: Brassey's Defence Publishers, 1988), pp. 12 & 14. And Paul Schmalenbach, Die Geschichte der Deutschen Schiffs-Artillerie (Herford: Koehlers Verlagsgesellschaft mbH, 1968), pp. 57 – 62. And Paul Schmalenbach, "German Heavy Large Bore Guns Operational Ashore During World War I," Warship International, No. 2, 1983, p. 148.

[34] The *Gabelverfahren* system had its crude origins in the Prussian Army Field Artillery in 1875. Their simple device consisted of two short poles connected by a known length of chain. On top of each pole was a graduaged plate with a sight bar. By aligning each sight bar with the same target, the two angles would be used with a pre-calculated Table to provide the range.

This concept was given to the Navy in 1880 for use in the coastal fortifications. Obviously the naval version would be scaled up considerably, and the problem of communications between the now distant observer stations and the fire control center addressed. In the aftermath of the *Bayern's* shoot, in addition to ordering range tables for the guns in the fleet, von Thomsen initiated a test project to determine if the two station range finder and conversion tables could be adopted for naval use. Over the next few years, a test ship [possibly *Oldenburg*] was used for experiments in the Baltic. By 1890 the results were favorable, and von Thomsen authorized its formal development, and in 1893 the system was accepted for deployment. The first ships constructed with the equipment were the *Kurfurst Friedrich Wilhelm* class, and the ironclad *Kaiser* the first to receive it during her re-construction.

In these early installations, a special circular top wa fitted to the fore and aft masts, generally at the same height. They were sheltered from the elements but had 360-degree traverse. On the inside rim was a finely graduated scale, and most likely races in the deck for movement of the sighting telescope. Each nearly identical top was connected to the conning tower by mechanical telegraph for reporting the angle of observation. The crows' nests, mounted still higher on the masts, were for spotting.

In the conning tower, calculations from successive range takes were used to calculate the rate of change of range, rate of horizontal deflection, target speed and course, and of course range. Bearing and range were then communicated to the guns, likely by voice pipe or possibly by mechanical telegraph. There is no evidence to hand that either a Director or electrical firing was used, nor what means were used to deal with the roll cycle.

In 1897 the system was upgraded considerably. The mechanical telegraphs were replaced by electric telegraph units, and a new device was added, quite possibly as a result of Dr. Raps and Siemens Halske's work. It was known as the *Stand Gerat* [St.G] it was to measure target bearing and change of bearing rate. This was most likely a telescopic sight mounted on a stand with a graduated ring, located on or near the conning tower. Its use simplified the calculation process by eliminating a number of steps, and thereby enhanced the speed of the FC solutions. Dariusz Mzurowski, e-mails to the author dated February 11 and 25, 2005, summarizing information from an article by Koop & Schmolke.

[35] Wright, op.cit, pp 86 – 93. And H.W. Wilson, Ironclads in Action, Vol. II (London: Sampson Low, Marston and Company Limited, 1896), pp. 88 – 111. And Peter Brook, "The Battle of the Yalu, 17 September 1894, " Warship 1999 – 2000 (CLondon: Conway Maritime Press, 1999), pp. 37 – 41.

[36] H.W. Wilson, The Downfall of Spain (London: Sampson Low, Marston and Company Limited, 1900) pp. 146 & 146, 172 & 173, 338 – 340. Peter Brook, "Spain's Farewell to Great-

ness: The Battle of Santiago, 3 July 1898," Warship 2001 – 2002 (London: Conway Maritime Press, 2001), p. 44. And Coletta, op.cit., pp. 54 & 55.

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HELP SOLVE AN HISTORICAL MYSTERY!

In 1859 France completed the first ocean-going ironclad warship, «La Gloire», and changed the definition of naval power completely. Russia, as all the other Powers, found that her most powerful naval gun, the 60-pdr, was insufficient for modern warfare, and realized the future naval armament relied on heavy rifled artillery. Both the Army and Navy began purchasing such cannon from foreign providers until a suitable domestic weapon could be produced. The relationship between the Russian military and Krupp is well known. But there was another provided, the Blakely Ordnance Company in England sold many guns to the Army and Navy, beginning with 8-inch MLR in early 1863 to a large number of 9- and 11-inch guns. Deliveries began in November 1863 and continued until mid-1866. But no sources on the armament of Russian ships and fortresses mentions these guns. What happened to them is a mystery.

С постройкой во Франции в 1859 г. первого океанского броненосца «Ла Глуар», ситуация с ранжированием военно-морской силы кардинально поменялась. В России, как и в других державах, неожиданно обнаружили, что самые мощные 60-фнт орудия стали недостаточными для современной войны, и стало понятно, что будущее военно-морских вооружений за тяжелой нарезной артиллерией. И армия, и флот начали искать зарубежных поставщиков, пока это оружие налаживалось в производстве на отечественных заводах. В настоящее время хорошо известны связи между русскими военными и Круппом. Но был и другой поставщик – компания Блекли из Англии, которая продала множество пушек для армии и флота, начиная с 8" дульнозарядных нарезных в начале 1863 г. и большим числом 9" и 11". Поставки начались в ноябре 1863 г. и продолжались до середины 1866 г. Но до сих пор нет однозначного ответа – на вооружении каких кораблей и крепостей стояли эти орудия. Что произошло с ними – также остается загадкой.

In the process of researching an entirely different subject, I came across some information that bore directly on the history of the Russian Navy and Coastal Fortifications during the years from 1860 to 1867. The predominant view, especially in the West, is that the revolutionary change to ocean-going ironclad warships and heavy rifled artillery left Russia with nothing but smooth bore guns until the M.1867 guns began to be produced. This has always struck me as unlikely, and now there is evidence to refute that common view.

The story seems to be this; in 1862 Captain Alexander Blakely, late of the Royal Artillery and one of the preimmenient artillery designers of the age, sent two heavy guns to St. Petersburg to be tested. These two guns were possibly an 8-inch 200 pdr steel muzzle loading rifle, and an 11-inch cast iron reinforced with steel hoops, capable of firing a 400 lb (181.4 kg) bolt using a 35 lb (15.88 kg) charge of black powder. [see the illustrations] It appears the Russian Navy and Army were pleased, and there is indication that a number of 8-inch, and perhaps 6-inch 70 pdr, guns were ordered for the Fleet.

Early in 1863, Blakely was in St. Petersburg, and entered into a partnership with Francis Biard (‘Bard’ in Russian). Francis owned and operated a foundry, originally started by his father Charles in 1762, located in Kolomenskaia on the mouth of the Neva River to the West of the city. Their efforts were rewarded in October of that year with Contracts from the Navy for 9-inch all steel guns for sea service, and 11-inch all steel guns for the Army for Kronstadt and other fortresses protecting St. Petersburg. The total number of guns seems to have been 160.

The first of the 11-inch guns for the order from Blakely's English facilities began in November 1863, and the planned rate of production was one gun per month for the following two years. Deliveries of the 9-inch guns from England began in February 1864. By October 1864 some forty of the 11-inch guns had either already been delivered or were in various stages of construction; a rate faster than the one gun per month planned the previous year.

Unfortunately, production at the Bard foundry is not known…

It appears that the Russian Army and Navy were happy with the guns there were receiving, for in March 1865 they increased the quantity to 220 guns, specifying 8-inch, 9-inch and 11-inch guns. There may have been a clause in the contract for the Army that encouraged Blakely to think in terms of larger and more powerful guns that the 11-inch, for in June 1865 he had a 12.75-inch 900-pdr gun (similar to the guns sent to Charleston, see illustrations) under construction for them.

All of this activity did not go unnoticed. For one thing, large sums of money were involved. The 160 guns ordered in 1863, with carriages, amounted to 960,000 Pounds. Even a Member of Parliament noted the "…immense orders for the Russian Government – 11-inch gund for the defence of Cronstadt [sic], and 8-inch guns for the Russian Fleet…the iron-clad fleet of Russia was now [1865] armed with Krupp's and Blakely's guns…" and speculated on the power of those guns against Britain's own ironclad warships.

The big question becomes what happened to all of those guns? From early 1863 to the time his business collapsed in 1866-67, Blakely's English facilities possibly delivered 200 guns to St. Petersburg, not including any production by Bard. Yet there seems to be no record or evidence of their use.

I examined Shirokorad's wonderful tome on Russian Artillery. There seemed to be some hints, but nothing specific. Then I saw the drawing on page 127. It purports to be the Krupp 9-inch smooth bores that were "supposedly" mounted on the monitors in 1865-66. Yet it did not resemble any Krupp configuration I was familiar with. So I examined Holley's <u>Treatise on Ordnance and Armour</u> from 1865. In it I found a drawing of the 9-inch Krupp smooth bore and a drawing of a 9-inch Blakely rifle. The two were not similar, but the Blakely gun and the drawing on page 127 are strikingly similar! (see illustrations) We therefore have a *modus ponens* logic problem:

If the Holley drawings are accurate, and

If the drawing Shirokorad provided on p. 127 is an accurate representation of the guns on the monitors,

Then the guns on the monitors were Blakely and not Krupp.

While this might be indicative, it is not conclusive. Nor is it conclusive that some of the projectiles for muzzle loading rifles strongly resemble the Blakely pattern, neither that of the French nor that of Armstrong.

Rifled artillery was introduced into the Russian Fleet as early as 1860 aboard the wooden *Gaidamak*, in the form of four 3.4-inch 4-pdr guns to supplement the smooth bores. The following year saw the 4.2-inch 8pdr gun carried in the wooden

Abrek. In 1862, the wooden *Almaz* and her three sisters carried three 6-inch rifled, two 4.2-inch rifled and two 3.4-inch rifled.

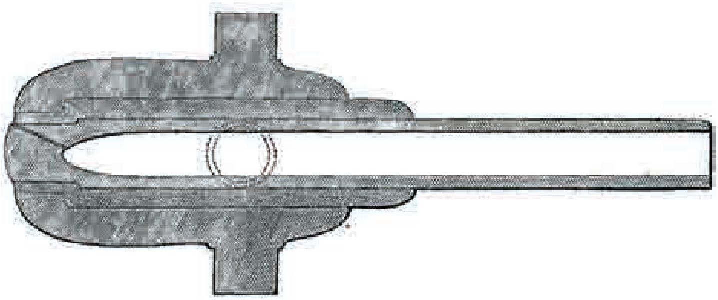

Image 1 Blakely 9-inch gun from Holley [1, p. 40]

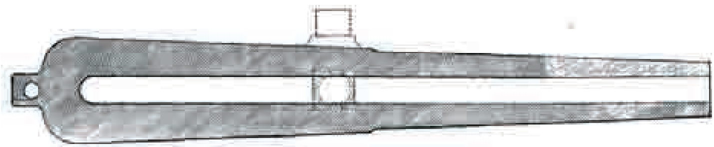

Image 2 Krupp 9-inch smooth bore from Holley [1, p. 93]

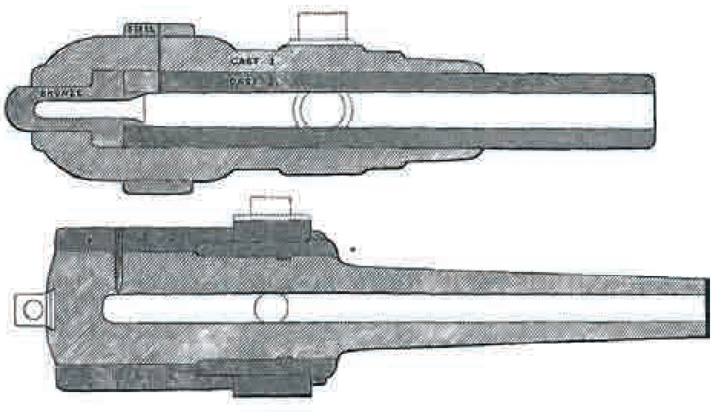

Image 3 11-inch Blakely gun probably sent in 1862, cast iron with steel hoops. And the 12.75-inch gun from Charleston. Blakely may have sent an improved version to St Petersburg. From Holley [1, p. 44]

The 4pdr and 8pdr guns were developed in Russia who began experimenting in 1858 to copy the "French" system. But at that time, the French were using two or three grooves, whereas the Russians settled on six grooves. So what was called the "French" system may very well have originated in Britain, possibly with Armstrong or Blakely.

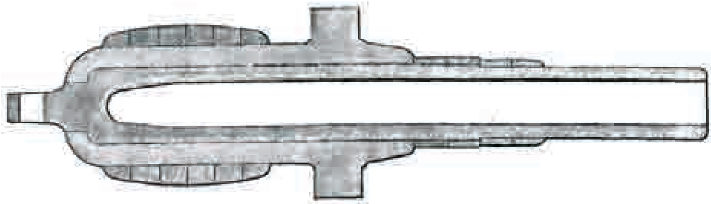

Image 4 8-inch all steel gun of the type sent to St Petersburg, from Holley [1, p. 41]

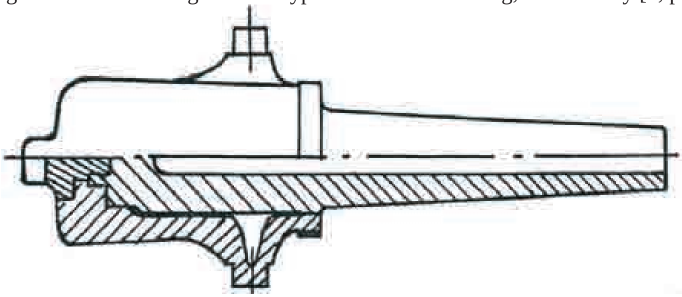

Image 5 From page 127 of Shirokorod's tome [3, c. 127]

The origins of the 6-in rifled are something of a mystery. We do not know if the guns were muzzle- or breech- loaders. If they were breech loaders, than Krupp is the most likely provider. If they were muzzle-loaders then the possible sources are very limited. At that time, 6-in was an unlikely caliber. The only two potential suppliers were Dahlgren and Blakely. The former can probably be ruled out, as the 80-pdr had the disconcerting tendency to burst, so most likely Blakely's 70-pdr provided these guns.

In summary, if the Russian Navy saw fit to put some rifled guns – admittedly shell guns -- on several small wooden ships, does it stand to reason that the iron-clads and steam warships, still the body of the Fleet, must make do with smooth bores, especially considering the tremendous sum of money the Government paid to Blakely and Krupp? I think not. I believe the story of the 1860 to 1867 period has yet to be told. The trick, of course, is to find the evidence.

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THOUGHTSON THE NAVAL TECHNOLOGY USED IN THE BATTLE OF THE YALU

Naval Combat is invariably a clash of technologies. The Battle of the Yalu is unique in that it was the last battle in which ironclads participated, and the first battle influenced by the new technologies of Range Finders and Quick Firing guns, and represents the transition from Black Powder propellants to slow burning Brown Powder and nitrocellulose propellants. This article seeks to focus on the technologies involved as a partial explanation of its outcome.

Морской бой представляет собой войну технологий. В этом отношении битва на Ялу уникальна тем, что это был последний бой, в котором участвовали броненосцы, и первый бой в котором сказалось влияние новых технологий: дальномеров и скорострельных орудий, и переход от дымного черного пороха, для замедления горения на коричневый порох и порох на основе нитроцеллюлозы. Эта статья представляет попытку объяснения результатов сражения путем анализа этих технологий.

Naval combat invariably is a confrontation between technologies, influenced by the people involved. A detailed study of any naval battle, be it Salamis, Trafalgar, Lissa, Tsushima, Jutland or Leyte Gulf, reveals men compensating for a technical inferiority or exploiting a technical superiority.

The Battle of the Yalu is no different. The Chinese fleet represented the best technology of the 1880s. The Japanese fleet represented a “mixed bag” of technologies, but were the clear victors. This brief paper is intended to examine the Fire Control/Gunnery technologies of both sides, hopefully to increase understanding of this brief period in history.

The engagement was fought at very close range. Compared to the well known actions at long range, such as the Run to the South at Jutland, or *Bismarck* and *Hood*, which have accustomed us to multiple thousands of meters range, the Battle of the Yalu was fought at “spitting distance.” The reason for this was primarily technical. These technical aspects also explain why gunnery practice and Battle Practice was made at short ranges, among all Navies.

First, it is necessary to understand that the Breech Loading Rifles (BLRs or RBLs) fired very slowly. Compared to the combats in the First and Second World Wars, the Battle of the Yalu was naval action in slow motion. Tactics and combat capabilities were severely limited by this aspect.

Under ideal conditions, which of course did not exist in real life, the Muzzle Loading Rifles (MLRs or RMLs) could fire once every four minutes. The large BLRs of the 1860s and 1870s were not any better. This begs the question of Fire Control, defined as calculating where the target will be in terms of range, bearing angle, and estimated target course angle. In a five minute period, a ship steaming at 12 knots will travel a distance of 1852 meters (2160 meters at 14 knots), which is several ship lengths. Even if the target cooperates and maintains a straight course, the changes in the situation are considerable. Consequently, each shot must have a new solution.

These Fire Control solutions were entirely manual. Target range was either estimated by eye, or estimated with a sextant-like instrument which keyed off the waterline and the known height of some feature, such as mast or funnel height. Obviously accurate estimates were increasingly difficult as range increased. An accurate and reliable rangefinder would do much to improve the situation.

The "state of the art" of gunnery may be described in the following eye witness accounts. According to Admiral George Ballard, as a young man aboard the *Resistance* in 1876, the rear sight had ranges marked off up to 4,000 yards, but "…firing practices were very seldom carried out at more than 800." A Petty Officer aboard *Victoria* in the 1890s noted that "the target was usually a spar with a red flag on it, at a distance of some two thousand yards or less…" And Admiral Ballard, while aboard *Temeraire* in 1884, described the Annual Prize Firing as a target "stretched on a row of poles on a raft…and ranges of about 900 to 1,400 yards were marked by buoys instead of being left to guess work…" At the time of the Yalu battle, the Imperial German Navy, the most advanced in the development of long range gunnery, had only recently increased their practice range to 2,500 meters.

The only ship equipped with a viable rangefinder was the Japanese cruiser *Yoshino*, which carried the eighth production model of the Barr and Stroud optical coincidence instrument. But this single device allowed the "Flying Squadron" to engage effectively at the then unheard of range of 3,000 yards, and gave the Japanese a tremendous advantage.

While firing to the correct range is no doubt a great accomplishment, the guns still needed to be laid correctly. All of the guns in the Chinese and Japanese fleets had only open sights, attached to the guns! Like a modern hunting rifle, the rear sight must be lined by eye with the front sight and the target. For the hunter, this is a precision skill. But imagine attempting the same feat with a gun weighing many tons, in the absence of precision controls for both elevation and traverse. Now imagine performing the task on a rolling and pitching ship at sea.

The "state of the art" called for firing "on the roll" when the sights were on target. There were two problems with this method. First, the recoil of one of the big guns would affect the motion of the ship, providing a *de facto* delay to other guns. Either the gun captain waited for the roll before firing his gun, or the gun was fired anyway, producing questionable results. And second, firing "on the roll" required that the target be visible.

Guns using black powder as a propellant produce a **lot** of smoke! And the smoke tends to linger in the area, making hazy conditions if not outright impenetrable fog. And virtually all of the guns in the Chinese and Japanese fleets used black powder. The most common propellant was Prismatic Black; a compressed mold of powder intended for slower ignition than loose powder. However, the nature of black powder prohibits dependable regularity of burning. This also mitigated in favor of short ranges, as the irregular performance of the propellant equated to irregular and undependable ranging, so the greater the range, the less likelihood being able to consistently fire to that range.

By extension, the test of the 71-ton (40cm bore) at Meppen on 5 August 1879 will serve as an example. Under ideal conditions, that is stable test platform and every effort made to duplicate the same conditions for each shot, the gun was fired several times at a range of 2,500 meters. The results were described as “very accurate…excluding the first two regarded as trial shots, the vertical dispersion was only 17 ¾ inches and the lateral dispersion 71 inches…” By inference, these variations are primarily due to the irregular burning of the Prismatic Black powder used as the propellant. From a rolling and pitching deck of a ship, such irregularity decreased the possibility of accurate shooting as range increases.

In the mid 1880s, Brown Powder came into use. This had the advantage of producing about half the smoke as black powder. It also burned with much greater regularity than did black powder. This made it more suitable for the “Quick Firing” gun cartridges then being introduced, and as a secondary effect, promoted firing at longer ranges.

But Brown Powder was being eclipsed by the advent of “smokeless” (by comparison with Black and Brown powder) nitro-cellulose powders, such as the British Cordite, the French Poudre B, and Noble’s Ballistite. Of all the guns used at the Yalu, only the newer guns used Brown Powder, and only the *Yoshino* had Cordite for her Quick Firing guns. Most of the Chinese guns used Prismatic Black powder, and the rest used Brown Powder.

The devices that would compensate for roll and provide simultaneous fire of the guns were already in existence. These were the Director Sight and electrical ignition circuits to the guns. The latter had been developed around 1868 in the British Royal Navy, and so was widely known. Yet even in the mid-1880s it was offered as an option by Armstrongs, and presumably by Krupp.

The history of the Director is a subject still awaiting full investigation. It seems to have been invented in the early 1850s by a Captain Moorsom, RN. In the mid-1870s, Admiral Sir George Elliot developed a serviceable Director system, first used successfully by *Shah* in her bout with the *Huascar* in 1877. Its use at Alexandria, Egypt, in 1882 gave mixed reviews. The problem was a method of communication from the Gunnery Officer to the guns, as the voice tube seemed insufficient in the din of battle. Sir Percy Scott, when a young Lieutenant in 1881, invented an electronic device to visually transmit information to the guns; but it was still lying dormant in the Admiralty. Bradley Fiske also invented electronic range transmitters and indicators, but they were not available outside the U.S. Navy. And Barr and Stroud began development of electric range and order indicators only in 1894.

However, four of the ships built by Armstrongs were equipped with both the Director and electrical circuits for salvo firing, two on each side! These were the Japanese *Naniwa* and *Takachiho*, and the Chinese *Chih Yuen* and *Ching Yuen*. From a gunnery effectiveness view, it is interesting that both the Japanese ships were in the Flying Squadron with *Yoshino*. Even though both were armed with slow firing BLRs, their ability to shoot accurately would be greatly enhanced.

Another side effect of the slow rate of fire of the BLRs was that a large ammunition supply was not required. There is not a great deal of specific information available, but what is widely known is probably indicative. By way of example, the official load-out of the Chinese *Ch’ao Yung* class, which includes the Japanese

Tsukushi, was 34 Common, 10 Shrapnel, 6 case shot, 36 chilled (Palliser) shells, and 14 chilled (Palliser) shot per ship. This is fifty rounds per 10” gun. For the short 4.7” guns, the supply was 12 Common, 30 segmental, 30 shrapnel, and 10 case shell per gun. The *Chen Yuen* class battleships carried fifty rounds per 30.5cm gun. The *Matsushima* type had sixty rounds for the 32cm guns, and one hundred for each 4.7-inch QF.

Bursters were most likely black powder. The British seemed loathe to experiment with high explosive fillers, only approving the use of Lyddite for medium caliber Common shell in the late 1890s, in time for Kitchener’s march up the Nile. The Germans adopted gun-cotton in 1883 (Gf/83), and the French shortly thereafter, but its use was short lived, being superseded by picric acid in the late 1880s (Gf/88 for the Germans, Melinite for the French). If some of the German made shells were filled with gun-cotton, it would in part explain why there was a shortage of explosive shells in the Chinese fleet; the valuable gun-cotton was removed and sold for its industrial/commercial uses. Nor could the supply of domestically produced shells could not be trusted. As Richard N.J. Wright noted, “*Ping Yuen* scored a direct hit on *Matsushima* at one point with her 10.2-inch [26cm] gun. Unfortunately the shell was Tientsin-made and found to contain cement, not HE.”

* * *

The late Peter Brook drew some conclusions in his treatment of the Battle of the Yalu, which deserve some closer scrutiny. He noted that “The battle exploded the myth that small, fast unarmoured ships carrying a powerful big gun armament could, by means of superior speed, defeat a battleship by choosing their own decisive range. *Ch’ao Yung*, *Yung Wei*, *Naniwa*, *Takachiho* and the three big Japanese cruisers were all designed on this principle.” This statement is misleading at best, and only partially valid.

In his <u>Warships for Export</u>, Dr. Brook gives the background of the so-called Elswick Cruisers at some length. The original memorandum was probably written by Stewart Randel in the late 1870s, and explained the specifications of the new cruiser type with its vitals protected by an armored deck only. Hence, they were the proto-types of the Protected Cruiser, and not completely unarmored or unprotected. The wording of the quote above is a little obscure, and seems to imply that a single such cruiser could overcome an ironclad battleship. Yet the specific memorandum says something quite different. “These larger [than gunboat] vessels from their great speed and artillery power combined, would be able to follow up and search out ironclads and to choose their own mode and time of attack…five of the new vessels could be built for the cost of one such ironclad. Collectively, they would offer greater power than the ironclad.” From the use of plurals when referring to the small cruisers, and the singular “ironclad,” it is logical that several such cruisers would combine against a single ironclad. It is equally obvious that this type of cruiser was never intended to be confined to a line of battle. In the context of when the memorandum was written, and bearing in mind the slow rate of fire which characterized the big guns of that time, it is entirely reasonable to envision a division of four such cruisers harrying a single unescorted ironclad to death. So there was a valid justification for the *Ch'ao, Yang Wei,* and their Japanese sister *Tsukushi* at that time, though singly or in pairs was obviously insufficient for the task. Nor were they ever intended to be exposed for long to the fire of opponents.

But it is questionable if *Naniwa* and *Takachiho* can be included as representatives of the same type of cruiser. The only point in which they comply with the original specifications is the heavy gun armament. But this is a characteristic they shared with many cruisers built for other navies, at that time and later. Otherwise, they had over twice the displacement, a much heavier armament, much better protection, and conform well to the other Second Class cruisers.

The three big Japanese cruisers, *Itsukushima, Matsushima,* and *Hashidate* have nothing in common with the origins of the Elswick Cruiser, and should not be considered with that type. Actually, Japan could not afford to build ironclads to compete the Chinese ironclads, and no Japanese ship at that time carried guns sufficiently powerful to penetrate their armor. So the Japanese Navy approached Emile Bertin, the famous French designer, with the problem of acquiring the largest and most powerful gun on the smallest possible hull. The resulting ships were almost complete failures, being outrageously unbalanced. The Japanese realized this after the French built pair were delivered and they had some experience with operations. So they altered the design of *Akitsushima* and *Chiyoda* to produce reasonable and viable cruisers. To re-apply an old adage, there is no form of criticism to which the *Matsushima* class do not offer themselves. The faults of the design and construction and armament, save for the Armstrong 4.7-inch (12cm) Quick-Firers, combined with the losses of the French designed and built *Unebi* and *Chishima,* had a great negative effect on the reputation of French shipbuilders.

Dr. Brooks also presented the following statement, by way of a conclusion. "While the Chinese could have made a more effective showing with better officers and sufficient explosive shell for their 12-inch guns, the most important factor in deciding the battle was that the Japanese had a more modern fleet, and in consequence mounted the quick-firers which proved so effective against the unarmoured Chinese ships." This is a very all-encompassing statement, and provides the basis for additional discussion.

The first point is that *Fuso* and *Hiei* dated to 1878, while all of the Chinese ships involved were products of the 1880s, although the *Kuang Yi* class torpedo gunboats were completed in the early 1890s, and were armed with quick-firing guns. The Japanese *Matsushima* type were completed in the early 1890s, but to such a poor design that they did not represent an advance or improvement over the Chinese cruisers, save for their quick-firers. Both *Chiyoda* and *Akistushima* were serviceable cruisers, but of something of a hybrid design, in an effort to obtain useful ships from French designs. *Akitsushima* was originally to have been of the *Matsushima* type, and *Chiyoda* was also to have carried one of the huge 32cm guns. By far the best Japanese cruisers were the *Naniwa* class and the new *Yoshino.* The former were contemporaries of the Chinese cruisers. So on the whole, the majority Japanese ships were not newer than their Chinese opponents.

As mentioned above, the 32cm guns on the *Matsushima* type were completely ineffective. The three ships managed to fire a total of thirteen rounds, but scored no hits. Not so the 30.5cm guns on the Chinese ironclads. So it seems fair to say that the actual factors which determined the course of the battle come down to the quick-firing guns, and tactics.

Quick-firing guns were not a surprise to the Chinese. As mentioned, the *Kuang Yi* class was armed with them. But whereas the Japanese had added 3-inch QFs to *Hiei*, and up-dated *Fuso* by replacing her slow firing 17cm BLRs with six 6-inch QFs, the Chinese did not take similar action. The interesting question is, why not?

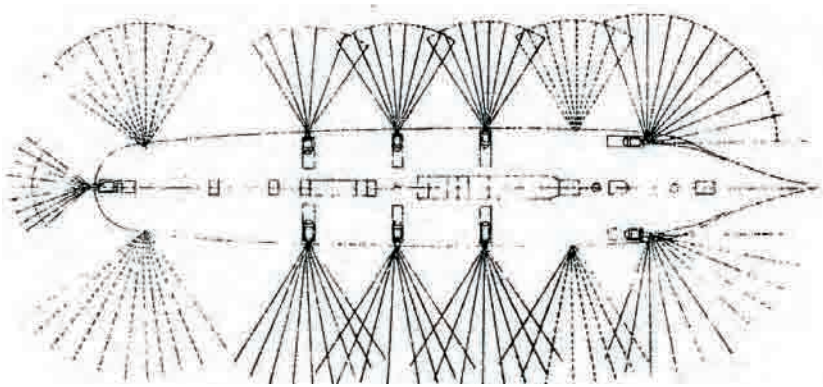
The answer is basically that Admiral Ting tried to keep his ships armed with the most modern pieces. Indeed, the constructors of the German-built ships felt that the ships were under-armed, and added two or four extra and unplanned 7.5cm field guns on naval carriages, a point often overlooked in most reference books. Andrzej Mach points out that Ting sought to strengthen the armament of the 6 best ships, and wanted 21 Krupp 12cm QF guns. Due to the lack of money, the plan was reduced to twelve guns to be split between the two battleships. But the Board of Revenue rejected the request as the Empress Dowager needed the money for her Diamond Jubilee the following year.

Another possible source was the Kiangnan Arsenal, which was building quick-firers domestically. Richard Wright notes that a "4.7-inch QF gun, firing a 45 lb. [20.41 kg.] shell had been test fired in Shanghai in June 1893. A dozen or more of these guns, replacing the Peiyang fleet's 6-inch BL guns which had a rate of fire of just 1 rpm [round per minute], would have made a significant improvement to the fleet's gunnery performance. Unfortunately the Chinese administration was too ponderous to be capable of arranging such a scheme. The best that was achieved was the late delivery of a few of the 4.7-inch QF guns directed to the additional defence of Wei-Hai-Wei."

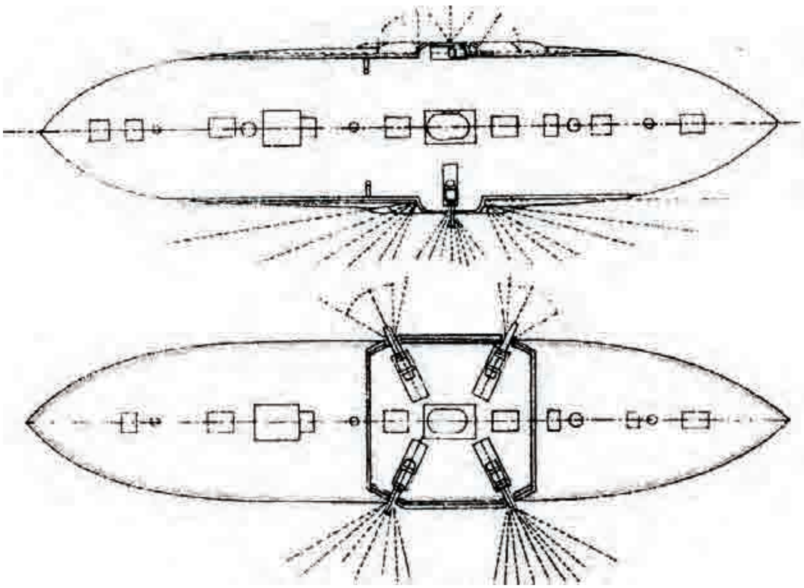
It seems that efforts to provide the most modern guns, and even explosive shells, fell victim to the endemic graft and corruption and bureaucratic inefficiency that characterized the final years of the Manchu dynasty. Thus, the Chinese relinquished the advantage of quick-firing guns to the Japanese.

Still, naval history is replete with examples of inferior forces besting a superior enemy with masterful tactics. We will never know if Admiral Ting and his foreign advisers could have handled his fleet effectively. He was rendered unconscious by the blast effect of the first ill-conceived shots from his flagship, the *Ting Yuen*, toward the *Yoshino*, at the impossible distance of 6,000 yards (around 5500 meters), and was unavailable for the rest of the battle. Lifting a page from his background in the cavalry, he approached in line abreast, a most dis-advantageous formation. Without the guidance of Ting and his staff, the formation remained unaltered, which allowed the Japanese Flying Squadron to fall on the weak flank, while their Main Body "crossed the 'T'" of the Chinese line.

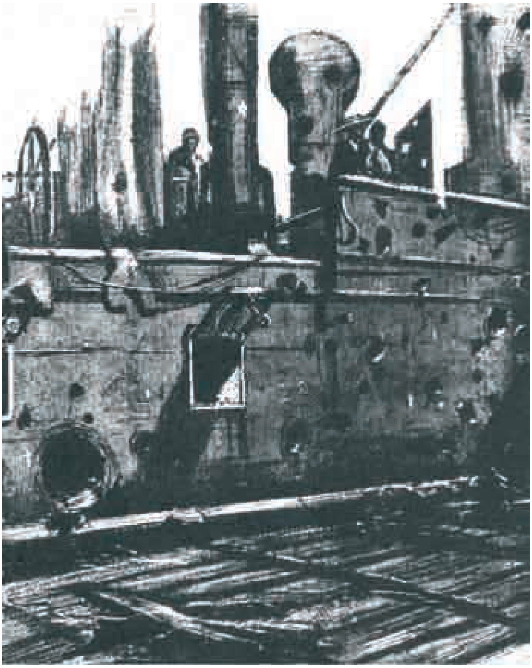
By way of a conclusion, it seems fair to say that the Battle of the Yalu was decided as much by bad tactics, perhaps inadvertent, on the part of the Chinese, as to the quick-firing gun and rangefinder advantages of the Japanese. All were required for the Chinese to lose so decisively.



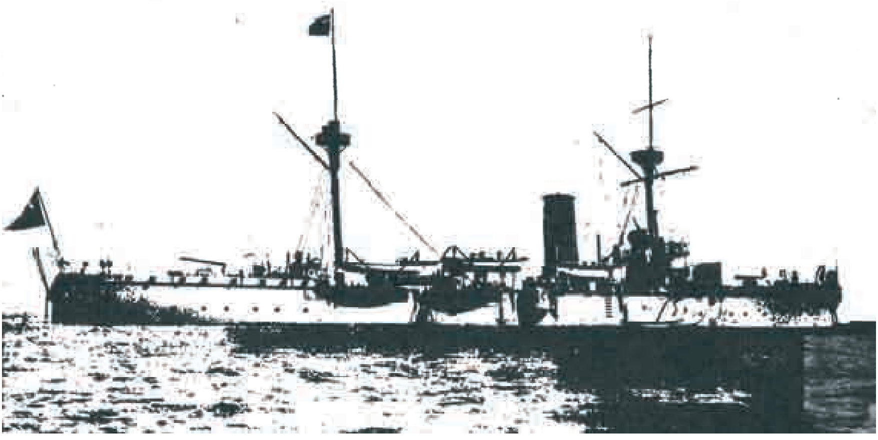
Armament layout of the Japanese ironclad cruisers *Kongo* and *Hiei*. (Brassey, The Naval Annual)



Armament layout of the Japanese ironclad *Fuso*. (Brassey, The Naval Annual)

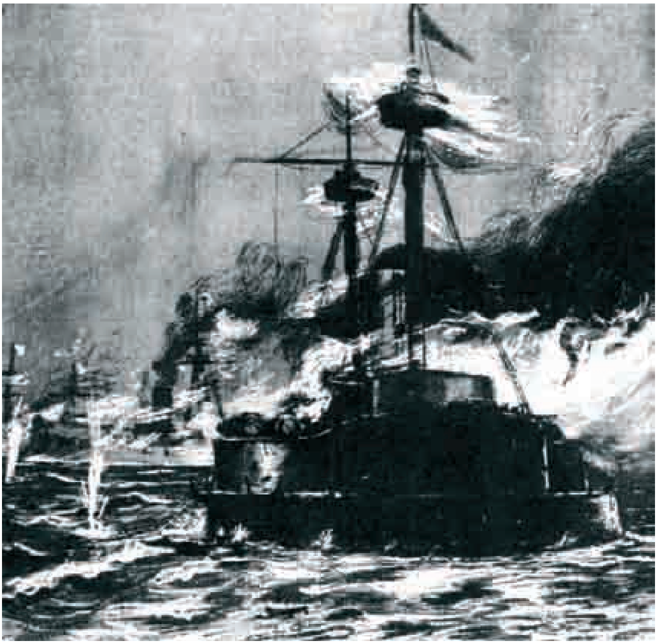


The Chinese ironclad battleship *Chen Yuen* after the Battle. Note the few large holes but the large number of small holes; testimony to the 'rain of fire' from the Quick Firing guns on the Japanese ships. (Wilson, Ironclads in Action)

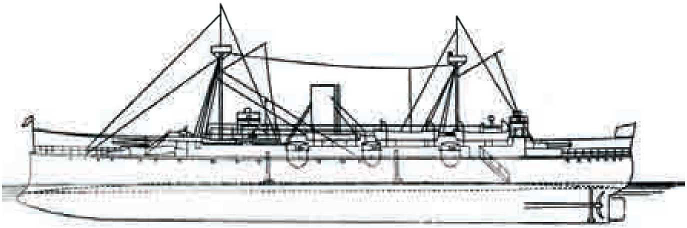


The Chinese cruiser *Chih Yuen*, lost during the Battle. (Wilson, Ironclads in Action)

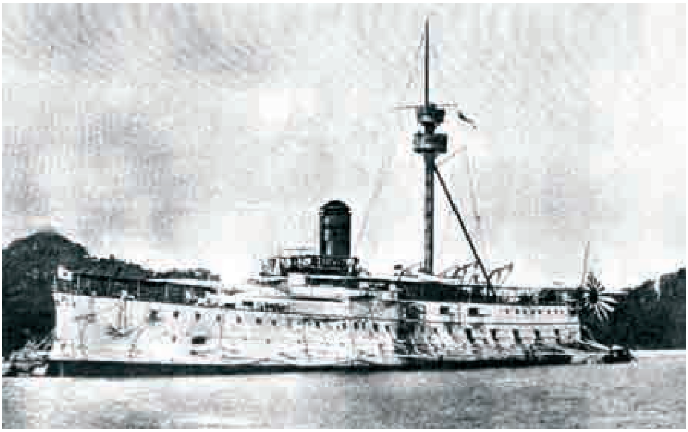
The Chinese ironclad battleship *Ting Yuen* at anchor before the War.
(Wilson, Ironclads in Action)



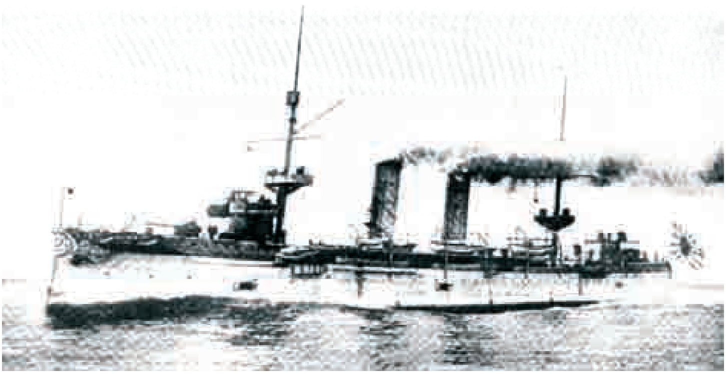
The Chinese ironclad battleship *Chen Yuen* in action. (Wilson, Ironclads in Action)



Drawing of the Japanese cruiser *Naniwa*. She and her sister were in the Flying Squadron that overwhelmed the Chinese right flank. (Wilson, Ironclads in Action)



The Japanese cruiser *Itsukushima*, one of the three ships of the *Matsushima* type, carrying the monstrous 32cm gun. As a design, they were failures, though they remained in service until after the Battle of Tsushima in 1905. (Wilson, Ironclads in Action)



The most modern of the large warships present at the Yalu, the Japanese cruiser *Yoshino* was the Flagship of the Flying Squadron and also was the only ship in the Battle to mount the new Barr & Stroud rangefinder. (Wilson, Ironclads in Action)

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MATHMETICS AND THE ANALYSIS OF NAVAL GUN PERFORMANCE AND PROJECTILES

As the opening of the popular TV show “NUMBERS” says, we use math every day. But in the study of gun performance, this was not the case. Indeed, most historians, being rather non-mathematical, merely perpetuated the errors made by previous historians, who did not have good information in the first place. But now, thanks to the power and availability of computers, mathematics can be used to analyze data and even infer solutions where information was lacking.

My research is in the area of naval gun performance and the projectiles fired. What follows is a brief explanation of how mathematics has been used to obtain very interesting results.

1. Naval gun performance

The basic formula used determines the “efficiency” per unit weight of the propellant charge, and is rendered simply as:

$$A = V^2 / B;\ \ F = M\,A;\ E = F / W,$$

where A – acceleration; B – the length of bore traveled; V – velocity; F – “force”; M – Mass of the projectile; W – the weight of the charge, and E – the “efficiency” per unit weight of the charge.

Obviously, to find the performance of an unknown gun, the calculated “efficiency” is then used to back into the Muzzle Velocity:

$$F = E \cdot W;\ A = F / M;\ V = \sqrt{2A \cdot B}\,.$$

The accuracy of this simple formula was tested against several instances of known data, such as the performance of the Armstrong 8”/45 Pattern S gun used to arm several cruisers of the Japanese and several South American navies. Using a 55 lb. (24,95 kg.) charge of cordite, the Muzzle Velocity firing a 210 lb. (95,26 kg.) projectile was 2817 ft/sec (858,6 m/sec). With a 250 lb. shell, the MV was 2582 ft/sec (787 m/sec). The formula exactly duplicated the known results using either projectile weight/MV combination as the “known.”

There are, of course, some practical limitations to the application of this formula. For example, the propellant should be the same in both cases, and the bore length should also be the same or very close. In other words, the comparisons should be “like” to “like” to the greatest extent possible.

This formula proved especially helpful in a recent analysis of the gunnery performance of the Italian Navy during World War II. The historical record shows that the Italians rarely obtained hits on their British Royal Navy opponents. The reason given is an overly large dispersion of the shells, due to the high muzzle velocity, and in some cases interference caused by the guns being mounted too close together. However, this does not seem to be completely valid, as the problem persisted even when the charge weight was reduced to produce a lower muzzle velocity, though to a lesser extent.

Jack Greene and Alessandro Massignani, in their recent book The Naval War in the Mediterranean 1940 – 1943, comment on the overly large manufacturing tolerance and poor quality control in the production of their projectiles. It appears that there was a ± 2% variance in the weight of the projectiles, and of the propellant charges. Could this account for the dispersion?

The "Range Table" performance of the Italian 381mm/50 M1934 gun was an 885 kg. shell fired at 870 m/sec using a charge of 271,7 kg. which produced a range of 44,120 meters at 35º elevation. The Table below shows the variations in range resulting from varying the shell and charge weights by 2%.

SHELL WT.	CHARGE WT.	MV	RANGE*
885,0	271,7	870	44 120
902,7	277,1	870	44 520
902,7	271,7	861	43 660
902,7	266,3	853	42 910
867,3	277,1	887	45 330
867,3	271,7	879	44 570
867,3	266,3	870	43 720

* Ranges computed using software designed by Dr. William Jurens.

These results are probably extreme, but demonstrate that the dispersion was due in large part to the lack of uniformity of the weights. Reducing the charge weight would have had a beneficial effect, but only by reducing the size of the variation and lowering the muzzle velocity threshold.

In the same manner, the formula may be used to calculate the gun performance in cases of different propellant charge weights and/or different shell weights. For example, the Ottoman ironclad *Osmanieh* mounted Armstrong 8" 9-ton Muzzle Loading Rifles. The Palliser and Common projectiles weighed 81,65 kg. But the propellant charge for the Common shell was lighter. Knowing that the Muzzle Velocity of the Palliser shell, it was possible to calculate the muzzle velocity for the Common shell.

Likewise, the Argentine coast defense ship *Patagonia* mounted Armstrong 10" 27,5-ton BLRs. The Palliser shell weighed 204,11 kg. while the Common Pointed shell weighed 181,44 kg. In addition, the lighter shell was fired with a lighter propellant charge. Again, knowing the muzzle velocity of the heavy shell/heavy charge combination allowed for calculation of the light shell/light charge.

Another interesting case deals with the accuracy of some supposedly "known" data. Virtually every published source lists the performance of the German 38cm SK L/45 C/13 gun as firing a 750 kg. Armor Piercing Shell at 800 m/sec. Most agree that the propellant charge was 183 kg. of RP C/12. However, there are a few sources that list the shell weight as 760 kg. and with the heavier charge to produce a MV of 890 m/s.

If the "known" information is correct, it should be verifiable by mathematical means. So by using the 28cm SK L/45 C/07 as the basis, a reasonably accurate performance could be derived for the 38cm gun.

SHELL WT.	CHARGE WT.	MV	Gun
302	105	855	28cm SK L/45
750	183	830	38cm SK L/45
760	183	825	“

Due to a scaling effect, verified by a comparison of the 28cm SK L/50 C/09 and the 30,5cm SK L/50 C/08 guns, the results are deemed accurate within a 1% margin of error, which is not a material difference.

The writer suspects that the performance of the German 38cm, and the 35cm guns to have been mounted on the uncompleted *Mackensen* class battle cruisers, stems from the use of the barrels by the Army and in coast defenses. It seems likely that the mountings of the railroad carriages and coast defense installations were insufficiently strong to take the full recoil, so the charge weight was reduced to compensate.

Some of the most interesting work involved an analysis of American Civil War artillery, both smooth bore and rifled guns for both the Union and the Confederacy. This was intriguing as while there is a wealth of data available, there is little on the actual performance of the guns, and much of that is unreliable. And what reliable data there is may apply for only for the explosive shell, and omit for the ball or shot of greater weight.

Calculations of the propellant efficiency, in this case black powder, indicated some interesting results. First, there was a marked difference in the three types of guns; smooth bores, muzzle loading rifles, and rifled breechloaders. There was also a direct correlation of the results for each type with the length of the bore!

For example, for the smooth bores the point of maximum efficiency occurs with a bore length of 11,9 calibers, and a distance traveled of about 9,9 calibers, allowing two calibers for the charge, wadding and ball. John Adolphus Dahlgren, later an Admiral and Chief of the Bureau of Ordnance, had calculated this empirically, and his 11-inch, 10-inch and 9-inch guns were of that length. The propellant efficiency for both models of the 15-inch gun, at 9,7 and 8,7 calibers, was less. Likewise, the efficiency for guns with a longer bore was also less, and the longer the bore, the lower the efficiency. In other words, there was a point of diminishing returns. Thus, a simple graph of the bore lengths on one axis, and the efficiency values on the other, allows determining the efficiency for various bore lengths.

This phenomenon was well known, and explains the short barrel length of the MLRs and early RBLs that used black powder, and later brown powder. But in brief, the rationale is that black powder ignites almost instantly, producing a single release of expanding gases. If the distance traveled in the bore is less than 9,9 calibers, then some of the energy produced by the propellant is wasted. Beyond 9,9 calibers, other factors, such as friction and air pressure, retard the speed of the projectile.

It should be noted that while this methodology would apply equally well for all of the black powder guns, the values based on US black powder differ from those used by other nations. The US powder was “hotter” than that used by the British, and the contemporary Italian *Fasano* powder was reputed to be “hotter” still. Thus the entire research and analysis process must be duplicated for each of the major Powers. It is very likely that the bore length for maximum efficiency would be different for each nation. At the present time, sufficient information has been obtained for an analysis of the Russian artillery during the same time period, and the work will commence in the near future.

2. Analysis of naval projectiles

Exterior ballistic calculations of the trajectory of a given projectile require a fairly complete knowledge of the of it's diameter, weight, length, and form or "pointiness." From about 1920, complete information is available for almost all projectiles. However, for the period from 1860 to 1919, information is much less complete.

By way of an example of the problem, most sources that the APC fired by the 28cm guns of the dreadnoughts in the Imperial German Navy weighed 302 kg. More detailed information reveals the nomenclature of 28 cm Pzgr. L/3,2 m. Bdz. u K. This projectile dated to 1911. But ballistic analysis using the software created by Dr. William Jurens revealed that the projectile in use in 1914, and the one used in 1916, was not quite the same shell. There is a material difference in the ballistic Form Factor.

This difference is substantiated by comparing the technical drawings of the L/3,2 APC with photographic evidence from the Battle of Jutland in 1916, and from the unloading of shells following the Armistice in 1918, prior to the internment of the German ships at Scapa Flow. The photographs do not show the same shell. Careful measurements of the photographed APC indicate a length of 3,4 to 3,5 calibers.

The writer believes that following test firings in October 1914 by Krupp, longer windscreens were fitted to German projectiles, including naval projectiles, to increase the maximum range. G.V. Bull provided much information about these experimental shoots in his Paris Kanonen – the Paris Guns (Wilhelmgeschutze) and Project HARP. Other substantiation can be found in D. Schmidt-Tapken's Deutsche Artillerie- und Minenwerfer- Munition 1914 – 1918. Consequently, the improved ballistic performance of the 28cm APC was likely caused by the simple expedient of adding a longer windscreen to the nose over the Armor Piercing cap.

However, the problem of unknown projectile specifics is substantially more difficult for the last forty years of the 19th Century. There were a bewildering number of different projectiles for the various guns. But deductive reasoning can be beneficial for organizing the data.

Fortunately, the vast majority of the naval projectiles were struck with a Caliber Radius Head (crh) of around 2,0. This will tend to limit the peculiarities to nationality and manufacturers.

So the first step is to sort the data by nationality and/or gun manufacturer.

Second, the projectiles can be sorted by type: armor piercing shot, armor piercing shell, Common shell (nose fuzed explosive projectile), and Common Pointed (base fuzed large cavity explosive projectile).

And third, the projectiles can be sorted by time, most easily by the date of the gun.

Hopefully, there will be a sufficient number of projectiles with known characteristics to allow for comparison. There are several formulas that allow mathematical analysis. The most common is to determine a "Constant" (K):

$$K = (W/D^3)/L,$$

where W is the shell weight, D is the diameter, and L is the shell length in calibers.

Other helpful formulas are:

$$V = \pi R^2 (D/10) L,$$

where V is Volume. This will give the volume of a cylinder, but given that the nose crh is a constant, there is no proportionate difference.

$$\rho = W/V,$$

where ρ is the Density;

$$A = \pi R^2,$$

where A is the Area.

$$V_2 = A L (D_2/10),$$

where V_2 is the Volume of the unknown shell, and D_2 is the bore of the unknown gun.

The length of the unknown shell (L_2) can be derived by two calculations:

$$L_2 = \frac{W_2}{D_2^3 \cdot K},$$

where W_2 is the weight of the unknown shell, and D_2 is the diameter of the unknown shell. Or

$$L_2 = \frac{W_2}{\rho A} \Big/ \frac{D_2}{10}.$$

And finally, an exact proportionate match for the weight of a shell for the bore of the unknown gun, to the shell of the known gun, the formula is:

$$P = \rho V_2,$$

where P is the Proportionate equivalent.

The formulas would yield results based on the data for a known shell. For example, the iron Palliser shell fired by the British 16,25”/30 BL Mk I gun was known to be 2,68 calibers in length. It is reasonable to assume that the iron Palliser shells for the other contemporary Breech Loading guns would be very similar. The results of this comparison are summarized below:

GUN	SHELL WT., kg	LENGTH	MATCH, kg
16,25”	816,47	2,68	–
13,5”	567,00	3,25	468,15
12”	323,87	2,64	328,79
10”	204,11	2,87	190,27
10”	181,44	2,56	190,27
9,2”	172,37	3,12	148,20
8”	95,26	2,62	97,42

Compared to the Proportionate Match, the shells for the 13,5” and 9,2” are substantially heavier, while the shells for the 12” and 8” are slightly lighter. This assumes, of course, that the explosive cavity of all the unknown shells is proportionately the same as for the known shell. But in the absence of information, this method provides a reasonable approximation.

Cavity size will indeed have an effect on the shell length. For example, the British 12” AP Mk. I had a cavity for a 5,68% charge of black powder. It was 3,16 calibers in length. But body of the 12” APC Mk. VIa, without the AP Cap, had a length of 3,0 calibers, and a cavity for a 3,08% charge of Lyddite (Picric Acid). Lyddite is about 1,62 times denser than black powder, so the cavity of the later shell was substantially smaller.

There are several other factors that must be considered, some of which are intangible exercises of judgement:

- The type of burster charge may have an effect on the data. For example, the German 24 cm Spgr L/2,5 m. Bdz., which dates to around 1888, originally had a cavity for a 2,5% charge of black powder. It was subsequently re-filled and re-fuzed, the new burster being 6,04% of Picric Acid. This resulted in a 5 kg. increase in all-up weight, with no increase in length.
- Some nations that manufactured their own shells may follow the patterns and designs of one of the major projectile manufacturers. The Swedish firm of Bofors made extensive use of Krupp designs. The Spanish Navy received much technical and design assistance from the French concerns of Schneider and Canet. Several Italian shells originated with the Skoda Works, and others are annotated that they are of German type. Such intangible information is beneficial for selecting the “known” shell from which the comparisons are made.
- Many of the armor piercing shot used from the 1860s had a small hollow cavity. This cavity may or may not have been filled with black powder, though there was no fuze; the charge being set off by the force of impact. However, this small filler was generally not included in the nominal projectile weight.

3. Conclusion

In the age of armored warships, how does one rate the effectiveness of any given ship? Historically, this has been by the power of the guns that it carried. But the late 19th century is replete with claims for the power of one gun over another, yet there was little actual combat from which to draw conclusions. Historians are operating in a vacuum of data.

To judge whether the guns of the Chilean cruiser “Esmeralda” could indeed have overawed the iron armor of contemporary battleships, the historian must know the capabilities of that gun, to calculate the exterior ballistics and determine the results of hits. But to calculate the ballistic trajectory, the performance of the gun and the essential details of the shell must be known, or as the case may be, calculated.

This Paper has demonstrated how mathematics has become the essential tool needed to make reasoned inferences of the fundamental characteristics of gun and shell. With these results, the projectile form factor can be inferred, and ballistic performance calculated. Mathematics is now as important to the modern historian as any other primary source.

RECONSTRUCTING THE 120-MM GUNS FOR THE DESTROYER *OQUENDO*

In 1959, the Spanish Government decreed that the main caliber guns for the *Oquendo* class destroyers then under construction, to be 120-mm guns in the new NG-53 mountings. In 1959-61 workshops in San Carlos produced 10 mountings of the specified type (three for each destroyer and one for coast testing), which proved not up to the specifications. So in 1962 they decided on the first great modification, to solve problems of the mounting. As a result, the *Oquendo* was fitted with only two mounting of this type, which were not used again in the Spanish Fleet. The other destroyers of the *Oquendo* class received six American mountings, Mk-32, derived from the well proven Mk-12 of WW 2 .

During the research for the monograph about destroyers *Oquendo* Class, the author discovered that accurate information on the main caliber guns was extremely limited. For example, J.L. Coello's informative book, the main caliber of *Oquendo* armament is given as only a modification of the gun applied earlier on *Canarias* and *Méndez Núñez*, the 120-mm guns of system Vickers-Armstrong Mk F. The basic difference made was to increase the length of a barrel from 45 to 50 calibers, which improved ballistic properties a little. In the same source it is stated that the Spaniards managed to obtain a muzzle velocity of 900 m/s with a new charge. Changing to the old propellant and charge as used in the destroyers of *Churruca* class reduced the muzzle velocity to 875 m/s.

With the use of modern computer software, it is possible to estimate the data for the 50 caliber gun from the information which is given in such a veiled form. For the analysis, the program "Strelets", developed under direction of Dr. N.M. Rusanov of the "Rifle arms" faculty of Izhevsk State Technical Institute has been chosen. The baseline data on the ballistics of the Vickers-Armstrong Mk F is taken from the directory by Campbell:

Length bore	5399.5 mm (45 cal)
Chamber volume	10.32 dm^3
Weight projectile	22.0 kg
Propellant charge	6.5 kg (CSP_2)
Muzzle velocity	853 m/s
Working pressure	3150 kg/cm^2

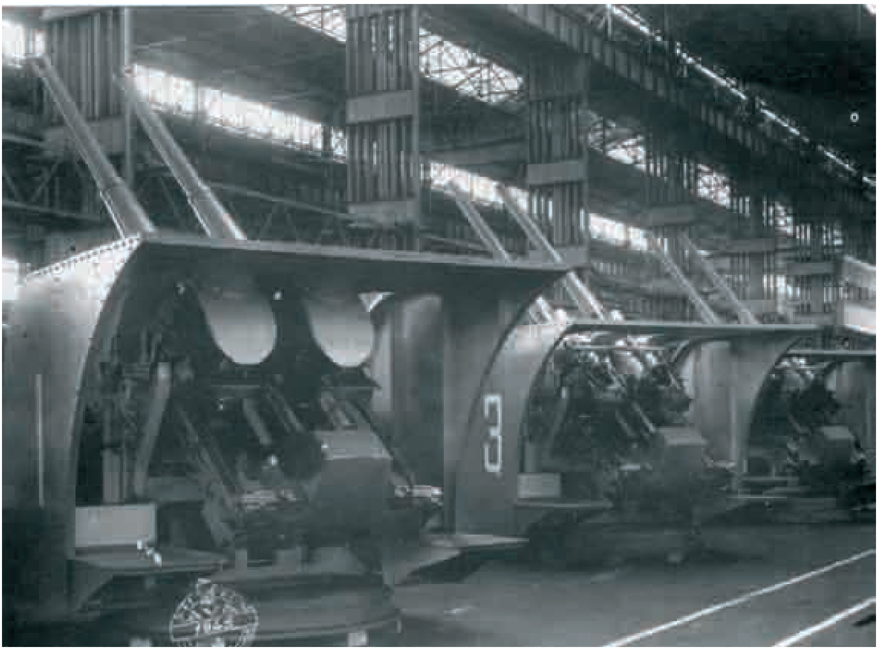
From this initial data, it is possible to achieve compatibility of data from Campbell, then the increase in length of the barrel by 5 calibers has been made, muzzle velocity thus has reached a value of 886 m/s.

On the one hand, the divergence with experimental data is only 1 % (886 or 875 m/s), i.e. normal engineering accuracy, but on the other, an increase of velocity from lengthening the barrel, of 22 or 33 m/s, is essential enough. From here it is possible to draw the conclusion that, apparently the Spaniards were not limited to simple increase in length of a barrel, and have undertaken serious enough modernization of the gun.

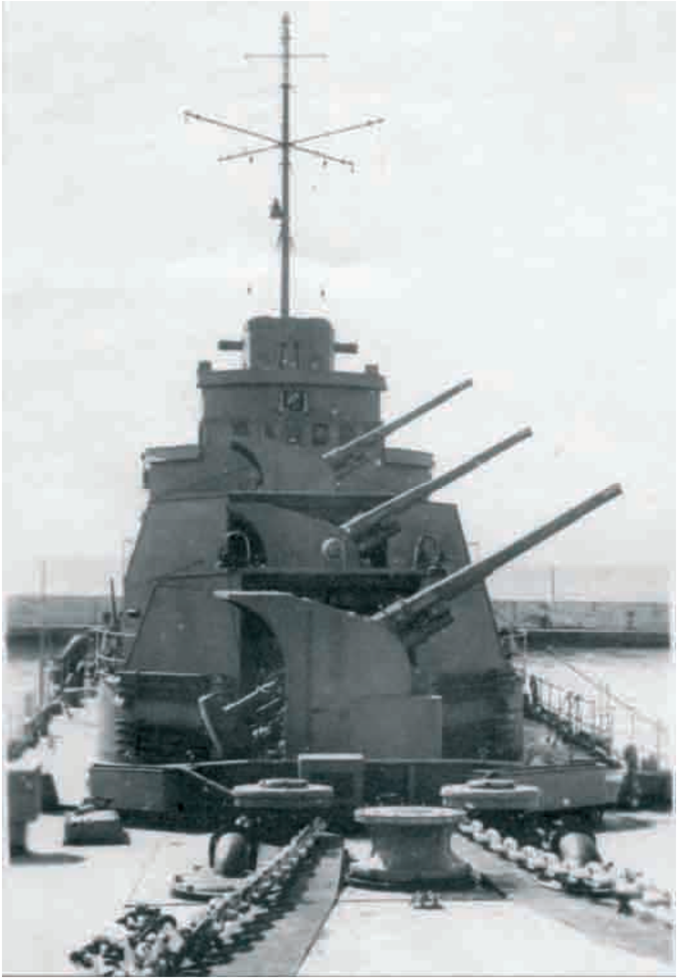
This conclusion was confirmed during the preparation of the monograph, owing to support of Spanish colleague, Capitán de Fragata (Ret) Antonio G. Erce Lizarraga, who provided a detailed enough description of the given guns [Ref. 4].

As acknowledgement of our conclusions, the material was really and extensively redesigned. The most important difference consisted in application, for manufacturing a barrel, steel of higher durability. It has enabled at practically same thickness of the barrel to make replaceable (loose) liner. Before, the exhausted barrel was subject to full replacement. Also the static part underwent a modernization; primarily it concerned a semi-automatic breech mechanism. In a manual mode it functioned completely identical to the Mk F.

The characteristics of the gun were: 36 grooves (the Mk E, roughly contemporary to the Mk F, had 28 grooves), pitched for one rotation in 30 cal.; length of recoil – 500 mm, weight of liner 922 kg, weight of a shell of 22 kg, weight of complete round 36 kg, including weight of propellant charge – 6.25 kg, muzzle velocity of 900 m/s, the maximal pressure of 3150 kg/sm^2, the maximum range of 21,240 meters. However, by order on the Ministry on January 8th, 1953, ammunition of the ships of the Spanish fleet unified was standardized. The standard propellant was to be CSP_2 made in charges 6.5 kg, but because of its inferior ballistic properties, the muzzle velocity fell to 875 m/s.



Producing of *Oquendo*'s guns



120mm guns on cruiser *Mendez Nunez*

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THE BRITISH – ITALIAN PERFORMANCE IN THE MEDITERRANEAN FROM THE ARTILLERY PERSPECTIVE

During the Second World War, the course of the naval conflict in the Mediterranean can be reduced to battles between the British and Italian fleets. Three years of operations against the Royal Navy only produced one more or less significant victory for the Italians, who enjoyed a considerable numerical superiority in this, their main theatre of operations, while the priority for Britain was minor or even third-hand! And most of the engagements, as a rule, ended with the Italian forces retiring as fast as possible.

Marc Antonio Bragadin's The Italian Navy in World War II is bewildering. Their 'greatest' victory was Pantellaria, in which a British destroyer and several transports were sunk. But given the correlation of the forces involved, the entire convoy should have been exterminated to the last vessel! And the 'super fast' Italian ships never could catch the much slower British vessels; *Bartilomeo Colleoni*, supposedly capable of 40 kts., was savaged by H.M.A.S. *Sydney*, which on her best day only made 32 kts.

How could it be that, having the larger fleet, magnificent artillery and well-trained crews, the Italian Fleet suffered one shattering defeat after another? Let us try to look at the problem through the prism of naval guns.

For the purposes of comparison, we shall select three artillery systems that were nearly analogous between the two navies: the 381-mm (15") main guns of the battleships, 203-mm (8") guns of the heavy cruisers, and the 152-mm (6") of the light cruisers. The performance of each is summarized below.

Caliber	Model	Shell's mass, kg	Muzzle velocity, m/s	Form factor to the low of 1943
152/50	Mk XXIII	50,8	841	1,08
203/50	Mk VIII	116,1	855	1,03
381/42	Mk I	871,0	752	1,27
152/53	Model 1926	47,5	1000	1,09
203/53	Model 1927	125,3	955	1,09
381/50	Model 1934	885,0	850	0,89

The technique and functions for ballistic calculations was presented in sufficient Detail in the pages of "Warship International" in an article by William Jurens. Many of the functions are of an empirical character, and so differ a little bit for each country. So in Russia the definitions of a standard atmosphere were set forth in the Russian State Standard 4401-78, which defined the character of temperature variations, density, viscosity, and air pressure at altitude functions. These are the functions used for this analysis. And for the laws of resistance the following were applied:

- Law resistance of Siacci (for shells of a form similar to the standard Type 1)
- The Law of 1930 (similar to a Type 8)
- The Law of 1943 (similar to a Type 7)

In this case for definition of the form factor of a shell, the Law of 1943 was selected. From the Table above, it is evident that the British and Italians have used shells with almost identical ballistic properties. However, here there is nothing exotic, as the British influence on Italian ordnance was very great. Up to the end of WW 1, the guns of the Italian fleet were made under license to designs from the firms of Armstrong [EOC] and Vickers. And as a matter of fact, subsequent gun development were modern versions of those designs. This connection, by the way, shows rather exponential comparison of the form factors for shells of the main guns of the leading maritime states. For example, for guns of about 127-mm (5”) which were introduced into the inventories during the 1920 – 30s, as the main guns for destroyers, the values are as follows (using the Law of Siacci):

System	State	Muzzle velocity, m/s	Shell's mass, kg	Range for angle, m	Form factor to the Siacci's low
120/45 Mk I, Mk II	England	814	22,70	14450 (30)	0,82
130/40 Model 1924	France	725	34,85	18700 (35)	0,60
127/45 SK C/34	Germany	830	28,00	17400 (30)	0,66
120/50 Model 1926	Italy	950	23,15	22000 (45)	0,62
120/45 Type 3	Japan	825	20,41	16000 (33)	0,66
130/50 B 13	USSR	870	33,40	25730 (45)	0,52
127/38 Mk 12	USA	762	25,04	15300 (35)	0,73

From the above table, taken from Tony DiGiulan’s contributions to the Warships1 website (www.warships1.com), the ballistics of guns of the main European states and Japan were at approximately the same level. It is interesting to note, however, that the Soviet shell had the best ballistic form. But this should not be surprising, as the attention given to ballistics in the USSR, which resulted in the M.1928 pattern projectiles, is well known now. Stalin even took a personal interest in the development program, which produced gun systems equal or superior to all foreign designs in all main parameters save one – barrel life. This unfortunately cancelled out all of their virtues, as the Effective Full Charge life of the gun was equal to the capacity of the magazine!

The American and British guns have the worst ballistics form, but this can not be the only criterion, since doctrine required the more universal application of both anti-surface and anti-air capabilities.

But to return to the Anglo-Italian conflict in the Mediterranean, it is well known that the hit probability is determined in large part by the angle in descent of a shell, known as the Danger Space. Steve McLaughlin defined this relationship as:

Danger space = Target width + Target height / Tangent of Angel of Descent

It follows, therefore, that the lower this angle of descent, the greater the hit probability, which is rationale behind the use of high velocity guns. Figure 1 reflects this parameter of the major British and Italian guns. Hereinafter the various graphs show 152mm guns as circles, 203mm guns as squares, and 381mm guns as diamonds, with white designating the British and black the Italians.

As is depicted in Figure 1, at all battle ranges the angle of descent of the Italian shells is less than that of their British opposite number. Indeed, at ranges up to 16,000 meters, the angle of descent of the Italian 203mm shell is less than that of the British 381mm!

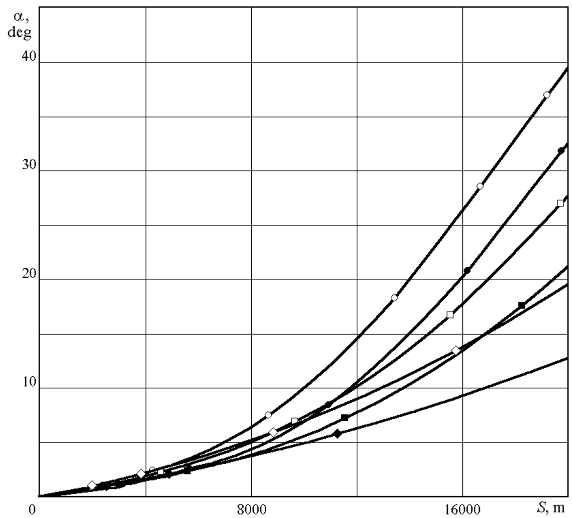

Fig. 1. Comparison of angle of incidences of shells

If comparison were only limited to the size of the danger space, than the Italians should have enjoyed a considerable advantage. This makes the results of the gun battles quite paradoxical. Therefore, as a second step we must try to estimate the values of the ballistic corrections. A technique for obtaining such values would be to determine the effect of corrections in an elevation angle: the variation of an elevation angle is applied, which affects the range. Thus, for each degree of deviation either way, the shell either falls short or flies over by a certain number of meters. Other corrections produce a similar result. The unique exception is a variation of the atmospheric density and pressure, the values of which are generally included in the Range Tables. The given technique was approved by the authors on the basis of Range Tables for the 122mm Soviet howitzer, model 1938, and has given satisfactory convergence.

1) Correction of elevation angle – sensitivity of the gun the roll of the ship (see Figure 2). Though Fire Control Suites were common before the War, the very sensitive instruments that appeared only afterwards had effect as if the ship were on an even keel, the consequences of roll being eliminated insofar as the guns were concerned. But in the absence of such systems, the divergence between the British and Italian guns is most obvious in the performance of the 381mm guns. Dispersion of the Italian shells was almost 1.5 – 2 times greater! This means that in the

presence of virtually any wave activity at sea (which is almost always), the British would have on average twice as many hits as would the Italians!

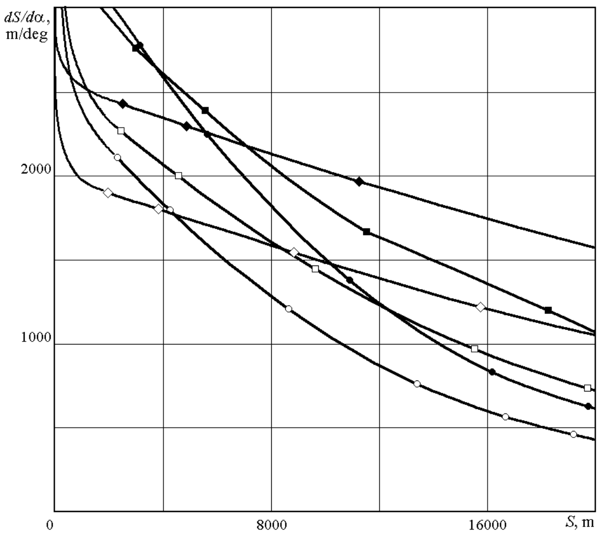

Fig. 2. The correction on an elevation angle

2) Correction for the mass of the shell – sensitivity of the gun to the 'know-how' of shells (see Figure 3). As is known, the more developed manufacturing processes warrant obtaining smaller tolerances. Thus, dispersion due to variation of the mass of the shell is lower, as the shells are more uniform. However, as Jack Greene and Alessandro Massignani have pointed out in their The Naval War in the Mediterranean 1940 – 1943, manufacturing tolerances in the production of the Italian shells were overly large on the one hand, as was the weight control of the propellant used in bagged charges.

The Table below shows the changes in range caused by a mere 1% variance in shell weight and propellant charge weight.

Condition	Shell Wt. (kg.)	M V (m/s)	Range @ 15-deg (meters)
Range Table	885	870	26,420
1% increase in charge	885	874.34	26,640
1% decrease in charge	885	865.64	26,201
1% increase in shell wt.	893.85	865.68	26,289
1% decrease in shell wt.	876.15	874.38	26,552
1% increase in both	893.85	870	26,507
1% decrease in both	876.15	870	26,332
1% increase in charge & 1% decrease in shell wt.	876.15	878.74	26,772
1% decrease in charge & 1% increase in shell wt.	893.85	861.34	26,070

So even though it may have been possible for the Italians to have adjusted for the variations in shell weight, which were often labeled on the projectile and allowed for in the Range Tables, the variation in the propellant charges could not. Thus the Italians were laboring under an additional burden with regard to dispersion.

3) Correction for atmospheric pressure (see Figure 4). In this area, the change in condition would affect both sides, with neither obtaining a material advantage. Thus, the value of this correction is not so great, as atmospheric pressure varies rather slowly, which allows for its rather exact measure.

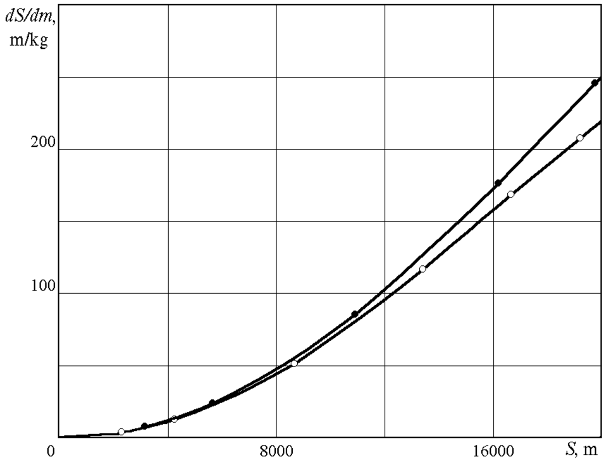

Fig. 3a. The correction on a mass for 152-mm shells

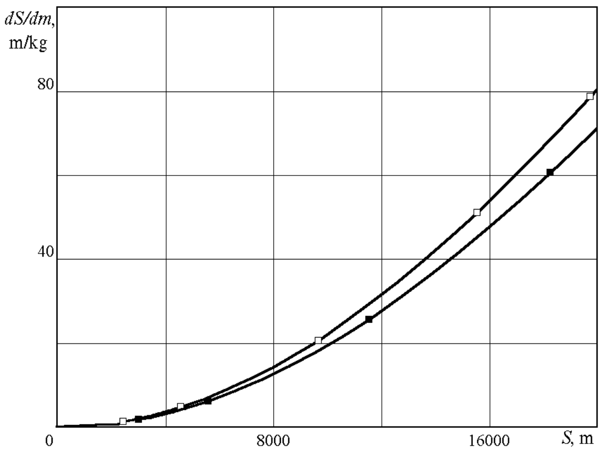

Fig. 3b. The correction on a mass for 203-mm shells

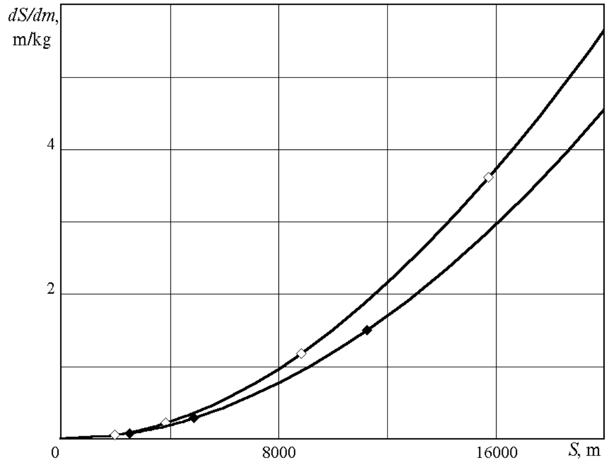

Fig. 3c. The correction on a mass for 381-mm shells

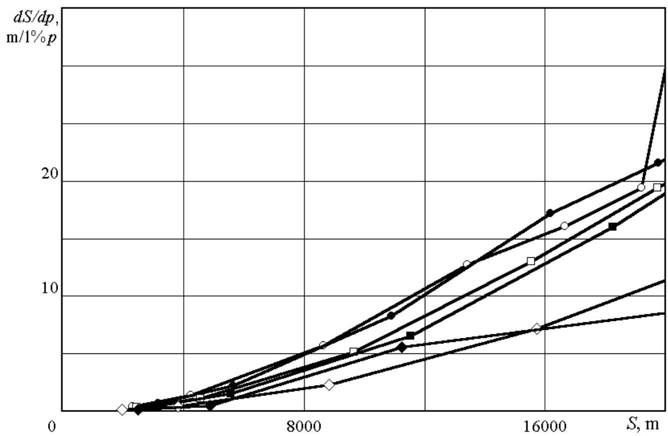

Fig. 4. The correction on atmospheric pressure

4) The correction for atmospheric density actually displays sensitivity of the gun to meteorological conditions, as the presence of rain or snow results in increased density of the air (see Figure 5). This correction, as opposed to atmospheric pressure, is rather difficult to take into account. Sudden rain or snow showers (the latter not common in the Mediterranean), or fog, would have a detrimental effect on ballistic performance. But in this regard, the opponents approximately correspond to each other, with neither obtaining an advantage.

5) Corrections in initial [muzzle] velocity caused by variations in the condition of the charges (see Figure 6). These include charge temperature. Within a range of tolerance, accounted for in the Range Tables, a higher temperature would result in a higher initial velocity, and a lower temperature a lower velocity. Other factors are not so predictable. The very conditions of storage can negatively effect

the charges, and could result in a breakdown of the chemical components, while excess moisture would reduce burning efficiency. It is the opinion of the authors that the Italians had a slight advantage in this area.

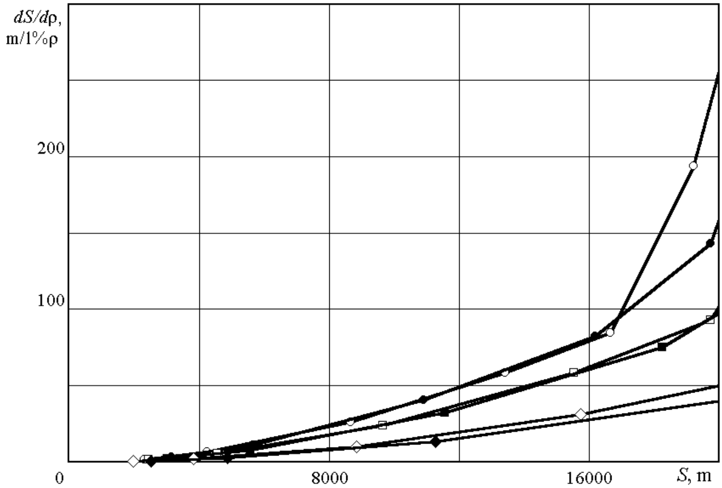

Fig. 5. A correction for air density

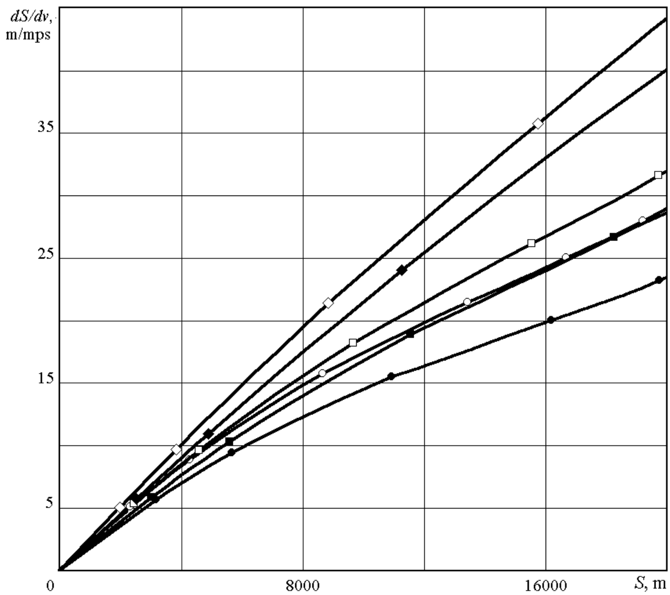

Fig. 6. The correction on initial velocity

British ships under Italian fire

On the face of it, the British Royal Navy have an advantage over the Italians in only one area of correction, but it is the most important and significant. What does this mean? In the theoretical sense, the smaller danger space of the lower velocity British guns would imply that only the most careful preparations and calculations would counter the Italian advantage in hit probability. However, the ballistic effects of roll are less for the British than for the Italians, and therefore correspondingly easier to correct for. The worse the sea state, the greater the British advantage in this regard. It is interesting that, empirically, the Italian gunnery performance should have improved as a result of their reducing the muzzle velocity of their guns. The effect would have been to decrease the danger space on the one hand, but to enjoy a corresponding decrease in the dispersion caused by the roll of the ship on the other.

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AN ESTIMATION OF THE PNEUMATIC GUN'S EFFECTIVENESS

At the end of 19th century, the armies and navies of several nations were experimenting with some systems of the pneumatic guns, which launched projectiles filled with dynamite. But the information about these guns contains many discrepancies, though the weapon's effectiveness was questioned. For example, Schroeder, writing in 1894 [see Bibliography], doubted the effectiveness for a number of subjective reasons. But Watson, writing in 1991, cites objective reasons for the weapon's failure. In an effort to arrive at an objective scientific conclusion, a simulation model program was created.

1. Describing of the model

The model consists of two components: internal and external ballistics. The first part is the gas-dynamic task. Its calculation scheme is the interplay of two fundamental components; the volume of the compressed air tank, and the volume of the chamber of the gun. The latter will increase as the projectile is propelled down the gun tube towards the muzzle. A simple schematic of gun's pneumatic-system is shown in the Fig.1.

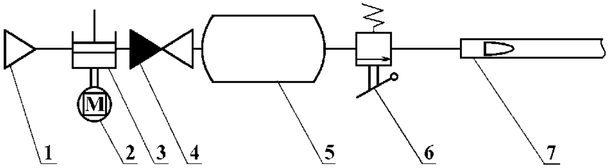

Fig. 1. The principal gun's pneuma-schematic: 1 - collector; 2 - compressor's drive; 3 - compressor; 4 - return valve; 5 - gas-reservoir; 6 - main valve; 7 – gun tube

The gas's outflow *G* from high-pressure balloon is over-critical only:

$$G = p_1 F_k \sqrt{\frac{k}{RT}\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}},$$

where p_1 – gas pressure in tank; F_k – the critical section of the main valve; k – the adiabatic index of the air; RT – the "powder's power", on this case power of the compressed air.

The gas pressure gives the acceleration to projectile during the travel through the gun tube, which at the muzzle yields the initial, or muzzle, velocity. That movement in the tube is the parameter of the interior ballistics component..

The mathematical model of this first component is contained in two differential equation: the equations of the law of the impulse preservation for the projectile in gun tube, and the equation of indissoluble (Law of Lomonosov – Low of the matter preservation) for the gas in the tank.

$$\frac{dm_b}{dt} = -G,$$

$$\frac{dv}{dt} = \frac{(p_2 - p_h)F}{m} - g(\sin\alpha - f\cos\alpha);$$

where m_b – the mass of gas in the tank; v – the projectile velocity; m – the projectile mass; p_2 – the air pressure in gun tube; p_h – the air pressure of the atmosphere; F – frontal area of projectile; g – gravity [9.81 m/s squared]; f – the index of friction (projectile and gun tube).

To this equation is added some algebraic equations:

$$p_1 = \frac{m_b RT}{V_b},$$

$$p_2 = \frac{(m_0 + \Delta m)RT}{V_g},$$

$$V_g = F\int v dt.$$

V_b – the volume of the air tank; V_g – the internal volume of the gun tube; m_0 – the initial mass of the air in the gun tube; Δm – the mass of the air released from the tank.

The equations of the second component of the mathematical model are very trivial, and are in every manual of exterior ballistics. The A.A. Dmitrievsky edition, for example, presents four differential equations and some algebraic equations to solve the exterior ballistics problem.

So, the model is complete and mathematically valid, only needing initial data for calculations. And for this, Patrick McSherry provided the research.

The initial pressure in the compressed air tank was about 70.5 atm. But the information about tank's volume is very interesting. Seaton Shroeder, the first commander of cruiser *Vesuvius*, which mounted three 381-mm [15-in] pneumatic guns, wrote: the "volume of tank is 276 sq feet" (7.83 m^3). But in his book, Shroeder wrote: "It's interesting, but the mass of the air in the tank is about three tons – this is result of displacement augmentation…before and after filling the tank".

If the condition of gas is normal (temperature about 300 K), the equation of Mendeleev-Klapeiron gives the tank a volume of 48 m^3. So, every gun had two tanks. It seems logical; one tank plumbed for the firing of the gun – the 'propellant charge' as it were -- and the second is connected to the compressor.

The interior ballistics component gave some interesting results (Fig. 2). Curves 1 and 2 show the normal changes of acceleration in the ordinary firing guns. If the velocity of combustion of the propellant is decreased, say by increasing the propellant powder grain size or form, the point of maximum acceleration occurs later and will be lower. Thus the difference between curve 1 and curve 2. But it turned out that the interior ballistics of pneumatic guns is very different!

Writing in 1993, M.C. West asserts that the air pressure in gun tube remains constant, and as a result of this, the acceleration is increased constantly for the length of the gun tube (curve 3b). But this is mistake! The assumption behind 3b can only be valid for a very great tank volume, and a large aperture diameter of main valve, providing a continuous flow of compressed air, which is not the case. Really, this is asymptotic assumption, and the more valid assumption is better reflected by curve 3a. It is similar to the curve for slow-burning powder. The maximum of pressure will be strongly pronounced, because the time the valve is open is small, anti-pressure is small too, and the consumption of compressed air is great. But with time, the anti-pressure will increase, and the compressed air consumption will decrease as the supply in the small tank used for ‘firing’ the gun is expended and the valve closed. So, if we have the extreme of pressure, then we also have the extreme of acceleration. From the point in time, represented by live T_3, the valve is closed and no more compressed air enters the gun tube, so the force continuing to push the projectile is from the expansion of compressed gasses that is similar adiabatic law.

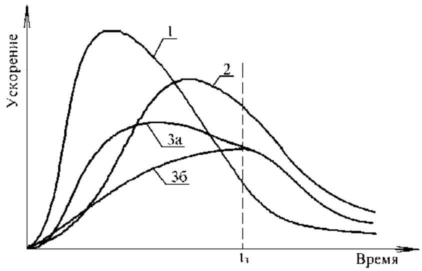

Fig 2. Projectile acceleration in the gun

The form of projectiles is very difficult to quantify. Theoretical determination of resistance law is very hard, as it had a very non-standard shape and inordinate length, so the existing methods for the determination of the form factor seem inapplicable. But, according to Shroeder, the projectile had a form factor using the Mayevskiy law of about 5.646. For the air resistance for the external ballistic component of the model, the superior Siacci law was used. So the form factor using Siacci law is about 5.06. The atmospheric condition used was the "Standard Atmosphere" (See GOST 4401-81).

2. The discussion of results

One of the complex criteria for estimating a projectile’s ballistic characteristics can be served by the thickness of armour that a hypothetical AP shell can perforate. As can be seen in the graph (fig. 3), the curve for a Zalinsky-type projectile is "non-standard.” For traditional artillery, armour penetration decreases as the distance increase. But for the pneumatic gun penetration increases. The "sawtooth" character of the curve for the Zalinsky projectiles is due to the necessity of using lighter projectiles to obtain longer ranges, see Tables below. *Vesuvius* used tables to estimate the maximum range for each weight of shell. The fixed elevation, coupled with the necessity to use lighter shells for longer ranges, effectively limits attack on armour to a small zone at the maximum range for each weight of projectile, reflected in Fig. 3 as the points in the "sawtooth" curve. Thus, unlike traditional artillery projectiles which would have an effect at any point along the trajectory, for the pneumatic shell, attack on armour would be limited to a few spots at range. At the usual combat range of about 2...3 kms, the effect on armour of a pneumatic shell is commensurable with shells Mk III (102/40) and Mk II (127/40) guns of the American fleet. Though this comparison, certainly, is speculative sense, as the high-explosive effect of the dynamite shell, in any case, would be more damaging than ordinary armour penetration.

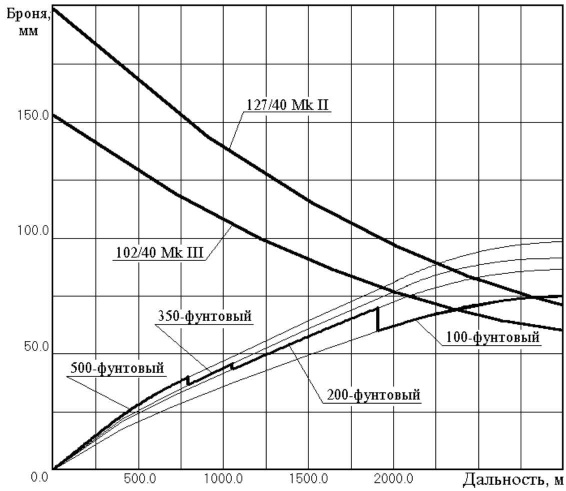

Fig. 3. Comparative perforate armour of the 127-mm, 102-mm shells and hypothetical armour piercing shell of a pneumatic gun

The simulation model revealed a "draw-down" effect in the pneumatic system, caused by continuous use. Bearing in mind that the main compressed air storage tank had to service three of the pneumatic guns, a decline of air pressure was inevitable, with a negative effect on shooting to range. This is best illustrated by simplifying the process to a single gun, shooting 200-pound [weight of explosive; 500 lb projectile weight] shell. For the first shot (muzzle velocity 204 m/s, the range 1880 m) pressure in the tank falls to 68.08 atm. So at the second shot and further these parameters are following:

2-nd	68.02 atm	198 m/s	1780 m
3-rd	65.73 atm	194 m/s	1700 m
4-th	63.55 atm	188 m/s	1600 m
5-th	61.50 atm	185 m/s	1550 m
6-th	59.52 atm	180 m/s	1470 m.

Thus, without recharging, the sixth shot range falls about a quarter. By the way, Shroeder tried to estimate fall of pressure after the first shot, using the law

Boil-Mariott; increase of gas volume he has estimated as: 0.08 m^3 – the volume of various internal cavities and 1.40 m^3 – 3/4 volumes of the gun. Thus, there was the 59 atm [70.5 - 7.8 / (7.8 + 0.08 + 1.4) = 59 atm] remaining.

The simulation model also allows an estimate of the tolerance in operation of the valve. As has shown testing, the time of valve open-shut operation is ideally 0.2 sec. It is interesting that if the tolerance of operation is off by 0.001 sec, the change of range is about 10 m, plus or minus. For engineering of that time such of the tolerance was very good, but for the grouping of shots it was obviously unsatisfactory. In this connection, the mediosquare deviation of shells was almost in some tens greater than traditional guns. By the results of May 1891 firing trials, intended to calibrate a single projectile weight, three shells were fired. The second landed about 50 yards short of the first, and the third about 50 yards over. So the probability of hitting a target was low.

Fig. 4. Dynamite gun of auxiliary cruiser *Nicheroy*

And finally, probably most essential shortcoming as a naval weapon, as mounted in *Vesuvius*, is its lack of range. In the literature there is no information on the maximum range, but most likely it was no more than 3 kms. The usual combat distance at the time was about a mile. Besides, because of its low velocity, the shell was rather a long time in flight. The simulation model gives the following interesting results for an estimation flying time:

Range, m.	700	1000	1400
Time, sec.	6.4	7.7	9.2

At such flight times, the target not only could to see a shell, but depart!

A unique way to radically increase muzzle velocity was to increase of pressure in entire system. According to A. Yakimovich, in a folder there were items of information that there was design development of a pneumatic gun with pressure of compressed air about 350 atm. But if the tolerance of the valve operation of this gun also was 0.001 sec, than the change of range turns out 40 m! From here it is clear why that the gun design was not pursued farther than the drawings.

Also there is information that ostensibly "the experiments with 600-pound (272-kg) dynamite charges" were carried out. In this case the shell weighed 680 kg (1500 pound) and had length 2.1 м (7 feet). In the literature there is no information on its range, it is underlined only, that it was less than mile. The simulation model demonstrates why a shell of this type was not used. In a gun it could be launched only up to a velocity of about 100 m/s, and thus, the range would be hardly 500 m. At such range the firing ship itself could be damaged from the explosion of the shell!

The developed simulation model allows us to estimate the various factors of combat efficiency of pneumatic guns, that, for example, was made by the author in work for 267-mm of the pneumatic gun of the Brazilian cruiser *Nictheroy*. The basic data on this system are taken from A. Saks work, and applied to the 381-mm gun of the cruiser *Vesuvius*.

The comparative characteristics of the dynamite guns

System	203-mm	267-mm		381-mm of cruiser "Vezuvius"			
Length of tube, m / feet	18 / 60	16,47 / 54		16,47 / 54			
Pressure, ath.	70.5	70.5		70.5			
Mass of explosive, kg	45.3	91	22.6	227	159	91	45
pound	100	200	50	500	350	200	100
Mass of shell, kg	62	158	91	445	350	227	130
pound	137	348	200**	980**	780**	500	285**
Shell's kaliber, mm	203	267	267	381	381	381	381
Muzzle velocity, m/s	230*	160*	230*	130*	150*	200	290*
Range, m	2100*	1200*	2100*	760*	1100*	1900	3000*

System	381-mm coastal gun					381-mm
Length of tube, m / feet	15 / 50					15 / 50
Pressure, ath.	140					350
Mass of explosive, kg	227	181	136	91	45	91
pound	500	400	300	200	100	200
Mass of shell, kg	448	390	330	252	195	227
pound	990	860	728	558	430	500
Shell's kaliber, mm	381	381	381	381	381	381
Muzzle velocity, m/s	210*	230*	260*	300*	350*	520*
Range, m	1900*	2100*	2400*	3000*	3200*	4500*

Note: * – account; ** – is chosen in a proportion to the nearest analogue. Pneumoautomatics for all guns is taken, as for guns *Vezuvius*. The eminence angle of guns in all cases is 18°.

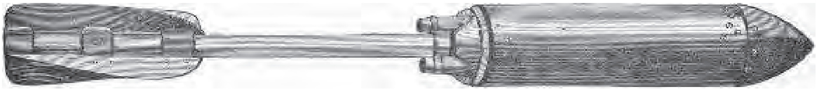

Fig. 5. Shell for dynamite gun

Also results of accounts for 381-mm of the coastal gun is interestingly. Work by V.G. Malikov contains the information, that the 227-kg shell flayed on range 1800 m (calculated data has given similar figure - see table), whereas the 51-kg shell on 5000 m. This last, however, appears exaggerated.

Conclusion

The history of creation and combat using of pneumatic artillery is very instructive. All its defects are objective, and caused by the low level of technical development of 19th century. But with our modern technology, the idea of pneumatic guns is very attractive. There are some advantages over traditional firing guns: noiseless, the ability to fire a shot in the every condition (even from under water!). And such a weapon would be useful in, say, anti-terrorists action.

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TWO UNUSUAL WEAPONS IN EARLY SUBMARINES

During performance of scientific work "Modeling Gas-mechanical Systems" (RU State registration 0198002046) there was a question on the characteristics of large caliber pneumatic artillery systems created by Polish engineer Zalinsky for launching shells filled with dynamite. At the end of 19th century a number of these systems had been accepted to arm ships and coastal defense of the United States and Brazil, with the cruiser *Nictheroy*. A more detailed examination of their performance was considered in our earlier works [see Bibliography]. Subsequent research, however, revealed information on the acceptance of pneumatic artillery to arm submarines, specifically American U.S.S. *Holland* (SS-1) and Peruvian vessel built by F. Blum, the *El Toro*.

From the archival sources, the basic armament of John Holland's submarine consisted of a normal torpedo launching apparatus, and a 203-mm dynamite gun! In the official reports concerning the early period of service confirm this, referring to the weapon as "the air torpedo." However, during the extensive period of trials and tests during 1898-99, "the apparatus for launching of air torpedoes" was dismantled. Unfortunately, no one kept any reports on its trials, so it is possible to judge the device only approximately. The "apparatus" was mounted in a "trainable" compartment, which was trained for shooting from below. And most likely, it represented an update of the pneumatic gun, intended to launch its projectiles into the bottom of a floating ship.

The pneumatic gun as designed by Holland represented a considerable modernization of Zalinsky's design. For this device, Holland received the patent No. 708552 [see fig. 1]. But as soon as it was tested submerged, the complete hopelessness of pneumatic artillery under water became clear. Nevertheless, Holland continued with the submarine a gun of his design. The government gave up all interest in the idea, now completely discredited, and for the entire term of service of SS-1, the gun was just unnecessary ballast!

The real caliber of the gun was 214 mm (8,425"), and it was installed in the boat with a fixed elevation of 15 deg. Small changes in elevation could be made by changing the trim of a boat, but a more serious problem was the charge of compressed air for the gun. The projectile weighed 100 kg (222 lbs), with a pyroxiline charge of 23 to 36 kg (50 to 80 lbs). Holland’s estimates of performance were 900m (1000 yards) from the surface position, but shooting submerged only about 25 m (30 yards). Magazines capacity was six shells, but if necessary additional shells could be located in the boat. It is necessary to note the important improvement of Holland's gun: it could shoot using either compressed air or a small charge of gunpowder!

In his official report to Captain Frederick Rogers, Lieutenant Nathan Sargent wrote on March, 28th 1899: "the forward pneumatic gun has been tested only on compressed air as powder charges have not arrived yet. The wooden shell charged in it in length of three feet and calibre eight and a half of inches was fired by pressure 600 lbs/sq in (40 atm). The shell has fired to four hundred yards without any deviation in line of sight."

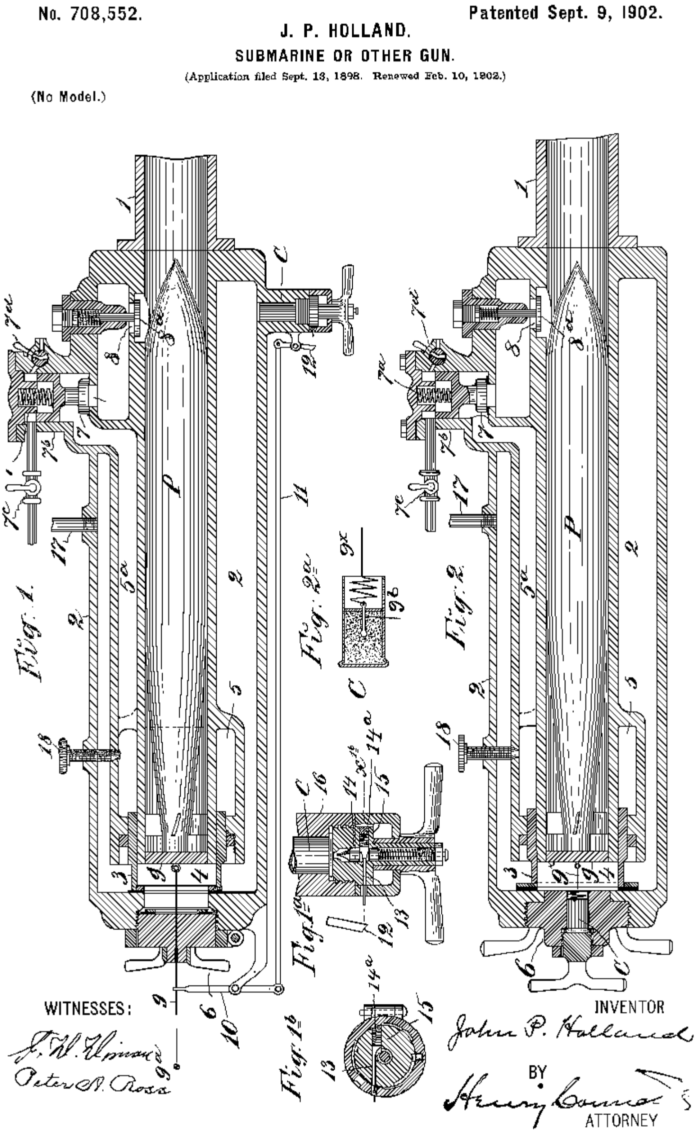

Fig. 1. The Plan from the Patent of Pneumatic Gun of Holland

For analyzing this found information, the author used the computer program "Pnevmobal" for the internal ballistics, which was structurally integrated into a package of external ballistic calculation programs known as "Artillery v 2.0." Earlier this package had been applied to the analysis of data on the pneumatic artillery of fleet and coastal defense.

The lead calculations have shown, that at pressure 40 atm. the 100-kg shell can be launched from the tube at a velocity of 90 m/s (295 ft/sec), which really produces a range up to 360 m (393 yards), matching well with N. Sargent's official report. However, assuming that the pressure in cylinders was 136 atm, as intended by Holland, then the same shell would have an initial velocity of 170 m/s (557 ft/sec) and carry to a range of 1200 meters (1312 yards), a bit more than calculated by Holland. These results have incontestably cast doubt on the idea of the installation of pneumatic artillery on submarines as viable weapons.

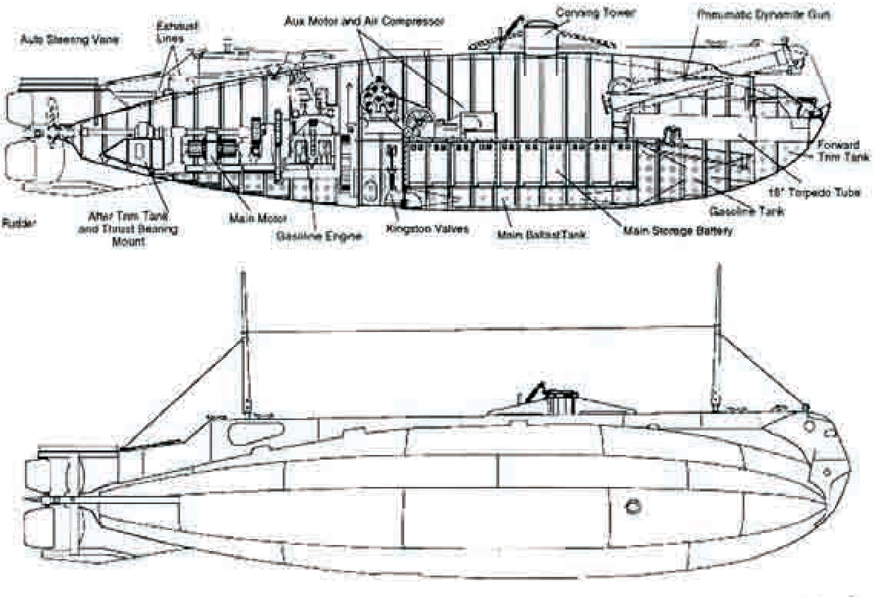

Fig. 2. U.S.S. *Holland* (SS-1) and her dynamite gun

As for the *El Toro*, these results do not apply. She was constructed for operations against Chile in a mode of strict secrecy, which has severely limited the volume of the documentation. And even that little archival information about her has been irretrievably been lost. In this connection, for example, the majority of directories on submarines omit her entirely, while the others provide extremely inconsistent data.

Research with attention to the archival Peruvian sources, generalized in a previous article, has unequivocally shown that the basic armament of the boat was made up of four "torpedoes" of system Ley, each containing 10 pounds of dynamite. Possibly, this information on the explosive filler formed the basis of the claim that she had been armed with pneumatic/dynamite gun, almost two decades prior to the submarine *Holland*. Actually each of these "torpedoes" had a normal "timed fuze," so *El Toro,* having passed near the keel of the target ship, merely released the weapon [see Fig. 3].

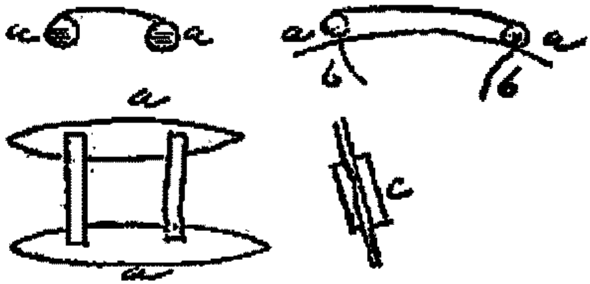

Fig. 3. The plan of fastening of Ley's torpedos (F. Blum's sketch)

Having positive buoyancy, the torpedo – actually more of a floating mine – surfaced, hopefully very near the hull of the target ship, and after a certain time of delay, exploded. Certainly such system was very far from perfect, but in the actual circumstances, single shot accuracy was not necessary for the Peruvians. In the plan of the inventor, the "torpedoes" should be used in two pairs, with each pair connected by a cable [similar to chain or dismantling shot] so on surfacing, one of the "torpedoes" should be on each side of the opponent's hull! In theory, the weapon would thus be effective against either moving or stationary targets, with the weight of the cable tending to draw the "torpedoes" toward the target hull.

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DATABASE OF BALLISTIC CHARACTERISTIC OF RIFLE'S GUNS

	Gun	Bore, Mm	Shell Weight, Kg	Muzzle Velocity, M/S	Eleva-tion, Deg	Shell Type	Shell Length	CRH	Gun Height	Shell Mark	Percent Caps	Percent Burster		Normal Range, m	
	GERMAN														
Krupp	40cm SKC/34	406,40	1 030,00	810,00	30,00	APCBC	4,40	10,00	8.8			2,35%	T	36 400	'H' class
	"	406,40	1 030,00	810,00	30,00	SAPCBC	4,60	10,00	8.8			4,10%	T	36 400	
Krupp	38cm SKC/34	380,00	800,00	820,00	30,00	APCBC	4,40	10,00	7.9		14,06%	2,35%	T	35 550	Bismarck, O-P-Q
	"	380,00	800,00	820,00	30,00	SAPCBC	4,50	10,00	7.9		8,67%	4,08%	T	35 550	
Krupp	30.5cm SKC/39	305,00	415,00	865,00	30,00	APCBC	4,40	10,00	8.0			2,60%	T	35 570	Coast Defence
	"	305,00	415,00	865,00	30,00	SAPCBC	4,50	10,00	8.0					35 570	
Krupp	28cm SKC/34	283,00	330,00	890,00	40,00	APCBC	4,40	10,00	8.0		13,53%	2,00%	T	40 930	Scharnhorst
	"	283,00	315,00	900,00	40,00	SAPBC	4,40	10,00	8.0			5,08%	T	40 930	
Krupp	28cm SKC/28	283,00	300,00	910,00	40,00	APCBC	3,70	8,50	8.8		10,67%	2,61%	T	36 475	Deutschland
	"	283,00	300,00	910,00	40,00	SAPBC	4,20	8,50	8.8			5,65%	T	36 475	
Krupp	20.3cm SKC/34	203,00	122,00	925,00	37,00	APCBC	4,40	10,00	8.4		13,36%	1,89%	T	33 540	Hipper
	"	203,00	122,00	925,00	37,00	SAPBC	4,70	10,00	8.4			5,36%	T	33 540	
Krupp	15cm SKC/25	149,10	45,50	960,00	40,00	APCBC	3,72	8,50	6.5		11,67%	1,95%	T	25 700	'K' class, Leipzig, Nurnberg
	"	149,10	45,50	960,00	40,00	SAPBC	4,56	8,50	6.5			6,72%	T	25 700	
Krupp	15cm SKC/28	149,10	45,30	875,00	40,00	APCBC	3,72	8,50	6.4			1,95%	T	23 000	'H', Bismarck, Scharnhorst, 'M'
	"	149,10	45,30	875,00	40,00	SAPBC	4,55	8,50	6.4			8,59%	T	23 000	
	"	149,10	44,80	880,00	40,00	CPC	4,50	8,50	6.4					23 000	
Krupp	15cm TKC/36	149,10	45,30	835,00	65,00	APCBC	3,72	8,50	6.4			1,95%	T	22 250	Emden (re-armed), 'O-P-Q', Z23 - Z34,
	"	149,10	45,30	835,00	65,00	SAPBC	4,55	8,50	4.8			8,59%	T	22 250	Z37 - Z39, SP1
	"	149,10	40,00	875,00	65,00	SAPBC	4,20	10,00	4.8			9,73%	T	23 500	

	"	149,10	44,80	840,00	65,00	CPC	4,50	8,50	4.8				22 250	
Krupp	12.8cm KMC/40	128,00	28,00	867,00	85,00	SAPBC	4,41	8,60	6.5				20 000	Z-46 - Z50
Krupp	12.7cm SKC/34	128,00	28,00	830,00	30,00	SAPBC	4,41	8,60	4.4				17 400	Z1 - Z22, Z35 - Z36, Z43 - Z45
Krupp	10.5cm SKC/33	105,00	15,80	880,00	80,00	APCBC	4,10	10,00	8.0				17 070	Standard HA gun
Krupp	10.5cm SKC/32	105,00	15,80	815,00	80,00	APCBC	4,10	10,00	3.5				15 900	
Krupp	8.8cm SKC/30	88,00	10,20	740,00	80,00	APCBC	4,50	8,50	6.0		1,52%	T	15 200	
	"	88,00	9,50	765,00	80,00	APCBC	2,91	8,50	6,0		1,63%	T	14 350	
Krupp	8.8cm SKC/35	88,00	10,20	655,00	30,00	APCBC	4,50	8,50	3.5		1,52%	T	12 800	
	"	88,00	9,50	680,00	30,00	APCBC	2,91	8,50	3,5		1,63%	T	12 150	
Krupp	8.8cm SKC/32	88,00	10,20	890,00	80,00	APCBC	4,50	8,50	6,0		1,52%	T	18 000	
	IMPERIAL GERMANY													
Krupp	42cm SKL/45 C/17	420,00	1 030,00	800,00	20,00	APC	3,28	4,00	6.5			T	24 400	'L20ea' 'GK 4542'
	"	420,00	1 030,00	800,00	20,00	CPC	4,00	4,00	6.5	9,71%	10,29%	T	24 400	
	hypothetical	420,00	1 030,00	800,00	30,00	APCBC		8,50	6,5				34 000	
Krupp	40cm SKL/35 Gerat 11	400,00	885,00	735,00	16,00	APC	3,26	4,00	6.5			T	19 300	proposed Derfflinger & Konig
	"	400,00	885,00	735,00	16,00	SAP	3,70	4,00	6.5			T	19 300	
Krupp	40cm RK L/25 C/79	400,00	775,00	520,00	24,00	AP	2,80	2,00	6.5		1,29%	BP	12 300	Coast Defence
	"	400,00	640,00	540,00	24,00	Common	3,20	2,00	6.5		5,19%	BP	12 050	
Krupp	38cm SKL/45 C/13	380,00	750,00	805,00	20,00	APC	3,26	4,00	6.5		3,33%	T	23 400	Bayern, Ersatz Yorck
	"	380,00	750,00	805,00	20,00	CPC	3,84	4,00	6.5		8,31%	T	23 400	
	"	380,00	750,00	805,00	20,00	SAP	4,08	4,00	6.5		8,93%	T	23 400	
	hypothetical	380,00	760,00	800,00	30,00	APCBC		8,50	6.5				32 500	
Krupp	35cm SKL/45 C/14	350,00	600,00	820,00	20,00	APC	3,30	4,00	6.5			T	23 400	Mackensen
	"	350,00	600,00	820,00	20,00	SAP	3,73	4,00	6.5			T	23 400	
	hypothetical	350,00	615,00	815,00	30,00	APCBC		8,50	6.5				32 600	
Krupp	34cm SKL/45 Gerat 10	337,00	535,00	835,00	16,00	APC	3,27	4,00	6.5			T	20 800	proposed Konig & Derfflinger
	"	337,00	535,00	835,00	16,00	SAP	3,70	4,00	6.5			T	20 800	
	"	337,00	535,00	835,00	20,00	APC	3,27	4,00	6.5			T	23 550	

	"	337,00	535,00	835,00	20,00	SAP	3,70	4,00	6.5			T	23 550	
Krupp	30.5cm SKL/50 C/08	305,00	405,00	855,00	13,50	APC	3,40	4,00	6.5	C/11		3,36%	T	18 750	Helgoland, Kaiser, Konig, Derfflinger
	"	305,00	405,00	855,00	13,50	SAP	3,80	4,00	6.5	C/11		6,67%	T	18 750	
	"	305,00	405,00	855,00	16,00	APC	3,40	4,00	6.5	C/11		3,36%	T	20 500	
	"	305,00	405,00	855,00	16,00	SAP	3,80	4,00	6.5	C/11		6,67%	T	20 500	
	"	305,00	405,00	855,00	16,00	CP	3,60	4,00	6.5	C/11		7,90%	T	20 500	
	"	305,00	405,00	855,00	45,00	APC	3,40	4,00	8,0	C/11		3,36%	T	32 500	Coast Defence
	"	305,00	405,00	855,00	30,00	APC	3,40	4,00	50,0	C/11		3,36%	T	28 500	CD turrets Helgoland
	hypothetical	305,00	415,00	850,00	30,00	APCBC		8,50	6.5					33 000	
Krupp	30.5cm RKL/22 C/76	305,00	329,00	485,00	20,00	AP	2,80	2,00	3.9	Chilled C/76		1,09%	BP	9 200	Wespe
	"	305,00	277,00	495,00	20,00	Common	2,80	2,00	3.9	Cast Iron C/76		3,61%	BP	8 900	
	"	305,00	329,00	520,00	20,00	AP	2,80	2,00	3.9	Steel C/81		2,55%	PA	10 000	
	"	305,00	329,00	520,00	20,00	Common	2,80	2,00	3.9	Steel C/81		2,74%	PA	10 000	
Krupp	28cm SKL/50 C/09	283,00	285,00	905,00	13,50	APC	2,90	3,00	7,3	C/07	6,53%	3,00%	T	16 200	Moltke, Goeben
	"	283,00	285,00	905,00	13,50	CPC	3,21	3,00	7,3	C/07	5,26%	6,43%	T	16 200	
	"	283,00	302,00	880,00	13,50	APC	3,30	4,00	7,3	C/11	5,20%	3,51%	T	17 850	Moltke, Seydlitz
	"	283,00	302,00	880,00	13,50	AP	3,30	4,00	7,3	C/11		2,58%	T	17 850	
	"	283,00	302,00	880,00	13,50	SAP	3,57	4,00	7,3	C/11		6,82%	T	17 850	
	"	283,00	302,00	880,00	16,00	APC	3,30	4,00	7,3	C/11		2,58%	T	19 500	
	"	283,00	302,00	880,00	16,00	SAP	3,57	4,00	7,3	C/11		6,82%	T	19 500	
	"	283,00	302,00	880,00	16,00	SAPC	3,60	4,00	7,3	C/17			T	19 500	
	"	283,00	302,00	880,00	22,50	APC	3,30	4,00	7,3	C/11	5,20%	3,51%	T	23 200	Goeben (1918)
	"	283,00	302,00	880,00	22,50	SAP	3,57	4,00	7,3	C/11		6,82%	T	23 200	
	"	283,00	285,00	905,00	50,00	APC	2,90	3,00	8,0	C/07	6,53%	3,00%	T	26 930	Coast Defence
	"	283,00	302,00	890,00	45,00	APC	3,30	4,00	8,0	C/11	5,20%	3,51%	T	31 000	Coast Defence
	hypothetical	283,00	315,00	870,00	30,00	APCBC		8,50	6.5					32 000	
Krupp	28cm SKL/45 C/07	283,00	285,00	880,00	20,00	APC	2,90	3,00	7.5	C/07	6,53%	3,00%	T	18 900	Nassau, Von der Tann
	"	283,00	285,00	880,00	20,00	CPC	3,21	3,00	7.5	C/07	5,26%	6,43%	T	18 900	
	"	283,00	302,00	855,00	20,00	APC	3,30	4,00	7.5	C/11	5,20%	3,51%	T	21 000	
	"	283,00	302,00	855,00	20,00	AP	3,30	4,00	7.5	C/11		2,58%	T	21 000	

	"	283,00	302,00	855,00	20,00	SAP	3,57	4,00	7.5	C/11		6,82%	T	21 000	
	"	283,00	285,00	855,00	37,00	APC	2,90	3,00	7.5	C/07	6,53%	3,00%	T	24 565	Coast Defence
	"	283,00	302,00	855,00	45,00	APC	3,30	4,00	7.5	C/11	5,20%	3,51%	T	29 200	Coast Defence
	hypothetical	283,00	315,00	845,00	30,00	APCBC		8,50	6.5					30 600	
Krupp	28cm SKL/40 C/01	283,00	240,00	820,00	30,00	APC	2,60	3,00	7.5	C/01	3,54%	2,52%	T	18 800	Braunschweig, Deutschland
	"	283,00	240,00	820,00	30,00	SAP	2,90	3,00	7.5	C/01		5,83%	T	18 800	
	"	283,00	285,00	740,00	45,00	APC	2,90	3,00	7.5	C/07	6,53%	3,00%	T	20 770	Coast Defence
Krupp	28cm MRK L/40 C/90	283,00	255,00	700,00	25,00	AP Shot	2,63	2,00	5.0	C/80		1,37%	BP	14 635	Kurfurst Friedrich Wilhelm
	"	283,00	215,00	740,00	25,00	Common	2,60	2,00	5.0	C/80		5,35%	PA	14 200	
	"	283,00	240,00	720,00	25,00	AP	2,57	2,00	5.0	C/95		2,52%	PA	14 600	[160 kg charge]
	"	283,00	240,00	700,00	25,00	AP	2,57	2,00	5.0	C/95		2,52%	PA	14 175	[150 kg charge]
	"	283,00	240,00	700,00	25,00	Common	2,90	2,00	5.0	C/95		4,81%	PA	14 175	
	"	283,00	240,00	715,00	25,00	APC	2,60	3,00	5.0	C/01	3,54%	2,52%	T	15 100	[1905 w/ RP C/00]
	"	283,00	240,00	715,00	25,00	SAP	2,90	3,00	5.0	C/01		5,83%	T	15 100	
	"	283,00	240,00	755,00	25,00	APC	2,60	3,00	5.0	C/01	3,54%	2,52%	T	15 900	[1915 w/ RP C/12]
	"	283,00	240,00	755,00	25,00	SAP	2,90	3,00	5.0	C/01		5,83%	T	15 900	
Krupp	28cm MRK L/35 C/86	283,00	255,00	650,00	25,00	AP Shot	2,63	2,00	5.0	C/80		1,37%	BP	13 530	Kurfurst Friedrich Wilhelm
	"	283,00	215,00	720,00	25,00	Common	2,60	2,00	5.0	C/80		5,35%	PA	13 760	
	"	283,00	240,00	680,00	25,00	AP	2,57	2,00	5.0	C/95		2,52%	PA	13 755	
	"	283,00	240,00	680,00	25,00	Common	2,90	2,00		C/95		4,81%	PA	13 755	
	"	283,00	240,00	685,00	25,00	APC	2,60	3,00	5.0	C/01	3,54%	2,52%	T	14 450	]1905 w/ RP C/00]
	"	283,00	240,00	685,00	25,00	SAP	2,90	3,00	5.0	C/01		5,83%	T	14 450	
	"	283,00	240,00	700,00	25,00	APC	2,60	3,00	5.0	C/01	3,54%	2,52%	T	14 650	[1915 w/ RP C/12]
	"	283,00	240,00	700,00	25,00	SAP	2,90	3,00	5.0	C/01		5,83%	T	14 650	
Krupp	28cm RK L/35 C/80	283,00	345,00	525,00	17,25	AP	3,50	3,00	4.0			2,32%	BP	10 175	Coast Defence
	"	283,00	296,00	560,00	17,25	Common	3,50	3,00	4.0			3,38%	BP	10 385	
	"	283,00	345,00	525,00	17,25	SAP	3,61	3,00	4.0			3,83%	BP	10 175	
Krupp	28cm RKL/22 C/78	283,00	255,00	460,00	24,00	AP	2,60	2,00	4.0	C/81		1,37%	BP	9 500	Coast Defence
	"	283,00	216,80	500,00	24,00	Common	2,60	2,00	4.0	C/81		5,30%	BP	9 700	Coast Defence
	"	283,00	240,00	490,00	24,00	AP	2,45	2,00	4.0	C/95		2,71%	PA	10 000	Coast Defence

	"	283,00	240,00	490,00	24,00	Common	2,96	2,00	4.0	C/95		4,79%	PA	10 000	
	"	283,00	240,00	490,00	24,00	APC	2,60	3,00	4.0	C/01	3,54%	2,52%	T	10 500	
	"	283,00	240,00	490,00	24,00	SAP	2,90	3,00	4.0	C/01		5,83%	T	10 500	
Krupp	26cm RKL/22 C/76	263,00	187,00	430,00	11,00	AP	2,40	2,00	4.5			1,28%	BP	5 000	Preussen
	"	263,00	162,00	460,00	11,00	Common	2,50	2,00	4.5			4,81%	BP	5 220	
	"	263,00	187,00	480,00	11,00	AP	2,40	2,00	4.5			1,28%	BP	5 650	
	"	263,00	162,00	500,00	11,00	Common	2,50	2,00	4.5			4,85%	BP	5 675	
	"	263,00	187,00	480,00	16,50	AP	2,40	2,00	4.5			1,28%	BP	7 400	Sachsen
	"	263,00	162,00	500,00	16,50	Common	2,50	2,00	4.5			4,81%	BP	7 360	
Krupp	26cm RKL/20 C/74	263,00	187,00	445,00	11,00	AP	2,40	2,00	4.5			1,28%	BP	5 200	Kaiser
	"	263,00	162,00	460,00	11,00	Common	2,50	2,00	4.5			4,81%	BP	5 440	
	"	263,00	187,00	480,00	11,00	AP	2,40	2,00	4.5			1,28%	BP	5 650	
	"	263,00	162,00	500,00	11,00	Common	2,50	2,00	4.5			4,85%	BP	5 675	
Krupp	24cm SK L/50	238,00	148,50	900,00	30,00	HE	4,20	8,50	4.5			10,01%	T	26 700	Coast Defence
	"	238,00	150,50	900,00	30,00	SAPBC	4,10	8,50	4.5			5,51%	T	26 700	Coast Defence
	"	238,00	151,00	900,00	30,00	CP	4,10	8,50	4.5			9,87%	T	26 700	Coast Defence
Krupp	24cm SKL/40 C/97 & C/98	238,00	215,00	700,00	30,00	AP	3,50	2,00	4.5	C/80		1,74%	PA	16 600	Kaiser Friedrich III, Wittelsbach, Furst Bismarck,
	"	238,00	215,00	700,00	30,00	Common	4,50	2,00	4.5	C/80		6,23%	PA	16 600	Prinz Heinrich
	"	238,00	140,00	835,00	30,00	AP	2,83	2,00	4.5	C/01		5,93%	T	16 900	Kaiser Friedrich III, Wittelsbach, Furst Bismarck,
	"	238,00	140,00	835,00	30,00	SAP	2,73	2,00	4.5	C/01		6,14%	T	16 900	Prinz Heinrich
	"	238,00	140,00	835,00	30,00	CP	3,00	2,00	4.5	C/01		9,93%	PA	16 900	
	"	238,00	146,00	835,00	30,00	APC	3,10	4,00	4.5	C/01/07	4,11%	5,68%	T	19 700	
	"	238,00	146,00	835,00	30,00	SAPC	3,00	4,00	4.5	C/01/07	4,11%	5,89%	T	19 700	
	"	238,00	148,50	810,00	45,00	HE	4,20	8,50	4.5			10,01%	T	26 600	Coast Defence
	"	238,00	150,50	810,00	45,00	SAPBC	4,10	8,50	4.5			5,51%	T	26 600	Coast Defence
	"	238,00	151,00	810,00	45,00	CP	4,10	8,50	4.5			9,87%	T	26 600	Coast Defence
Krupp	24cm MRKL/35 C/88	238,00	215,00	580,00	25,00	AP	3,50	2,00	5.0	C/80		1,74%	PA	13 030	Siegfried, Odin
	"	238,00	215,00	580,00	25,00	Common	4,50	2,00	5.0	C/80		7,67%	PA	13 030	
	"	238,00	140,00	690,00	25,00	AP	2,40	2,00	5.0	C/01		2,47%	PA	13 000	

	"	238,00	140,00	690,00	25,00	SAP	2,60	2,00	5.0	C/01		6,04%	PA	13 000	
	"	238,00	146,00	690,00	25,00	SAPC	2,90	3,00	5.0	C/01/07	4,11%	5,79%	T	14 900	
	"	238,00	148,50	675,00	45,00	HE	4,20	8,50	5.0			10,01%	T	21 200	Coast Defence
	"	238,00	150,50	675,00	45,00	SAPBC	4,10	8,50	5.0			5,51%	T	21 200	Coast Defence
	"	238,00	151,00	675,00	45,00	CP	4,10	8,50	5.0			9,87%	T	21 200	Coast Defence
Krupp	24cm RKL/30 C/84	238,00	215,00	505,00	16,50	AP	3,50	2,00	4.1	C/80		1,49%	BP	8 800	Oldenburg
	"	238,00	215,00	505,00	16,50	Common	4,50	2,00	4.1	C/80		3,78%	BP	8 800	
	"	238,00	215,00	505,00	8,00	AP	3,50	2,00	4.1	C/80		1,49%	BP	5 330	(Battery)
	"	238,00	215,00	505,00	8,00	Common	4,50	2,00	4.1	C/80		3,78%	BP	5 330	
	"	238,00	148,50	640,00	34,50	HE	4,20	8,50	4,0			10,01%	T	18 700	
	"	238,00	150,50	640,00	34,50	SAPBC	4,10	8,50	4,0			5,51%	T	18 700	
	"	238,00	151,00	640,00	34,50	CP	4,10	8,50	4,0			9,87%	T	18 700	
Krupp	24cm RKL/20 C/68	235,40	139,00	455,00	25,00	AP	2,40	2,00	3.5			1,04%	BP	9 100	Konig Wilhelm
	"	235,40	118,60	450,00	25,00	Common	2,50	2,00	3.5			5,90%	BP	8 170	
Krupp	21cm SKL/45 C/09	209,30	108,00	900,00	30,00	APC	2,91	3,00	8.2	M1907	6,45%	3,30%	T	19 100	Blucher
	"	209,30	108,00	900,00	30,00	SAP	3,10	3,00	8.2	M1907		5,86%	T	19 100	
	"	209,30	115,00	900,00	45,00	CPBC	4,20	8,50	8.2			7,08%	T	29 000	Coast Defence
Krupp	21cm SKL/40 C/04	209,30	108,00	780,00	30,00	APC	2,91	3,00	6.5	C/01	6,45%	3,30%	T	16 300	Scharnhorst
	"	209,30	108,00	780,00	30,00	SAP	3,10	3,00	6.5	C/01		5,86%	T	16 300	
	"	209,30	108,00	780,00	16,00	APC	2,90	3,00	6.5	C/01	6,45%	3,30%	T	12 400	
	"	209,30	108,00	780,00	16,00	SAP	3,10	3,00	6.5	C/01		5,86%	T	12 400	
	"	209,30	108,00	780,00	30,00	APC	2,91	3,00	6.5	C/07	6,45%	3,30%	T	16 770	
	"	209,30	108,00	780,00	30,00	SAP	3,10	3,00	6.5	C/07		5,86%	T	16 770	
	"	209,30	108,00	780,00	16,00	APC	2,91	3,00	6.5	C/07	6,45%	3,30%	T	12 685	
	"	209,30	108,00	780,00	16,00	SAP	3,10	3,00	6.5	C/07		5,86%	T	12 685	
	"	209,30	115,00	815,00	30,00	CPBC	4,20	8,50	6.5			7,08%	T	22 600	Coast Defence
Krupp	21cm SKL/40 C/97	209,30	140,00	720,00	30,00	AP	3,50	2,00	6.5	C/80		2,86%	PA	16 000	Victoria Louise, Prinz Adalbert
	"	209,30	140,00	720,00	30,00	HE	4,30	2,00	6.5	C/80		6,43%	PA	16 000	
	"	209,30	108,00	780,00	30,00	APC	2,91	3,00	6.5	C/01	6,45%	3,30%	T	16 300	Victoria Louise, Prinz Adalbert, Roon
	"	209,30	108,00	780,00	30,00	SAP	3,10	3,00	6.5	C/01		5,86%	T	16 300	

	"	209,30	108,00	780,00	30,00	APC	2,91	3,00	6.5	C07	3,29%	T	16 770	
	"	209,30	108,00	780,00	30,00	SAP	3,10	3,00	6.5	C/07	5,86%	T	16 770	
	"	209,30	115,00	815,00	30,00	CP	4,20	8,50	6.5		7,08%	T	22 600	Coast Defence
Krupp	21cm RKL/30 C/84	209,30	140,00	505,00	13,00	AP	3,50	2,00	4.0		1,79%	BP	7 100	Brummer
	"	209,30	140,00	505,00	13,00	Common	4,30	2,00	4.0		3,93%	BP	7 100	
Krupp	21cm RKL/22.5 C/68	209,30	98,50	446,00	14,00	AP	2,50	3,00	2.5	Steel 1872	1,32%	BP	5 900	Kronprinz, Friedrich Carl, Konig Wilhelm
	"	209,30	79,00	425,00	14,00	Common	2,40	2,00	2.5		5,95%	BP	5 280	Kaiser
Krupp	21cm RKL/20 C/68	209,30	98,50	433,00	14,00	AP		3,00	2.5		1,29%	BP	5 700	Hansa
	"	209,30	79,00	425,00	14,00	Common		2,00	2.5		5,95%	BP	5 280	
Krupp	21cm RKL/19 C/67	209,30	89,00	421,00	12,00	AP	2,50	2,00	2.5	Gruson chilled	1,35%	BP	4 700	Arminius, Prinz Adalbert
	"	209,30	78,00	391,00	12,00	Common		2,00	2.5		8,72%	BP	4 230	
	"	209,30	89,00	421,00	14,00	AP	2,50	2,00	2.5	Gruson chilled	1,35%	BP	5 200	Friedrich Carl, Kronprinz
	"	209,30	78,00	391,00	14,00	Common		2,00	2.5		8,72%	BP	4 690	
	"	209,30	98,50	401,00	14,50	AP		3,00	2.5	Steel 1872	1,32%	BP	4 700	Friedrich Carl, Kronprinz
	"	209,30	79,00	389,00	14,50	Common	2,40	2,00	2.5		5,95%	BP	4 970	
	"	209,30	98,50	437,00	14,50	AP		2,00	2.5		1,32%	BP	5 900	
	"	209,30	79,00	425,00	14,50	Common		2,00	2.5		5,95%	BP	5 410	
Krupp	21cm L/12.25 C/65	209,30	89,00	335,00	12,75	AP	2,50	2,00	2.5	Gruson chilled	1,35%	BP	3 900	Camaleon
	"	209,30	78,00	311,00	12,75	Common	2,40	2,00	2.5		6,03%	BP	3 440	
Krupp	17cm SKL/40 C/01	172,60	64,00	850,00	22,00	HE	3,00	3,00	4.0	M1901	5,47%	PA	14 500	Braunschweig, Deutschland
	"	172,60	64,00	850,00	22,00	APC	2,60	3,00	4.0	M1901		T	14 500	
	"	172,60	64,00	850,00	30,00	HE	3,00	3,00	4.0	M1901	5,47%	PA	16 900	(turrets and coast defence)
	"	172,60	64,00	850,00	30,00	APC	2,60	3,00	4.0	M1901		T	16 900	
	"	172,60	62,80	815,00	45,00	HE	4,70	10,00	8,0		10,24%	T	24 000	Coast Defence
Krupp	17cm RKL/24.6 C/72	172,60	55,90	472,00	11,00	AP	2,40	2,00	3.7		1,07%	BP	5 000	Preussen. Leipzig
	"	172,60	51,00	465,00	11,00	Common	2,80	2,00	3.7		8,24%	BP	5 000	
	"	172,60	53,50	475,00	11,00	AP	2,41	2,00	3.7		1,12%	BP	5 000	
	"	172,60	51,30	490,00	11,00	Common	2,79	2,00	3.7		4,48%	BP	5 090	
	"	172,60	53,50	490,00	11,00	AP	2,41	2,00	3.7		1,12%	BP	5 150	

	"	172,60	51,30	504,00	11,00	Common	2,79	2,00	3.7		4,48%	BP	5 225	
Krupp	17cm RKL/20 C/67	172,60	55,90	404,00	14,00	AP	2,40	2,00	3.7		1,07%	BP	4 270	Leipzig
	"	172,60	51,00	409,00	14,00	Common	2,80	2,00	3.7		8,24%	BP	4 410	
	"	172,60	53,50	404,00	14,00	AP	2,41	2,00	3.7		1,12%	BP	5 000	Leipzig
	"	172,60	51,30	409,00	14,00	Common	2,79	2,00	3.7		4,48%	BP	5 000	
Krupp	17cm RK L/20 C/64	172,60	55,00	390,00	10,00	AP		2,00	3.7		1,09%	BP	3 800	Prinz Adalbert
	"	172,60	45,00	390,00	10,00	Common		2,00	3.7		6,67%	BP	3 650	
Krupp	15cm SKL/45 C/16	149,10	45,30	835,00	30,00	APC	3,70	4,00	4.4	C/09	1,95%	T	17 600	Emden, Schliesen, Schleswig-Holstein (1920s)
	"	149,10	45,30	835,00	30,00	SAP	4,10	4,00	4.4	C/09	8,61%	T	17 600	
	"	149,10	45,30	835,00	30,00	APCBC	3,72	8,50	4.4	C/28	1,95%	T	19 600	WW II Emden & raiders
	"	149,10	45,30	835,00	30,00	SAP	4,56	8,50	4.4	C/28	8,59%	T	19 600	
Krupp	15cm SKL/45 C/09	149,10	45,30	835,00	19,00	APC	3,70	4,00	4.0	C/09	1,95%	T	14 950	dreadnoughts and light cruisers
	"	149,10	45,30	835,00	19,00	SAP	4,10	4,00	4.0	C/09	8,61%	T	14 950	
	"	149,10	45,30	835,00	22,00	APC	3,70	4,00	4.0	C/09	1,95%	T	15 800	
	"	149,10	45,30	835,00	22,00	SAP	4,10	4,00	4.0	C/09	8,61%	T	15 800	
	"	149,10	45,30	835,00	30,00	APC	3,70	4,00	4.0	C/09	8,61%	T	17 600	light cruisers
	"	149,10	45,30	835,00	30,00	SAP	4,10	4,00	4.0	C/09	8,61%	T	17 600	
Krupp	15cm TKL/45 C/16	149,10	45,30	680,00	40,00	SAP	3,80	4,00	4.5	C/09	8,61%	T	15 900	S113 class DD
	"	149,10	45,30	680,00	40,00	CP	4,10	4,00	4.5	C/09	8,61%	T	15 900	
Krupp	15cm SKL/40 C/97	149,10	51,00	725,00	30,00	AP	3,18	2,00	4.4		2,94%	PA	13 700	Kaiser Friedrich III, Wit-telsbach, Victoria Louise, Roon, Furst Bismarck, Prinz Heinrich, Prinz Adalbert, Scharnhorst
	"	149,10	51,00	725,00	30,00	Common	3,84	2,00	4.4		7,85%	PA	13 700	
	"	149,10	40,00	800,00	30,00	AP	2,75	3,00	4.4	C/01	2,50%	PA	13 900	
	"	149,10	40,00	800,00	30,00	CP	3,38	3,00	4.4	C/01	10,00%	PA	13 900	
	"	149,10	40,00	800,00	30,00	HE	3,60	3,00	4.4	C/07	11,00%	PA	14 270	
	"	149,10	40,00	800,00	30,00	SAP	3,02	3,00	4.4	C/07	4,05%	PA	14 270	
	"	149,10	45,00	805,00	30,00	SAPBC	4,20	8,50	4.4				20 000	
Krupp	15cm SKL/35 C/92	149,10	51,00	620,00	30,00	AP	3,56	2,00	4.4		2,94%	PA	12 100	Kaiserin Augusta

	"	149,10	51,00	620,00	30,00	CP	4,31	2,00	4.4		7,85%	PA	12 100	
	"	149,10	40,00	680,00	30,00	AP	2,75	3,00	4.4	C/01	2,50%	PA	12 300	
	"	149,10	40,00	680,00	30,00	SAP	3,02	3,00	4.4	C/07	4,05%	PA	12 600	
	"	149,10	40,00	680,00	30,00	CP	3,38	3,00	4.4	C/01	10,00%	PA	12 300	
	"	149,10	40,00	680,00	30,00	HE	3,60	3,00	4.4	C/07	11,00%	PA	12 600	
	"	149,10	45,00	675,00	30,00	SAPBC	4,20	8,50	4.4				16 585	
Krupp	15cm RKL/30 C/83	149,10	51,00	495,00	21,00	AP	3,35	2,00	4,0		1,33%	BP	8 500	Irene
	"	149,10	51,00	495,00	21,00	Common	4,00	2,00	4,0		3,82%	BP	8 500	
	"	149,10	51,00	495,00	14,50	AP	3,35	2,00	4,0		1,33%	BP	6 788	Alexandrine, Arcona
	"	149,10	51,00	495,00	14,50	Common	4,00	2,00	4,0		3,82%	BP	6 788	
	RP C/88 QFC	149,10	51,00	505,00	20,50	AP	3,35	2,00	4,0		1,33%	BP	8 530	Kaiser 1895
	"	149,10	51,00	505,00	20,50	Common	4,00	2,00	4,0		3,82%	BP	8 530	
	"	149,10	51,00	505,00	22,50	AP	3,35	2,00	4,0		1,33%	BP	8 990	Konig Wilhelm 1896
	"	149,10	51,00	505,00	22,50	Common	4,00	2,00	4,0		3,82%	BP	8 990	
	"	149,10	51,00	505,00	28,00	AP	3,35	2,00	4,0		2,94%	PA	10 055	Irene after 1902
	"	149,10	51,00	505,00	28,00	Common	4,00	2,00	4,0		7,85%	PA	10 055	
Krupp	15cm K L/22 C/65	149,10	35,50	414,00	13,00	AP	2,40	2,00	4,0		1,13%	BP	4 600	Arcona, Albatross
	"	149,10	27,70	441,00	13,00	Common	2,50	2,00	4,0		3,07%	BP	4 480	Thetis
Krupp	15cm K L/22 C/68	149,10	34,50	414,00	13,00	AP	2,41	2,00	4,0		1,04%	BP	4 700	
	"	149,10	29,50	441,00	13,00	Common	2,49	2,00	4,0		6,44%	BP	4 740	
Krupp	15cm RK L/22 C/72	149,10	34,50	450,00	13,00	AP	2,41	2,00	4,0		1,16%	BP	5 000	Arcona, Augusta, Ariadne, Carola
	15cm RK L/22 C/65	149,10	29,50	485,00	13,00	Common	2,49	2,00	4,0		6,44%	BP	5 010	
	15cm RK L/22 C/68	149,10	34,50	446,00	14,60	AP	2,41	2,00	4,0		1,04%	BP	5 400	Habicht
	15cm RK L/22 QFC	149,10	29,50	474,00	14,60	Common	2,49	2,00	4,0		6,44%	BP	5 390	
		149,10	34,50	446,00	15,00	AP	2,41	2,00	4,0		1,04%	BP	5 500	Charlotte, Bismarck
		149,10	29,50	474,00	15,00	Common	2,49	2,00	4,0		6,44%	BP	5 490	
Wahrendorf	15cm G.L/21 M.61 (24-pdr)	149,10	35,50	300,00	14,00	AP	2,40	2,00	3.0		1,13%	BP	3 540	Jager & Caaleon
	"	149,10	27,70	310,00	14,00	Common	2,00	2,00	3.0		7,22%	BP	3 540	
Krupp	12.5cm RKL/23 C/78	125,00	18,20	471,00	14,00	Common	3,00	2,00	3,8		6,04%	BP	5 000	Arcona, Nixe
	"	125,00	18,20	471,00	15,00	Common	3,00	2,00	3,8		6,04%	BP	5 200	Grille, Wolf

	"	125,00	18,20	471,00	17,00	Common	3,00	2,00	3,8		6,04%	BP	5 600	Habicht
Uchiatus	12cm/19 C/65 (Bronze)	120,00	12,00	350,00	13,00	Common	2,00	2,00	3.6			BP	2 900	Rhein
Krupp	12cm RKL/23 C/69	120,03	15,00	390,00	18,00	Common	2,30	2,00	3,0		7,53%	BP	5 000	Habicht, Otter, Nymphe, Thetis, Falke
	"	120,03	15,00	390,00	21,50	Common	2,30	2,00	3,0		7,53%	BP	5 500	Albatross, Cyclop
	"	120,03	15,00	390,00	25,00	Common	2,30	2,00	3,0		7,53%	BP	5 900	Augusta, Ariadne, Nymphe
Wahrendorff	12cm G.L/23 M.61 (12-pdr)	121,92	20,00	332,00	14,00	Shot	2,80	2,00	3,0				3 890	Jager & Caaleon
	"	121,92	15,00	321,00	14,00	Common	2,30	2,00	3,0		6,67%	BP	3 520	
Krupp	10.5cm SK L/50 C/06	105,00	18,00	820,00	45,00	HE	4,76	8,50	8,0		10,00%	T	19 500	Coast Defence
	"	105,00	16,00	850,00	45,00	HE	5,20	10,00	8,0		9,06%	T	19 500	
	"	105,00	18,20	820,00	45,00	AP	3,80	4,00	8,0		3,46%	T	16 000	
Krupp	10.5cm SKL/45 C/06 & C/12	105,00	17,40	710,00	30,00	SAP	"	4,00	4.4	C/07	5,40%	T	12 700	Kolberg through Regensberg
	"	105,00	17,50	710,00	30,00	HE	3,60	4,00	4.4	C/07	9,64%	T	12 700	
	"	105,00	14,25	940,00	30,00	APC	2,77	2,00	4.4	C/07	4,56%	T	11 880	
Krupp	10.5cm TKL/45 C/16	105,00	17,40	650,00	30,00	SAP	3,90	4,00	4.4	C/07	5,40%	T	11 810	destroyers
	"	105,00	17,50	650,00	30,00	HE	3,85	4,00	4.4	C/07	9,64%	T	11 810	
Krupp	10.5cm SKL/40 C/97	105,00	18,20	715,00	30,00	AP	3,80	3,00	4.4		3,46%	PA	12 200	Gazelle through Dresden
	"	105,00	18,00	715,00	30,00	HE	3,89	3,00	4.4		10,00%	T	12 200	
	"	105,00	17,40	690,00	30,00	SAP	3,90	3,00	4.4	C/07	5,40%	T	12 450	
	"	105,00	17,50	690,00	30,00	HE	3,85	3,00	4.4	C/07	9,64%	T	12 450	
	"	105,00	14,25	890,00	30,00	APC	2,77	2,00	4.4	C/07	4,56%	T	11 500	
Krupp	10.5cm SKL/35 C/91	105,00	18,20	620,00	30,00	AP	3,80	3,00	3.1		3,46%	PA	11 020	
	"	105,00	18,00	620,00	30,00	HE	3,89	3,00	3.1		10,00%	PA	11 020	
	"	105,00	17,40	600,00	30,00	SAP	3,70	3,00	3.1	C/07	5,40%	T	10 820	
	"	105,00	17,50	600,00	30,00	HE	3,50	3,00	3.1	C/07	9,64%	T	10 820	
	"	105,00	14,25	800,00	30,00	APC	2,77	2,00	3.1	C/07	4,56%	T	10 785	
Krupp	10.5cm RKL/35 C/86	105,00	18,00	465,00	27,00	Common		2,00	3,0	C/80	2,28%	BP	8 200	Greif, Schwalbe, Wacht, Eber, Bussard, Arcona, Alexandrine
	"	105,00	18,00	465,00	27,00	Common	3,90	2,00	3,0	C/92	5,36%	PA	8 200	
Krupp	8.8cm FLAKL/45 C/13	88,00	9,93	765,00	70,00	SAP	3,80	3,00	6.0	C/07	6,40%	T	12 400	standard HA gun from c. 1913

	"	88,00	9,80	765,00	70,00	HE	3,60	3,00	6.0	C/07	5,73%	T	12 400	
	"	88,00	9,65	765,00	70,00	HE	3,70	3,00	6.0	C/07	5,31%	T	12 400	
Krupp	8.8cm SKL/45 C/09	88,00	9,93	750,00	25,00	SAP	3,80	3,00	4.3	C/07	6,40%	T	10 700	standard anti-torpedo boat gun till c. 1918
	"	88,00	9,80	750,00	25,00	HE	3,60	3,00	4.3	C/07	5,73%	T	10 700	
	"	88,00	9,65	750,00	25,00	HE	3,70	3,00	4.3	C/07	5,31%	T	10 700	
Krupp	8.8cm TKL/45 C/14	88,00	9,93	650,00	25,00	SAP	3,80	3,00	3.3	C/07	6,40%	T	9 600	destroyers
	"	88,00	9,80	650,00	25,00	HE	3,60	3,00	3.3	C/07	5,73%	T	9 600	
	"	88,00	9,65	650,00	25,00	HE	3,70	3,00	3.3	C/07	5,31%	T	9 600	
Krupp	8.8cm TKL/30 C/08	88,00	9,93	590,00	20,00	SAP	3,80	3,00	3.1	C/07	6,40%	T	8 200	destroyers
	"	88,00	9,80	590,00	20,00	HE	3,60	3,00	3.1	C/07	5,73%	T	8 200	
	"	88,00	9,65	590,00	20,00	HE	3,70	3,00	3.1	C/07	5,31%	T	8 200	
	"	88,00	9,93	590,00	30,00	SAP	3,70	3,00	3.1	C/07	6,40%	T	9 400	
	"	88,00	9,80	590,00	30,00	HE	3,70	3,00	3.1	C/07	5,73%	T	9 400	
	"	88,00	9,65	590,00	30,00	HE	3,70	3,00	3.1	C/07	5,31%	T	9 400	
	"	88,00	9,93	590,00	45,00	SAP	3,70	3,00	3.1	C/07	6,40%	T	9 800	
	"	88,00	9,80	590,00	45,00	HE	3,70	3,00	3.1	C/07	5,73%	T	9 800	
	"	88,00	9,65	590,00	45,00	HE	3,70	3,00	3.1	C/07	5,31%	T	9 800	
Krupp	8.8cm SKL/35 C/01	88,00	6,81	770,00	25,00	Common	2,60	3,00	3.1	C/83/88	5,14%	PA	9 100	
	"	88,00	7,04	770,00	25,00	SAP	2,80	3,00	3.1	C/01	4,85%	T	9 100	
	"	88,00	9,80	650,00	25,00	HE	3,60	3,00	3.1	C/07	5,73%	T	9 600	
	"	88,00	9,97	650,00	25,00	SAP	3,80	3,00	3.1	C/07	6,37%	T	9 600	
	"	88,00	9,65	650,00	25,00	HE	3,70	3,00	3.1	C/07	3,53%	T	9 600	
	"	88,00	6,81	690,00	25,00	Common	2,60	2,00	3.1	C/83/88	5,14%	PA	8 800	old Torpedoboat destroyers
	"	88,00	7,04	690,00	25,00	SAP	2,80	3,00	3.1	C/01	4,85%	T	8 800	
Krupp	8.8cm SKL/30 C/89	88,00	6,68	670,00	20,00	Common	2,60	2,00	3.7	C/83	3,29%	BP	7 300	standard anti-torpedo boat gun till c. 1904
	"	88,00	6,81	670,00	20,00	Common	2,60	2,00	3.7	C/83/88	5,14%	PA	7 300	
	"	88,00	7,04	670,00	20,00	SAP	2,80	3,00	3.7	C/01	4,85%	T	7 300	
	"	88,00	9,80	565,00	20,00	HE	3,60	3,00	3.7	C/07	5,73%	T	8 000	
	"	88,00	9,93	565,00	20,00	SAP	3,80	3,00	3.7	C/07	6,40%	T	8 000	
	"	88,00	9,65	565,00	20,00	HE	3,70	3,00	3.7	C/07	5,31%	T	8 000	

	"	88,00	6,68	615,00	20,00	Common	2,60	2,00	3,1	C/83		3,29%	BP	6 900	old Torpedoboat destroyers
	"	88,00	6,81	615,00	20,00	Common	2,60	3,00	3,1	C/83/88		5,14%	PA	6 900	
	"	88,00	7,04	615,00	20,00	SAP	2,80	3,00	3,1	C/01		4,85%	T	6 900	
Krupp	8.7cm RKL/24 C/82	87,00	6,76	471,00	20,00	Common	2,87	2,00	4.4			2,66%	BP	5 700	standard light gun till c. 1889
Krupp	8cm K L/19.4 C/65 (Bronze)	81,00	3,76	320,00	13,00	Common	2,00	2,00	4,0			7,18%	BP	2 900	Rhein, Undine
Krupp	8cm K L/27 C/65	78,50	4,26	341,00	14,00	Common	2,47	2,00	4,0			6,34%	BP	3 400	Musquito, Pommerania
Krupp	8cm RK L/27 C/73	78,50	4,26	350,00	14,00	Common	2,47	2,00	4,0			6,34%	BP	3 460	Grille
	"	78,50	4,26	404,00	14,00	Common	2,47	2,00	4,0			6,34%	BP	3 800	
	AUSTRIA-HUNGARY														
Skoda	42cm G. L/45 K/18	420,00	1 200,00	770,00	30,00	APCBC	4,20	8,50	6.8	PzGr m Hb		2,00%	T	33 400	
	"	420,00	1 200,00	770,00	30,00	SAPCBC	4,50	8,50		EGr m Hb				33 400	
	"	420,00	1 200,00	770,00	30,00	CPCBC	4,80	8,50	6.8	ZuGr m Hb		7,75%	T	33 400	
Skoda	38cm G. L/45 K/17	380,00	825,00	800,00	30,00	APCBC	3,90	8,50	7.0	PzGr m Hb		2,00%	T	33 100	
	"	380,00	825,00	800,00	30,00	SAPCBC	4,20	8,50		EGr m Hb				33 100	
	"	380,00	825,00	800,00	30,00	CPBC	4,50	8,50	7.0	ZuGr m Hb		7,67%	T	33 100	
Skoda	35cm G. L/45 K/16	350,00	700,00	770,00	20,00	APCBC	4,20	8,50	6.8	PzGr m Hb		2,00%	T	25 000	Ersatz Monarch
	"	350,00	700,00	770,00	20,00	SAPCBC	4,50	8,50		EGr m Hb				25 000	
	"	350,00	700,00	770,00	20,00	CPCBC	4,80	8,50	6.8	ZuGr m Hb		7,60%	T	25 000	
Skoda	30.5cm G. L/45 K/08	305,00	455,00	800,00	20,00	APC	3,50	3,00	6.5	K/09	5,85%	2,04%	T	20 000	Radetzky
	"	305,00	455,00	800,00	20,00	SAPC	3,85	3,00	6.5	Egr K/09	5,85%	5,45%	T	20 000	
	"	305,00	455,00	800,00	20,00	CPC	4,00	3,00	6.5	K/08	5,85%	7,52%	T	20 000	
	"	305,00	455,00	800,00	20,00	APC	3,70	4,00	6.5	K/09 m Hb	6,95%	2,04%	T	22 000	Radetzky & Tegetthoff
	"	305,00	455,00	800,00	20,00	SAPC	4,10	4,00	6.5	EGr m Hb	6,95%	5,45%	T	22 000	
	"	305,00	455,00	800,00	20,00	CPC	4,20	4,00	6.5	K/08 m Hb	6,95%	7,52%	T	22 000	
	"	305,00	455,00	800,00	20,00	APCBC	4,10	8,50	6.5	K/09 m Hb	6,95%	2,04%	T	25 000	Radetzky, Tegetthoff & Coast Defence
	"	305,00	455,00	800,00	20,00	SAPCBC	4,40	8,50	6.5	EGr m Hb	6,95%	5,45%	T	25 000	
	"	305,00	455,00	800,00	20,00	CP	4,70	8,50	6.5	K/16?		10,00%	T	25 000	

Krupp	30.5cm G. L/35 C/80	305,00	455,00	535,00	16,00	AP	3,71	2,00	6.75	M.80		1,05%	BP	10 000	Kronprizzen Stefani, Kronprinz Rudolf
	"	305,00	455,00	535,00	16,00	SAP	4,49	2,00	6.75	M.80		3,56%	BP	10 000	
	"	305,00	455,00	600,00	16,00	AP	3,71	2,00	6.75	M.80		1,05%	BP	11 600	
	"	305,00	455,00	600,00	16,00	SAP	4,49	2,00	6.75	M.80		9,76%	BP	11 600	
	"	305,00	425,00	620,00	20,00	APC	3,47	2,00	6.75	M.08				13 600	Coast Defence
	"	305,00	450,00	600,00	20,00	HC	4,35	2,00	6.75	M.08			PA	13 350	
Krupp	28cm G. L/35 C/86	283,00	345,00	550,00	20,00	AP	3,60	2,00	8,0	M.80			BP	11 500	Coast Defence
	"	283,00	315,00	580,00	20,00	Common	3,61	2,00	8,0	M.80			BP	11 850	
Krupp	28cm G. L/22 C/75	283,00	253,50	478,00	11,00	AP	2,76	2,00	3.3	Steel C/81		2,56%	BP	5 900	Tegetthoff
	"	283,00	222,00	510,00	11,00	Common	2,79	2,00	3.3	Steel C/81		3,83%	BP	6 150	
Krupp	26cm G. L/22 C/73	263,00	179,50	428,00	11,00	AP	2,28	2,00	3.3	Steel		2,23%	BP	4 950	Custoza
	"	263,00	162,00	420,00	11,00	Common	2,50	2,00	3.3			4,81%	BP	4 700	
	"	263,00	179,50	480,00	11,00	AP	2,28	2,00	3.3	Steel		2,23%	BP	5 650	
	"	263,00	162,00	505,00	11,00	Common	2,50	2,00	3.3			5,68%	BP	5 800	
Skoda	24cm G. L/45 K/09	238,00	215,00	800,00	20,00	APC	3,70	2,00	6.8	K/08	6,19%	1,74%	T	16 400	Radetzky
	"	238,00	215,00	800,00	20,00	CPC	4,00	2,00	6.8	K/08	6,19%	7,67%	T	16 400	
Skoda	24cm G. L/40 K/01	238,00	215,00	765,00	20,00	AP	3,45	2,00	7.5	C/80 K/01		1,74%	BP	16 000	Sankt Georg, Erzherzog Karl
	"	238,00	215,00	765,00	20,00	CP	3,57	2,00	7.5	K/01		6,23%	BP	16 000	
	"	238,00	228,30	745,00	20,00	APC	3,65	2,00	7.5	K/01.08	5,83%	1,64%	BP	15 625	
	"	238,00	228,30	745,00	20,00	CPC	3,78	2,00	7.5	K/01.08	5,83%	5,87%	BP	15 625	
	"	238,00	215,00	765,00	20,00	APC	3,70	2,00	7.5	K/08	6,19%	1,74%	T	15 625	
	"	238,00	215,00	765,00	20,00	CPC	4,00	2,00	7.5	K/08	6,19%	7,67%	T	15 625	
Krupp	24cm G. L/40 K/97	238,00	215,00	765,00	20,00	AP	3,45	2,00	6.8	C/80 K/01		1,74%	BP	16 000	Habsburg, Arpad, Karl IV
	"	238,00	215,00	765,00	20,00	CP	3,57	2,00	6.8	K/01		6,23%	BP	16 000	
	"	238,00	228,30	745,00	20,00	APC	3,65	2,00	6.8	K/01.08	5,83%	1,64%	BP	15 625	
	"	238,00	228,30	745,00	20,00	CPC	3,78	2,00	6.8	K/01.08	5,83%	5,87%	BP	15 625	
Krupp	24cm G. L/40 K/94	238,00	215,00	690,00	25,00	AP	3,50	2,00	5.0	C/80 K/01		1,74%	BP	15 900	Monarch
	"	238,00	215,00	690,00	25,00	CP	4,47	2,00	5.0	C/80 K/01		6,23%	BP	15 900	
Krupp	24cm G. L/35 C/86	238,00	215,00	640,00	13,50	AP	3,50	2,00	6.0	C/80 K/01		1,74%	BP	10 525	Kaiser Franz Josef
	"	238,00	215,00	640,00	13,50	CP	4,47	2,00	6.0	C/80 K/01		6,23%	BP	10 525	

	"	238,00	215,00	620,00	13,50	AP	3,50	2,00	6.0	C/80	1,74%	BP	10 020	Kaiser Franz Josef
	"	238,00	215,00	620,00	13,50	CP	4,47	2,00	6.0	C/80	6,23%	BP	10 020	
	"	238,00	215,00	640,00	20,00	AP	3,50	2,00	6.0	C/80	1,74%	BP	12 965	Maria Theresia
	"	238,00	215,00	640,00	20,00	CP	4,47	2,00	6.0	C/80	6,23%	BP	12 965	
Krupp	24cm G. L/35 C/80	235,40	132,50	600,00	10,00	AP	2,79	2,00	8,0		2,26%	BP	6 700	Tegetthoff (as re-armed)
	"	235,40	119,50	630,00	10,00	Common	2,30	2,00	8,0		5,69%	BP	6 800	
	"	235,40	132,50	600,00	20,00	HC	2,90	2,00	8,0	M.98	2,26%	BP	10 000	
Krupp	24cm G. L/22 C/74	235,40	132,50	433,00	9,00	AP	2,26	2,00	3.5		2,26%	BP	4 230	Albrecht
	"	235,40	119,50	455,00	9,00	Common	2,30	2,00	3.5		5,69%	BP	4 380	
	"	235,40	132,50	483,00	9,00	AP	2,26	2,00	3.5		2,26%	BP	4 830	
	"	235,40	119,50	508,00	9,00	Common	2,30	2,00	3.5		5,69%	BP	4 980	
	"	235,40	132,50	510,00	35,00	AP	2,26	2,00	8,0		2,26%	BP	11 200	Coast Defence
	"	235,40	132,50	510,00	35,00	HC	2,90	2,00	8,0	M.98		PA	11 200	
Krupp	24cm G. L/20 C/68	235,40	140,00	410,00	9,00	AP	2,26	2,00	3,5	Gruson	1,21%	BP	4 070	Lissa
	"	234,50	132,50	420,00	9,00	AP	2,26	2,00	3,5	Steel	2,26%	BP	4 070	
	"	235,40	119,50	410,00	9,00	Common	2,30	2,00	3,5		5,69%	BP	3 870	
	"	235,40	132,50	483,00	20,00	AP	2,26	2,00	8,0		2,26%	BP	10 200	Coast Defence
	"	235,40	132,50	483,00	20,00	HC	2,90	2,00	8,0	M.98	5,13%	BP	10 200	
Armstrong	9"/15.3 12-Ton MLR	228,60	116,12	432,82	12,00	AP	2,28	2,00	3.0	Palliser			5 081	Kaiser (rebuilt)
	"	228,60	113,40		12,00	Common	2,60	2,00	3.0		7,60%	BP	5 042	
	"	228,60	115,98		12,00	AP Shell		2,00	3.0	Palliser	2,33%	BP		
	"	228,60	120,02	361,00	12,00	Common		2,00	3.0		6,99%	BP		
Krupp	21cm G. L/20 C/68	209,30	94,00	463,00	12,00	AP	2,36	2,00	2.5	Steel	2,13%	BP	5 600	Kaiser Max (II), Fasana
	"	209,30	89,00	483,00	12,00	AP	2,50	2,00	2.5	Gruson chilled	1,35%	BP	5 400	
	"	209,30	78,00	435,00	12,00	Common	2,38	2,00	2.5		6,03%	BP	4 700	
	"	209,30	94,00	500,00	12,00	CP	2,93	2,00	4,0	C/98		PA	5 900	Coast Defence
	"	209,30	78,00	545,00	12,00	CP	2,84	2,00	4,0	C/99	9,62%	PA	6 000	
Krupp	21cm G. L/12.25 C/65	209,30	89,00	335,00	12,75	AP	2,50	2,00	2.5	Gruson chilled	1,35%	BP	3 900	
	"	209,30	78,00	311,00	12,75	Common	2,40	2,00	2.5		6,03%	BP	3 440	
Skoda	19cm G. L/45 K/18	190,00	97,00	850,00	30,00	APCBC	4,00	10,00	6.8				26 500	Cruiser Plan VII

	"	190,00	97,00	850,00	30,00	SAPBC	4,20	10,00	6.8					26 500	
Skoda	19cm G. L/42 K/03	190,00	90,00	850,00	20,00	AP	2,90	2,00	4.4			3,22%		13 950	Sankt Georg, Erzherzog Karl
	"	190,00	90,00	850,00	20,00	CP	3,10	2,00	4.4			5,33%		13 950	
	"	190,00	97,00	800,00	20,00	APC	3,10	3,00	4.4		7,22%	2,99%		15 000	
	"	190,00	97,00	800,00	20,00	CPC	3,30	3,00	4.4		7,22%	4,95%		15 000	
Paixhans	48-pdr SB (a/k/a 50-pdr)	194,00	25,25	509,00	5,00	Ball	1,00	1,00	2,0					1 740	
	"	194,00	21,80	547,00	5,00	Shell	1,00	1,00	2,0					1 713	
Armstrong	7"/16 6.5-Ton MLR	177,80	52,20	465,00	12,00	AP	2,18	2,00	2.0	Palliser				5 034	Drache, Kaiser Max, Ferdinand Max
	"	177,80	52,60		12,00	Common	2,57	2,00	2.0			7,76%	BP	5 005	(after 1867)
	"	177,80	53,39		12,00	AP Shell		2,00	2.0	Palliser		1,05%	BP		
	"	177,80	55,79	354,00	12,00	Common		2,00	2.0			6,46%	BP		
Skoda	15cm G. L/50 K/10	149,10	45,50	880,00	15,00	APC	3,56	2,00	4.4					11 650	Tegetthoff, Ersatz Monarch, dreadnought
	"	149,10	45,50	880,00	15,00	SAP	3,75	2,00	4.4	K/08				11 650	plans, cruiser plans
	"	149,10	45,50	880,00	15,00	APC		4,00	4.4					14 300	
	"	149,10	45,50	880,00	15,00	CPC		4,00	4.4					14 300	
	"	149,10	45,50	880,00	15,00	CPCBC	4,20	8,50	4.4					17 000	
Skoda	15cm G. L/40 K/96	149,10	45,50	700,00	15,00	APC	3,56	2,00	4.4	M.97/08		1,89%	BP	9 400	Habsburg, Kaiser Karl IV, Sankt Georg,
	"	149,10	45,50	700,00	15,00	SAP	3,75	2,00	4.4	M.08		8,02%	BP	9 400	Kaiser Franz Josef (re-armed)
	"	149,10	45,50	700,00	15,00	AP	3,38	2,00	4.4			1,89%	BP	9 400	
	"	149,10	45,50	700,00	15,00	HC	4,25	2,00	4.4	M.99		9,29%	PA	9 400	
Krupp	15cm G. L/40 K/94	149,10	45,50	690,00	15,00	AP	3,38	2,00	5.0			1,89%	BP	9 270	Monarch
	"	149,10	45,50	690,00	15,00	HC	4,25	2,00	5.0	M.99		9,29%	BP	9 270	
	"	149,10	45,50	690,00	15,00	APC	3,56	2,00	4.4	M.97/08		1,89%	BP	9 270	
	"	149,10	45,50	690,00	15,00	SAP	3,75	2,00	4.4	M.08		8,02%	BP	9 270	
Krupp	15cm G. L/35 K/86	149,10	51,00	575,00	16,00	AP	3,50	2,00	4.0			1,18%	BP	8 760	Kronprizzen Stefani, Tegetthoff (re-armed)
	"	149,10	51,00	575,00	16,00	CP		2,00	4.0			4,71%	BP	8 760	KuK Maria Theresia, Kaiser Franz Josef
	"	149,10	51,00	650,00	16,00	AP	3,50	2,00	4.0			1,18%	BP	9 845	
	"	149,10	51,00	650,00	16,00	CP		2,00	4.0			4,71%	BP	9 845	
	"	149,10	45,50	650,00	16,00	AP	3,38	2,00	4.0			1,89%	BP	9 060	KuK Maria Theresia,

														Kaiser Franz Josef
	"	149,10	45,50	650,00	16,00	Common	3,75	2,00	4.0	M.08	9,29%	BP	9 060	
	"	149,10	45,50	650,00	16,00	APC	3,56	2,00	4.0	M.97	1,76%	BP	9 060	
	"	149,10	45,50	650,00	16,00	HC	4,25	2,00	4.0	M.99	8,02%	PA	9 060	
Krupp	15cm G. L/35 K/80	149,10	39,00	600,00	15,00	AP	2,88	2,00	5.5	M.80	2,05%	BP	7 600	
	"	149,10	31,70	665,00	15,00	Common	2,53	2,00	5.5	M.78	5,52%	BP	7 580	
	"	149,10	39,00	600,00	15,00	APC	3,56	2,00	5.5	M.98			7 600	
	"	149,10	39,00	600,00	15,00	Common	2,97	2,00	5.5	M.80	5,90%	BP	7 600	
	"	149,10	39,00	600,00	25,00	APC	3,56	2,00	5.5	M.98			9 900	Coast Defence
	"	149,10	39,00	600,00	25,00	Common	2,97	2,00	5.5	M.80			9 900	
Krupp	15cm G. L/26 C/72	149,10	38,50	476,00	14,50	AP		2,00	3.0	Steel	2,47%	BP	6 000	Radetzky (II), Donau (ii)
	"	149,10	29,50	540,00	14,50	Common	2,30	2,00	3.0	M.78	5,93%	BP	6 000	
	"	149,10	31,70	525,00	14,50	Common	2,94	2,00	3.0	M.80	5,52%	BP	6 090	
Krupp	15cm G. L/26 C/78	149,10	33,00	500,00	14,50	AP		2,00	3.0	Steel	2,27%	BP	5 880	Fasana, Saida
	"	149,10	29,50	525,00	14,50	Common	2,30	2,00	3.0	M.78	5,93%	BP	5 870	
	"	149,10	30,50	520,00	14,50	Common		2,00	3.0		5,74%	BP	5 970	
Uchatius	15cm G. L/25 M.80	149,10	38,50	476,00	15,00	AP	2,69	2,00	3.0	Steel	2,47%	BP	6 000	
	"	149,10	31,50	527,00	15,00	Common	2,66	2,00	3.0		7,30%	BP	6 090	
Wahrendorf	15cm G.L/21 M.61 (24-pdr)	149,10	35,50	300,00	14,00	AP	2,40	2,00	3.0		1,13%	BP	3 550	Drache, Kaiser Max, Aurora
	"	149,10	29,50	310,00	14,00	Common	2,50	2,00	3.0	M.78	5,93%	BP	3 550	
	"	149,10	27,70	310,00	14,00	Common	2,00	2,00	3.0	M.61	3,07%	BP	3 550	
Skoda	12cm G. L/45 K/14	120,00	23,80	800,00	30,00	CPC	4,20	4,00	5.1		5,46%	T	15 000	Ersatz Zenta plan
Skoda	12cm G. L/40 K/96	120,00	23,80	700,00	30,00	AP	2,85	2,00	3.5		2,10%	PA	11 715	Zenta
	"	120,00	23,80	700,00	30,00	CP	3,10	2,00	3.5		5,46%	PA	11 715	
Skoda	12cm G. L/35 K/04	120,00	23,80	675,00	30,00	AP	2,85	2,00	3.0		2,10%	PA	11 410	River Monitors
	"	120,00	23,80	675,00	30,00	CP	3,10	2,00	3.0		5,46%	PA	11 410	
Krupp	12cm G. L/35 C/93	120,00	23,80	650,00	30,00	AP	2,85	2,00	3.0		2,10%	PA	11 105	
	"	120,00	23,80	650,00	30,00	CP	3,10	2,00	3.0		5,46%	PA	11 105	
Krupp	12cm G. L/35 C/87	120,00	26,00	580,00	25,00	AP	3,50	2,00	3.0		2,88%	BP	9 680	Kronprinz Rudolf, Panther, Tiger, Gaa
	"	120,00	26,00	580,00	25,00	CP	4,20	2,00	3.0		6,54%	BP	9 680	

	"	120,00	23,80	650,00	25,00	AP	2,85	2,00	3.0			2,10%	PA	10 285	
	"	120,00	23,80	650,00	25,00	CP	3,10	2,00	3.0			5,46%	PA	10 285	
Krupp	12cm G. L/35 C/80	120,00	26,00	530,00	25,00	AP	3,48	2,00	3.0			2,88%	BP	9 040	
	"	120,00	26,00	530,00	25,00	Common	4,21	2,00	3.0			6,54%	BP	9 040	
Uchatius	12cm G. L/36.5 M.87	120,00	26,00	535,00	25,00	AP	3,48	2,00	3.0			2,88%	BP	9 100	
	"	120,00	26,00	535,00	25,00	Common	4,21	2,00	3.0			6,54%	BP	9 100	
Uchatius	12cm G. L/35 M.87	120,00	26,00	535,00	25,00	AP	3,48	2,00	3.0			2,88%	BP	9 100	
	"	120,00	26,00	535,00	25,00	Common	4,21	2,00	3.0			6,54%	BP	9 100	
Wahrendorff	12cm G.L/23 M.61 (12-pdr)	121,92	20,00	332,00	14,00	AP	2,80	2,00	3.0			5,25%	BP	3 900	
	"	121,92	15,00	321,00	14,00	Common	2,30	2,00	3.0			6,67%	BP	3 530	
Finspong	10cm L/19.4 M.63 (8-pdr)	106,10	11,00	305,00	9,50	Common		2,00	3.0			6,55%	BP	2 471	
Skoda	10 cm L/50 K/11	100,00	13,75	900,00	18,00	CP	4,20	4,00	3.9	K/09		12,36%	T	12 575	Helgoland, Tatra
Skoda	10 cm L/50 K/07 & K/10	100,00	13,75	880,00	14,00	CP	4,20	4,00	3.7	K/09		12,36%	T	11 000	Radetzky, Admiral Spaun
Skoda	9 cm G. L/45 K/13 BAG	90,00	10,20	780,00	70,00	CP	4,20	3,00	5.0					12 555	Ersatz Monarch, dread-nought & cruiser plans
Skoda	9 cm G. L/45 K/12 TAG	90,00	10,20	840,00	30,00	CP	4,20	3,00	5.3					12 300	Ersatz Monarch, dread-nought & cruiser plans
Uchatius	9cm G. L/24 M.75	87,00	6,45	448,00	15,00	CP	2,74	2,00	4.4			3,10%	BP	4 580	Ferdinand Max, Custo-za, Lissa, Kaiser, Kaiser Max (II)
Finspong	8cm L/19.5 M.63 (4-pdr)	87,00	5,75	284,00	19,00	Common	2,87	2,00				7,13%	BP	3 512	
Wahrendorff	8cm G. L/20.1 M.61 (3-pdr)	83,30	4,70	370,00	14,00	Common	2,00	2,00				4,26%	BP	3 557	
	GREAT BRITAIN														
	18"/40 Mk. I	457,20	1 505,94	737,62	30,00	APC	3,74	4,00	8.08			3,58%	L	29 050	Furious
	"	457,20	1 505,94	737,62	30,00	CPC	4,21	4,00	8.08			7,32%	BP	29 050	
	"	457,20	1 505,94	737,62	30,00	APCBC	4,43	8,00	8.08			2,38%	S	32 004	
	"	457,20	1 322,69	787,06	30,00	APCBC	4,14	6,00	8.08			2,50%	T	33 387	
	18"/45 Mk. II	457,20	1 322,69	807,72	40,00	APCBC	4,14	6,00	8.84			2,50%	T	40 088	'N 3'
	"	457,20	1 505,94	757,00	40,00	APCBC	4,43	8,00	8.84			2,38%	S	37 561	
	16"/45 Mk. I	406,40	928,97	788,21	40,00	APCBC	4,14	6,00	8.84		9,50%	2,50%	T	36 524	'G 3', Nelson

	"	406,40	928,97	796,75	40,00	APCBC	4,14	6,00	8.84	Mk. II Rifling	9,50%	2,50%	T	36 809	
	"	406,40	1 020,59	784,86	40,00	APCBC	4,29	6,00	8.84					37 033	
	16"/45 Mk. II	406,40	1 077,29	757,43	40,00	APCBC	4,54	6,00	8.84		9,50%	2,51%	S	37 361	Lion
	15"/42 Mk. I	381,00	870,91	751,94	20,00	APC	3,63	4,00	6.63	Mk. I a	8,09%	3,15%	L	22 265	Queen Elizabeth, Revenge, Renown
	"	381,00	870,91	751,94	20,00	CPC	4,22	4,00	6.63	Mk. IIa	5,44%	6,73%	BP	22 265	
	"	381,00	870,91	751,94	30,00	APC	3,63	4,00	6.63	Mk. I a	8,09%	3,15%	L	27 596	Monitors during WW I
	"	381,00	870,91	751,94	30,00	CPC	4,22	4,00	6.63	Mk. IIa	5,44%	6,73%	BP	27 596	
	"	381,00	765,67	801,93	30,00	APCBC	4,14	6,00	6.63	Mk. IV b		2,50%	T	31 773	
	"	381,00	765,67	801,93	20,00	APCBC	4,14	6,00	6.63	Mk. IV b		2,50%	T	25 453	
	"	381,00	866,37	753,77	20,00	APC	3,73	4,00	6.63	Mk. II a	11,61%	2,37%	S	22 339	Queen Elizabeth, Revenge, Renown
	"	381,00	866,37	753,77	30,00	APC	3,73	4,00	6.63	Mk. II a	11,61%	2,37%	S	27 679	Hood
	"	381,00	869,55	752,25	20,00	APC	3,73	4,00	6.63	Mk. Va		2,36%	S	22 504	Queen Elizabeth, Revenge, Renown
	"	381,00	869,55	752,25	30,00	APC	3,73	4,00	6.63	Mk. Va		2,36%	S	27 802	Hood
	"	381,00	878,62	749,39	20,00	APC	3,75	4,00	6.63	Mk. XIIa		2,50%	S	22 468	Queen Elizabeth, Revenge, Renown
	"	381,00	878,62	749,39	30,00	APC	3,75	4,00	6.63	Mk. XIIa		2,50%	S	27 773	Hood
	"	381,00	879,07	749,20	30,00	APCBC	4,11	5,00	6.63	Mk. XVIIb		3,18%	S	30 678	Renown, Queen Eliza-beth, Valiant, Warspite, Vanguard
	"	381,00	879,07	749,20	20,00	APCBC	4,11	5,00	6.63	Mk. XVIIb		3,18%	S	24 369	Repulse, Malaya, Barham, Revenge
	" super chg	381,00	879,07	804,06	20,00	APCBC	4,11	5,00	6.63	Mk. XVIIb		3,18%	S	27 368	Malaya, Revenge
	15"/45 Mk. II	381,00	879,07	765,05	40,00	APCBC	4,33	5,00	7.32	Mk. XXIb		2,50%		35 799	proposed for King George V
EOC	14"/45 Mk. I	355,60	719,40	764,14	20,00	APC		4,00	7.32	Mk. Ia	7,73%	3,87%	L	22 311	Canada
	"	355,60	719,40	764,14	20,00	CPC		4,00	7.32			6,57%	BP	22 311	
	"	355,60	723,49	762,00	20,00	APC		4,00	7,32	Mk. IIIa	11,11%	2,35%	S	22 273	
	14"/45 Mk. VII	355,60	721,22	756,82	40,00	APCBC	4,40	6,00	7.32			3,05%	S	35 260	King George V
	13.5"/45 Mk. V (L)	342,90	574,48	781,81	20,00	APC	3,34	3,00	7.01	Mk. II a	3,64%	3,16%	L	21 572	Orion, George V, Lion
	"	342,90	567,00	787,00	20,00	CPC	4,10	3,00	7.01			9,42%	BP	21 781	
	"	342,90	570,17	784,56	20,00	APC	3,25	4,00	7.01	Mk. III a	10,05%	2,35%	S	21 678	
	13.5"/45 Mk. V (H)	342,90	635,04	759,26	20,00	APC	3,67	3,00	7.01	Mk. I a	5,26%	3,18%	L	21 708	Queen Mary, Tiger, Iron Duke
	"	342,90	635,04	759,26	20,00	CPC	4,43	3,00	7.01			8,39%	BP	21 708	

	"	342,90	639,57	756,52	20,00	APC	3,64	4,00	7.01	Mk. II a	11,30%	2,34%	S	21 589	
Vickers	13.5"/45 Mk. VI	342,90	635,04	745,24	20,00	APC	3,88	4,00	6.7				L	21 132	Erin
	"	342,90	635,04	745,24	20,00	CPC	4,86	4,00	6.7				L	21 132	
	"	342,90	639,57	742,59	20,00	APC	3,64	4,00	6.7	Mk. II a	11,50%	2,34%	S	21 029	
	12"/35.5 Mk. VIII	304,80	385,56	736,70	13,50	AP	3,16	2,00	7.01	Mk. I		5,68%	BP	12 993	Majestic, Canopus
	" Cordite	304,80	385,56	736,70	13,50	CP	3,80	2,00	7.01			9,43%	BP	12 993	
	" MD	304,80	385,56	723,90	13,50	AP	3,16	2,00	7.01	Mk. I		5,68%	BP	12 710	
	" MD	304,80	385,56	723,90	13,50	CP	3,80	2,00	7.01			9,43%	BP	12 710	
	" MD	304,80	385,56	723,90	30,00	CPC	4,03	3,00	7.01		3,53%	9,41%	BP	20 912	Monitors during WW I
	" MD	304,80	385,56	723,90	30,00	HE	4,03	3,00	7.01			12,59%	L	20 912	
	12"/40 Mk. IX (s)	304,80	385,56	796,14	13,50	APC	3,50	2,00	7.01	Mk. IV	3,33%	2,01%	L	14 265	King Edward VII
	"	304,80	385,56	796,14	13,50	CP	3,80	2,00	7.01			9,42%	BP	14 307	
	"	304,80	389,84	791,57	30,00	APC	3,30	3,00	7.01	Mk. VI a	3,71%	3,08%	L	24 231	
	"	304,80	385,56	796,14	30,00	CPC	4,03	3,00	7.01			9,41%	BP	24 232	
	12/40 Mk. IX	304,80	385,56	777,85	13,50	AP	3,16	2,00	7.01	Mk. II		5,68%	BP	13 902	Formidable, London, Duncan
	"	304,80	385,56	777,85	13,50	CP	3,80	2,00	7.01			9,42%	BP	13 902	
	"	304,80	385,56	777,85	13,50	APC	3,50	2,00	7.01	Mk. III	3,33%	2,01%	BP	13 853	
	12"/45 Mk. X	304,80	385,56	830,58	13,50	APC	3,50	2,00	6.71	Mk. IV	3,33%	2,01%	BP	15 042	Dreadnought, Bellerophon, Invincible
	"	304,80	385,56	830,58	13,50	CP	3,80	2,00	6.71			9,42%	BP	15 067	Indefatigable, Lord Nelson
	"	304,80	385,56	830,58	13,50	APC	3,30	3,00	6.71	Mk. IV a	3,53%	3,10%	BP	16 880	
	"	304,80	389,84	826,01	13,50	APC	3,30	3,00	6.71	Mk. VI a	3,49%	3,08%	L	17 069	
	"	304,80	388,28	827,53	13,50	APC	3,17	3,00	6.71	Mk. VII a	12,04%	2,37%	S	17 237	
	"	304,80	385,56	830,58	13,50	CPC	4,03	3,00	6.71			9,41%	BP	17 236	
	"	304,80	398,20	807,72	13,50	APCBC	3,90	8,00	6.71	Mk. VIII b		2,50%	S	19 320	
	12"/50 Mk. XI	304,80	389,81	864,41	15,00	APC	3,30	3,00	6.71	Mk. V a	3,71%	3,07%	L	19 385	St. Vincent, Neptune, Colossus
	"	304,80	388,28	866,24	15,00	APC	3,17	4,00	6.71	Mk. VII a	12,04%	2,37%	S	19 406	
	"	304,80	385,56	869,29	15,00	CPC	4,03	3,00	6.71			9,41%	BP	19 391	
	"	304,80	398,20	845,82	15,00	APCBC	3,90	8,00	6.71	Mk. VIII b		2,50%	S	22 109	
EOC	12"/45 Mk. XIII	304,80	385,56	830,58	13,50	APC	3,30	4,00	7.54					17 210	Agincourt

	"	304,80	385,56	830,58	13,50	CPC	3,90	4,00	7.54				T	17 210	
	"	304,80	385,56	830,58	16,00	APC	3,30	4,00	7.54					18 901	
	"	304,80	385,56	830,58	16,00	CPC	3,90	4,00	7.54				T	18 901	
	"	304,80	388,28	827,53	16,00	APC	3,30	4,00	7,54	Mk. VII a	11,57%	2,37%	S	18 944	
	12"/50 Mk. XIV	304,80	430,92	808,33	40,00	APCBC	4,15	6,00	7.62	Mk. IX b				33 833	proposed for King George V
	10"/50 Mk. V	254,00	226,80	893,07	15,00	AP	3,00	2,00	7.0	Mk I		4,40%	BP	15 928	proposed for Dreadnought
	"	254,00	226,80	893,07	15,00	CP	3,83	2,00	7.0	Mk II		7,46%	BP	15 928	
EOC & VSM	10"/45 Mks. VI & VII	254,00	226,80	809,55	13,50	AP Shot		2,00	7,39					13 533	Swiftsure & Triumph
	"	254,00	226,80	809,55	13,50	AP Shell		2,00	7,39					13 533	
	"	254,00	226,80	809,55	13,50	CP		2,00	7,39					13 533	
	9.2"/40 Mk. VIII	233,68	172,37	709,88	15,00	AP	3,00	2,00	10.51	Mks I - III		4,74%	BP	11 746	Powerful
	"	233,68	172,37	709,88	15,00	CP	3,85	2,00	10.51	Mks II - V		7,89%	BP	11 746	
	"	233,68	172,37	709,88	15,00	CP		2,00	10.51	Mk VI & VII		7,53%	BP	11 746	
	"	233,68	172,37	709,88	15,00	APC	3,27	4,00	10.51	Mk. VI	5,12%	2,04%	BP	13 634	
	9.2"/46.7 Mk. X	233,68	172,37	846,74	15,00	AP	3,00	2,00	6.10	Mks I - III		4,74%	BP	14 173	Cressy, Drake, Warrior
	"	233,68	172,37	846,74	15,00	CP	3,77	2,00	6.10	Mks II - V		7,89%	BP	14 173	Duke of Edinburgh, King Edward VII
	"	233,68	172,37	846,74	15,00	CP		2,00	6.10	Mks VI & VII		7,53%	BP	14 173	
	"	233,68	172,37	846,74	30,00	APC	3,27	4,00	6.10	Mk. VIIIa	5,12%	2,04%	BP	23 500	
	"	233,68	172,37	846,74	30,00	CPC	3,77	4,00	6.10	Mk IXa		6,37%	BP	23 500	
	"	233,68	177,36	863,00	35,00	APCBC	3,90	8,00	6,25	Mk. XIIb			S	30 631	Edinburgh (Churchill Special)
	"	233,68	172,37	875,39	35,00	APCBC	3,49	6,00	6,25	Mk. XIIIb			S	29 810	
	9.2"/50.1 Mk. XI	233,68	172,37	880,87	15,00	AP	3,00	2,00	5.64	Mks VI & VII	5,12%	2,04%	BP	14 813	Minotaur, Lord Nelson
	"	233,68	172,37	880,87	15,00	CP	3,85	2,00	5.64			7,89%	BP	14 813	
	"	233,68	172,37	880,87	15,00	APC	3,30	4,00	5.64	Mks VIa & VIIa	5,12%	2,04%	BP	17 770	
	"	233,68	172,37	880,87	15,00	CPC	3,77	4,00	5.64	Mk VIIIa		6,37%	BP	17 770	
	"	233,68	177,36	929,64	40,00	APCBC	3,90	8,00	6,25	Mk. XIIb			S	35 662	Edinburgh (Churchill Special)
	"	233,68	172,37	945,80	40,00	APCBC	3,49	6,00	6,25	Mk XIIIb			S	34 703	
	8"/50 Mk. VIII	203,20	116,12	854,97	70,00	SAPCBC	4,50	6,00	6.25	Mk I b		4,49%	T	28 026	Treaty Cruisers

	8"/50 Mk. IX		203,20	131,54	813,82	45,00	SAPCBC	5,00	6,00	6.17				28 621	
	7.5"/45 Mk. I		190,50	90,72	842,77	15,00	APC	3,85	2,00	6.09	Mks I, II, III	2,00%	BP	12 809	Hampshire
	"		190,50	90,72	842,77	15,00	CP	3,70	2,00	6.09	Mks I & II	7,81%	BP	12 809	
	"		190,50	90,72	842,77	15,00	APC	3,85	3,00	6.09				13 913	
	"		190,50	90,72	842,77	15,00	CPC	3,83	3,00	6.09				13 913	
	7.5"/50 Mk. II		190,50	90,72	861,67	15,00	APC	3,85	2,00	6.09	Mks I, II, III	2,00%	BP	13 101	
	"		190,50	90,72	861,67	15,00	CP	3,70	2,00	6.09	Mks I & II	7,81%	BP	13 101	
	"		190,50	90,72	861,67	15,00	APC	3,85	3,00	5.64	Mk IIIa	2,00%	BP	14 238	Achilles, Minotaur
	"		190,50	90,72	861,67	15,00	CPC	3,83	3,00	5.64	Mk IIIa	8,12%	L	14 238	
	"		190,50	90,72	861,67	15,00	APC	3,85	3,00	5.64	Mk IVa	3,25%	L	14 238	
	"		190,50	90,72	861,67	15,00	CPC	3,83	3,00	5.64	Mk III*a	8,12%	S	14 238	
EOC & VSM	7.5"/50 Mks. III & IV		190,50	90,72	847,65	15,00	APC Shot		2,00	4,01			BP	12 882	Swiftsure & Triumph
	"		190,50	90,72	847,65	15,00	APC Shell		2,00	4,01			BP	12 882	
	"		190,50	90,72	847,65	15,00	Common		2,00	4,01			BP	12 882	
	"		190,50	90,72	847,65	15,00	APC		4,00	4,01			L	13 999	
	"		190,50	90,72	847,65	15,00	CPC		4,00	4,01			BP	13 999	
	"		190,50	90,72	847,65	15,00	HE	3,96	4,00	4,01		11,50%	L	13 999	
	7.5"/45 Mk. VI		190,50	90,72	844,30	30,00	CPC	3,83	3,00	6.09	Mk III*a	8,12%	S	19 307	Hawkins
	"		190,50	90,72	844,30	30,00	APC	3,85	3,00	6.09	Mk III*a	3,25%	L	19 307	
	"		190,50	90,72	844,30	30,00	SAPC	4,00	3,00	6.09	Mk Ia (1928)	5,00%	T	19 307	
	6"/40 QF Mks. I-III		152,40	45,36	573,63	15,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	7 786	Royal Soveriegn to Ca-nopus, Edgar to Diadem & re-armed Blake (casemates)
	"	EXE	152,40	45,36	573,63	15,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	7 786	
	"	EXE	152,40	45,36	573,63	20,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	9 138	Diadem, re-armed Blake, Aeolus, Brilliant, Highflyer, re-armed Hercules (deck mounts)
	"	EXE	152,40	45,36	573,63	20,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	9 138	
	"	EXE	152,40	45,36	573,63	19,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	8 889	
	"	EXE	152,40	45,36	573,63	19,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	8 889	
	"	Cordite	152,40	45,36	679,71	15,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	9 144	
	"	Cordite	152,40	45,36	679,71	15,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	9 144	

"	Cordite	152,40	45,36	679,71	20,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	10 571	
"	Cordite	152,40	45,36	679,71	20,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	10 571	
"	Cordite	152,40	45,36	679,71	19,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	10 308	
"	Cordite	152,40	45,36	679,71	19,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	10 308	
"	MD	152,40	45,36	683,67	15,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	9 194	
"	MD	152,40	45,36	683,67	15,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	9 194	
"	MD	152,40	45,36	683,67	20,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	10 624	
"	MD	152,40	45,36	683,67	20,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	10 624	
"	MD	152,40	45,36	683,67	19,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	10 361	
"	MD	152,40	45,36	683,67	19,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	10 361	
"	MD	152,40	45,36	683,67	25,00	AP	3,21	2,00	2.59	AP Mks II - IV	5,50%	BP	11 786	Monitors during WW I
"	MD	152,40	45,36	683,67	25,00	CP		2,00	2.59	CP Mks I - III	9,25%	BP	11 786	
6"/45 BL Mks. VII & VIII		152,40	45,36	772,97	15,00	AP	3,21	2,00	3.96	AP Mks II - IV	5,50%	BP	10 313	Formidable, London, Duncan, Cressy, Drake, Monmouth, re-armed Barfleur class
"	cordite	152,40	45,36	772,97	15,00	CP		2,00	3.96	CP Mks I - III	9,25%	BP	10 313	
"	MD	152,40	45,36	780,90	15,00	AP	3,21	2,00	3.96	AP Mks II - IV	5,50%	BP	10 411	
"	MD	152,40	45,36	780,90	15,00	CP		2,00	3.96	CP Mks I - III	9,25%	BP	10 411	
"	MD	152,40	45,36	780,90	15,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	11 600	
"	MD	152,40	45,36	780,90	15,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	11 600	
"	SC	152,40	45,36	784,25	15,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	11 650	
"	SC	152,40	45,36	784,25	15,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	11 650	
"	MD	152,40	45,36	844,30	14,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	12 242	Tiger, Iron Duke class
"	MD	152,40	45,36	844,30	14,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	12 242	
"	SC	152,40	45,36	845,82	14,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	12 264	
"	SC	152,40	45,36	845,82	14,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	12 264	
"	MD	152,40	45,36	844,30	15,00	AP	3,17	2,00	3.96	APC Mks V & VI	1,87%	BP	11 178	1st 5 K E VII, Hampshire, Swift

"	MD	152,40	45,36	844,30	15,00	CP		2,00	3.96	CP Mk IV	8,87%	BP	11 178	
"	MD	152,40	45,36	844,30	15,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	12 646	
"	MD	152,40	45,36	844,30	15,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	12 646	
"	SC	152,40	45,36	845,82	15,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	12 668	
"	SC	152,40	45,36	845,82	15,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	12 668	
"	MD	152,40	45,36	780,90	20,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	13 297	re-armed Highflyer, Edgar, Endymion, The- seus,
"	MD	152,40	45,36	780,90	20,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	13 297	Grafton, Vindictive, Hya- cinth, Astraea, Fox,
"	SC	152,40	45,36	784,25	20,00	APC	3,17	3,00	3.96	APC Mk VIIa	4,75%	L	13 350	Challenger class, Ame- thyst, Adventure, Atten- tive,
"	SC	152,40	45,36	784,25	20,00	CPC	3,92	3,00	3.96	CPC Mk VIIa	8,75%	BP	13 350	all Dido escept Eclipse
6"/50 BL Mk. XI		152,40	45,36	895,20	13,00	APC	3,17	3,00	3.06	APC Mk VIIa	4,75%	L	12 258	Africa, Britannia, Hiber- nia, Black Prince class,
"		152,40	45,36	895,20	13,00	CPC	3,92	3,00	3.06	CPC Mk VIIa	8,75%	BP	12 258	Bristol class
"		152,40	45,36	895,20	20,00	APC	3,17	3,00	3.06	APC Mk VIIa	4,75%	L	14 865	Bristol class
"		152,40	45,36	895,20	20,00	CPC	3,92	3,00	3.06	CPC Mk VIIa	8,75%	BP	14 865	
"		152,40	45,36	895,20	15,00	APC	3,17	3,00	3.06	APC Mk VIIa	4,75%	L	13 085	Falmouth, Chatham
"		152,40	45,36	895,20	15,00	CPC	3,92	3,00	3.06	CPC Mk VIIa	8,75%	BP	13 085	
6"/45 BL Mk. XII		152,40	45,36	855,58	14,00	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	12 175	Queen Elizabeth, Revenge, Cleopatra,
"		152,40	45,36	855,58	14,00	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	12 175	Champion
"		152,40	45,36	855,58	17,50	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	13 490	Cleopatra, Champion
"		152,40	45,36	855,58	17,50	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	13 490	
"		152,40	45,36	855,58	15,00	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	12 571	Birmingham, Arethusa to Centaur
"		152,40	45,36	855,58	15,00	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	12 571	
"		152,40	45,36	855,58	20,00	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	14 319	Birmingham, Arethusa to Centaur later
"		152,40	45,36	855,58	20,00	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	14 319	
"		152,40	45,36	855,58	30,00	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	16 898	Caledon, Cardiff, Cairo, Danae, Emerald

	"	152,40	45,36	855,58	30,00	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	16 898	
	"	152,40	45,36	855,58	40,00	APC		3,00	4.27	APC Mk VIIaQ	4,75%	L	18 355	turret/enclosed mounts on
	"	152,40	45,36	855,58	40,00	CPC	3,92	3,00	4.27	CPC Mk VIIIaQ	7,50%	BP	18 355	Enterprise and Diomede
EOC	6"/50 BL Mk. XIII	152,40	45,36	844,30	15,00	APC		4,00	6,09				12 322	Agincourt
	"	152,40	45,36	844,30	15,00	CPC		4,00	6,09				12 322	
VSM	6"/50 BL Mks. XIV & XV	152,40	45,36	883,92	15,00	APC		4,00	3,05				12 921	Humber class
	"	152,40	45,36	883,92	15,00	CPC		4,00	3,05				12 921	
VSM	6"/50 BL Mk. XVI	152,40	45,36	914,40	15,00	APC		4,00	6,25				13 387	Erin
	"	152,40	45,36	914,40	15,00	CPC		4,00	6,25				13 387	
EOC	6"/50 BL Mk. XVII	152,40	45,36	885,45	15,00	APC		4,00	4,27				13 022	Canada
	"	152,40	45,36	885,45	15,00	CPC		4,00	4,27				13 022	
	6"/50 BL Mk. XXII	152,40	45,36	902,21	60,00	CPC	3,90	6,00	8.83		7,50%	L	23 592	Nelson, planned for G3 and N3
	6"/50 BL Mk. XXIII	152,40	50,80	840,64	45,00	SAPBC	4,50	6,00	6.25		3,35%	S	23 299	light cruisers Leander thru Superb
COW	5.5"/50 BL Mk. I	139,70	37,19	850,39	15,00	CPC	4,00	3,00	4.27		6,40%	L	12 103	Birkenhead
	"	139,70	37,19	850,39	25,00	CPC	4,00	3,00	4.27		6,40%	L	15 150	Furious, Hermes
	"	139,70	37,19	850,39	30,00	CPC	4,00	3,00	4.27		6,40%	L	16 249	Hood
	5.25"/50 BL Mk. I	133,35	36,29	814,43	70,00	SAPBC	4,80	10,00	6.25		4,06%	S	22 010	King George V, Dido
	4.7"/40 QF Mks. I-IV	120,00	20,41	544,37	15,00	AP	3,02	2,00	2.57	Cast Iron Palliser	2,08%	BP	6 576	Barfleur, Nile classes
	" SP	120,00	20,41	544,37	15,00	Common		2,00	2.57	Cast Iron	5,56%	BP	6 576	
	" cordite	120,00	20,41	647,70	15,00	AP	3,02	2,00	2.57	Steel AP Shell	4,44%	BP	7 593	
	" cordite	120,00	20,41	647,70	15,00	Common	3,63	2,00	2.57	Cast Steel	10,00%	BP	7 593	
	" SP	120,00	20,41	544,37	20,00	AP	3,02	2,00	2.57	Cast Iron Palliser	2,08%	BP	7 715	Apollo, Astraea, Eclipse, Arrogant,
	" SP	120,00	20,41	544,37	20,00	Common		2,00	2.57	Cast Iron	5,56%	BP	7 715	Barracouta, Barham, Pearl, Alarm,
	" cordite	120,00	20,41	647,70	20,00	AP	3,02	2,00	2.57	Steel AP Shell	4,44%	BP	8 779	Sharpshooter, Halcyon
	" cordite	120,00	20,41	647,70	20,00	Common	3,63	2,00	2.57	Cast Steel	10,00%	BP	8 779	
	" MD	120,00	20,41	675,13	20,00	AP	3,02	2,00	2.57	Steel AP Shell	4,44%	BP	9 053	
	" MD	120,00	20,41	675,13	20,00	Common	3,63	2,00	2.57	Cast Steel	10,00%	BP	9 053	

4.7"/43.9 QF Mk. V	120,00	22,68	710,19	20,00	CPC	3,70	4,00	2.57				10 936	Halcyon
4.7"/40 QF Mk. VIII	120,00	22,68	748,90	90,00	SAPC	4,20	4,00	6.25				14 777	Nelson, Courageous, Albatross, Adventure
4.7"/45 QF Mks. IX & XII	120,00	22,68	807,72	40,00	SAPC	4,20	4,00	3.66				15 517	Destroyers
4.7"/50 QF Mk. XI	120,00	28,12	773,58	50,00	SAPC	5,20	8,00	7.0				19 422	M' class destroyers (and some 'L')
4.7"/45 BL Mk. I	120,00	22,68	813,51	30,00	SAP	4,20	4,00	3.66				14 447	Destroyers
4.5"/45 QF Mk. I	113,00	24,95	746,46	80,00	SAPC	5,50	10,00	3.96				18 974	Queen Elizabeth, Va-liant, Ark Royal, Renown
4"/40 QF Mk. IV	101,60	14,06	662,94	30,00	CP	3,70	2,00	4.27				10 581	destroyers
"	101,60	14,06	662,94	30,00	SAP		3,00					10 739	
"	101,60	14,06	662,94	30,00	SAP		3,00					10 911	
4"/45 QF Mk. V (LA)	101,60	14,06	805,28	30,00	SAP	3,70	3,00	4.42				12 655	Arethusa, Calliope, Castor, Argus
4"/45 QF Mk. V (HA)	101,60	14,06	727,56	80,00	HE		6,00	4.42				15 025	standard DP between Wars
"	101,60	14,06	727,56	80,00	SAP		3,00	4.42				12 728	
4"/45 QF Mk. XVI	101,60	15,88	810,77	80,00	SAPC	4,80	6,00	4.42				18 151	standard DP during WW 2
4"/40.5 QF Mk. XIX	101,60	15,88	396,24	40,00	SAPC	4,80	6,00	4,42				8 870	
4"/50.3 BL Mk. VII	101,60	14,06	872,95	15,00	CP	3,70	3,00	5.48				9 747	Bellerophon thru King George V
"	101,60	14,06	872,95	15,00	SAP		4,00					10 607	Indefatigable thru Queen Mary
"	101,60	14,06	872,95	15,00	HE		4,00					10 607	Boadicea, Active, Bristol
4"/40 BL Mk. VIII	101,60	14,06	697,08	20,00	CP	3,70	3,00	3.05				9 336	destroyers
"	101,60	14,06	697,08	20,00	SAP		3,00					9 336	
4"/44.3 BL Mk. IX	101,60	14,06	805,28	30,00	SAP	3,70	3,00	11.12				12 655	Renown, Courageous, Inflexible (1917)
12-pdr/12cwt QF Mks. I, II	76,20	5,67	682,75	20,00	CP	3,70	2,00	3.66	M. 1894	9,15%	BP	7 418	
"	76,20	5,67	688,85	20,00	CP	3,70	2,00	3.66	M. 1894	9,15%	BP	7 459	
"	76,20	5,87	681,23	20,00	CP	3,72	2,00	3.66	Lyddite	10,14%	L	7 537	
"	76,20	5,87	681,23	30,00	SAP	3,53	4,00	3.66	Amatol	4,11%	A	10 265	
12-pdr/8cwt QF Mk. I	76,20	5,67	495,91	20,00	CP	3,72	2,00	3.66	M. 1894	9,15%	BP	6 082	
"	76,20	5,87	487,38	20,00	CP	3,72	2,00	3.66	Lyddite	10,14%	L	6 102	
12-pdr/18cwt QF Mk. I	76,20	5,87	778,77	20,00	CP	3,72	2,00	3.66	Lyddite	10,14%	L	8 209	
"	76,20	5,67	792,48	20,00	CP	3,72	2,00	3.66	Lyddite	6,00%	L	8 203	

"	76,20	5,87	778,77	30,00	SAP	3,53	4,00	3.66	Amatol	4,11%	A	11 310	
12-pdr/20cwt QF Mks. I - IV	76,20	5,67	762,00	90,00	CP	3,72	2,00	3.66	Lyddite	6,00%	L	9 931	
"	76,20	5,87	748,29	90,00	SAP	3,53	4,00	3.66	Amatol	4,11%	A	11 645	
16.25"/30 BL Mk. I	412,75	816,47	636,12	13,00	AP	2,68	2,00	4.57	iron Palliser			11 339	Benbow, Victoria
"	412,75	816,47	636,12	13,00	Common	3,38	2,00	4.57	Iron	10,72%	BP	11 339	
"	412,75	816,47	636,12	13,00	Common	3,50	2,00	4.57	forged steel	10,42%	BP	11 339	
"	412,75	816,47	636,12	13,00	Common	3,50	2,00	4.57	cast steel	9,96%	BP	11 339	
"	412,75	816,47	636,12	13,00	Shot	3,65	2,00	4.57	steel			11 339	
"	412,75	816,47	636,12	13,00	CP	3,53	2,00	4.57	base fuzed	10,11%	BP	11 339	
" cordite	412,75	816,47	694,34	13,00	Shot	3,65	2,00	4.57	steel			12 788	
"	412,75	816,47	694,34	13,00	CP	3,53	2,00	4.57	base fuzed	10,11%	BP	12 788	
13.5"/30 BL Mks. I-IV	342,90	567,00	614,48	13,50	AP	3,25	2,00	4.28				10 927	Royal Sovereign class, Hood
"	342,90	567,00	614,48	13,50	Common	4,09	2,00	4.28	cast steel	6,76%	BP	10 927	
" cordite	342,90	567,00	639,78	13,50	AP	3,25	2,00	4.28				11 540	
"	342,90	567,00	639,78	13,50	Common	4,09	2,00	4.28	cast steel	6,76%	BP	11 540	
"	342,90	567,00	614,48	13,00	AP	4,42	2,00	4.28				10 670	Anson class, Nile, Trafalgar
"	342,90	567,00	614,48	13,00	Common	4,28	2,00	4.28	cast steel	6,76%	BP	10 670	
" cordite	342,90	567,00	639,78	13,00	AP	4,42	2,00	4.28				11 274	
"	342,90	567,00	639,78	13,00	Common	4,28	2,00	4.28	cast steel	6,76%	BP	11 274	
12"/25.1 BL Mk. II	304,80	323,87	583,39	13,00	AP	2,64	2,00	6.09				8 806	Collingwood
"	304,80	323,87	583,39	13,00	Common	3,33	2,00	6.09	Cast Iron	4,42%	BP	8 806	
"	304,80	323,87	583,39	12,50	AP	2,64	2,00	6.09				8 595	
"	304,80	323,87	583,39	12,50	Common	3,33	2,00	6.09	Cast Iron	4,42%	BP	8 595	
12"/25.5 BL Mks. III-V	304,80	323,87	583,39	13,00	AP	2,64	2,00	6.09				8 806	Collingwood
" PB	304,80	323,87	583,39	13,00	Common	3,33	2,00	6.09	Cast Iron	4,42%	BP	8 806	
" cordite	304,80	323,87	592,53	13,00	AP	2,64	2,00	6.09				8 975	
" cordite	304,80	323,87	592,53	13,00	Common	3,50	2,00	6.09	Forged Steel	13,31%	BP	8 975	

"	cordite	304,80	323,87	592,53	13,00	Common	3,50	2,00	6.09	Cast Steel	11,06%	BP	8 975	
"	PB	304,80	323,87	583,39	12,50	AP	3,60	2,00	6.09				8 595	Conqueror, Colossus
"	PB	304,80	323,87	583,39	12,50	Common	3,33	2,00	6.09	Cast Iron	4,42%	BP	8 595	
"	cordite	304,80	323,87	592,53	12,50	AP	3,60	2,00	6.09				8 762	
"	cordite	304,80	323,87	592,53	12,50	Common	3,50	2,00	6.09	Forged Steel	13,31%	BP	8 762	
"	cordite	304,80	323,87	592,53	12,50	Common	3,50	2,00	6.09	Cast Steel	11,06%	BP	8 762	
10"/32 BL Mks. I-IV		254,00	226,80	621,79	12,00	AP Shot	3,65	2,00	6.85	Mks I & II			9 198	re-armed Thunderer
"	PB	254,00	226,80	621,79	12,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	9 198	
"	Cordite	254,00	226,80	623,62	12,00	AP Shot	3,65	2,00	6.85	Mks I & II			9 231	
"	Cordite	254,00	226,80	623,62	12,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	9 231	
"	PB	254,00	226,80	621,79	13,00	AP Shot	3,65	2,00	6.85	Mks I & II			9 650	re-armed Devastation
"	PB	254,00	226,80	621,79	13,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	9 650	
"	Cordite	254,00	226,80	623,62	13,00	AP Shot	3,65	2,00	6.85	Mks I & II			9 683	
"	Cordite	254,00	226,80	623,62	13,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	9 683	
"	PB	254,00	226,80	621,79	14,00	AP Shot	3,65	2,00	6.85	Mks I & II			10 088	Victoria & Sans Pareil
"	PB	254,00	226,80	621,79	14,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	10 088	
"	Cordite	254,00	226,80	623,62	14,00	AP Shot	3,65	2,00	6.85	Mks I & II			10 114	
"	Cordite	254,00	226,80	623,62	14,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	10 114	
"	PB	254,00	226,80	621,79	15,00	AP Shot	3,65	2,00	6.85	Mks I & II			10 490	Barfleur, Centurion, Renown
"	PB	254,00	226,80	621,79	15,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	10 490	
"	Cordite	254,00	226,80	623,62	15,00	AP Shot	3,65	2,00	6.85	Mks I & II			10 527	
"	Cordite	254,00	226,80	623,62	15,00	CP	3,83	2,00	6.85	Mks I, II, V	7,46%	BP	10 524	
9.2"/25.5 BL Mks. I & II		233,70	172,37	542,85	10,00	AP Shot	3,14	2,00	5.79	Mk. II			6 858	Cuckoo, Snake
"		233,70	172,37	542,85	10,00	Common	3,93	2,00	5.79	cast iron Mk II	4,80%	BP	6 858	
"		233,70	172,37	542,85	15,00	AP Shot	4,07	2,00	5.79	Mk. II			8 933	
"		233,70	172,37	542,85	15,00	Common	3,80	2,00	5.79	cast steel Mk IV	8,39%	BP	8 933	
9.2"/31.5 Mks. III-VII		233,70	172,37	629,41	12,00	AP Shot	3,14	2,00	5.79	Mk II			9 007	Orlando class

"	PB	233,70	172,37	629,41	12,00	AP Shell		2,00	5.79	Iron Palliser	1,32%	BP	9 007	
"	PB	233,70	172,37	629,41	12,00	Common	3,93	2,00	5.79	cast iron Mk II	4,80%	BP	9 007	
"	Cordite	233,70	172,37	645,37	12,00	AP		2,00	5.79	Mks I, II, III	4,74%	BP	9 294	
"	Cordite	233,70	172,37	645,37	12,00	Common	4,07	2,00	5.79	forged steel Mk III	8,68%	BP	9 294	
"	Cordite	233,70	172,37	645,37	12,00	Common	3,80	2,00	5.79	cast steel Mk IV	8,39%	BP	9 294	
"	Cordite	233,70	172,37	645,37	12,00	CP	3,80	2,00	5.79	Mks II & III	7,89%	BP	9 294	
"	PB	233,70	172,37	629,41	15,00	AP Shot	3,14	2,00	5.79	Mk II			10 247	Imperieus, Blake, Edgar classes
"	PB	233,70	172,37	629,41	15,00	AP Shell		2,00	5.79	Iron Palliser	1,32%	BP	10 247	
"	PB	233,70	172,37	629,41	15,00	Common	3,93	2,00	5.79	cast iron Mk II	4,80%	BP	10 247	
"	Cordite	233,70	172,37	645,37	15,00	AP		2,00	5.79	Mks I, II, III	4,74%	BP	10 553	
"	Cordite	233,70	172,37	645,37	15,00	Common	4,07	2,00	5.79	forged steel Mk III	8,68%	BP	10 553	
"	Cordite	233,70	172,37	645,37	15,00	Common	3,80	2,00	5.79	cast steel Mk IV	8,39%	BP	10 553	
"	Cordite	233,70	172,37	645,37	15,00	CP	3,80	2,00	5.79	Mks II & III	7,89%	BP	10 553	
"	MD	233,70	172,37	638,56	15,00	AP		2,00	5.79	Mks I, II, III	4,74%	BP	10 417	
"	MD	233,70	172,37	638,56	15,00	CP	3,80	2,00	5.79	Mks II & III	7,89%	BP	10 417	
"	Cordite	233,70	172,37	645,37	10,00	AP		2,00	5.79	Mks I, II, III	4,74%	BP	8 341	re-armed Alexandra
"	Cordite	233,70	172,37	645,37	10,00	Common	4,07	2,00	5.79	forged steel Mk III	8,68%	BP	8 341	
"	Cordite	233,70	172,37	645,37	10,00	Common	3,80	2,00	5.79	cast steel Mk IV	8,39%	BP	8 341	
"	Cordite	233,70	172,37	645,37	10,00	CP	3,80	2,00	5.79	Mks II & III	7,89%	BP	8 341	
"	Cordite	233,70	172,37	645,37	13,00	AP		2,00	5.79	Mks I, II, III	4,74%	BP	9 733	re-armed Rupert
"	Cordite	233,70	172,37	645,37	13,00	Common	4,07	2,00	5.79	forged steel Mk III	8,68%	BP	9 733	
"	Cordite	233,70	172,37	645,37	13,00	Common	3,80	2,00	5.79	cast steel Mk IV	8,39%	BP	9 733	
"	Cordite	233,70	172,37	645,37	13,00	CP	3,80	2,00	5.79	Mks II & III	7,89%	BP	9 733	
"	MD	233,70	172,37	638,56	30,00	CP	3,80	2,00	5.79	Mks VI & VII	7,89%	BP	15 238	Monitors

" MD	233,70	172,37	638,56	30,00	HE	3,80	2,00	5.79	Mks VI & VII		BP	15 238	
8"/25.6 BL Mk. III	203,20	95,26	605,64	10,00	AP	2,62	2,00	3.05	Iron Palliser	1,10%	BP	6 714	re-armed Bellerophon
"	203,20	95,26	605,64	10,00	Common	3,31	2,00	3.05	Cast Iron Mk II	6,43%	BP	6 714	
"	203,20	95,26	605,64	10,00	Common	3,63	2,00	3.05	Steel Mk III	13,81%	BP	6 714	
"	203,20	95,26	605,64	10,00	CP	3,34	2,00	3.05	Mk I (1894)	8,72%	BP	6 714	
8"/29.6 BL Mks. IV & VI	203,20	95,26	670,56	15,00	AP	2,62	2,00	6.4	Iron Palliser	1,10%	BP	10 020	Mersey class
"	203,20	95,26	670,56	15,00	Common	3,31	2,00	6.4	Cast Iron Mk II	6,43%	BP	10 020	
"	203,20	95,26	670,56	15,00	Common	3,63	2,00	6.4	Steel Mk III	13,81%	BP	10 020	
" cordite	203,20	95,26	653,80	15,00	AP	2,62	2,00	6.4	Mk II (1904)	5,00%	BP	9 761	
"	203,20	95,26	653,80	15,00	Common	3,63	2,00	6.4	Steel Mk III	13,81%	BP	9 761	
"	203,20	95,26	653,80	15,00	CP	3,34	2,00	6.4	Mk I (1894)	8,72%	BP	9 761	
"	203,20	95,26	653,80	15,00	CP	3,34	2,00	6.4	Mk IV (1900)	8,57%	BP	9 761	
"	203,20	95,26	653,80	15,00	HE	3,16	2,00	6.4	Mk I (c 1900)	10,98%	L	9 761	
"	203,20	95,26	653,80	10,00	AP	2,62	2,00	6.4	Mk II (1904)	5,00%	BP	9 026	re-armed Magdala & Abyssinia
"	203,20	95,26	653,80	10,00	Common	3,63	2,00	6.4	Steel Mk III	13,81%	BP	9 026	
"	203,20	95,26	653,80	10,00	CP	3,34	2,00	6.4	Mk I (1894)	8,72%	BP	9 026	
"	203,20	95,26	653,80	10,00	CP	3,34	2,00	6.4	Mk IV (1900)	8,57%	BP	9 026	
"	203,20	95,26	653,80	10,00	HE	3,16	2,00	6.4	Mk I (c 1900)	10,98%	L	9 026	
6"/26 BL Mk.I	152,40	36,29	573,05	13,00	Common	2,90	2,00	3.35		7,66%	BP	6 424	re-armed Rover
6"/26 BL Mk. II	152,40	45,36	509,63	15,00	Common	3,60	2,00	3.35		7,37%	BP	6 940	Agamemnon & Ajax
"	152,40	45,36	509,63	15,00	AP	3,17	2,00	3.35	AP Mk. I	4,25%	BP	6 940	
"	152,40	45,36	509,63	20,00	Common	3,60	2,00	3.35		7,37%	BP	8 237	re-armed Comus, Cana-da, Cordelia
"	152,40	45,36	509,63	20,00	AP	3,17	2,00	3.35	AP Mk. I	4,25%	BP	8 237	
"	152,40	45,36	509,63	16,00	Common	3,60	2,00	3.35		7,37%	BP	7 220	re-armed Volage, Active, Bacchante class, Eme-rald,
"	152,40	45,36	509,63	16,00	AP	3,17	2,00	3.35	AP Mk. I	4,25%	BP	7 220	Raleigh, Dolphin class, Pelican, Wild Swan,

														Hotspur
6"/25.5 BL Mk. III, IV, VI		152,40	45,36	597,41	16,00	Common	3,60	2,00	3.05		7,37%	BP	8 370	Orlando, Imperieus, Mersey, Leander classes
"		152,40	45,36	597,41	16,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	8 370	re-armed Achilles, Bellerophon, Black Prince, et.al.
"		152,40	45,36	597,41	20,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	9 439	Orlando, Blake, Mersey, Leander, Archer,
"		152,40	45,36	597,41	20,00	Common	3,60	2,00	3.05		7,37%	BP	9 439	Medea, Apollo classes
"		152,40	45,36	597,41	15,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	8 074	Victoria, Conqueror & Admiral classes
"		152,40	45,36	597,41	15,00	Common	3,60	2,00	3.05		7,37%	BP	8 074	
6"/26 QFC		152,40	45,36	583,08	12,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	6 929	
"	EXE	152,40	45,36	583,08	12,00	Common	3,60	2,00	3.05		7,25%	BP	6 929	
"		152,40	45,36	628,19	12,00	AP	3,21	2,00	3.05	AP Mks II - IV	4,25%	BP	7 495	
"		152,40	45,36	628,19	12,00	Common	3,60	2,00	3.05		7,25%	BP	7 495	
"	EXE	152,40	45,36	583,08	15,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	7 887	
"	EXE	152,40	45,36	583,08	15,00	Common	3,60	2,00	3.05		7,25%	BP	7 887	
"		152,40	45,36	628,19	15,00	AP	3,21	2,00	3.05	AP Mks II - IV	4,25%	BP	8 481	
"		152,40	45,36	628,19	15,00	Common	3,60	2,00	3.05		7,25%	BP	8 481	
"	EXE	152,40	45,36	583,08	16,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	8 180	
"	EXE	152,40	45,36	583,08	16,00	Common	3,60	2,00	3.05		7,25%	BP	8 180	
"	cordite	152,40	45,36	628,19	16,00	AP	3,21	2,00	3.05	AP Mks II - IV	4,25%	BP	8 782	
"	cordite	152,40	45,36	628,19	16,00	Common	3,60	2,00	3.05		7,25%	BP	8 782	
"	EXE	152,40	45,36	583,08	16,50	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	8 322	
"	EXE	152,40	45,36	583,08	16,50	Common	3,60	2,00	3.05		7,25%	BP	8 322	
"	cordite	152,40	45,36	628,19	16,50	AP	3,21	2,00	3.05	AP Mks II - IV	4,25%	BP	8 928	
"	cordite	152,40	45,36	628,19	16,50	Common	3,60	2,00	3.05		7,25%	BP	8 928	
"	EXE	152,40	45,36	583,08	20,00	AP	3,17	2,00	3.05	AP Mk. I	4,25%	BP	9 241	
"	EXE	152,40	45,36	583,08	20,00	Common	3,60	2,00	3.05		7,25%	BP	9 241	
"	cordite	152,40	45,36	628,19	20,00	AP	3,21	2,00	3.05	AP Mks II - IV	4,25%	BP	9 871	
"	cordite	152,40	45,36	628,19	20,00	Common	3,60	2,00	3.05		7,25%	BP	9 871	

	5"/25 BL Mks. IV & V	127,00	22,68	533,40	15,00	Common	3,10	2,00	3.05	Cast Iron	8,12%	BP	6 781	
	"	127,00	22,68	533,40	15,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	6 781	
	"	127,00	22,68	533,40	20,00	Common	3,10	2,00	3.05	Cast Iron	8,12%	BP	7 988	
	"	127,00	22,68	533,40	20,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	7 988	
	"	127,00	22,68	533,40	22,00	Common	3,10	2,00	3.05	Cast Iron	8,12%	BP	8 404	
	"	127,00	22,68	533,40	22,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	8 404	
	5"/25 BLC	127,00	22,68	580,65	15,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	7 306	
	"	127,00	22,68	580,65	20,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	8 541	
	"	127,00	22,68	580,65	22,00	Common	3,10	2,00	3.05	Forged Steel	13,87%	BP	8 965	
	4"/25 BL Mk. I	101,60	11,34	545,59	18,50	Common	3,00	2,00	4.42		7,00%	BP	6 584	Swiftsure
	4"/27 BL Mks. II-VI	101,60	11,34	579,12	20,00	Common	3,00	2,00	4.42		7,00%	BP	7 041	Inflexible, Sultan, Swift-sure, Alexandra, Teme-raore, Superb,
	4" QFC	101,60	11,34	668,12	20,00	Common	3,00	2,00	4.42		7,00%	BP	7 723	Alert, Phoenix, Condor, Cadmus
	"	101,60	11,34	668,12	20,00	CP	3,00	2,00	4.42		12,75%	BP	7 723	
	4"/40 QF Mks. I-III	101,60	11,34	701,04	20,00	CP	3,00	2,00	3.05		7,00%	BP	8 610	Invincible, Amethyst, Pelorus
	20-pdr/29 BLR Mk. I	87,00	8,85	511,15	15,00	Common	3,61	2,00	2,66	Forged Steel	10,58%	BP	5 535	
	"	87,00	8,44	511,15	15,00	Common	3,73	2,00	2,66	Cast Iron	11,08%	BP		
	12-pdr/28 BLR Mk. I	76,20	5,67	524,26	15,00	Common	3,65	2,00	4,57	Cast Iron	5,00%	BP	5 252	
	"	76,20	5,67	524,26	15,00	Common	3,73	2,00	4,57	Forged Steel	12,25%	BP	5 252	
Armstrong	17.72"/20.48 RML Mk. II	450,00	907,19	471,83	12,00	AP	2,74	2,00	7.62	iron Palliser	1,60%	BP	6 733	Coast Defence
	"	450,00	907,19	471,83	12,00	Common	2,74	2,00	7.62		3,90%	BP	6 733	
	"	450,00	907,19	471,83	12,00	CP	2,97	2,00	7.62	cast steel	9,70%	BP	6 724	
	16"/18 RML Mk. I (80-T)	406,40	771,11	484,63	10,00	AP	2,70	2,00	3.96	iron Palliser	0,94%	BP	6 153	Inflexible
	"	406,40	771,11	484,63	10,00	Common	3,19	2,00	3.96		3,53%	BP	6 153	
	"	406,40	771,11	469,39	10,00	AP	2,70	2,00	3.96	Palliser	0,94%	BP	5 874	
	"	406,40	771,11	469,39	10,00	CP	3,50	2,00	3.96	cast steel	6,63%	BP	5 857	
	12.5"/15.8 RML Mk. I	317,50	371,04	439,52	14,00	AP	2,69	2,00	4.42				6 547	Dreadnought,

(38-T)													Thunderer
"	317,50	371,04	439,52	14,00	Common	3,14	2,00	4.42		4,58%	BP	6 547	
12.5"/15.8 RML Ml. II	317,50	371,04	480,06	14,00	AP	2,69	2,00	4.42				7 297	Agamemnon
"	317,50	371,04	480,06	14,00	Common	3,14	2,00	4.42		4,58%	BP	7 297	
12"/13.5 RML Mk. I (35-T)	304,80	320,70	423,67	14,00	AP	2,66	2,00	4.42				6 172	Devastation, Thunderer
"	304,80	323,87	408,43	14,00	Common	3,11	2,00	4.42		4,85%	BP	5 918	
12"/12.1 RML Mk. II (25-T)	304,80	276,20	392,58	17,25	AP	2,29	2,00	4.42				6 400	Monarch, Captain, Hotspur
"	304,80	276,20	392,58	17,25	Common	2,67	2,00	4.42	Cast Iron	4,62%	BP	6 400	
"	304,80	278,51	393,80	17,25	Common		2,00	4.42	Steel	10,04%	BP	6 433	
11"/12 RML Mk. II (25-T)	279,40	246,80	400,51	28,50	AP	2,66	2,00	6.4				9 144	Alexandra, Temeraire
"	279,40	248,57	414,53	28,50	Common	3,10	2,00	6.4		4,93%	BP	9 468	
10"/14.5 RML Mk. II (18-T)	254,00	184,60	420,32	10,00	AP	2,65	2,00	3.05				4 562	Sultan, Hercules, Alexandra, Temeraire
"	254,00	185,97	420,32	10,00	Common	3,09	2,00	3.05		5,73%	BP	4 569	
9"/13.9 RML Mk. IV (12-T)	228,60	115,21	438,91	10,00	AP	2,27	2,00	3.05	iron Palliser			4 534	Minotaur, Royal Alfred, Lord Clyde, Bellerophon, Audacious
"	228,60	115,21	438,91	10,00	Common	2,64	2,00	3.05	cast iron	6,69%	BP	4 534	Sultan, Swiftsure, Hercules, Prince Consort
"	228,60	116,12	430,99	10,00	AP	2,28	2,00	3.05	steel shot			4 449	
"	228,60	116,12	430,99	10,00	Common	2,96	2,00	3.05	cast steel			4 439	
9"/13.9 RML Mk. V	228,60	115,21	440,44	10,00	AP	2,27	2,00	3.05	iron Palliser			4 552	
"	228,60	115,21	440,44	10,00	Common	2,64	2,00	3.05	cast iron	6,69%	BP	4 546	
"	228,60	116,12	438,91	10,00	AP	2,28	2,00	3.05	steel shot			4 543	
"	228,60	116,12	438,91	10,00	Common	2,96	2,00	3.05	cast steel			4 532	
9"/13.9 RML Mk. VI	228,60	163,29	363,93	10,00	AP	3,21	2,00	3.05	steel shot			3 842	
"	228,60	163,29	363,93	10,00	Common	4,16	2,00	3.05	cast steel	7,57%	BP	3 832	
8"/14.8 RML Mk. III (9-T)	203,20	81,08	424,28	10,00	AP	2,22	2,00	3.05	Palliser Mk IV	1,47%	BP	4 245	Warrior, Defence, Hector, Achilles, Northumberland, Lord Clyde
"	203,20	81,19	423,98	10,00	Common		2,00	3.05	Cast Iron	9,92%	BP	4 243	
"	203,20	81,87	422,21	10,00	Common	2,59	2,00	3.05	Cast Iron Mk III	8,14%	BP	4 232	
"	203,20	81,31	423,68	10,00	Shell		2,00	3.05	Palliser Mk IV	2,51%	BP	4 241	

Armstrong	RBL 110-pdr 82cwt	177,80	50,05	361,80	16,00	Bolt	1,76	2,00	2.59				4 676	(upper deck)
	" 12# chg	177,80	50,05	342,90	16,00	Bolt	1,76	2,00	2.59				4 520	
	"	177,80	47,91	355,40	16,00	Common	2,65	2,00	2.59		7,22%	BP	4 523	
	"	177,80	40,94	355,09	16,00	Common	2,25	2,00	2.59	Service 1865	7,20%	BP	4 414	
	"	177,80	41,39	338,02	16,00	Common	2,07	2,00	2.59	Steel c.1890	9,04%	BP	4 361	
	"	177,80	50,05	361,80	12,00	Bolt	1,76	2,00	2.59				3 833	(main deck)
	"	177,80	50,05	342,90	12,00	Bolt	1,76	2,00	2.59				3 639	
	"	177,80	47,91	355,40	12,00	Common	2,65	2,00	2.59		7,22%	BP	3 713	
	"	177,80	40,94	355,09	12,00	Common	2,25	2,00	2.59	Service 1865	7,20%	BP	3 636	
	7"/15.9 RML Mk. I (4.5-T)	177,80	50,80	393,19	12,00	AP	2,12	2,00	3.05	iron Palliser			4 277	Volage, Bacchante
	"	177,80	50,80	393,19	12,00	Common	2,48	2,00	3.05	cast iron	8,07%	BP	4 277	
	"	177,80	51,98	393,19	12,00	AP	2,17	2,00	3.05	steel shot			4 300	
	"	177,80	51,98	393,19	12,00	Common	2,82	2,00	3.05	cast steel	9,65%	BP	4 300	
	7"/15.9 RML Mk. III (6.5-T)	177,80	50,80	403,86	12,00	AP	2,12	2,00	3.05	iron Palliser			4 388	Warrior, Defence, Hector, Achilles, Minotaur,
	"	177,80	50,80	403,86	12,00	Common	2,48	2,00	3.05	cast iron	8,07%	BP	4 388	Zealous, Pallas, Bellerophon, Lord Clyde,
	"	177,80	51,98	403,86	12,00	AP	2,17	2,00	3.05	steel shot			4 413	Royal Oak, King Alfred
	"	177,80	51,98	403,86	12,00	Common	2,82	2,00	3.05	cast steel	9,65%	BP	4 413	
	7"/18 RML Mk. IV (7-T)	177,80	51,98	426,72	15,00	AP	2,17	2,00	3.05	steel shot			5 416	Coast Defence
	"	177,80	51,98	426,72	15,00	Common	2,82	2,00	3.05	cast steel	9,65%	BP	5 416	
Armstrong	RBL 70-pdr 69cwt	162,60	32,52	424,70	15,00	Bolt	1,50	2,00	3.51				4 849	
	"	162,60	36,29	424,10	15,00	AP	1,98	2,00	3.51				5 114	
	"	162,60	31,80	453,10	15,00	Common	2,30	2,00	3.51		4,81%	BP	5 075	
	64-pdr/16.4 RML Mk. I	160,00	29,26	342,90	12,00	AP	1,66	2,00	3.5				3 469	Volage
		160,00	29,26	342,90	12,00	Common	1,94	2,00	3.5		12,89%	BP	3 469	
	64-pdr/15.5 RML Mk. III	160,00	29,26	342,90	12,00	AP	1,66	2,00	3.5				3 469	Emerald, Bacchante, Comus
	"	160,00	29,26	342,90	12,00	Common	1,94	2,00	3.5		12,89%	BP	3 469	
Armstrong	RBL 40-pdr 35cwt	120,65	18,60	354,79	15,00	Bolt	2,17	2,00	2.59				4 496	
	"	120,65	18,37	359,66	15,00	Common	2,92	2,00	2.59		6,17%	BP	4 538	
	"	120,65	18,46	353,57	15,00	Common	2,95	2,00	2.59	Steel c.	5,84%	BP	4 389	

										1890				
	40-pdr/22 RML Mk. II	120,65	17,37	434,34	15,00	AP	2,32	2,00	3.05				4 980	
	"	120,65	17,37	434,34	15,00	Common	3,02	2,00	3.05		8,65%	BP	4 964	
	25-pdr/22 RML Mk. I	101,60	11,34	411,48	16,00	AP Shot	2,53	2,00	3.05				4 842	
	"	101,60	11,34	411,48	16,00	Common	3,29	2,00	3.05		7,37%	BP	4 842	
Armstrong	RBL 25-pdr 13cwt Mk. I	101,60	11,34	359,66	20,00	Common	3,00	2,00	2.66		11,62%	BP	5 029	
	"	101,60	11,34	359,66	12,00	Common	3,00	2,00	2,66		11,62%	BP	3 591	
Armstrong	RBL 20-pdr 16cwt (/21.3)	95,25	9,89	426,72	16,00	Common	2,96	2,00	2.66		6,02%	BP	4 990	Warrior, Sultan
Armstrong	RBL 20-pdr 15cwt (/14.4)	95,25	9,89	335,28	16,00	Common	2,96	2,00	2,66		6,02%	BP	4 124	
Armstrong	RBL 12-pdr 12 cwt (/20.4)	76,20	5,10	377,65	16,00	Common		2,00	3,05		4,45%	BP	4 278	
Armstrong	RBL 9-pdr 6 cwt (/17.5)	76,20	3,88	321,56	16,00	Common		2,00	3,05		4,38%	BP	3 429	
	68-pdr 95cwt SB	200,00	31,50	581,58	7,50	BALL	1,00	1,00	3.05				2 306	Minotaur, Agincourt
	32-pdr 56cwt SB	162,80	14,30	511,15	7,50	BALL	1,00	1,00	2.59				2 105	
	18-pdr 42cwt SB	134,40	8,20	464,21	7,50	BALL	1,00	1,00	2.59				1 962	
	8" 65cwt Carronade	204,50	25,40	432,82	7,50	BALL	1,00	1,00	2.59				2 084	
	8" 36cwt Carronade	204,50	25,40	157,58	7,50	BALL	1,00	1,00	2.59				608	
	ITALIAN													
Ansaldo	381mm/50 M1934	381,00	885,00	870,00	35,00	APCBC	4,38	6,00	8.5			T	44 126	Littorio
Ansaldo	320mm/43.8 M1934	320,00	525,00	830,00	27,00	APCBC	4,36	4,00	5.7			T	30 258	Conte di Cavour, Caio Duilio
Ansaldo	203mm/53 M1927	203,20	125,30	900,00	45,00	APCBC	4,17	4,00	7.3		2,71%	T	31 105	Zara, Bolzano
	"	203,20	125,30	960,00	45,00	APCBC	4,17	4,00	7.3		2,71%	T	34 875	
Ansaldo	203mm/50 M1924	203,20	125,30	905,00	45,00	APCBC	4,17	4,00	7.7		2,71%	T	31 623	Trento
	"	203,20	118,00	840,00	45,00	APCBC	4,17	8,00	7.7		2,88%	T	28 000	
Ansaldo	152mm/55 M1934	152,40	50,00	910,00	45,00	APCBC	4,13	8,00	6.3		2,00%	T	26 100	Abruzzi, Costanzo Ciano, Littorio
Ansaldo	152mm/53 M1926	152,40	50,00	975,00	45,00	APCBC	4,13	8,00	6.3		2,00%	T	28 400	Giussano, Cadorna, Montecuccoli, Duca D'Aosta

	"	152,40	50,00	850,00	45,00	APCBC	4,13	8,00	6.3		2,00%	T	23 930	
	"	152,40	47,50	850,00	45,00	APCBC	4,13	8,00	6.3		2,11%	T	22 600	
OTO	135mm/45 M1937	135,00	32,70	825,00	45,00	SAPBC	4,30	5,00	6.3			T	19 600	Ciao Duilio, Capitani Romani
	"	135,00	32,70	825,00	45,00	APCBC		5,00	6.3			T	19 600	
Terni	120mm/45 M1924	120,00	23,15	850,00	33,00	SAPBC	4,30	3,00	5.2		5,31%	T	15 500	Sella, Sauro, Turbine
	"	120,00	22,13	850,00	33,00	CP		2,00	5.2		9,94%	T	13 470	
Ansaldo	120mm/50 M1926	120,00	23,50	920,00	45,00	SAPBC	4,40	8,00	6.2			T	19 600	Navigatori, Dardo, Folgore
	"	120,00	23,50	920,00	42,00	SAPBC	4,40	8,00	6.2			T	19 310	Cavour, Soldati (2nd group)
	"	120,00	23,50	920,00	40,00	SAPBC	4,40	8,00	6.2			T	19 050	Soldati (1st group)
	"	120,00	23,50	920,00	35,00	SAPBC	4,40	8,00	6.2			T	18 200	Oriani
	"	120,00	23,50	920,00	33,00	SAPBC	4,40	8,00	6.2			T	17 790	Maestrale
OTO	100mm/47 M1924	100,00	13,80	850,00	80,00	SAP	3,80	3,00	6.1			T	15 240	Standard HA gun
OTO	100mm/47 M1931	100,00	13,80	855,00	60,00	SAP	3,80	3,00	6.1			T	15 310	Spica thru Ariete
EOC & VSM	381mm/40 M1914	381,00	884,00	700,00	20,00	APC	3,80	4,00	7.5		4,36%	T	19 800	Caracciolo
	(Pattern A & Mk. A)	381,00	875,00	770,00	20,00	CPC	3,85	3,00	7.5		6,40%	T	21 000	
EOC & VSM	305mm/46 M1909	304,80	417,00	860,00	20,00	APC	3,40	3,00	6.6	7,40%	4,80%		20 050	Dante Alighieri, Conte di Cavour, Caio Duilio
	(Pattern T & Mk. G)	304,80	401,00	870,00	20,00	CPC	4,00	3,00	6.6		6,01%		21 500	
	"	304,80	452,00	840,00	20,00	APC	3,80	3,00	6.6		3,69%	T	24 000	
EOC	305mm/50 Pattern Q	305,80	445,00	865,00	12,00			4,00	8.0				19 000	Coast Defence
EOC	305mm/40 M1900	304,80	385,56	780,00	25,00	APC	3,40	2,00	6.0		2,79%	T	19 000	Regina Margherita
	"	304,80	385,56	780,00	25,00	CP	3,80	2,00	6.0		6,59%	T	19 000	
	"	304,80	417,00	780,00	25,00	APC	3,40	3,00	6.0		4,80%	T	20 000	
	"	304,80	400,00	795,00	25,00	CPC	4,00	3,00	6.0		6,35%	T	20 000	
EOC	305mm/40 M 1904	304,80	385,56	800,00	25,00	APC	3,40	2,00	6.0		2,79%	T	19 555	Regina Elena
	"	304,80	385,56	800,00	25,00	CP	3,80	2,00	6.0		6,59%	T	19 555	
	"	304,80	417,00	780,00	25,00	APC	3,40	3,00	6.0		4,80%	T	20 000	
	"	304,80	400,00	795,00	25,00	CPC	4,00	3,00	6.0		6,35%	T	20 000	
EOC & VSM	254mm/45 M1906	254,00	225,00	870,00	25,00	APC	3,30	4,00	6.5		1,94%	T	25 000	Pisa, San Giorgio

	(Pattern W & Mk.)	254,00	225,00	870,00	25,00	CPC	3,80	4,00	6.5			6,67%	T	25 000	
Armstrong	254mm/40 M1893 & 1899	254,00	204,11	810,00	13,50	AP		2,00	7.7			1,58%	BP	14 000	Ammiraglio di Saint Bon
	"	254,00	204,11	810,00	13,50	CP		2,00	7.7			4,41%	BP	14 000	
	"	254,00	204,11	810,00	13,50	Common		2,00	7.7			6,25%	BP	14 000	
	"	254,00	204,60	810,00	13,50	AP		2,00	7.7	refilled AP		1,81%	T	14 000	
	"	254,00	204,60	810,00	13,50	CP		2,00	7.7	refilled CP		7,14%	T	14 000	
	"	254,00	205,40	810,00	13,50	HE		2,00	7.7	refilled Common		9,74%	T	14 000	
	"	254,00	213,50	740,00	20,00	SAP		3,00	7.7	[1911?]	4,07%	6,93%	T	15 100	
	"	254,00	214,60	740,00	20,00	SAPC		3,00	7.7	[1911?]	4,57%	6,80%	T	15 100	
	"	254,00	225,00	735,00	35,00	APC		4,00	7.7	M.1907		1,94%	T	23 300	
	"	254,00	225,00	735,00	35,00	CPC		4,00	7.7	M.1907		6,67%	T	23 300	
	"	254,00	216,30	790,00	35,00	CPC		4,00	7.7	M.1916		8,32%	T	20 500	
EOC	203mm/45 M1897 Patt. W	203,20	113,40	770,00	20,00	AP		2,00	5.0			0,89%	BP	14 000	Regina Margherita, Regina Elena, Giuseppe
	"	203,20	113,40	770,00	20,00	Common		2,00	5.0			3,00%	BP	14 000	Garabaldi
	"	203,20	114,60	800,00	30,00	SAPC		3,00	5.0	M.1909		5,28%	T	17 900	
	"	203,20	116,23	800,00	30,00	CPC		3,00	5.0	M.1911		5,70%	T	17 900	
	"	203,20	115,90	800,00	30,00	APC		3,00	5.0	M.1915		3,96%	T	17 900	
EOC & VSM	190mm/45 M1906	190,50	90,90	880,00	25,00	APC	3,60	4,00	6.5			2,57%		22 000	Pisa, San Giorgio
	(Pattern C & Mk. D)	190,50	86,10	905,00	25,00	CPC	3,50	4,00	6.5			6,16%		22 000	
Schneider	152mm/45 M1911	152,40	47,00	830,00	20,00	CPC	3,90	4,00	4.0			8,01%	T	14 860	Caio Duilio, Caracciolo
EOC & VSM	152mm/50 M1913	152,40	50,00	870,00	20,00	CPC		4,00	5.1			5,44%	T	16 000	Libia
EOC	152mm/40 M1899	152,40	45,36	790,00	15,00	AP	3,27	2,00	5.1			4,87%	BP	10 280	Campania, Regina Margherita, St. Bon, Garibaldi
	"	152,40	45,36	790,00	15,00	Common	3,61	2,00	5.1			9,81%	BP	10 280	
	"	152,40	46,30	790,00	15,00	HE	3,61	2,00	5.1	Mod.1885		5,29%	BA	10 280	
	"	152,40	45,94	790,00	15,00	HE		2,00	5.1			12,76%	T	10 280	
	"	152,40	47,45	695,00	25,00	SAP		4,00	5.1	[1913?]		5,08%	T	13 900	
	"	152,40	46,44	695,00	25,00	CP		4,00		[1913?]		5,19%	T	13 900	
	"	152,40	48,57	695,00	25,00	APC		4,00		[1915?]		1,17%	T	13 900	

EOC	152mm/40 M1891	152,40	45,36	700,00	15,00	AP	2,88	2,00		Steel		1,25%	BP	9 260	Re Umberto, Umbria, Calabria, Vettor Pisani,
	"	152,40	45,36	700,00	15,00	AP	3,27	2,00		Steel		4,87%	BP	9 260	Marco Polo
	"	152,40	45,36	700,00	15,00	Common	3,61	2,00		Steel		9,81%	BP	9 260	
	"	152,40	46,30	700,00	15,00	HE	3,61	2,00		Mod.1885		11,66%	BA	9 260	
	"	152,40	45,94	700,00	15,00	HE		2,00				12,76%	T	9 260	
	"	152,40	47,45	695,00	25,00	SAP		4,00		[1913?]		5,08%	T	13 900	
	"	152,40	46,44	695,00	25,00	CP		4,00		[1913?]		5,19%	T	13 900	
	"	152,40	48,57	695,00	25,00	APC		4,00		[1915?]		1,17%	T	13 900	
EOC	152mm/40 M1888	152,40	45,36	655,00	15,00	AP	2,88	2,00		Steel		1,25%	BP	8 660	
	"	152,40	45,36	655,00	15,00	AP	3,27	2,00		Steel		4,87%	BP	8 660	
	"	152,40	45,36	655,00	15,00	Common	3,61	2,00		Steel		9,81%	BP	8 660	
	"	152,40	46,30	655,00	15,00	HE	3,61	2,00		Mod.1885		11,66%	BA	8 660	
	"	152,40	45,94	700,00	15,00	HE		2,00				12,76%	T	9 260	
	"	152,40	47,45	695,00	25,00	SAPC		4,00		[1913?]		5,08%	T	13 900	
	"	152,40	46,44	695,00	25,00	CPC		4,00		[1913?]		5,19%	T	13 900	
	"	152,40	48,57	695,00	25,00	APC		4,00		[1915?]		1,17%	T	13 900	
EOC	120mm/50 M1909 Pattern EE	120,00	22,13	850,00	30,00	CPC	4,20	3,00	3.1			9,94%	T	13 700	Dante Alighieri, Conte di Cavour, Quarto, Nino Bixio
	"	120,00	24,43	805,00	30,00	CPC		3,00	3.1			6,96%	T	13 610	
	"	120,00	24,30	805,00	30,00	HE		3,00	3.1			7,57%	T	13 610	
	120mm/45 M1913	120,00	22,13	750,00	32,00	CP	4,20	3,00	5.1			9,94%	T	12 235	Libia
	"	120,00	23,15	750,00	32,00	AP		3,00	5.1			5,31%		13 611	
	"	120,00	24,43	730,00	32,00	CP		3,00	5.1			7,53%	T	12 996	Coast Defence
Terni	102mm/35 M1914	101,60	13,35	760,00	25,00	HE	3,80	2,00	3.7	M 1914		8,58%	PA	11 000	Poerio, Mirabello, Audace (ii), Sirtori
	"	101,60	15,00	755,00	25,00	AP		2,00	3.7	M 1914				11 500	
	"	101,60	13,74	750,00	25,00	CP	3,80	4,00	3.7	M 1917		9,46%	T	12 180	
Ansaldo	102mm/45 M1917	101,60	13,74	850,00	35,00	CP	3,80	4,00	3.7	M 1917		9,46%	T	15 000	Leone, La Masa, Palestro, Cantore, Curtatone
	"	101,60	16,00	840,00	35,00	CP		3,00	3.7	M 1917				14 600	
	76mm/50 M1908	76,20	6,30	795,00	20,00	CP	3,80	2,00	5.4			4,76%		9 287	
	"	76,20	6,50	783,00	20,00	CP	3,00	2,00	5.4		3,08%	4,62%		9 370	

	"	76,20	6,00	815,00	20,00	AP		4,00	5.4					10 000	
	76mm/45 M1911	76,20	6,30	750,00	20,00	CP	3,80	2,00	3.7			4,76%		8 914	
	"	76,20	6,00	770,00	20,00	AP		4,00	3.7					9 545	
	"	76,20	6,50	740,00	20,00	CP	4,10	2,00	3.7		3,08%	4,62%		8 968	
Armstrong	100-Ton MLR	450,00	907,19	518,00	13,00	AP	2,74	2,00	4.8	Palliser		1,60%	BP	8 142	Duilio
	"	450,00	907,19	504,00	13,00	Common	2,74	2,00	4.8	Cast Iron		3,90%	BP	7 846	
	" reduced chg	450,00	907,19	492,00	13,00	AP	2,74	2,00	4.8	Palliser		1,60%	BP	7 595	
Turin	Rosset 450mm/16 BLR	450,00	1 000,00	455,00	15,00	AP	2,75	2,00	4,0			1,20%	BP	7 820	Coast Defence
Armstrong	17"/27 BLR	432,00	907,19	607,00	13,00	AP	2,70	2,00	4.7			1,60%	BP	10 777	Ruggiero di Lauria
	"	432,00	907,19	566,00	13,00	Common	3,20	2,00	4.7			3,00%	BP	9 755	
Armstrong	17"/26 BLR M1882	432,00	907,19	590,00	13,00	AP	2,70	2,00	4.7			1,60%	BP	10 350	Italia
	"	432,00	907,19	548,00	13,00	Common	3,20	2,00	4.7			3,00%	BP	9 338	
Krupp	40cm MRKL/35 C/86	400,00	900,00	560,00	13,00	AP	3,30	2,00	2.5					9 770	Castore, then Coast Defence
	"	400,00	750,00	613,00	13,00	Common	3,30	2,00	2.5					10 497	
	"	400,00	921,00	536,00	13,00	APC		3,00	8.0		2,28%			9 500	Coast Defence
Armstrong	13.5"/30 M	342,90	567,00	614,00	13,00	AP	3,30	2,00	7.7			1,39%	BP	10 775	Re Umberto
	"	342,90	567,00	614,00	13,00	Common	3,90	2,00	7.7			6,97%	BP	10 775	
	"	342,90	567,00	614,00	13,00	CP	3,90	2,00	7.7			2,48%	PA	10 775	
Armstrong	11"/13.2 25-Ton MLR	279,40	254,00	405,00	10,00	AP	3,10	2,00	4.0	Palliser		2,68%	BP	4 486	Principe Amedeo
	"	279,40	242,00	400,00	10,00	Common	3,27	2,00	4.0			4,88%	BP	4 376	
Armstrong	254mm/30 M. 1882	254,00	204,12	640,00	16,00	AP	2,88	2,00	4.0			1,58%	BP	11 580	Affondatore (1885), Etna
	"	254,00	181,44	650,00	16,00	Common	3,57	2,00	4.0			4,95%	BP	11 240	
	"	254,00	204,12	650,00	16,00	AP		2,00	4.0			1,58%	BP	11 790	
	"	254,00	204,12	650,00	16,00	Common		2,00	4.0			6,25%	BP	11 790	
	"	254,00	204,60	650,00	16,00	AP		2,00	4.0			1,81%	T	11 790	
	"	254,00	204,60	650,00	16,00	CP		2,00	4.0			7,14%	T	11 790	
	"	254,00	213,50	635,00	35,00	CPC		2,00	4.0	[1906?]	4,07%	6,93%	T	18 215	Coast Defence
	"	254,00	214,60	630,00	35,00	CPC		3,00	4.0	[1915?]	4,57%	6,90%	T	18 853	Coast Defence
	"	254,00	225,00	665,00	35,00	APC		4,00	4.0	M.1907		1,94%	T	20 543	Coast Defence

	"	254,00	225,00	665,00	35,00	CPC		4,00	4.0	M.1907	6,67%	T	20 543	Coast Defence
	"	254,00	216,30	675,00	35,00	CPC		3,00	4.0	M.1916	8,32%	T	21 292	Coast Defence
Armstrong	254mm/26 M	254,00	204,12	579,12	16,00	AP	2,88	2,00	4.0		1,58%	BP	10 280	Giovanni Bausan
	"	254,00	181,44	614,17	16,00	Common	3,57	2,00	4.0		4,95%	BP	10 546	
	"	254,00	204,12	640,00	16,00	AP		2,00	4.0		1,58%	BP	11 580	
	"	254,00	204,12	640,00	16,00	Common		2,00	4.0		6,25%	BP	11 580	
Armstrong	10"/14.6 18-Ton MLR No. 1	254,00	205,00	423,00	10,00	AP	3,44	2,00	3.35	Palliser	2,44%	BP	4 720	Principe Amedeo
	"	254,00	181,00	433,00	10,00	Common	3,30	2,00	3.35		5,97%	BP	4 738	
Armstrong	10"/14 18.1-Ton MLR No. 2	254,00	205,00	423,00	10,00	AP	3,44	2,00	3.35	Palliser	2,44%	BP	4 720	Messina, Conte Verde, Re di Portogallo (1870)
	"	254,00	181,00	433,00	10,00	Common	3,30	2,00	3.35		5,97%	BP	4 738	Roma
Armstrong	10"/12.6 12.1-Ton MLR No. 3	254,00	150,50	418,50	10,00	AP	2,53	2,00	3.35	Palliser	2,52%	BP	4 380	Re de Portogallo
	"	254,00	129,00	429,00	10,00	Common	2,35	2,00	3.35		6,40%	BP	4 349	
Armstrong	9"/13.9 12.6-Ton MLR	228,60	143,50	423,00	10,00	AP	3,30	2,00	2.0	Palliser	2,06%	BP	4 577	Regina Maria Pia, Venezia, San Martino (1875),
	"	228,60	113,00	443,00	10,00	Common	2,83	2,00	2.0		7,52%	BP	4 566	Roma (1870), Ancona & Castelfidardo (1871)
	" new chg	228,60	143,50	439,50	10,00	AP	3,30	2,00	2.0	Palliser	2,06%	BP	4 801	
	" new chg	228,60	113,00	471,00	10,00	Common	2,83	2,00	2.0		7,52%	BP	4 908	
Armstrong	8"/13.1 7-Ton MLR	203,20	87,50	449,00	10,00	AP	2,86	2,00	2.0	Palliser	1,86%	BP	4 633	Formidabile, Principe di Carignano, Re D'Italia
	"	203,20	68,00	494,00	10,00	Common	2,90	2,00	2.0		6,47%	BP	4 776	Regina Maria Pia, Palestro
	" new chg	203,20	87,50	412,00	10,00	AP	2,86	2,00	2.0	Palliser	1,86%	BP	4 202	
	" new chg	203,20	68,00	425,00	10,00	Common	2,90	2,00	2.0		6,47%	BP	4 094	
Palliser	16cm/15.5 3.54-Ton MLR	164,00	30,00	312,00	12,00	Common	2,07	2,00	2.0		4,23%	BP	3 144	Formidabile, Principe di Carignano, Re D'Italia
Palliser	16cm/16.8 5.12-Ton MLR	164,00	46,00	397,00	12,00	AP	2,53	2,00	2.0	Palliser	1,86%	BP	4 404	" "
	"	164,00	30,00	325,00	12,00	Common	2,07	2,00	2.0		4,23%	BP	3 299	
Armstrong	152mm/26.1 Pattern B	152,40	36,29	593,00	12,00	AP	2,37	2,00	4.57		1,87%	BP	6 410	Giovanni Bausan
	"	152,40	36,29	593,00	12,00	Common	3,12	2,00	4.57		6,26%	BP	6 410	
	"	152,40	45,23	530,00	12,00	CP		2,00	4.57		4,45%	BP	6 340	
	"	152,40	45,72	530,00	12,00	CP		2,00	4.57	above refilled	5,47%	T	6 340	

	"	152,40	46,30	530,00	12,00	HE		2,00	4.57	M.1885	11,66%	BA	6 340	
EOC	152mm/33 M1883 BLR	152,40	36,29	593,00	15,00	AP		2,00	5.2		1,87%	BP	7 280	Ancona & Castelfidardo (1884)
	"	152,40	36,29	593,00	15,00	Common		2,00	5.2		6,26%	BP	7 280	
	"	152,40	45,23	530,00	15,00	AP		2,00	5.2		4,45%	BP	7 280	
	"	152,40	45,72	530,00	15,00	AP		2,00	5.2	above refilled	5,47%	T	7 280	
	"	152,40	46,30	530,00	15,00	Common		2,00	5.2		11,66%	BA	7 280	
EOC	152mm/32 Pattern M [1887]	152,40	45,36	595,00	15,00	AP	2,87	2,00	4.2	iron Palliser	1,36%	BP	7 920	Etna, Lepanto, Ruggiero di Lauria
		152,40	45,36	595,00	15,00	Common	3,34	2,00		iron	3,36%	BP	7 920	
		152,40	45,36	595,00	15,00	CP	3,44	2,00		iron	4,75%	BP	7 920	
		152,40	45,36	595,00	15,00	AP	2,88	2,00		steel shot	1,25%	BP	7 920	
		152,40	45,36	595,00	15,00	AP	3,27	2,00		steel shell	4,87%	BP	7 920	
		152,40	45,36	595,00	15,00	Common	3,61	2,00		steel	9,81%	BP	7 920	
		152,40	45,23	595,00	15,00	CP		2,00			4,45%	BP	7 920	
		152,40	45,71	675,00	30,00	CP		2,00			5,47%	T	12 300	
		152,40	45,94	675,00	30,00	HE		2,00			12,76%	T	12 300	
		142,50	46,38	675,00	30,00	AP		2,00			1,15%	T	12 300	
Armstrong	149mm/26 M.1882 C	149,10	30,42	615,00	15,00	Common		2,00	3.5	M.1885	5,59%	BP	7 200	Italia, Terrible (1885), Amerigo Vespucci
	"	149,10	36,82	590,00	15,00	AP		2,00		M.1885	2,08%	BP	7 490	
	"	149,10	37,58	590,00	15,00	AP		2,00	3.5		2,59%	BP	7 490	Flavio Gioia
	"	149,10	31,87	615,00	15,00	HE		2,00			5,49%	PA	7 200	
	"	149,10	37,29	590,00	15,00	CP		2,00			5,90%	T	7 490	
	"	149,10	44,82	540,00	15,00	CP		2,00			4,83%	T	7 410	
Armstrong	149mm/27 M.1885 B	149,10	30,42	615,00	12,00	Common		2,00	3.5	M.1885	5,59%	BP	6 380	
	"	149,10	36,82	590,00	12,00	AP		2,00		M.1885	2,08%	BP	6 600	
	"	149,10	37,58	590,00	12,00	AP		2,00	3.5		2,59%	BP	6 600	
	"	149,10	31,87	615,00	12,00	HE		2,00			5,49%	PA	6 380	
	"	149,10	37,29	590,00	12,00	CP		2,00			5,90%	T	6 600	
	"	149,10	44,82	540,00	12,00	CP		2,00			4,83%	T	6 470	
	120mm/20.2 1.26-Ton BLR	120,00	14,40	425,00	15,00	Common		2,00	2.0		9,76%	BP		Formidabile (1881)

	"	120,00	16,50	395,00	15,00	Common		2,00	2,0	M.1885	6,06%	BP	4 650	
	120mm/23.5 1.38-Ton BLR	120,00	16,50	485,00	15,00	Common		2,00	2.0	M.1885	6,06%	BP	5 430	Ancona & Castelfidardo (1884), Affondatore (1885)
Armstrong	120mm/32 Patt. M [1885]	120,00	16,33	580,00	30,00	AP		2,00	4.0	M.1885	5,08%	BP	8 530	Lepanto, Italia, Ruggiero di Lauria, Tripoli, Con-fienza
	"	120,00	16,33	580,00	30,00	Common	2,88	2,00	4.0		8,39%	BP	8 530	
	"	120,00	16,33	580,00	30,00	Common		2,00	4.0		2,78%	BP	8 530	
	"	120,00	16,50	580,00	30,00	HE		2,00	4.0	refilled Common	2,75%	PA	8 530	
	"	120,00	17,23	580,00	30,00	HE	2,88	2,00		refilled Common	12,19%	PA	8 530	
	"	120,00	20,38	580,00	30,00	AP	3,02	2,00		refilled Palliser	3,71%	T	9 850	
	"	120,00	20,55	580,00	30,00	HE		2,00		refilled Common	8,58%	T	9 850	
	"	120,00	24,43	580,00	30,00	CPC		3,00			7,53%	T	10 710	
	"	120,00	24,30	580,00	30,00	HE		3,00			7,00%	T	10 710	
EOC	120mm/40 M1889 [Patt.M]	120,00	20,41	665,00	30,00	AP	3,02	2,00	4.0	iron Palliser	1,94%	BP	10 790	Duilio, Partenope, Piemonte
	"	120,00	20,41	665,00	30,00	AP	3,02	2,00	4.0	Steel	4,44%	BP	10 790	
	"	120,00	20,41	665,00	30,00	Common		2,00	4.0		5,56%	BP	10 790	
	"	120,00	20,41	665,00	30,00	CP	3,63	2,00	4.0	cast steel	10,00%	BP	10 790	
	"	120,00	20,38	665,00	30,00	AP	3,02	2,00	4.0	refilled Palliser	3,71%	T	10 790	
	"	120,00	20,55	665,00	30,00	HE		2,00	4.0	refilled Common	8,58%	T	10 790	
	"	120,00	24,43	605,00	30,00	CPC		3,00	4.0		7,53%	T	11 040	
	"	120,00	24,30	605,00	30,00	HE		3,00	4.0		7,00%	T	11 040	
EOC	120mm/40 M1891 [Patt P]	120,00	20,41	665,00	30,00	AP	3,02	2,00	4.0	iron Palliser	1,94%	BP	10 790	Re Umberto, Ammiraglio de St. Bon, Umbria Calabria, Marco Polo, Vettor Pisani
	"	120,00	20,41	665,00	30,00	AP	3,02	2,00	4.0	Steel	4,44%	BP	10 790	
	"	120,00	20,41	665,00	30,00	Common		2,00	4.0		5,56%	BP	10 790	
	"	120,00	20,41	665,00	30,00	CP	3,63	2,00	4.0	cast steel	10,00%	BP	10 790	
	"	120,00	20,38	665,00	30,00	AP	3,02	2,00	4.0	refilled Palliser	3,71%	T	10 790	
	"	120,00	20,55	665,00	30,00	HE		2,00	4.0	refilled Common	8,58%	T	10 790	
	"	120,00	24,43	605,00	30,00	CPC		3,00	4.0		7,53%	T	11 040	

	"	120,00	24,30	605,00	30,00	HE		3,00	4.0			7,00%	T	11 040	
EOC	76mm/40 M1897	76,20	6,30	700,00	20,00	CP	3,00	2,00	3.7			4,76%	BP	8 494	
	"	76,20	6,00	717,00	20,00	APC	3,30	4,00	3.7					9 051	
	"	76,20	6,50	690,00	20,00	CPC	4,30	3,00	3.7		3,08%	4,62%		8 544	
Uchatius	7.5cm /20.7 29-cwt BL #1	75,00	4,26	407,00	12,00	Common	2,86	2,00	3.7			4,23%	BP	3 634	Terribile (1880), Affondatore (1885)
Uchatius	7.5cm/13 9.5-cwt BL # 2	75,00	4,26	225,00	12,00	Common	2,86	2,00	3.7			4,23%	BP	1 807	Re di Portogallo (1871)
	SWEDEN														
Bofors	28cm. K./45 M/12	283,00	305,00	870,00	18,00	APC	3,20	4,00	5.6	M/14 kp			T	20 600	Sverige
	"	283,00	305,00	870,00	18,00	SAP	3,50	4,00	5.6	M/14			T	20 600	
	"	283,00	305,00	870,00	19,00	APCBC	3,60	10,00	5.6	M/36 kp			T	24 000	
	"	283,00	305,00	870,00	19,00	SAPCBC	4,10	10,00	5.6	M/14-36 kp			T	24 000	
	"	283,00	305,00	870,00	19,00	SAPBC	4,10	10,00	5.6	M/36			T	24 000	
	"	283,00	280,00	905,00	19,00	CPBC	4,10	10,00	5.6	M/16-36			T	24 247	
	"	283,00	280,00	905,00	19,00	CPBC	4,10	10,00	5.6	M/36			T	24 247	
Finspong	9-inch L/ SB M/66	276,00				Ball		1,00							
	"	276,00				Shell		1,00							
Armstrong	27cm.K./26 M/81	274,40	216,00	545,00	12,50	AP	2,44	2,00	4.0					7 310	Edda
	"	274,40	180,00	564,00	12,50	Common	2,45	2,00	4.0					7 124	
Finspong	27cm.K./20 M/76	274,40	216,00	414,00	11,00	AP	2,44	2,00	4.0					4 836	John Ericsson class, Loke, Blenda, Urd
	"	274,40	180,00	449,00	11,00	Common	2,45	2,00	4.0					5 103	
Armstrong	27cm.K./20 M/74	274,40	216,00	414,00	9,00	AP	2,44	2,00	4.0					4 147	
	"	274,40	180,00	449,00	9,00	Common	2,45	2,00	4.0					4 417	
Finspong	27cm.K./19 M/69	274,40	216,00	400,00	11,00	AP	2,44	2,00	4.0					4 637	Loke, Thordon, Tirfing, Berserk class
	"	274,40	180,00	438,00	11,00	Common	2,45	2,00	4.0					4 961	
Armstrong	25cm.K./34 M/85	254,00	204,11	640,00	9,50	AP	2,88	2,00	4,0					8 300	Coast Defence, Svea
	"	254,00	181,44	650,00	9,50	Common	3,35	2,00	4,0					8 117	
Armstrong	25cm.K./34 M/89	254,00	204,11	640,00	9,50	AP	2,88	2,00	4,0					8 300	Coast Defence, Gota, Thule

	"	254,00	181,44	650,00	9,50	Common	3,35	2,00	4,0				8 117	
Bofors	25cm.K./42 M/94	254,00	204,11	720,00	10,00	AP	2,88	2,00	5.0				9 950	Oden
	"	254,00	181,44	760,00	10,00	CP	3,35	2,00	5.0				10 133	
Finspong	24cm.K/19 M/69	240,00	144,00	397,00	8,00	AP	2,43	2,00	2.0	Pig Iron			3 560	
	"	240,00	102,00	419,00	8,00	Common	2,45	2,00	2.0	Pig Iron			3 574	
Finspong	24cm.K./21 M/76	240,00	144,00	413,00	11,50	AP	2,43	2,00	2.0	Pig Iron			5 005	
	"	240,00	124,00	445,00	11,50	Common	2,45	2,00	2.0	Pig Iron			5 284	
Armstrong	24cm.K./34.3 M/90	240,00	182,00	625,00	15,00	AP	3,03	2,00	4,0				10 000	Coast Defence
	"	240,00	182,00	625,00	15,00	CP	3,96	2,00	4,0				10 000	
Whitworth	24cm.K./35.4 M/92	240,00	215,00	640,00	8,00	AP	3,70	2,00	4,0				7 500	Coast Defence
	"	240,00	215,00	640,00	8,00	CP	4,47	2,00	4,0				7 500	
Bofors	24cm.K./43 M/96	238,00	215,00	685,00	15,00	AP		3,00	4,0	M/95			12 300	Coast Defence
	"	238,00	215,00	685,00	15,00	Common		3,00	4,0	M/95			12 300	
Bofors	24cm.K./50 M/04	238,00	215,00	785,00	12,00	AP		3,00	4,0	M/95			13 000	Coast Defence
	"	238,00	215,00	785,00	12,00	Common		3,00	4,0	M/95			13 000	
Wahrendorff	7-inch BK L/9.5 M/1854	226,20	40,20	258,00	5,00	Ball		1,00					979	
	"	226,20	31,00	294,00	5,00	Shell		1,00			2,42%	BP	1 100	
Wahrendorff	7-inch BK L/11.2 M/1854	226,20	40,20	281,00	5,00	Ball		1,00					1 103	
	"	226,20	31,00	320,00	5,00	Shell		1,00			2,42%	BP	1 200	
Bofors	21cm.K./44.4 M/98	209,30	140,00	750,00	12,00	AP	3,49	2,00	5.0				10 925	Oscar II, Aran, Dristighe-ten, re-armed Svea
	"	209,30	140,00	750,00	12,00	CP	4,24	2,00	5.0				10 925	
Wahrendorff	6.5-inch L/15 KK M/44 [60-pdr]	203,80	29,40	484,00	5,00	Ball		1,00					1 897	
		203,80	20,60	568,00	5,00	Shell		1,00			2,67%	BP	1 835	
Wahrendorff	6.5-inch L/14.5 KK M/48 [60-pdr]	203,80	29,40	452,00	5,00	Ball		1,00					1 774	
		203,80	20,60	531,00	5,00	Shell		1,00			2,67%	BP	1 739	
Finspong	17cm.K./21 M/69	167,20	48,60	416,00	14,50	AP		2,00	2.0				5 248	Vanadis & Balder
	"	167,20	44,30	427,00	14,50	Common	2,25	2,00	2.0				5 234	
Wahrendorff	30-pdr KK/11 M/1853	162,40	14,40	388,00	5,00	Ball		1,00					1 493	
	"	162,40	10,30	450,00	5,00	Shell		1,00			2,91%	BP	1 477	

Wahrendorff	30-pdr KK/16.75 M/1853	162,40	14,40	479,00	5,00	Ball		1,00					1 771	
	"	162,40	10,30	556,00	5,00	Shell		1,00			2,91%	BP	1 698	
Wahrendorff	24-pdr KK L/11 M/1854	154,80	12,00	347,00	5,00	Ball		1,00					1 285	
	"	154,80	8,60	402,00	5,00	Shell		1,00			2,91%	BP	1 274	
Wahrendorff	24-pdr KK L/18.5 M/1854	154,80	12,00	474,00	5,00	Ball		1,00					1 644	
	"	154,80	8,60	550,00	5,00	Shell		1,00			2,91%	BP	1 556	
Wahrendorff	24-pdr RK/20 M/1854	153,50	12,25	428,00	5,00	Shot		2,00					1 870	
		153,50	24,80	301,00	5,00	Shell		2,00			5,40%	BP	1 460	
Armstrong	15cm.K./28 M/83	152,40	45,36	506,00	13,00	AP	2,96	2,00	4.0				6 107	Edda, Svea
	"	152,40	45,36	506,00	13,00	Common	3,86	2,00	4.0				6 107	
Bofors	15cm.K./32 M/89	152,40	45,36	630,00	13,00	AP	2,96	2,00	4.0				7 665	Gota, Thule, & Disa, Urd, & Skagul re-armed
	"	152,40	45,36	506,00	13,00	Common	3,86	2,00	4.0				6 107	
	15cm.K./32 M/98-02 (QFC)	152,40	45,36	700,00	15,00	AP	2,96	2,00	4.0				9 130	
	"	152,40	45,36	700,00	15,00	Common	3,86	2,00	4.0				9 130	
Bofors	15cm.K./44.5 M/98	152,40	45,40	750,00	15,00	AP	2,97	2,00	4.5	M/98			9 780	Aran, Dristigheten, re-armed Svea
	" new chg '30s	152,40	46,00	770,00	15,00	SAPBC	4,20	8,50	4.5	M/30			13 700	
Bofors	15cm.K./43.4 M/98B	152,40	45,40	770,00	12,00	AP		2,00	4,0	M/98			8 990	Coast Defence
Bofors	15cm.K./50 M/03	152,40	45,40	850,00	15,00	APC	3,15	4,00	5.0	M/03			13 000	Fylgia
	"	152,40	46,00	850,00	15,00	SAPBC	4,20	8,50	5.0	M/30			15 300	
	"	152,40	45,40	850,00	12,00	APC	3,15	4,00	5.0	M/03			11 700	Oscar II
	"	152,40	46,00	850,00	12,00	SAPBC	4,20	8,50	5.0	M/30			13 700	
Bofors	15cm.K./50 M/12	152,40	45,40	850,00	15,00	APC	3,47	4,00	5.0	M/03			13 000	Sverige
	"	152,40	46,00	850,00	17,50	SAPBC	4,20	8,50	5.0	M/30			16 500	
Bofors	15cm.K./55 M/30	152,40	46,00	900,00	45,00	SAPBC	4,20	8,50	6.5	M/30			24 700	Gotland
Wahrendorff	18-pdr RK/17.2 M/1854	138,50	9,00	433,00	5,00	Shot		2,00					1 797	
	"	138,50	17,50	328,00	5,00	Shell		2,00			2,86%	BP	1 590	
Wahrendorff	12-pdr RK/20 M/1841/45	127,50	6,00	471,00	5,00	Shot		2,00					1 787	
	"	127,50	13,50	314,00	5,00	Shell		2,00			2,96%	BP	1 488	

Finspong	12.2cm.K./22 M/73 MLR	121,70	15,60	411,00	9,00	Common	2,42	2,00	4.0					3 166	Blenda & Urd originally
Finspong	12cm. K./26 M/81	121,70	22,00	500,00	13,50	AP Shot		2,00	4.0					5 967	Blenda & Urd re-armed
	"	121,70	15,70	500,00	13,50	Common		2,00	4.0					5 000	
Bofors	12cm.K./45 M/94 & /97	120,00	21,00	740,00	15,00	AP	2,81	2,00	4.5					8 200	Oden, re-armed Berserk, Solve,
	"	120,00	21,00	740,00	15,00	Common	3,30	2,00	4.5					8 200	& Ulf, Ornen class
	"	120,00	21,00	830,00	15,00	SAPBC	3,72	10,00	4.5					12 900	
Bofors	12cm.K./50 M/03	120,00	21,00	860,00	10,00	AP	2,81	2,00	4,0					8 000	Coast Defence
	"	120,00	21,00	860,00	10,00	Common		2,00	4,0					8 000	
	" (1940)	120,00	21,00	860,00	17,00	SAPBC	3,72	10,00	4,0					14 200	
Bofors	12cm.K./50 M/11	120,00	21,00	860,00	17,00	SAP	3,33	2,00	4,0					10 000	Clas Fleming
	" (1940)	120,00	21,00	860,00	22,50	SAPBC	3,72	10,00	4,0					16 000	
Bofors	12cm.K./45 M/24	120,00	20,50	800,00	45,00	HC		10,00	4.0	M/24				19 300	Ehrenskold, Clas Horn, Goteborg
OTO	120mm/45 M1926	120,00	23,15	850,00	33,00	SAP	4,30	3,00	5.2					14 947	Psilander
Bofors	10cm. K./41 M/40	105,00	16,00	700,00	60,00	SAP	4,28	5,00	5,0	M/25				15 500	Arholma
Bofors	10cm. K./50 M/42	105,00	16,00	840,00	60,00	SAP	4,28	5,00	5,0	M/25				18 200	Mode
OTO	100mm/47 M1931	100,00	13,80	855,00	60,00	SAP	3,80	3,00	6.1					14 708	Romolus
Bofors	8cm.K./27.4 M/83	84,00	6,70	470,00	21,00	Common	3,04	2,00	4,0					5 900	Coast Defence
Finspong	8cm.K./26.2 M/94	84,00	6,70	470,00	20,00	Common		2,00	4,0					6 000	Coast Defence
Finspong	7.5cm.K./53 M/05	75,00	6,50	780,00	20,00	CP	4,30	2,00	3.0	M/05		4,88%		8 715	Ragnar, Hugin, Sverige
Bofors	7.5cm.K./53 M/12	75,00	6,50	810,00	20,00	CP	4,30	2,00	4,0	M/05		4,88%		8 930	Wale, Wrangel
Bofors	7.5cm. LK./53 M/15	75,00	6,50	810,00	75,00	CP	4,30	2,00	4,0	M/05		4,88%		10 880	
Bofors	7.5cm. LK./53.2 M/24	75,00	6,50	780,00	80,00	CP		2,00	4,0			4,88%		14 245	
Bofors	7.5cm. LK./60 M/26	75,00	6,50	840,00	90,00	CP		2,00	4,0			4,88%		15 000	
Bofors	7.5cm.K./60 M/28	75,00	6,50	840,00	90,00	CP	4,20	2,00	4,0			4,88%		15 000	Gotland
	FRANCE														
	380mm/45 M1935	380,00	884,00	830,00	35,00	APCBC	5,00	10,00	9.0		9,40%	2,48%	M	41 700	Richelieu
	330mm/50 M1931	330,00	560,00	870,00	35,00	SAPCBC	5,00	10,00	9.2		16,05%	3,63%	M	41 700	Dunkerque
	203mm/50 M1924	203,00	123,10	850,00	45,00	APCBC	4,95	10,00	6.2	M1924		3,25%		31 400	Duquesne, Suffren

"	203,00	134,00	820,00	45,00	APCBC	4,78	7,00		M1936			29 973	
203mm/55 M1931	203,00	134,00	840,00	45,00	APCBC	4,78	7,00	7.0	M1936			31 030	Algerie
155mm/50 M1920	155,00	56,50	850,00	40,00	SAPBC	4,88	10,00	5.7		5,91%	M	26 100	Bearn, Duguay Trouin, Jeanne D'Arc
"	155,00	56,50	850,00	40,00	CPBC	5,16	10,00		M1925	9,96%		26 100	
"	155,00	59,00	830,00	40,00	SAPBC	4,69				5,00%		26 100	
152mm/55 M1930	152,40	54,50	882,00	80,00	APCBC	4,70	7,00	6.1	M1931			26 441	Richelieu, Emile Bertin, La Galissonniere,
"	152,40	56,00	855,00	80,00	APCBC	4,76	4,00		M1931	5,96%		26 470	De Grasse
"	152,40	57,15	847,00	80,00	APCBC	5,40	12,50		M1937			27 000	
"	152,40	54,44	867,00	80,00	SAPBC	4,77	5,00		M1936			27 049	
"	152,40	49,00	909,00	80,00	SAPBC	4,77	5,00		M1937			27 075	
138.6mm/40 M1923	138,60	40,60	700,00	35,00	SAPBC	4,93	8,00	5.0		5,91%	T	18 200	Guepard
138.6mm/40 M1927	138,60	40,60	700,00	28,00	SAPBC	4,93	8,00	5.0		5,91%	T	16 600	Pluton, Aigle, Vauquelin, Bougainville
138.6mm/50 M1929-34	138,60	40,60	800,00	30,00	SAPBC	4,93	8,00	5.0		5,91%	T	20 000	Le Fantasque, Mogador
130mm/40 M1919	130,00	32,11	739,00	36,00	SAPBC	5,00	10,00	4.0		5,61%	T	18 081	Chacal, Bourrasque
"	130,00	33,40	725,00	36,00	SAPBC	4,98	10,00			4,79%	T	18 700	
130mm/40 M1924	130,00	32,11	739,00	35,00	SAPBC	5,00	10,00	4.0		5,61%	T	18 241	L'Adrpot
"	130,00	33,40	725,00	35,00	SAPBC	4,98	10,00			4,79%	T	18 871	
130mm/45 M1932-35	130,00	32,11	800,00	75,00	SAPBC	5,00	10,00	4.0		5,61%	T	20 870	Dunkerque, Joffre, Le Hardi
"	130,00	33,40	784,00	75,00	SAPBC	4,98	10,00			4,79%	T	21 683	
100mm/45 M1932	100,00	14,95	755,00	34,00	SAPBC	5,00	5,00	4.0				15 000	Richelieu, Algerie, La Melpomene, Le Fier
450mm/45 M1920	450,00	1 365,00	850,00	40,00	APCBC		7,00	8,0				52 000	
450mm/45 M1918	450,00	1 300,00	785,00	23,00	APC	3,74	4,00	7.2				26 520	
400mm/45 M1917	400,00	990,00	760,00	23,00	APC	4,05	4,00	7.0				24 860	
380mm/45 M1917	380,00	800,00	785,00	23,00	APC	3,34	2,00	7.8		5,00%	M	21 860	
"	380,00	800,00	785,00	23,00	APC		4,00	7.8		5,00%	M	24 900	
370mm/45 M1916	370,00	780,00	785,00	23,00	APC	3,92	2,00	6.9				22 150	Durand-Viel 'B'
340mm/45 M1912M	340,00	570,00	786,00	18,00	APC	3,80	4,00	7.2	M.1912M			20 650	Lyon, Durand-Viel 'A'
"	340,00	590,00	772,00	18,00	APC	3,82	2,00	7.2		3,66%	M	18 070	

"	340,00	630,00	748,00	18,00	APC	4,29	2,00	7.2			3,97%	M	17 850	
"	340,00	540,00	800,00	18,00	APC	3,18	2,00	7.2	M.1912		4,07%	M	18 145	
340mm/45 M1912	340,00	540,00	795,00	12,00	APC	3,18	2,00	6.2	M.1912		4,07%	M	14 500	Bretagne, Normandie
"	340,00	540,00	795,00	18,00	APC	3,18	2,00	6.2	M.1912		4,07%	M	18 000	
"	340,00	555,00	794,00	18,00	APC	3,70	4,00		M.1921		3,96%	M	21 000	
"	340,00	575,00	780,00	23,00	APCBC	4,40	10,00		M.1924	8,23%	3,77%	M	26 600	
305mm/45 M1910	305,00	432,00	783,00	23,00	APC	4,00	4,00	6.2	M 1919?		3,01%	M	23 000	Courbet
"	305,00	419,00	786,00	23,00	CPC	4,40	4,00		M 1919?				22 790	
"	305,00	432,00	783,00	13,00	APC	3,40	2,00		M1906		3,01%	M	14 500	
"	305,00	419,00		13,00	CPC	3,70	2,00		M1906					
305mm/45 M1906	305,00	440,00	780,00	12,00	APC	3,40	2,00	6.8	M1906		2,95%	M	13 500	Danton
"	305,00	436,00		12,00	CPC	3,70	2,00		M1906					
305mm/40 M1893-96M	305,00	340,00	815,00	12,00	APC	2,60	2,00	7.5	M1900	14,12%	3,09%	M	12 700	Republique, Liberte
"	305,00	340,00	815,00	12,00	CPC	2,90	2,00		M1900	14,12%				
"	305,00	350,00	791,00	12,00	APC	3,20	4,00		M 1919?	16,57%			14 850	
"	305,00	350,00	791,00	12,00	CPC		4,00						14 850	
274mm/50 M1906X	274,40	255,00	865,00	12,00	APC	2,70	2,00	6.8	M1900	15,29%			13 155	
"	274,40	262,60	850,00	18,00	APC	3,30	4,00		M 1919?	17,90%			19 800	
240mm/49.5 M1902/06	240,00	220,00	800,00	13,00	APC	3,45	2,00	8.0	M 1906		2,95%	M	13 000	Danton
"	240,00	220,00	800,00	45,00	APC		3,00						23 812	Coast Defence
194mm/50 M1902	194,00	115,00	875,00	15,00	APC	3,00	2,00	4.0	M 1906				14 000	Liberte, turrets in Jules
"	194,00	90,00	905,00	15,00	CPC	3,40	2,00		M 1906				12 645	Michelet & Edgar Quinet
"	194,00	115,00	875,00	14,00	APC	3,00	2,00		M 1906				13 545	Edgar Quinet casemates
"	194,00	90,00	905,00	14,00	CPC	3,40	2,00		M 1906				12 250	
"	194,00	89,50	945,00	18,00	APC	3,20	4,00		M 1921				18 000	
"	194,00	89,50	945,00	45,00	APC	3,20	4,00		M 1921				25 960	Coast Defense
164.7mm/45 M1893-96M	164,70	52,00	865,00	15,00	APC	2,50	2,00	3.5	M 1900	13,46%			10 800	Republique, Jules Michelet, Ernest Renan
"	164,70	55,00	840,00	15,00	APC	3,20	4,00		M 1919?	18,18%			12 000	
138.6mm/55 M1910	138,60	36,50	830,00	15,00	CP	3,60	2,00	3.0	M1910		7,29%	M	10 725	Courbet, Bretagne, Normandie, Lyon,

"	138,60	37,60	804,00	25,00	CPBC	4,60	7,00		M1919		7,07%	M	15 725	Lamotte Picquet design, BC designs
"	138,60	39,50	790,00	25,00	CPBC	5,10	10,00		M1921		6,73%	M	16 100	
75mm/65 M1908	75,00	6,40	930,00	20,00	APC	2,20	2,00	5.0	M1908				10 000	Danton
305mm/40 M1893-96	305,00	340,00	815,00	12,00	APC	2,60	3,00	6.5	M 1900	14,12%	3,09%	M	12 650	Charlemagne, Iena, Suffren
"	305,00	340,00	815,00	12,00	CPC	2,66	2,00		M 1900	14,12%			12 650	
"	305,00	350,00	790,00	12,00	APC	3,20	7,00		M 1919?	16,57%			14 850	
"	305,00	292,00	865,00	12,00	AP	2,40	2,00		M 1887?		3,60%	M	13 000	
"	305,00	292,00	865,00	12,00	CP	2,90	2,00		M 1887?				13 000	
274mm/40 M1893-96	274,40	255,00	815,00	11,50	APC	2,70	2,00	4.5	M 1900	15,29%			12 000	Henri IV, re-armed Re-doutable #2,
"	274,40	255,00	815,00	11,50	CPC	3,00	2,00		M 1900	15,29%			12 000	re-armed Requin et.al.
"	274,40	262,60	805,00	11,50	APC	3,30	4,00		M 1919?	17,90%			14 400	
240mm/40 M1893-96	240,00	170,00	830,00	12,00	APC	2,70	2,00		M 1900	15,29%			11 690	re-armed Devastation #2
"	240,00	170,00	830,00	12,00	CPC	3,00	2,00		M 1900	15,29%			11 690	
194mm/40 M1893-96	194,00	86,00	840,00	18,00	APC	2,60	2,00	6.5	M 1900	12,79%			12 500	Jeanne D'Arc, Gueydon, Gloire,
"	194,00	86,00	840,00	18,00	CPC	2,85	2,00		M 1900	12,79%			12 500	Leon Gambetta
"	194,00	89,50	823,00	18,00	APC	3,20	4,00		M 1919?	16,20%			12 740	
164.7mm/45 M1893-96	164,70	52,00	865,00	15,00	APC	2,50	3,00	4.5	M1900	13,46%			10 800	Iena, Suffren, Gueydon, Dupleix,
"	164,70	52,00	865,00	15,00	CPC	2,80	2,00		M1900	13,46%			10 800	Gloire, Leon Gambetta
"	164,70	55,00	840,00	15,00	APC	3,20	4,00		M 1919?	18,18%			12 000	
340mm/35 M1893	340,00	420,00	800,00	12,00	AP	2,49	2,00	6.0	M 1887?				12 760	re-armed Terrible
"	340,00	420,00	800,00	12,00	Common	3,01	2,00		M 1887?				12 760	
"	340,00	490,00	740,00	12,00	APC		2,00		M.1900	14,29%				
305mm/40 M1893	305,00	292,00	820,00	12,00	AP	2,40	2,00	6.5	M 1887?		3,60%	M	12 250	Masena, Bouvet
"	305,00	292,00	820,00	12,00	Common	2,90	2,00		M 1887?				12 250	
"	305,00	340,00	780,00	12,00	APC	2,60	2,00		M 1900	14,12%	3,09%	M	12 000	
"	305,00	340,00	780,00	12,00	CPC	2,90	2,00		M 1900	14,12%			12 000	
"	305,00	350,00	760,00	12,00	APC	3,20	4,00		M 1919?	16,57%			14 060	

274mm/45 M1893	274,40	216,00	800,00	12,00	AP	2,44	2,00	6.5	M 1887?				11 370	Masena, Bouvet, re-armed Courbet
"	274,40	216,00	800,00	12,00	Common	2,95	2,00		M 1887?				11 370	
"	274,40	255,00	800,00	12,00	APC	2,70	2,00		M 1900	15,29%			12 000	
"	274,40	255,00	800,00	12,00	CPC	3,00	2,00		M 1900	15,29%			12 000	
"	274,40	262,60	780,00	12,00	APC	3,30	4,00		M 1919?	17,90%			14 140	
240mm/40 M1893	240,00	144,00	800,00	12,00	AP	2,43	2,00	8.5	M 1893?				10 650	D'Entrecasteaux
"	240,00	144,00	800,00	12,00	Common	2,94	2,00		M 1893?				10 650	
"	240,00	170,00	800,00	12,00	APC	2,70	2,00		M1900	15,29%			11 235	
"	240,00	170,00	800,00	12,00	CPC	3,00	2,00		M 1900	15,29%			11 235	
194mm/40 M1893	194,00	75,00	800,00	12,00	AP	2,40	2,00	6.5	M 1887?				9 450	Pothuau
"	194,00	75,00	800,00	12,00	Common	2,89	2,00		M 1887?				9 450	
"	194,00	86,00	770,00	12,00	APC	2,60	2,00		M 1900	12,79%			9 500	
"	194,00	89,50	770,00	12,00	APC	3,20	4,00		M 1919?	16,20%			11 750	
164.7mm/45 M1893	164,70	45,00	800,00	12,00	AP	2,35	2,00	4.0	M 1887?				9 730	Brennus, Guichen, Chateaurenault, Linois
"	164,70	45,00	800,00	12,00	Common	2,84	2,00		M 1887?				9 730	
"	164,70	52,00	765,00	12,00	APC	2,50	2,00		M 1900	13,46%			10 000	
"	164,70	55,00	770,00	12,00	APC	2,70	3,00		M 1919?	18,18%			10 840	
138.6mm/45 M1893-91	138,60	30,00	770,00	12,00	AP	2,63	2,00	5.5	M 1893?				7 920	Bouvet, Charlemagne, Henri IV, Pothuau,
"	138,60	30,00	770,00	12,00	Common	3,18	2,00		M 1887?				7 920	Jeanne D'Arc, Friant, Descartes, D'Assas,
"	138,60	38,00	730,00	12,00	CPC	3,45	2,00		M 1900	21,05%			8 700	Catinat, Guichen, Chateaurenault,
"	138,60	36,50	725,00	12,00	SAP	3,60	2,00		M 1910				8 455	Jurien de la Graviere
100mm/45 M1893-91	100,00	14,00	740,00	25,00	Common	3,94	2,00	7.0	M 1881?				10 225	Bouclier, Bisson, Enseigne Roux,
"	100,00	16,00	710,00	25,00	CP	3,20	2,00		M 1905		10,63%	M	10 750	Enseigne Gabolde, Bouvet, Massena
340mm/42 M1887	340,00	420,00	780,00	12,00	AP	2,49	2,00	5.0	M 1887?				12 370	Brennus, Jammapes
"	340,00	420,00	780,00	12,00	Common	3,01	2,00		M 1887?				12 370	
305mm/45 M1887	305,00	292,00	800,00	12,00	AP	2,40	2,00	5.0	M 1887?		3,60%	M	11 623	Charles Martel, Carnot, Jaureguiberry,
"	305,00	292,00	800,00	12,00	Common	2,90	2,00		M 1887?				11 623	

"	305,00	340,00	780,00	12,00	APC	2,60	2,00		M 1900	14,12%	3,09%	M	12 000	
"	305,00	340,00	780,00	12,00	CPC	2,90	2,00		M 1900	14,12%			12 000	
"	305,00	292,00	800,00	10,00	AP	2,40	2,00	5.0	M 1887?		3,60%	M	10 579	Bouvines
"	305,00	292,00	800,00	10,00	Common	2,90	2,00		M 1887?				10 579	
"	305,00	340,00	780,00	10,00	APC	2,60	2,00		M 1900	14,12%	3,09%	M	10 879	
"	305,00	340,00	780,00	10,00	CPC	2,90	2,00		M 1900	14,12%			10 879	
274mm/45 M1887	274,40	216,00	800,00	15,50	AP	2,44	2,00	6.5	M 1887?				12 800	Charles Martel, Carnot, Jaureguiberry
"	274,40	216,00	800,00	15,50	Common	2,95	2,00		M 1887?				12 800	
"	274,40	255,00	780,00	15,50	APC	2,70	2,00		M 1900	15,29%			13 310	
"	274,40	255,00	780,00	15,50	CPC	3,00	2,00		M 1900	15,29%			13 310	
194mm/45 M1887	194,00	75,00	800,00	11,00	AP	2,40	2,00	5.0	M 1887?				9 046	Dupuy de Lome, Amiral Charner
"	194,00	75,00	800,00	11,00	Common	2,89	2,00		M 1887?				9 046	
"	194,00	86,00	770,00	12,00	APC	2,60	2,00		M 1900	12,79%			9 000	
"	194,00	86,00	770,00	12,00	CPC	2,85	2,00		M 1900	12,79%			9 000	
164.7mm/45 M1887	164,70	45,00	800,00	12,00	AP	2,35	2,00	5.0	M 1887?				8 490	Dupuy de Lome,
"	164,70	45,00	800,00	12,00	Common	2,84	2,00		M 1887?				8 490	
"	164,70	52,00	765,00	12,00	APC	2,50	2,00		M 1900	13,46%			10 000	
138.6mm/45 M1887	138,60	30,00	800,00	15,00	Common	3,18	2,00	3.5	M 1881?				9 100	Charles Martel, Carnot, Jairegioberry,
"	138,60	30,00	770,00	15,00	Common	3,18	2,00		M 1887?				8 815	Massena, Amiral Charner
"	138,60	36,50	725,00	15,00	Common	3,70	2,00		M 1910				9 315	
100mm/50 M1889	100,00	14,00	760,00	25,00	Common	3,94	2,00	6.5	M 1881?				10 415	
"	100,00	16,00	740,00	25,00	CP	3,20	3,00		M 1905		10,63%	M	11 085	
340mm/30 M1884	340,00	420,00	600,00	13,50	AP	2,49	2,00	4,0	M 1887?				9 356	Neptune
"	340,00	350,00	621,00	13,50	Common	2,51	2,00		M 1875?				9 109	
274mm/30 M1884	274,40	216,00	600,00	35,00	AP	2,44	2,00	6.5	M 1870?				13 903	Coast Defence
"	274,40	180,00	657,00	35,00	Common	2,45	2,00		M 1870?				13 585	
240mm/30 M1884	240,00	144,00	600,00	11,00	AP	2,43	2,00	3.5	M 1870?				7 225	re-armed [#2] Redoutable
"	240,00	120,00	657,00	11,00	Common	2,45	2,00		M 1870?				7 356	

164.7mm/30 M1884		164,70	45,00	600,00	10,00	AP	2,35	2,00	5.0	M 1870?			5 482	Amiral Cecille
"		164,70	45,00	600,00	10,00	Common	2,84	2,00	5.0	M 1875?			5 482	
"		164,70	45,00	600,00	15,00	AP	2,35	2,00	5.0	M 1870?			7 474	Tage
"		164,70	45,00	600,00	15,00	Common	2,84	2,00	5.0	M 1875?			7 474	
"		164,70	45,00	600,00	35,00	AP	2,35	2,00	5.0	M 1870?			11 008	Amiral Baudin, Tage, Amiral Cecille, Davout,
"		164,70	45,00	600,00	35,00	Common	2,84	2,00	5.0	M 1875?			11 008	Suchet, Forbin
"	QFC	164,70	45,00	650,00	35,00	AP	2,35	2,00	5.0	M 1870?			11 508	
"		164,70	45,00	650,00	35,00	Common	2,84	2,00	5.0	M 1875?			11 508	
138.6mm/30 M1884		138,60	30,00	600,00	15,00	Common	3,18	2,00	3.5	M 1881?			7 234	Marceau, Sfax, Tage, Amiral Cecille, Arethuse
"		138,60	30,00	600,00	35,00	Common	3,18	2,00		M 1881?			10 604	Forbin, Inconstant, Troude, Alger
"	QFC	138,60	35,00	640,00	15,00	Common	3,70	2,00					7 614	
"		138,60	30,00	640,00	35,00	Common	3,18	2,00					11 019	
340mm/28.5 M1881		340,00	420,00	600,00	12,00	AP	2,49	2,00	4.5	M 1881?			8 710	Hoche
"		340,00	350,00	621,00	12,00	Common	2,51	2,00	4.5	M 1875?			8 506	
"		340,00	420,00	600,00	13,50	AP	2,49	2,00	4.5	M 1881?			9 356	Marceau, Magenta
"		340,00	350,00	621,00	13,50	Common	2,51	2,00	4.5	M 1875?			9 109	
340mm/21 M1881		340,00	420,00	550,00	12,00	AP	2,49	2,00	4.5	M 1881?			7 821	Courbet
"		340,00	350,00	602,00	12,00	Common	2,51	2,00	4.5	M 1875?			8 210	
"		340,00	420,00	550,00	16,00	AP	2,49	2,00	4.5	M 1881?			9 373	Amiral Duperre, Furieux
"		340,00	350,00	602,00	16,00	Common	2,51	2,00	4.5	M 1875?			9 709	
320mm/24.9 M 1870-81		320,00	345,00	550,00	14,00	AP	2,46	2,00	4.0				8 512	re-armed Devastation #1
"		320,00	286,00	600,00	14,00	Common	2,46	2,00	4.0		5,87%	BP	8 746	
super-charged		320,00	345,00	605,00	14,00	AP	2,46	2,00	4.0				9 535	
"		320,00	286,00	660,00	14,00	Common	2,46	2,00	4.0		5,87%	BP	9 702	
274mm/28.5 M1881		274,40	216,00	600,00	12,00	AP	2,44	2,00	6.5	M 1870?			8 068	Acheron
"		274,40	180,00	657,00	12,00	Common	2,45	2,00		M 1870?			8 195	
"		274,40	216,00	600,00	35,00	AP	2,44	2,00	6.5	M 1870?			13 903	

"	274,40	180,00	657,00	35,00	Common	2,45	2,00		M 1870?	13 585	
" de-rated	274,40	216,00	519,00	10,00	AP	2,44	2,00	6.5	M 1870?	6 054	Redoutable
"	274,40	180,00	535,00	10,00	Common	2,45	2,00		M 1870?	5 891	
274mm/24.9 M1870-81	274,40	216,00	575,00	16,50	AP	2,44	2,00	6.5	M 1870?	9 291	Coast Defence
"	274,40	180,00	630,00	16,50	Common	2,45	2,00		M 1870?	9 356	
240mm/28.5 M1881	240,00	144,00	600,00	11,00	AP	2,43	2,00	3.5	M 1870?	7 225	re-armed Redoutable
"	240,00	120,00	657,00	11,00	Common	2,45	2,00		M 1870?	7 356	
"	240,00	144,00	600,00	33,00	AP	2,43	2,00	3.5	M 1870?	12 751	Fusee
"	240,00	120,00	657,00	33,00	Common	2,45	2,00		M 1870?	12 473	
164.7mm/28 M1881	164,70	45,00	555,00	35,00	AP	2,35	2,00	5.0	M 1870?	10 437	Sfax, Alger, Arethuse, Dubourdieu
"	164,70	45,00	555,00	35,00	Common	2,84	2,00		M 1875?	10 437	
" heavy	164,70	45,00	600,00	10,00	AP	2,35	2,00		M 1870?	5 482	Amiral Duperre
"	164,70	45,00	600,00	10,00	Common	2,84	2,00		M 1870?	5 482	
" QFC	164,70	45,00	650,00	35,00	AP	2,35	2,00		M 1870?	11 508	Sfax, Alger, Arethuse, Dubourdieu
"	164,70	45,00	650,00	35,00	Common	2,84	2,00		M 1870?	11 508	
138.6mm/28 M1881	138,60	30,00	590,00	15,00	Common	3,18	2,00	3.5	M 1881?	7 138	Amiral Baudin, Hoche
"	138,60	30,00	590,00	35,00	Common	3,18	2,00	3.5		10 498	Courbet
" QFC	138,60	30,00	640,00	15,00	Common	3,18	2,00	3.5		7 614	
"	138,60	30,00	640,00	35,00	Common	3,18	2,00	3.5		11 019	
100mm/26 M1881	100,00	14,00	510,00	20,00	Common	3,94	2,00	6.0	M 1881?	7 080	Terrible, Milan
" QFC	100,00	14,00	560,00	20,00	AP		2,00	6.0		7 573	
"	100,00	14,00	560,00	20,00	Common	3,94	2,00	6.0		7 573	
90mm/28 M1881	90,00	8,00	455,00	20,00	Common	2,56	2,00	6.0	M 1881?	5 757	
420mm/19.5 M1875	420,00	780,00	507,00	12,00	AP	2,46	2,00	6.0	M 1875?	7 461	Terrible
"	420,00	650,00	555,00	12,00	Common	2,47	2,00		M 1875?	7 958	
420mm/22 M1875	420,00	780,00	530,00	12,00	AP	2,46	2,00	6.0	M 1875?	7 920	Terrible
"	420,00	650,00	555,00	12,00	Common	2,47	2,00		M 1875?	8 407	
370mm/28.4 M1875-79	370,00	560,00	600,00	14,00	AP	2,58	2,00	7.5	M 1875?	10 140	Amiral Baudin

"	370,00	465,00	660,00	14,00	Common	2,59	2,00		M 1875?			10 389	
340mm/21 M1875	340,00	420,00	507,00	12,00	AP	2,49	2,00	7.5	M 1875?			7 066	Courbet
"	340,00	350,00	555,00	12,00	Common	2,51	2,00		M 1875?			7 481	
"	340,00	420,00	507,00	16,00	AP	2,49	2,00		M 1875?			8 541	Furieux
"	340,00	350,00	555,00	16,00	Common	2,51	2,00		M 1875?			8 922	
340mm/18 M1875	340,00	420,00	486,00	12,00	AP	2,49	2,00	7.5	M 1875?			6 700	Devastation, Courbet
"	340,00	350,00	510,00	12,00	Common		2,00		M 1875?			6 776	
"	340,00	420,00	486,00	16,00	AP		2,00					8 138	Amiral Duperre, Tonnant, Furieux
"	340,00	350,00	510,00	16,00	Common		2,00		M 1875?			8 158	
"	340,00	420,00	486,00	10,00	AP		2,00					5 890	Vengeur
"	340,00	350,00	510,00	10,00	Common		2,00					5 994	
274mm/19.75 M1875 No. 1	274,40	216,00	500,00	10,00	AP Shell	2,87	2,00	3.5	M 1875		BP	5 773	Redoutable
"	274,40	180,00	505,00	10,00	Common	2,72	2,00		M 1870	6,08%	BP	5 514	
"	274,40	216,00	500,00	14,00	AP Shell	2,87	2,00	3.5	M 1875		BP	7 240	
"	274,40	180,00	505,00	14,00	Common	2,72	2,00		M 1870	6,08%	BP	6 873	
"	274,40	216,00	500,00	20,00	AP Shell	2,87	2,00	3.5	M 1875		BP	9 048	
"	274,40	180,00	505,00	20,00	Common	2,72	2,00		M 1870	6,08%	BP	8 545	
"	274,40	216,00	500,00	35,00	AP Shell	2,87	2,00	3.5	M 1875		BP	11 971	
"	274,40	180,00	505,00	35,00	Common	2,72	2,00		M 1870	6,08%	BP	11 200	
274mm/19.9 M1875 No. 2	274,40	216,00	470,00	10,00	AP Shell	2,87	2,00	3.5	M 1875		BP	5 337	Courbet, Tonnerre, Tempete
"	274,40	180,00	505,00	10,00	Common	2,72	2,00		M 1870	6,08%	BP	5 514	
"	274,40	216,00	470,00	20,00	AP Shell	2,87	2,00	3.5	M 1875		BP	8 507	Courbet
"	274,40	180,00	505,00	20,00	Common	2,72	2,00		M 1870	6,08%	BP	8 545	
"	274,40	216,00	470,00	33,00	AP Shell	2,87	2,00	3.5	M 1875		BP	11 100	Courbet
"	274,40	180,00	505,00	33,00	Common	2,72	2,00		M 1870	6,08%	BP	10 969	
240mm/21 M1875	240,00	144,00	441,00	12,00	AP	2,43	2,00	6.5	M 1870?			5 412	
"	240,00	120,00	483,00	12,00	Common	2,45	2,00		M 1870?			5 681	
240mm/20 M1876	240,00	162,00	435,00	30,00	AP		2,00	4,0	M 1898			9 700	Coast Defence
120mm/27 M1878	120,00	18,30	484,00	12,00	Common	2,98	2,00	3.5	M 1875?			4 900	
100mm/26.5 M1875	100,00	12,00	485,00	10,00	Common	3,35	2,00					4 240	

jacketed	100,00	14,00	510,00	10,00	Common	3,94	2,00					4 660	
90mm/25.3 M1878	90,00	7,90	455,00	20,00	Common	3,05	2,00	3.6	M 1878?			3 750	
90mm/24 M1877	90,00	8,30	455,00	20,00	Common	3,21	2,00	3.5	M 1875?			3 800	
320mm/19.5 M1870	320,00	345,00	438,00	14,00	AP	2,46	2,00	4.0	M 1870?			6 475	Coast Defence
"	320,00	286,00	480,00	14,00	Common	2,46	2,00		M 1870?	5,87%	BP	6 826	
320mm/19.5 M 1870M	320,00	345,00	470,00	14,00	AP	2,46	2,00	4.0	M 1870?			7 050	
"	320,00	309,00	496,00	14,00	Common	2,66	2,00		M 1870?	5,44%	BP	7 240	
274mm/17.98 M1870	274,40	216,00	434,00	14,00	AP Shot	2,44	2,00	3.5	M 1870?			6 167	Ocean, Friedland, Richelieu, Colbert
"	274,40	180,00	475,00	14,00	Common	2,45	2,00		M 1870	6,08%	BP	6 450	
"	274,40	216,00	434,00	25,00	AP Shot	2,44	2,00	3.5				8 953	Friedland, Colbert
"	274,40	180,00	475,00	25,00	Common	2,45	2,00			6,08%	BP	9 175	
274mm/17.98 M 1870M	274,40	216,00	480,00	14,00	AP Shell	2,44	2,00	3.5	M 1875		BP	6 914	Ocean, Friedland, Richelieu, Colbert
"	274,40	180,00	510,00	14,00	Common	2,45	2,00		M 1870	6,08%	BP	6 944	
"	274,40	216,00	480,00	25,00	AP Shell	2,44	2,00	3.5	M 1875		BP	9 830	Friedland, Colbert
"	274,40	180,00	510,00	25,00	Common	2,45	2,00		M 1870	6,08%	BP	9 746	
240mm/18.1 M1870	240,00	144,00	440,00	10,00	AP	2,43	2,00	2.5	M 1870?			4 766	Colbert, Cerbere
"	240,00	120,00	482,00	10,00	Common	2,45	2,00		M 1870?			5 065	
"	240,00	144,00	440,00	14,00	AP	2,43	2,00	2.5				6 067	La Galissonniere
"	240,00	120,00	482,00	14,00	Common	2,45	2,00					6 341	
"	240,00	144,00	440,00	20,00	AP	2,43	2,00	2.5				7 692	Ocean, Richelieu, La Galissonniere,
"	240,00	120,00	482,00	20,00	Common	2,45	2,00					7 914	Bayard, Vauban
"	240,00	144,00	440,00	33,00	AP	2,43	2,00	2.5				10 069	Colbert
"	240,00	120,00	482,00	33,00	Common	2,45	2,00					10 175	
240mm/18.1 M 1870M	240,00	144,00	495,00	14,00	AP	2,43	2,00	2.5	M 1870?			6 889	
"	240,00	120,00	523,00	14,00	Common	2,45	2,00		M 1870?			6 876	
"	240,00	144,00	495,00	20,00	AP	2,43	2,00	2.5				8 601	
"	240,00	120,00	523,00	20,00	Common	2,45	2,00					8 495	
194mm/19.8 M1870	194,00	75,00	448,00	10,00	AP Shot	2,42	2,00	2.5	M 1870			4 567	Couronne, Belliqueuse, Alma,

"	194,00	62,00	492,70	10,00	Common	2,65	2,00	2.5	M 1870			4 785	La Galissonniere, Bayard, Vauban
"	194,00	75,00	448,00	25,00	AP Shot	2,42	2,00	2.5	M 1870			8 231	Duguay-Trouin, Duquesne, Tourville
"	194,00	62,00	492,70	25,00	Common	2,65	2,00	2.5	M 1870			8 272	
194mm/19.8 M 1870M	194,00	75,00	534,00	10,00	AP Shell	2,82	2,00	2.5	M 1870			5 539	
"	194,00	62,50	585,00	10,00	Common	2,68	2,00	2.5	M 1870			5 707	
"	194,00	75,00	534,00	25,00	AP Shell	2,82	2,00	2.5	M 1870			9 445	
"	194,00	62,50	585,00	25,00	Common	2,68	2,00	2.5	M 1870			9 379	
164.7mm/21.2 M1870	164,70	45,00	400,00	15,00	AP		2,00	2.5	M 1870?			5 115	Iphigenie, Naiade, Alma
"	164,70	31,30	480,00	15,00	Common		2,00		M 1870?	4,15%	BP	5 497	
"	164,70	45,00	400,00	30,00	AP		2,00	2.5				7 667	Bourayne, Guichen
"	164,70	31,30	480,00	30,00	Common		2,00			4,15%	BP	7 851	
"	164,70	45,00	400,00	35,00	AP		2,00	2.5				8 116	Alma
"	164,70	31,30	480,00	35,00	Common		2,00			4,15%	BP	8 245	
164.7mm/21.2 M 1870M	164,70	45,00	544,00	15,00	AP		2,00	2.5				6 658	Iphigenie, Naiade, Alma
"	164,70	45,00	544,00	15,00	Common		2,00					6 658	
"	164,70	45,00	544,00	30,00	AP		2,00	2.5				9 448	Bourayne, Guichen
"	164,70	45,00	544,00	30,00	Common		2,00					9 448	
"	164,70	45,00	544,00	35,00	AP		2,00	2.5				9 943	Alma
"	164,70	45,00	544,00	35,00	Common		2,00					9 943	
138.6mm/21.1 M1870	138,60	21,00	455,00	15,00	Common	2,22	2,00	7,0	M 1870?			5 145	Friedland, Bayard, Tourville, Duquesne,
"	138,60	21,00	455,00	30,00	Common		2,00	7,0				7 355	Naiade, Iphigenie
"	138,60	21,00	455,00	42,00	Common		2,00	7,0				7 925	
"	138,60	28,00	406,00	15,00	Common	2,96	2,00	7,0	M 1875			5 113	Richelieu, Colbert, Re-doutable, Villars, Sane,
"	138,60	28,00	406,00	30,00	Common		2,00	7,0				7 600	La Galissonniere, Du-guay-Trouin, Laperouse,
"	138,60	28,00	406,00	42,00	Common		2,00	7,0				8 308	
138.6mm/21.1 M 1870M	138,60	28,00	466,00	15,00	Common	2,96	2,00	7,0	M 1875			5 741	Redoutable, Amiral Duperre
"	138,60	28,00	466,00	30,00	Common		2,00	7,0				8 340	
"	138,60	28,00	466,00	42,00	Common		2,00	7,0				9 081	
120mm/25 M1870	120,00	14,80	455,00	10,00	Common	2,41	2,00	4.0	M 1870?				Richelieu

90mm/36 M1870	90,00	7,90	455,00	12,00	Common	3,05	2,00	3,5				3 750	
274mm/18 M1864-66	274,00	216,00	331,00	14,00	AP Shot		2,00	3.5	M 1864			4 413	Ocean
"	274,00	144,00	361,90	14,00	Common		2,00		M 1864			4 682	
240mm/17.5 M1864-66	240,00	144,00	340,00	10,00	AP Shot		2,00	2.0	M 1864?			3 450	
"	240,00	100,00	363,60	10,00	Common		2,00		M 1864?			3 560	Magenta, Provence, Taureau
"	240,00	144,00	340,00	16,50	AP Shot		2,00	2.0	M 1864?			5 155	Magenta
"	240,00	100,00	363,60	16,50	Common		2,00		M 1864?			5 182	
"	240,00	144,00	340,00	25,00	AP Shot		2,00	2.0	M 1864?			6 873	Ocean
"	240,00	100,00	363,60	25,00	Common		2,00		M 1864?			6 773	
194mm/19 M1864	194,00	75,00	341,00	15,00	AP Shot		2,00	2.0	M 1864			4 551	Gloire (re-armament 3), Couronne (re-armament 1), Embuscade
"	194,00	52,25	366,00	15,00	Common		2,00		M 1864			4 632	
164.7mm/18 M1864	164,70	31,30	392,50	15,00	Common	2,12	2,00	2.0	M 1860?	4,14%	BP	4 604	Gloire (re-armament 2)
"	164,70	30,00	400,00	15,00	AP Shot	1,48	2,00					4 556	
138.6mm/ M1864	138,60	21,00		15,00	Common		2,00		M 1864				
164.7mm/17.9 M1858-60	164,70	31,30	317,00	15,00	Common	2,12	2,00	2.0	M 1860?	4,14%	BP	3 827	Gloire (armament 1), Couronne, Magenta, Palestro
"	164,70	30,00	353,70	15,00	AP Shot	1,48	2,00		M 1859			4 133	
138.6mm/16.7 M1858-60	138,60	21,00	325,00	15,00	Common	2,12	2,00	2.5	M 1858		BP	3 887	
120mm/16 M1858-60	120,00	17,40	419,00	15,00	Common	2,80	2,00	2.5	M 1860?			4 795	
164.7mm/17.9 MLR M1858	164,70	31,30	322,00	15,00	Common	2,12	2,00	2.5	M 1858	4,14%	BP	3 833	Gloire
Marie Jeanne 30-pdr (10kg chg)	164,70	30,00	480,00	35,00	Shot	1,68	2,00	2.0				7 675	Test Gun
Marie Jeanne 30-pdr (12kg chg)	164,70	30,00	505,00	35,00	Shot	1,68	2,00	2.0				7 890	Test Gun
Marie Jeanne 30-pdr (12kg chg)	164,70	45,00	413,00	35,00	Shot	2,53	2,00	2.0				8 300	Test Gun
Marie Jeanne 30-pdr (12kg chg)	164,70	80,00	309,00	35,00	Shot	4,49	2,00	2.0				7 370	Test Gun
164.7mm M1855 (/16)	164,70	26,40	347,00	21,00	Common	1,48	2,00	2.5				4 925	gunboats 1856
Canon-Obusier 50	194,00	25,25	509,00	5,00	BALL	1,00	1,00	2,00				1 740	Gloire (armament 1), Couronne, Magenta

Canon-Obusier 30	164,70	15,00	485,00	5,00	BALL	1,00	1,00	2,50				1 739	
SOVIET UNION													
406mm/50 B-37	406,40	1 108,00	830,00	45,00	APCBC	4,68	8,00	4,5	M.1915/28	2,32%	T	45 670	Sovyetskiy Soyuz
"	406,40	1 108,00	830,00	45,00	SAPCBC	5,00	8,00	4,5	M.1915/28	7,94%	T	45 670	
305mm/56	305,00	470,00	900,00	45,00	APCBC	4,70	12,50	4.6	M.1928			47 580	Kronshtadt
"	305,00	470,00	900,00	45,00	SAPBC	5,00	12,50	4.6	M.1928			47 580	
180mm/57	181,00	97,50	920,00	50,00	APCBC	5,04	12,50	4.3	M.1928	2,00%	T	37 494	Krasnyi Kavkaz, Kirov, Maxim Gorkiy
"	181,00	97,50	920,00	50,00	SAPCBC	5,30	12,50	4.3	M.1928	7,18%	T	37 494	
"	181,00	97,50	920,00	50,00	CPC	5,30	12,50	4.3	M.1928	8,06%	T	37 494	
152mm/57	152,40	55,00	950,00	45,00	APCBC	4,50	8,00	4,5	M.1915/28	2,00%	T	30 070	Sovyetskiy Soyus, Kronshtadt, Chapayev
"	152,40	55,00	950,00	45,00	SAPCBC	4,84	8,00	4,5	M.1915/28	7,31%	T	30 070	
"	152,40	55,00	950,00	45,00	CPC	5,11	8,00	4,5	M.1915/28	10,91%	T	30 070	
130mm/50 B-13	130,00	33,50	870,00	50,00	SAPBC	5,00	12,50	3,0	M.1928	7,01%	T	25 731	Tashkent, Gnevnyi, Kiev, Storohevoi
"	130,00	33,50	870,00	50,00	SAPBC	4,82	12,50	3,0	M.1928	4,99%	T	25 731	
"	130,00	33,50	870,00	50,00	CPC	4,90	12,50	3,0	M.1928	8,09%	T	25 731	
102mm/45 B-2	101,60	17,50	755,00	45,00	CPC	5,00	4,00	4,4	M1915	12,00%	T	16 470	
100mm/47	100,00	15,80	800,00	45,00	CPC	5,05	6,00	5,0	M.1915	12,47%	T	18 546	
"	100,00	15,80	800,00	45,00	SAPCBC	5,20	12,50	5,0	M.1928	7,85%	T	19 570	
100mm/51 B-24	100,00	15,80	872,00	45,00	SAPCBC	5,20	12,50	4.7	M.1928	8,23%	T	22 314	
100MM/56 B-24m	100,00	15,80	895,00	85,00	SAPCBC	5,20	12,50	4,7	M.1928	8,23%	T	23 005	Kirov, Maxim Gorkiy, Chapayev
76mm/55 K-34	76,20	6,60	813,00	85,00	SAP	4,00	4,00	4.4	M.1928			13 500	
IMPERIAL RUSSIA													
16"/45 M.1916	406,40	1 116,00	758,00	25,00	APCBC	3,89	6,00	8.8	M.1915			26 160	Imperator Nikolai I, design 1916
"	406,40	1 116,00	758,00	25,00	SAPCBC	4,25	6,00	8.8	M.1915			26 160	
"	406,40	1 116,00	758,00	25,00	CPCBC	4,73	6,00	8.8	M.1915			26 160	

16-inch/20 M.1867	406,00	631,50	449,00	13,00	Common	2,30	2,00	4.5	M.1867				6 242	planned for Petr Veliki
"	406,00	697,00	427,00	13,00	AP	2,45	2,00	4.5	M.1867				5 993	
14"/52 M.1912	355,60	747,80	731,50	25,00	APCBC	3,88	4,00	8.7	M.1911		2,73%	T	23 200	Borodino
"	355,60	747,80	731,50	25,00	CPCBC	4,75	4,00	8.7	M.1913		8,83%	T	23 200	
12"/52 M.1910	304,80	470,90	762,00	25,00	APC	3,88	4,00	8.0	M.1911	9,30%	2,75%	T	23 228	Gangut, Imperatritsa Mariya
"	304,80	470,90	762,00	25,00	CPC	4,90	4,00	8.0	M.1911		10,28%	T	23 228	
"	304,80	331,70	914,00	25,00	APC	2,72	3,00	8.0	M.1907		1,81%	T	22 614	
"	304,80	331,70	914,00	25,00	CPC	3,16	3,00	8.0	M.1907		8,62%	T	22 614	
12"/40 M.1892	304,80	331,70	792,50	15,00	APC	2,65	3,00	5.5	M.1895		1,60%	W	14 630	Tri Svititelia, Sissoi Veli-ki, Petropavlovsk
"	304,80	331,70	792,50	15,00	CP	2,80	3,00	5.5	M.1895		3,74%	W	14 630	Potemkin, Retvisan, Tsessarevitch, Borodino
"	304,80	331,70	792,50	15,00	APC	2,72	3,00	5.5	M.1907		1,81%	T	16 276	Slava, Tsessarevich
"	304,80	331,70	792,50	15,00	CP	3,16	3,00	5.5	M.1907		8,50%	T	16 276	
"	304,80	331,70	792,50	25,00	APC	2,72	3,00	5.5	M.1907		1,81%	T	21 031	Tri Svititelia (1912), Slava (1916)
"	304,80	331,70	792,50	25,00	CP	3,16	3,00	5.5	M.1907		8,50%	T	21 031	
"	304,80	331,70	792,50	35,00	APC	2,72	3,00	5.5	M.1907		1,81%	T	24 140	Evsatfi, Andrei Pervoswanni,
"	304,80	331,70	792,50	35,00	CP	3,16	3,00	5.5	M.1907		8,50%	T	24 140	Panteleimon (1906)
12"/35 M. 1885	304,80	331,70	637,00	15,00	AP	2,60	2,00	5.0	M. 1886		2,41%	BP	10 614	Tchesma & Georgi Pobiedonosets
"	304,80	331,70	637,00	15,00	Common	2,80	2,00	5.0	M. 1882		4,82%	BP	10 614	
"	304,80	455,00	547,00	15,00	AP	3,50	2,00	5.0	M. 1891		2,44%	BP	10 058	
"	304,80	455,00	547,00	15,00	Common	4,20	2,00	5.0	M.1891		5,38%	BP	10 058	
"	304,80	331,70	637,00	15,00	Common	3,10	2,00	5.0	M.1886		7,54%	BP	10 614	
"	304,80	331,70	735,00	15,00	APC	2,65	3,00	5.0	M.1895		1,60%	W	13 168	
"	304,80	331,70	735,00	15,00	CP	3,16	3,00	5.0	M.1895		3,74%	W	13 168	
"	304,80	331,70	735,00	15,00	Common	3,50	3,00	5.0	M.1900		4,70%	W	13 168	
"	304,80	331,70	637,00	12,50	AP	2,60	2,00	5.0	M. 1886		2,41%	BP	9 510	Navarin
"	304,80	331,70	637,00	12,50	Common	2,80	2,00	5.0	M. 1882		4,82%	BP	9 510	
"	304,80	455,00	547,00	12,50	AP	3,50	2,00	5.0	M. 1891		2,44%	BP	8 870	
"	304,80	455,00	547,00	12,50	Common	4,20	2,00	5.0	M.1891		5,38%	BP	8 870	
"	304,80	331,70	637,00	12,50	Common	3,10	2,00	5.0	M.1886		7,54%	BP	9 510	

"	304,80	331,70	735,00	12,50	APC	2,65	3,00	5.0	M.1895	1,60%	W	11 887	
"	304,80	331,70	735,00	12,50	CP	3,16	3,00	5.0	M.1895	3,74%	W	11 887	
"	304,80	331,70	735,00	12,50	Common	3,50	3,00	5.0	M.1900	4,70%	W	11 887	
12"/30 M. 1877	304,80	331,70	570,00	15,00	AP	2,60	2,00	7.7	M. 1882	2,41%	BP	9 510	Ekaterina II & Sinop, Imperator Alexandr II, Dvienadsat Apostolov, Gangut
"	304,80	331,70	570,00	15,00	Common	2,80	2,00	7.7	M.1882	4,82%	BP	9 510	
"	304,80	331,70	570,00	15,00	Common	3,10	3,00	7.7	M.1886	7,54%	BP	9 510	
"	304,80	331,70	570,00	15,00	APC	2,65	3,00	7.7	M. 1895	1,60%	W	9 693	
"	304,80	331,70	570,00	15,00	CP	2,80	3,00	7.7	M. 1895	3,74%	W	9 693	
"	304,80	331,70	570,00	15,00	Common	3,50	3,00	7.7	M.1900	4,70%	W	9 693	
12"/20 M.1867	304,80	302,00	447,00	15,00	AP	2,50	2,00	4.5	M. 1867			6 688	Vice-Admiral Popov
"	304,80	290,00	411,00	15,00	Common	2,50	2,00	4.5	M. 1867	3,22%	BP	6 038	
"	304,80	302,00	447,00	9,50	AP	2,50	2,00	4.5	M. 1867			4 801	Petr Veliki
"	304,80	290,00	411,00	9,50	Common	2,50	2,00	4.5	M. 1867	3,22%	BP	4 273	
11"/22 M.1877	279,40	250,00	454,00	10,00	AP	2,50	2,00	2.5	M.1884	1,10%	BP	5 196	re-armed Admiral Lazarev & Admiral Chichagov
"	279,40	250,00	454,00	10,00	Common	2,80	2,00	2.5	M.1884	1,86%	BP	5 196	
11"/20 M.1867	279,40	222,00	392,00	15,00	Common	2,50	2,00	4.0	M.1867	3,36%	BP	5 456	Novgorod
"	279,40	225,20	404,00	15,00	AP	2,50	2,00	4.0	M.1867	1,46%	BP	5 474	
"	279,40	222,00	392,00	10,00	Common	2,50	2,00	4.0	M.1867	3,36%	BP	4 023	Ersh, Burun
"	279,40	225,20	404,00	10,00	AP	2,50	2,00	4.0	M.1867	1,46%	BP	4 177	
"	279,40	222,00	392,00	9,00	Common	2,50	2,00	4.0	M.1867	3,36%	BP	3 704	rearmed Lazarev & Chichagov
"	279,40	225,20	404,00	9,00	AP	2,50	2,00	4.0	M.1867	1,46%	BP	3 850	
10"/50 M.1906	254,00	225,20	899,00	35,00	APC	3,07	3,00	8.0	M.1907	1,73%	T	25 998	Rurik (ii)
"	254,00	225,20	899,00	35,00	HE	4,00	3,00	8.0	M.1907	12,57%	T	25 998	
"	254,00	225,20	899,00	35,00	SAP	3,20	2,00	8.0	M.1911	3,86%	W	25 998	
10"/45 M.1877	254,00	225,20	693,00	15,00	APC	3,00	2,00	6.5	M.1896	1,29%	W	11 521	Ushakov, Seniavin
"	254,00	225,20	693,00	15,00	CP	3,20	2,00	6.5	M.1898	3,86%	W	11 521	
"	254,00	225,20	693,00	15,00	Common	3,60	2,00	6.5	M.1884/04	4,26%	W	11 521	
"	254,00	225,20	693,00	35,00	APC	3,00	2,00	6.5	M.1896	0,89%	W	17 373	Apraxin, Rostislav, Peresvet, Oslabia
"	254,00	225,20	693,00	35,00	CP	3,20	2,00	6.5	M.1898	3,86%	W	17 373	

	"	254,00	225,20	693,00	35,00	Common	3,60	2,00	6.5	M.1884/04	4,26%	W	17 373	
	"	254,00	225,20	777,00	30,00	APC	3,00	2,00	6.5	M.1896	0,89%	W	18 288	Pobeda
	"	254,00	225,20	777,00	30,00	CP	3,20	2,00	6.5	M.1898	3,86%	W	18 288	
	"	254,00	225,20	777,00	30,00	Common	3,60	2,00	6.5	M.1884/04	4,26%	W	18 288	
	"	254,00	225,20	693,00	35,00	APC	3,07	3,00	6.5	M.1907	1,73%	T	21 031	Rostislav
	"	254,00	225,20	693,00	35,00	CP	4,00	3,00	6.5	M.1907	12,57%	T	21 031	
	"	254,00	225,20	693,00	35,00	CP	3,20	3,00	6.5	M.1911	3,86%	T	21 031	
	9"/35 M.1877	228,60	126,10	653,00	15,00	AP	2,60	2,00	3.7	M.1891	1,78%	BP	9 343	Imperator Alexandr II, Gangut, Grozyaschchi,
	"	228,60	126,10	653,00	15,00	Common	2,70	2,00	3.7	M.1891	4,44%	BP	9 343	
	"	228,60	208,80	534,00	15,00	AP	3,50	2,00	3.7	M.1894	2,87%	BP	9 005	
	"	228,60	208,80	534,00	15,00	Common	4,20	2,00	3.7	M.1894	5,32%	BP	9 005	
	"	228,60	188,40	569,00	15,00	AP		2,00	3.7	M.1896	2,97%	W	9 250	
	"	228,60	126,10	709,00	15,00	CP	2,70	2,00	3.7	M.1896	4,76%	W	9 998	
	9"/30 M.1877	228,60	126,10	561,00	12,00	AP	2,50	2,00	3.7	M.1877	1,31%	BP	7 037	Sivuch
	"	228,60	113,40	561,00	12,00	Common	2,50	2,00	3.7	M.1877	4,43%	BP	6 902	
	"	228,60	126,10	597,00	12,00	AP	2,60	2,00	3.7	M.1891	1,78%	BP	7 489	
	"	228,60	126,10	597,00	12,00	CP	2,70	2,00	3.7	M.1891	4,76%	BP	7 489	
	9"/22 M.1877	228,60	126,10	471,00	9,00	AP	2,50	2,00	2.5	M.1877	0,65%	BP	4 726	re-armed Latnik & Lava, Charodeika
	"	228,60	113,40	486,00	9,00	Common	2,50	2,00	2.5	M.1877	4,43%	BP	4 771	
	"	228,60	126,10	471,00	9,00	Common	2,70	2,00	2.5	M.1891	4,44%	W	4 704	
	9"/20 M.1867	228,60	126,10	420,00	9,00	AP	2,20	2,00	2.5	M.1867	0,65%	BP	3 917	Bronenosetz, Smerch, Charodeika,
	"	228,60	122,80	434,00	9,00	Common	2,40	2,00	2.5	M.1867	3,84%	BP	4 023	Admiral Lazaev, Admiral Chichagov
Blakely	9"/ MLR	228,60				Shot								
	"	228,60				Common								
	8"/50 M.1906	203,20	112,20	807,70	35,00	CPC	3,89	2,00	8.0	M.1907	12,57%	T	17 585	Imperator Pavel, Rurik (ii)
	"	203,20	112,20	807,70	19,00	CPC	3,89	2,00	8.0	M.1907	12,57%	T	14 283	(casemates)
	"	203,20	139,20	792,50	35,00	CPC	4,75	4,00	8.0	M.1913	10,99%	T	23 574	
	"	203,20	139,20	792,50	19,00	CPC	4,75	4,00	8.0	M.1913	10,99%	T	17 889	
	"	203,20	112,20	807,70	35,00	SAPC	3,85	4,00	8.0	M.1915	6,77%	T	20 593	

	"	203,20	112,20	807,70	19,00	SAPC	3,85	4,00	8.0	M.1915	6,77%	T	16 558	
	"	203,20	112,20	807,70	35,00	CPC	3,90	4,00	8.0	M.1915	13,37%	T	20 593	
	"	203,20	112,20	807,70	19,00	CPC	3,90	4,00	8.0	M.1915	13,37%	T	16 558	
	8"/45 M. 1892	203,20	87,80	899,00	18,00	AP	2,50	2,00	3.8	M.1892	3,03%	W	12 699	Rossia, Gromoboi, Bayan, Khrabri
	"	203,20	87,80	899,00	18,00	CP	2,60	2,00	3.8	M.1892	3,85%	W	12 699	
	"	203,20	87,80	874,80	18,00	CP	3,04	3,00	3.8	M.1907	10,59%	T	13 169	
	"	203,20	106,90	813,80	18,00	CPC	4,00	4,00	3.8	M.1907	8,70%	T	16 095	
	"	203,20	112,20	792,50	18,00	SAPC	3,85	4,00	3.8	M.1915	6,77%	T	15 920	
	"	203,20	112,20	792,50	18,00	CPC	3,90	4,00	3.8	M.1915	13,37%	T	15 920	
	8"/35 M.1877	203,20	87,80	663,00	15,00	AP	2,50	3,00	6.0	M.1886	3,01%	BP	9 144	Admiral Nakhimov, Pa-miat Azova, Rurik,
	"	203,20	87,80	663,00	15,00	Common	2,50	3,00	6.0	M.1884	4,56%	BP	9 144	Kubanetz
	"	203,20	133,10	541,00	15,00	Common	4,00	2,00	6.0	M.1880	4,88%	BP	8 895	
	"	203,20	133,10	541,00	15,00	AP	3,50	2,00	6.0	M.1889	2,00%	BP	8 895	
	"	203,20	87,80	663,00	15,00	AP	2,50	2,00	6.0	M.1892	1,67%	W	9 052	
	"	203,20	87,80	663,00	15,00	CP	2,60	2,00	6.0	M.1892	2,76%	W	9 052	
	8"/30 M.1877	203,20	87,80	599,00	12,00	AP	2,50	2,00	4.1	M.1886	3,01%	BP	7 315	re-armed General Ad-miral, Vladimir Mono-makh,
	"	203,20	78,40	638,00	12,00	Common	2,50	2,00	4.1	M.1884	4,31%	BP	7 447	Dmitri Donskoi
	"	203,20	133,10	495,00	12,00	Common	4,00	2,00	4.1	M.1880	4,88%	BP	6 766	
	"	203,20	133,10	495,00	12,00	AP	3,50	2,00	4.1	M.1889	2,00%	BP	6 766	
	"	203,20	87,80	599,00	12,00	APC	2,50	3,00	4.1	M.1892	1,67%	W	7 223	
	"	203,20	87,80	599,00	12,00	CP	2,60	3,00	4.1	M.1892	2,76%	W	7 223	
	8"/21.9 M.1867	203,20	84,80	404,00	15,00	AP	2,40	2,00	2.0	M. 1867			5 264	Sevastopol, Petropavlovsk, Pervenetz,
	"	203,20	73,70	431,00	15,00	Common	2,20	2,00	2.0	M. 1867	3,58%		5 352	Kniaz Pojarski, Minin, General Admiral
	"	203,20	73,70	421,00	15,00	Common	2,20	2,00	2.0	M. 1867	3,58%		5 244	
	"	203,20	73,70	375,00	15,00	Common	2,20	2,00	2.0	M. 1867	3,58%		4 737	
	"	203,20	78,60	419,00	15,00	Common	2,20	2,00	2.0	M.1887			5 559	
	"	203,20	80,90	413,00	15,00	AP	2,20	2,00	2.0	M.1887			5 526	
Blakely	8"/ MLR	203,20				Shot								

"	203,20				Common								
6.03"/24.2 M.1867	153,20	38,10	400,00	19,00	AP	2,50	2,00	2.0	M.1867	1,84%	BP	5 703	
"	153,20	36,80	407,00	19,00	Common	2,50	2,00	2.0	M.1867	3,67%	BP	5 715	
"	153,20	38,10	438,00	19,00	AP	2,50	2,00	2.0	M.1867	1,84%	BP	6 125	
"	153,20	36,80	446,00	19,00	Common	2,50	2,00	2.0	M.1867	3,67%	BP	6 133	
6"/50 M. 1911	152,40	41,46	879,00	30,00	CP	3,20	3,00	3.7	M.1907	8,92%	T	14 760	
"	152,40	47,30	823,00	30,00	HE	4,00	3,00	3.7	M.1907	13,53%	T	14 640	
"	152,40	49,76	802,00	30,00	CPC	4,10	4,00	3.7	M.1911	7,23%	T	17 910	
"	152,40	41,46	879,00	30,00	CPC	4,10	4,00	3.7	M.1915	13,99%	T	19 050	
"	152,40	47,30	823,00	30,00	HE	4,45	4,00	3.7	M.1915	13,95%	T	17 385	
6"/45 M. 1891	152,40	41,40	792,50	20,00	APC	2,80	3,00	3.7	M.1892	2,97%	W	11 155	Tri Svititelia, Silloi Veliki, Petropavlovsk,
"	152,40	41,40	792,50	20,00	CP	3,00	3,00	3.7	M.1892	6,55%	W	11 155	Rostislav, Peresviet, Potemkin, Retvisan,
"	152,40	41,40	792,50	20,00	AP	3,25	2,00	3.7	M.1885	3,30%	BP	11 045	Tsessarevitch, Borodino, Evstafi, Rurik,
"	152,40	41,46	792,50	20,00	CP	3,20	3,00	3.7	M.1907	8,92%	T	11 523	Rossia, Gromoboi, Bayan, Svietlana,
"	152,40	49,76	752,90	20,00	CPC	4,10	4,00	3.7	M.1907/15	7,23%	T	14 083	Pallada, Variag, Askold, Bogatyr, Khrabri
"	152,40	41,46	792,50	20,00	CPC	4,10	4,00	3.7	M.1915	13,99%	T	14 450	
6"/35 M.1877	152,40	41,50	701,00	12,00	AP	3,00	2,00	3.7	M.1884	2,94%	BP	7 722	Ekaterina II, Tchesma, Sinop,
"	152,40	41,50	701,00	12,00	AP	3,25	2,00	3.7	M.1884	3,29%	BP	7 722	Dmitri Donskoi, Dvienadsat Apostolov
"	152,40	41,50	701,00	12,00	Common	3,50	2,00	3.7	M.1884	5,88%	BP	7 722	
"	152,40	55,69	578,00	12,00	AP	3,50	2,00	3.7	M.1887	2,94%	BP	7 256	
"	152,40	55,69	578,00	12,00	CP	4,00	2,00	3.7	M.1887	5,89%	BP	7 256	
"	152,40	55,69	578,00	12,00	Common	4,30	2,00	3.7	M.1887	8,82%	BP	7 256	
"	152,40	41,40	701,00	12,00	APC	2,80	2,00	3.7	M.1892	2,97%	W	7 788	
"	152,40	41,40	701,00	12,00	CP	3,00	2,00	3.7	M.1892	6,55%	W	7 788	
"	152,40	41,50	701,00	13,00	AP	3,00	2,00	3.7	M.1884	2,94%	BP	8 053	Georgi Podiedonosets, Aleksandr II,
"	152,40	41,50	701,00	13,00	AP	3,25	2,00	3.7	M.1884	3,29%	BP	8 053	Navarin, Admiral Nakhimov
"	152,40	41,50	701,00	13,00	Common	3,50	2,00	3.7	M.1884	5,88%	BP	8 053	
"	152,40	55,69	578,00	13,00	AP	3,50	2,00	3.7	M.1887	2,94%	BP	7 615	

"	152,40	55,69	578,00	13,00	CP	4,00	2,00	3.7	M.1887	5,89%	BP	7 615	
"	152,40	55,69	578,00	13,00	Common	4,30	2,00	3.7	M.1887	8,82%	BP	7 615	
"	152,40	41,40	701,00	13,00	APC	2,80	2,00	3.7	M.1892	2,97%	W	8 122	
"	152,40	41,40	701,00	13,00	CP	3,00	2,00	3.7	M.1892	6,55%	W	8 122	
"	152,40	41,50	701,00	15,00	AP	3,00	2,00	3.7	M.1884	2,94%	BP	8 671	Nikolai I, Gangut, Pamiat Azova,
"	152,40	41,50	701,00	15,00	AP	3,25	2,00	3.7	M.1884	3,29%	BP	8 671	Grozyashchi, Rurik (i)
"	152,40	41,50	701,00	15,00	Common	3,50	2,00	3.7	M.1884	5,88%	BP	8 671	
"	152,40	55,69	578,00	15,00	AP	3,50	2,00	3.7	M.1887	2,94%	BP	8 291	
"	152,40	55,69	578,00	15,00	CP	4,00	2,00	3.7	M.1887	5,89%	BP	8 291	
"	152,40	55,69	578,00	15,00	Common	4,30	2,00	3.7	M.1887	8,82%	BP	8 291	
"	152,40	41,40	701,00	15,00	APC	2,80	2,00	3.7	M.1892	2,97%	W	8 747	
"	152,40	41,40	701,00	15,00	CP	3,00	2,00	3.7	M.1892	6,55%	W	8 747	
"	152,40	41,50	701,00	20,00	AP	3,00	2,00	3.7	M.1884	2,94%	BP	10 012	Admiral Kornilov, Kubanetz
"	152,40	41,50	701,00	20,00	AP	3,25	2,00	3.7	M.1884	3,29%	BP	10 012	
"	152,40	41,50	701,00	20,00	Common	3,50	2,00	3.7	M.1884	5,88%	BP	10 012	
"	152,40	55,69	578,00	20,00	AP	3,50	2,00	3.7	M.1887	2,94%	BP	9 766	
"	152,40	55,69	578,00	20,00	CP	4,00	2,00	3.7	M.1887	5,89%	BP	9 766	
"	152,40	55,69	578,00	20,00	Common	4,30	2,00	3.7	M.1887	8,82%	BP	9 766	
"	152,40	41,40	701,00	20,00	APC	2,80	2,00	3.7	M.1892	2,97%	W	10 101	
"	152,40	41,40	701,00	20,00	CP	3,00	2,00	3.7	M.1892	6,55%	W	10 101	
"	152,40	41,50	701,00	25,00	AP	3,00	2,00	3.7	M.1884	2,94%	BP	11 003	Korietz
"	152,40	41,50	701,00	25,00	AP	3,25	2,00	3.7	M.1884	3,29%	BP	11 003	
"	152,40	41,50	701,00	25,00	Common	3,50	2,00	3.7	M.1884	5,88%	BP	11 003	
"	152,40	55,69	578,00	25,00	AP	3,50	2,00	3.7	M.1887	2,94%	BP	10 987	
"	152,40	55,69	578,00	25,00	CP	4,00	2,00	3.7	M.1887	5,89%	BP	10 987	
"	152,40	55,69	578,00	25,00	Common	4,30	2,00	3.7	M.1887	8,82%	BP	10 987	
"	152,40	41,40	701,00	25,00	APC	2,80	2,00	3.7	M.1892	2,97%	W	11 205	
"	152,40	41,40	701,00	25,00	CP	3,00	2,00	3.7	M.1892	6,55%	W	11 205	
6"/28 M.1877	152,40	37,26	535,00	12,00	AP	2,50	2,00	4.1	M.1877	2,20%	BP	5 852	Popov, Pervenetz & Krieser (re-armed)
"	152,40	33,40	555,00	12,00	Common	2,50	2,00	4.1	M.1877	5,84%	BP	5 811	

"	152,40	41,50	542,00	12,00	Common	3,50	2,00	4.1	M.1877	5,88%	BP	6 034	
"	152,40	41,50	542,00	12,00	AP	3,25	2,00	4.1	M.1884	3,29%	BP	6 034	
"	152,40	41,50	542,00	12,00	AP	3,00	2,00	4.1	M.1884	2,94%	BP	6 034	
"	152,40	37,26	535,00	13,00	AP	2,50	2,00	4.1	M.1877	2,20%	BP	6 154	Dmitri Donskoi, Pamiat Merkuria
"	152,40	33,40	555,00	13,00	Common	2,50	2,00	4.1	M.1877	5,84%	BP	6 101	
"	152,40	41,50	542,00	13,00	Common	3,50	2,00	4.1	M.1877	5,88%	BP	6 336	
"	152,40	41,50	542,00	13,00	AP	3,25	2,00	4.1	M.1884	3,29%	BP	6 336	
"	152,40	41,50	542,00	13,00	AP	3,00	2,00	4.1	M.1884	2,94%	BP	6 336	
"	152,40	37,26	535,00	15,00	AP	2,50	2,00	4.1	M.1877	2,20%	BP	6 722	Vladimir Monomakh, Admiral Nakhimov, Minin
"	152,40	33,40	555,00	15,00	Common	2,50	2,00	4.1	M.1877	5,84%	BP	6 644	
"	152,40	41,50	542,00	15,00	Common	3,50	2,00	4.1	M.1877	5,88%	BP	6 905	
"	152,40	41,50	542,00	15,00	AP	3,25	2,00	4.1	M.1884	3,29%	BP	6 905	
"	152,40	41,50	542,00	15,00	AP	3,00	2,00	4.1	M.1884	2,94%	BP	6 905	
6"/23.3 M.1867	152,40	38,08	409,00	19,00	AP	2,50	2,00	2.0	M.1867	1,84%	BP	6 097	Sevastopol, Petropavlovsk, Pevenetz,
"	152,40	33,37	437,00	19,00	CP	2,50	2,00	2.0	M.1867	5,84%	BP	6 165	Kniaz Pojarski, Minin, General Admiral
24-pdr Blakely Pat. Conversion	151,10												
130mm/55 M. 1913	130,00	36,86	823,00	20,00	SAP	5,00	4,00	4.4	M.1911	10,58%	T	15 355	Imperatritsa Mariya, Imperator Nikolai I,
"	130,00	36,86	823,00	20,00	CP	4,74	4,00	4.4	M.1911	12,78%	T	15 355	Borodino, Muravev Amurski, Svetlana,
"	130,00	36,86	823,00	30,00	SAP	5,00	4,00	4.4	M.1911	10,58%	T	18 290	
"	130,00	36,86	823,00	30,00	CP	4,74	4,00	4.4	M.1911	12,78%	T	18 290	
"	130,00	33,50	861,00	30,00	SAP	5,00	7,00	4.4	M.1928	4,99%	T	22 314	
120mm/50 M.1908	120,00	20,48	823,00	20,00	CP	3,55	3,00	4.8	M.1907	12,50%	T	10 431	Imperator Pavel, Rurik (ii), Gangut
"	120,00	28,97	792,50	20,00	CPC	5,00	4,00	4.8	M.1911	12,88%	T	13 863	
"	120,00	26,30	825,00	20,00	SAP	5,00	7,00	4.8	M.1928	6,84%	T	17 010	
120mm/45 M.1891	120,00	20,47	823,00	20,00	AP	2,80	2,00	4.0	M.1892	3,42%	W	9 875	Tri Sviitelia, Admiral Ushakov, Novik,
"	120,00	20,47	823,00	20,00	CP	3,50	2,00	4.0	M.1892	8,11%	W	9 875	Boyarin, Izumrud
"	120,00	20,48	823,00	20,00	CP	3,55	3,00	4,0	M.1907	12,50%	T	10 331	
"	120,00	28,97	686,00	20,00	CPC	5,00	4,00	4,0	M.1911	12,88%	T	11 895	

"	120,00	20,48	823,00	25,00	CP	3,55	3,00	4,0	M.1907		12,50%	T	11 306	
"	120,00	28,96	686,00	25,00	CPC	5,00	4,00	4,0	M.1911		12,88%	T	13 215	
9-pdr M.1877 (106.6mm/19.7)	106,60	12,50	373,00	15,00	Common	2,60	2,00	4.4	M.1877		3,28%	BP	4 080	
"	106,60	12,50	373,00	15,00	Common	3,00	2,00	4.4	M.1877		13,12%	BP	4 080	
9-pdr M.1867 (106.6mm/20)	106,60	11,08	320,00	20,00	Common	2,15	2,00	2.0	M.1867		3,70%	BP	4 491	
8-pdr M.1860 MLR (106.1mm/17)	106,10	7,99	381,00	9,50	Common		1,00	3.0			4,51%	BP	2 425	
102mm/60 M.1908	101,60	17,50	823,00	30,00	CP	5,00	4,00	3.0	M.1911		13,71%	T	15 364	Novik, Bespoloiny, Ilin, Orfej, Gavril, Izyaslav, Gogland, Kerch
"	101,60	17,50	823,00	30,00	CP	5,00	4,00	3.0	M.1915		12,00%	T	16 095	
4-pdr M.1877 (86.87mm/24.1)	86,87	6,86	442,00	14,50	Common	2,60	2,00	4.4	M.1877		2,97%	BP	4 539	
4-pdr M.1867 (86.87mm/20)	86,87	5,74	306,00	21,50	Common	2,15	2,00	2.0	M.1867		3,57%	BP	4 241	
4-pdr M.1859 (86.8mm/17)	86,80	4,78		20,00	Common						7,49%	BP		
75mm/50 M.1891	75,00	4,90	823,00	20,00	AP	2,70	2,00	3.0	M.1892				7 726	
"	75,00	4,91	823,00	20,00	CP	3,36	3,00	3.0	M.1907		10,59%	T	7 869	
UNITED STATES														
18"/48 Mk. 1	457,20	1 315,43	838,20	30,00	APC	3,53	4,00	7.47					35 112	
16"/45 Mk. 1	406,40	957,09	792,48	30,00	APC	3,53	4,00	5.87	AP Mark 3		2,73%	D	30 998	Colorado
16"/50 Mk. 2	406,40	957,09	853,44	30,00	APC	3,53	4,00	7.47	AP Mark 3		2,73%	D	34 839	South Dakota, Lexington
"	406,40	1 016,06	807,72	30,00	APCBC	4,00	7,00	7.47	AP Mark 5	12,10%	1,50%	D	35 333	
16"/45 Mk. 5	406,40	1 016,06	768,10	30,00	APCBC	4,00	7,00	5.87	AP Mark 5	12,10%	1,50%	D	32 004	re-armed Colorado
16"/45 Mk. 6	406,40	1 224,71	701,04	45,00	APCBC	4,50	9,00	8.84	AP Mark 8	11,60%	1,51%	D	33 695	North Carolina, South Dakota
16"/50 Mk. 7	406,40	1 224,71	762,00	45,00	APCBC	4,50	9,00	8.99	AP Mark 8	11,60%	1,51%	D	38 720	Iowa, Montana
14"/45 Mk. 1	355,60	635,94	792,48	15,00	APC	3,53	4,00	7.16	AP Mk 8	6,40%	2,45%	D	19 202	New York, Nevada, Pennsylvania
"	355,60	639,57	792,48	15,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	19 246	
14"/45 Mk. 3	355,60	635,94	822,96	15,00	APC	3,53	5,00	7.16	AP Mk 8	6,40%	2,45%	D	21 031	
"	335,60	639,57	822,96	15,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	20 355	
14"/50 Mk. 4	355,60	635,94	853,44	15,00	APC	3,53	5,00	7.54	AP Mk 8	6,40%	2,10%	D	21 973	New Mexico, California

"	355,60	639,57	853,44	15,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	21 549	
"	355,60	635,94	853,44	30,00	APC	3,53	5,00	7.54	AP Mk 8	6,40%	2,10%	D	32 635	
"	355,60	639,57	853,44	30,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	31 550	
14"/45 Mk. 8	355,60	680,40	792,48	30,00	APCBC	4,00	7,00	7.16	AP Mark 16	11,60%	1,53%	D	31 400	re-armed Nevada, Pennsylvania
"	355,60	639,57	822,96	30,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	29 845	
"	355,60	680,40	792,48	15,00	APCBC	4,00	7,00	7.16	AP Mark 16	11,60%	1,53%	D	21 031	re-armed Texas
"	355,60	639,57	822,96	15,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	20 355	
14"/50 Mk. 11	355,60	680,40	822,96	30,00	APCBC	4,00	7,00	7.54	AP Mark 16	11,60%	1,52%	D	33 650	re-armed New Mexico, California
"	355,60	639,57	853,44	30,00	CP	4,00	4,00		Mk. 9 Class B		7,45%	D	31 550	
13"/35 Mk. 1	330,20	498,96	640,08	15,00	AP	3,22	2,00	5.56			2,05%	BP	12 139	Indiana
"	330,20	512,56	609,60	15,00	APC	3,41	2,00	5.56	Johnson Cap	2,65%	1,20%	D	11 403	
13"/35 Mk. 2	330,20	498,96	701,04	15,00	AP	3,22	2,00	5.64			2,05%	BT	13 661	Kearsarge, Illinois
"	330,20	512,56	701,04	15,00	APC	3,41	2,00	5.64	Johnson Cap	2,65%	1,20%	D	13 680	
12"/35 Mk. 1	304,80	385,56	640,08	15,00	AP	3,16	2,00	6.71			5,68%	BP	11 613	Monterey, Texas, Puritan
"	304,80	394,63	640,08	15,00	APC	3,30	2,00	6.71	Johnson Cap	2,30%	2,76%	BP	11 704	
"	304,80	394,63	640,08	15,00	APC	3,34	4,00	6.71			2,84%	BT	13 200	
12"/35 Mk. 2	304,80	385,56	640,08	14,00	AP	3,16	2,00	5.03			5,68%	BP	11 156	Iowa
"	304,80	394,63	640,08	14,00	APC	3,30	2,00	5.03	Johnson Cap	2,30%	2,76%	BP	11 238	
"	304,80	394,63	640,08	14,00	APC	3,34	4,00	5.03			2,84%	BT	12 637	
12"/40 Mk. 3	304,80	385,56	853,44	15,00	AP	3,16	2,00	5.79			5,68%	BP	15 633	Maine, Arkansas
"	304,80	394,63	792,48	15,00	APC	3,30	2,00	5.79			2,84%	BT	15 270	
"	304,80	394,63	731,52	15,00	APC	3,34	4,00	5.79			2,84%	D	15 879	
12"/40 Mk. 4	304,80	394,63	792,48	20,00	APC	3,34	4,00	8.08			2,84%	D	20 720	Virginia
"	304,80	394,63	731,52	20,00	APC	3,34	4,00	8.08			2,84%	D	18 654	
12"/45 Mk. 5	304,80	395,08	822,96	15,00	APC	3,50	7,00	5.94	AP Mark 15	8,80%	2,87%	D	19 751	Connecticut, Mississippi, South Carolina, Dela-ware
12"/45 Mk. 6	304,80	395,08	868,68	15,00	APC	3,50	7,00	7.46	AP Mark 15	8,80%	2,87%	D	21 031	Florida
"	304,80	395,08	838,20	15,00	APC	3,50	7,00	7.46	AP Mark 15	8,80%	2,87%	D	20 035	

12"/50 Mk. 7	304,80	395,08	883,92	15,00	APC	3,50	7,00	7.08	AP Mark 15	8,80%	2,87%	D	21 488	Wyoming
12"/50 Mk. 8	304,80	517,10	762,00	45,00	APCBC	4,50	9,00	9.07	AP Mark 18	12,10%	1,53%	D	34 767	Alaska
10"/30 Mk. 1	254,00	226,80	609,60	15,00	AP	3,00	2,00	3.05					10 337	Miantonomoh, Maine
"	254,00	231,33	609,60	15,00	APC		7,00	3.05			2,60%	D	12 363	
10"/34 Mk. 1/2	254,00	226,80	634,00	13,50	AP	3,00	2,00	3.05					10 196	Miantonomoh
"	254,00	231,33	634,00	13,50	APC		7,00	3.05			2,60%	D	12 216	
10"/35 Mk. 2	254,00	226,80	634,00	15,00	AP	3,00	2,00	4.11					10 836	Amphitrite, Monterey
"	254,00	231,33	634,00	15,00	APC		7,00	4.11			2,60%	D	13 067	
10"/40 Mk. 3	254,00	226,80	853,44	13,00	APC	3,40	2,00	8.08					14 173	Tennessee
"	254,00	231,33	822,96	13,00	APC		7,00	8.08			2,60%	D	17 227	
8"/30 Mks. 1 & 2	203,20	113,40	609,60	12,00	AP	3,20	2,00	4.57					8 230	Atlanta, Chicago
"	203,20	117,94	609,60	12,00	APC	3,30	4,00	4.57		3,85%			10 113	
8"/35 Mk. 3	203,20	113,40	633,99	13,00	AP	3,20	2,00	6.55					9 034	Charleston, New York, Olympia, Brooklyn, Indi-ana
"	203,20	117,94	640,08	13,00	APC	3,30	4,00	6.55		3,85%			11 704	
8"/40 Mk. 3/3	203,20	113,40	655,32	13,00	AP	3,20	2,00	6.55					9 382	Columbia
"	203,20	117,94	640,08	13,00	APC	3,30	4,00	6.55		3,85%			11 704	
8"/35 Mk. 4	203,20	113,40	701,04	14,00	AP	3,30	2,00	8.69					10 548	Kearsarge
"	203,20	117,94	701,04	14,00	APC	3,30	4,00	8.69		3,85%			13 881	
8"/40 Mk. 5	203,20	113,40	822,96	20,00	AP	3,56	2,00	8.08					14 905	Pennsylvania
"	203,20	117,94	762,00	20,00	APC	3,56	4,00	8.08		3,85%			18 555	
8"/45 Mk. 6	203,20	113,40	838,20	20,00	AP	3,56	7,00	7.92			2,40%	D	15 179	Virginia, Connecticut, Mississippi, re-armed Pennsylvania
"	203,20	117,94	838,20	20,00	APC	3,56	7,00	7.92			2,50%	D	20 574	
"	203,20	117,94	838,20	20,00	CP		4,00	7,92			6,00%	D	19 001	
8"/55 Mk. 9	203,20	117,94	853,44	41,00	APCBC	4,50	9,00	6.02	Mk 19	16,80%	1,40%	D	29 132	Pensacola through Wichita
"	203,20	117,94	853,44	41,00	APCBC	4,00	7,00	6.02	Mk. 16	8,30%	1,40%	D	28 419	
"	203,20	117,94	853,44	41,00	SAPC	4,25	7,00	6.02	Mk 14 S C	8,30%	4,20%	D	28 419	
"	203,20	117,94	853,44	41,00	SAPC	4,50	7,00	6.02	Mk 15 S C	14,80%	4,41%	D	28 582	
"	203,20	117,94	853,44	41,00	SAPC	4,50	7,00		Mk 17 S C	7,70%	3,99%	D	28 582	

8"/55 Mk. 12	203,20	151,96	762,00	41,00	APCBC	4,50	9,00	8.23	Mk 21	19,80%	1,50%	D	27 478	Baltimore
"	203,20	117,94	853,44	41,00	SAPC	4,50	7,00		Mk 17 S C	7,70%	3,99%	D	28 582	
7"/45 Mk. 2	177,80	74,84	822,96	15,00	Common		2,00	5.11				BT		Connecticut, Mississippi
"	177,80	74,84	822,96	15,00	APC	3,17	2,00	5.11	APC Mk I & VIII			BT	11 860	
	177,80	74,84	822,96	15,00	APC	3,22	2,00	5.11	APC Mk II			BT	11 773	
	177,80	74,84	822,96	15,00	APC	3,28	4,00	5.11	APC Mk IV & IX			D		
	177,80	74,84	822,96	15,00	APC	3,38	5,00	5.11	APC Mk. VI	8,80%	2,61%	D		
	177,80	74,84	822,96	15,00	APCBC	3,39	7,00	5.11	APC Mk. 10	8,80%	2,61%	D	15 087	
	177,80	74,84	822,96	15,00	APCBC	3,38	7,00	5.11	APC Mk. XII		2,42%	D	15 087	
6"/30 Mks. 1, 2 & 3/0	152,40	45,36	609,60	12,00	AP	2,88	2,00	3.96	Steel		1,25%	BP	7 087	Atlanta, Chicago, Char-leston, San Francisco, Yorktown, Indiana, Maine
"	152,40	45,36	609,60	12,00	AP	3,27	2,00	3.96	Steel		4,87%	BP	7 087	
"	152,40	45,36	609,60	12,00	CP	3,44	2,00	3.96	Cast Iron		4,75%	BP	7 087	
"	152,40	45,36	609,60	12,00	Common	3,61	2,00	3.96	Cast Steel		9,81%	BP	7 087	
"	152,40	47,13	634,00	12,00	APC		2,00		Johnson Cap	4,81%			7 441	
6"/35 Mk. 3/1	152,40	45,36	634,00	12,00	AP	2,88	2,00	4.11	Steel		1,25%	BP	7 370	Texas, Minneapolis
"	152,40	45,36	634,00	12,00	AP	3,27	2,00	4.11	Steel		4,87%	BP	7 370	
"	152,40	45,36	634,00	12,00	CP	3,44	2,00	4.11	Cast Iron		4,75%	BP	7 370	
"	152,40	45,36	634,00	12,00	Common	3,61	2,00	4.11	Cast Steel		9,81%	BP	7 370	
"	152,40	47,13	655,32	12,00	APC		2,00		Johnson Cap	4,81%			7 696	
6"/40 Mks. 3/2 & 4	152,40	45,36	655,32	12,00	AP	2,88	2,00	4.11	Steel		1,25%	BP	7 621	Columbia, Cincinnati
"	152,40	45,36	655,32	12,00	AP	3,27	2,00	4.11	Steel		4,87%	BP	7 621	
"	152,40	45,36	655,32	12,00	CP	3,44	2,00	4.11	Cast Iron		4,75%	BP	7 621	
"	152,40	45,36	655,32	12,00	Common	3,61	2,00	4.11	Cast Steel		9,81%	BP	7 621	
"	152,40	47,13	731,52	12,00	APC	3,20	2,00	4.11	Johnson Cap	4,81%			8 595	
"	152,40	47,63	731,52	12,00	APC		4,00	4.11					10 571	
6"/48 Mk. 6	152,40	47,13	792,48	15,00	APC	3,20	2,00	4.57	Johnson Cap	4,81%			10 389	Maine
"	152,40	47,63	822,96	15,00	APC		4,00				2,48%	D	13 716	

"	152,40	47,63	853,44	15,00	APC		5,00						14 630	
"	152,40	47,63	822,96	15,00	CP		4,00				6,00%	D	13 716	
"	152,40	47,63	853,44	15,00	CP		5,00		Comm. Mk. 20		6,74%	D	14 630	
6"/40 Mk. 7	152,40	47,13	731,52	15,00	APC		2,00	4.65	Johnson Cap	4,81%			11 340	Illinois
"	152,40	47,63	731,52	15,00	APC		4,00				2,48%	D	11 915	
6"/50 Mk. 8	152,40	47,63	853,44	15,00	APC		5,00	5.03			2,29%	D	14 630	Pennsylvania, Tennes-see, St. Louis, Virginia
"	152,40	47,63	853,44	15,00	CP		4,00				6,00%	D	14 299	
"	152,40	47,63	853,44	15,00	CP	3,78	5,00		Comm. Mk. 20		3,81%	D	14 630	
6"/53 Mk. 12	152,40	47,63	914,40	30,00	APCBC	3,80	7,00	5.64			2,48%	D	23 134	Omaha turrets
"	152,40	47,63	914,40	30,00	SAPC	4,50	5,25	5.64	Sp ComMk 27	9,10%	2,10%	D	21 580	
"	152,40	47,63	914,40	20,00	APCBC	3,80	7,00	5.64			2,48%	D	19 294	Omaha casemates
"	152,40	47,63	914,40	20,00	SAPC	4,50	5,25	5.64	Mk. 27	9,10%	2,10%	D	18 105	
"	152,40	47,63	914,40	25,00	APCBC	3,80	7,00	7,47			2,48%	D	21 306	Lexington, South Dakota
"	152,40	47,63	914,40	25,00	CPC	4,50	5,25	7,47	Mk. 24		6,74%	D	19 998	
6"/47 Mk. 16	152,40	58,97	762,00	40,00	APCBC	4,50	9,00	8.23	Mk 35	18,40%	1,54%	D	23 317	Cleveland
"	152,40	47,63	853,44	40,00	APCBC	3,80	7,00					D	21 543	
"	152,40	47,63	847,35	40,00	SAPC	4,50	5,25		Mk 28	8,00%	5,45%	D	21 401	
6"/47 Mk. 17	152,40	47,63	914,40	20,00	APCBC	3,80	7,00	8.23					18 105	Erie
"	152,40	47,63	914,40	20,00	SAPC	4,50	5,25		Mk 28	8,00%	5,45%	D	17 817	
5"/31 Mk. 1	127,00	22,68	609,60	15,00	AP	2,90	2,00	3.96					7 155	Chicago
"	127,00	22,68	609,60	15,00	Common	3,10	2,00						7 155	
"	127,00	22,68	701,04	15,00	CP	3,40	4,00		Mk. 15 ['05]		3,46%	BT	9 574	
"	127,00	22,68	701,04	15,00	AP		4,00						9 574	
5"/40 Mk. 2	127,00	22,68	685,80	15,00	AP	2,90	2,00	4.57					7 891	Olympia, Brooklyn, Cincinnati, Montgomery
"	127,00	22,68	685,80	15,00	CP								7 891	
"	127,00	22,68	701,04	15,00	CP	3,40	4,00		Mk. 15 ['05]		3,46%	BT	9 574	
"	127,00	22,68	701,04	15,00	AP		4,00						9 574	
5"/40 Mk. 3 & 4	127,00	22,68	701,04	15,00	AP	2,90	2,00	5.11					8 038	Kearsarge
"	127,00	22,68	701,04	15,00	CP								8 038	

"	127,00	22,68	807,72	15,00	CP	3,40	4,00	5.11	Mk. 15 ['05]		3,46%	BT	9 960	
"	127,00	22,68	807,72	15,00	AP		4,00						9 960	
5"/50 Mk. 5	127,00	22,68	914,40	15,00	APC	3,30	4,00	3.58			3,40%	D	12 344	Delaware
"	127,00	22,68	914,40	15,00	CP	3,40			Mk. 15 ['05]		3,46%	BT	12 212	
5"/50 Mk. 6	127,00	22,68	914,40	15,00	APC	3,30	4,00	5.87			3,40%	D	12 344	Denver
"	127,00	22,68	914,40	15,00	CP	3,40			Mk. 15 ['05]		3,46%	BT	12 217	
5"/51 Mk. 7	127,00	22,68	960,12	20,00	APC	3,30	4,00	3.66			3,40%	D	14 493	Florida, Wyoming, New York, Nevada, Pennsyl-vania, New Mexico, Tennessee, Colorado
"	127,00	22,68	960,12	20,00	CP	3,40			Mk. 15 ['05]		3,46%	BT	14 479	
5"/25 Mk. 10	127,00	25,03	634,00	85,00	SAPC	4,15	5,25	6.93	Mk 38 S C	14,00%	3,70%	D	13 282	
"	127,00	22,68	666,00	85,00	APC	3,30	4,00	6.93					13 103	
"	127,00	24,49	641,61	85,00	CPBC	4,15	5,25	6.93	Mk 32	8,00%	4,60%	D	13 250	
5"/38 Mk. 12	127,00	25,03	798,58	85,00	SAPC	4,15	5,25	4.42	Mk 38 S C	14,00%	3,70%	D	16 797	
"	127,00	24,49	798,58	85,00	CPBC	4,15	5,25	4,42	Mk 32	8,00%	4,78%	D	16 555	
"	127,00	22,68	838,20	85,00	APC	3,30	4,00	4,42			3,40%	D	16 075	
4"/40 Mks. 1 - 6	101,60	14,97	609,60	20,00	AP	3,20	2,00	5.11					9 180	New York, Iowa
"	101,60	14,97	609,60	20,00	CP	4,00	2,00	5.11					9 180	
"	101,60	14,97	701,04	20,00	CPC	3,20	3,00	5.11					9 528	
4"/50 Mk. 7	101,60	14,97	762,00	20,00	SAPC	4,90	3,00	3.66			3,33%	BP	10 108	
"	101,60	14,97	853,44	20,00	CP	3,95	7,00	3.66	Mk 6 ('15)	0,00%	4,21%	BT	14 329	
"	101,60	14,97	853,44	20,00	SAPC	4,38	7,00	3.66	Mk 16 S C	8,60%	3,51%	D	14 329	
4"/50 Mk. 9	101,60	14,97	883,92	20,00	SAPC	4,38	5,25	3.66	Mk 16 S C	8,60%	3,51%	D	14 813	
"	101,60	14,97	883,92	20,00	CP	3,95	2,00	3.66	Mk 6 ('15)	0,00%	4,21%	BT	14 813	
3"/50 Mk. 2	76,20	5,94	640,08	15,00	AP	4,05	2,00	4.65	Mk 29		2,29%	D	6 400	
"	76,20	5,90	640,08	15,00	CP	3,35	2,00	4.65	Mk 3 Common	0,00%	2,15%	BT	6 400	
"	76,20	5,94	822,96	15,00	AP	4,05	5,00		Mk 29		2,29%	D	9 418	
"	76,20	5,90	822,96	15,00	CP	4,04	5,00		Common		9,76%	BT	9 418	
3"/50 Mks. 3 & 6	76,20	5,94	822,96	15,00	AP	4,05	5,00		Mk 29		2,29%	D	9 418	
"	76,20	5,90	822,96	15,00	CP	4,04	5,00		Common		9,76%	BT	9 418	
3"/50 Mk. 10	76,20	5,90	822,96	85,00	AP	4,05	5,00		Mk 29		2,31%	D	13 341	

	76,20	5,90	822,96	85,00	CP	4,04	5,00		Common Mk 3		9,76%	BT	13 341
3"/23.5 Mk. 14	76,20	5,90	502,92	75,00	CP	3,35	2,00	4.65	Common	0,00%	2,15%	BT	8 046
"	76,20	5,90	502,92	75,00	CP	4,04	5,00		Common		9,76%	BT	9 235
CIVIL WAR													
20-in Dahlgren SB 200#	508,00	486,26	417,58	25,00	Cored	1,00	1,00	1,98					5 632
15-in Columbiad 40#	381,00	199,58	485,55	10,00	Solid	1,00	1,00	2,53					4 285
" 60#	381,00	199,58	508,10	10,00	Solid	1,00	1,00	2,53					4 478
15-in Dahlgren SB (short) 50#	381,00	199,58	370,64	10,00	Solid	1,00	1,00	1,98	cast iron				
" 50#	381,00	181,44	388,93	10,00	Cored	1,00	1,00	1,98					
15-in Dahlgren SB (long) 60#	381,00	199,58	430,07	10,00	Solid	1,00	1,00	2,53	cast iron				
" 60#	381,00	181,44	451,10	10,00	Cored	1,00	1,00	2,53					
11-in Dahlgren SB 30#	279,40	75,30	430,38	10,00	Solid	1,00	1,00	1,98	cast iron				
" 30#	279,40	84,37	405,38	10,00	Solid	1,00	1,00	1,98	wrought iron				
10-in Dahlgren SB 40#	254,00	56,25	557,79	10,00	Solid	1,00	1,00	2,53					3 404
10-in Columbiad SB 18#	254,00	56,20	508,41	10,00	Solid	1,00	1,00	2,53					3 191
9-in Dahlgren SB 28.5#	228,60	40,96	526,09	10,00	Solid	1,00	1,00	2,53					3 074
8-in Columbiad SB 10#	203,20	29,48	440,74	10,00	Solid	1,00	1,00	2,53					2 604
" 20#	203,20	29,48	525,48	10,00	Solid	1,00	1,00	2,53					2 927
8-in 65cwt SB 20#	203,20	29,48	491,95	10,00	Solid	1,00	1,00	2,53					2 805
8-in 63cwt SB 20#	203,20	29,48	502,01	10,00	Solid	1,00	1,00	2,53					2 842
8-in 55cwt SB 20#	203,20	29,48	489,81	10,00	Solid	1,00	1,00	2,53					2 797
42-pdr SB 10.5#	177,80	19,37	540,41	10,00	Solid	1,00	1,00	2,53					2 482
32-pdr 72cwt SB 8#	162,56	14,79	545,59	10,00	Solid	1,00	1,00	2,53					2 657

	32-pdr 57cwt SB	9#	162,56	14,79	518,16	10,00	Solid	1,00	1,00	2,53		2 579	
	32-pdr 42cwt SB	6#	162,56	14,79	441,96	10,00	Solid	1,00	1,00	2,53		2 341	
	32-pdr 32cwt SB	4.5#	162,56	14,79	389,23	10,00	Solid	1,00	1,00	2,53		2 154	
	32-pdr 27cwt SB	4#	162,56	14,79	363,93	10,00	Solid	1,00	1,00	2,53		2 056	
	24-pdr 62cwt SB	6#	147,83	11,07	530,66	10,00	Solid	1,00	1,00	2,53		2 446	
	18-pdr 46cwt SB	4.5#	134,62	8,39	526,39	10,00	Solid	1,00	1,00	2,53		2 179	
	12-pdr 31cwt SB	4#	117,35	5,58	574,55	10,00	Solid	1,00	1,00	2,53		2 444	
	7-in James MLR		177,80	36,85	353,57	10,00	AP	1,51	2,00	2,53		3 166	
	80-pdr Dahlgren MLR		152,40	36,29	286,82	10,00	AP	2,36	2,00	2,53		2 534	
	50-pdr Dahlgren MLR		129,54	22,68	253,29	10,00	AP	2,40	2,00	2,53		2 030	
	20-pdr MLR		101,60	9,07	362,10	10,00	AP	2,50	2,00	2,53		3 036	
	12-pdr MLR		86,36	5,13	354,17	10,00	AP	2,13	2,00	2,53		2 792	
	8-in MLR M1876 (Converted 11" SB)		203,20	81,65	441,96	12,00	AP	2,29	2,00	2,53	Palliser	5 075	Tennessee, Trenton, Shenondoah, et.al
Palliser	6.4-in BL (Conversion of Parrott)		162,56	36,29	380,85	15,00	AP	1,95	2,00	2,53	Palliser	4 842	Tennessee
	5.3-in BL (Conversion of Parrott)		134,62	20,64	471,83	15,00	AP	2,03	2,00	2,53	Palliser	5 473	Shenondoah, Ticonde-roga, Kearsarge, et.al.
	300-pdr MLR	(/17.3)	254,00	154,22	359,97	15,00	Solid	1,86	2,00	2.53		4 936	
Parrott	"		254,00	113,40	420,02	15,00	Hollow	1,71	2,00	2.53		5 292	
	300-pdr MLR	(/14.4)	254,00	154,22	326,44	15,00	Solid	1,86	2,00	2.53		4 406	
Parrott	"		254,00	113,40	380,70	15,00	Hollow	1,71	2,00	2.53		4 850	
	200-pdr MLR	(/19.8)	203,20	79,38	380,70	15,00	Solid	1,87	2,00	2.53		4 962	
Parrott	"		203,20	68,04	411,18	15,00	Hollow	2,01	2,00	2.53		5 092	
	150-pdr MLR	(/17)	203,20	67,59	384,81	15,00	Bolt	1,81	2,00	2.53	Flat top		
Parrott	"		203,20	56,70	420,02	15,00	Bolt	1,53	2,00	2.53	Short bottle top		
	"		203,20	49,90	441,96	15,00	Bolt	1,60	2,00	2.53	Stafford sub-caliber		
	"		203,20	68,04	383,44	15,00	Bolt	2,02	2,00	2.53	steel Bottle top		
	100-pdr MLR	(/20.3)	162,56	34,02	493,47	25,00	Shot	2,03	2,00	2.53	Flat top Hollow		
Parrott	"		162,56	43,55	390,75	25,00	Bolt	2,06	2,00	2.53	Bottle top		
	"		162,56	36,29	477,62	25,00	Bolt	2,27	2,00	2.53	Stafford sub-caliber		

	"	162,56	31,75	475,18	25,00	AP Shell	2,27	2,00	2.53	Stafford sub-caliber		
	"	162,56	42,18	396,85	25,00	Bolt	2,13	2,00	2.53	steel Bottle top		
	100-pdr MLR (/23.4)	162,56	45,36	393,80	25,00	Solid	2,09	2,00	2.53		6 714	
Parrott	"	162,56	36,29	440,13	25,00	Hollow	2,09	2,00	2.53		6 693	
	"	162,56	38,10	429,77	25,00	Solid	1,76	2,00	2.53		6 700	
	60-pdr MLR (/19.8)	134,60	27,22	343,21	25,00	Solid	2,21	2,00	2.53		5 724	
Parrott	30-pdr MLR (/23) 3.25#	106,68	13,15	358,45	25,00	Solid	2,14	2,00	2.53		5 872	Dessalines
Parrott	" 3.5#	106,68	13,15	369,42	25,00	Solid	2,14	2,00	2.53		6 006	
	" 3.75#	106,68	13,15	379,78	25,00	Solid	2,14	2,00	2.53		6 126	
	30-pdr MLR (/28.6) 3.25#	106,68	13,15	401,42	25,00	Solid	2,14	2,00	2.53		6 363	
Parrott	" 3.5#	106,68	13,15	413,61	25,00	Solid	2,14	2,00	2.53		6 490	
	" 3.75#	106,68	13,15	425,50	25,00	Solid	2,14	2,00	2.53		6 610	
	20-pdr MLR (/22.9)	93,22	8,85	363,93	25,00	Solid	2,16	2,00	2.53		5 595	
Parrott	20-pdr MLR (/21.5)	93,22	8,85	352,04	25,00	Solid	2,16	2,00	2.53		5 464	
Parrott	10-pdr MLR (/23)	76,20	4,76	356,62	25,00	Solid	2,13	2,00	2.53		5 152	
Parrott	"	76,20	3,74	402,34	25,00	Hollow	2,09	2,00	2.53		5 008	
	10-pdr MLR (/24.7)	76,20	4,76	370,64	25,00	Solid	2,13	2,00	2.53		5 281	
Parrott	"	76,20	3,74	418,19	25,00	Hollow	2,09	2,00	2.53		5 105	
	CONFEDERATE STATES OF AMERICA											
	6.4-in Brooke MLR 8#	162,56	43,09	312,73	10,00	SHOT	1,99	1,00	1,98	Mullane	2 829	
	" 10#	162,56	43,09	359,06	10,00	SHOT	1,99	1,00	1,98	Mullane	3 346	
	(armor test) " 12# 6.4-in Brooke MLR (2 bands)	162,56	38,56	380,39	10,00	SHOT	1,25	2,00	1,98	Read	3 628	
	7-in Brooke MLR (2 bands) 10#	177,80	54,43	317,60	10,00	SHOT	1,99	1,00	1,98	Brooke	2 922	
	" 13#	177,80	54,43	338,33	10,00	SHOT	1,99	1,00	1,98	Brooke	3 170	
	" 16#	177,80	54,43	358,14	10,00	SHOT	1,99	1,00	1,98	Brooke	3 374	

	" 13#	177,80	55,34	335,28	10,00	SHOT	1,99	1,00	1,98	Mullane	3 145
	" 16#	177,80	55,34	355,09	10,00	SHOT	1,99	1,00	1,98	Mullane	3 354
	7-in Brooke MLR (3 bands) 20#	177,80	54,43	384,96	10,00	SHOT	1,99	1,00	1,98	Brooke	3 630
	" 30#	177,80	54,43	420,90	10,00	SHOT	1,99	1,00	1,98	Brooke	3 967
	" 16#	177,80	55,34	349,00	10,00	SHOT	1,99	1,00	1,98	Mullane	3 292
	" 20#	177,80	55,34	381,30	10,00	SHOT	1,99	1,00	1,98	Mullane	3 609
	" 30#	177,80	55,34	417,27	10,00	SHOT	1,99	1,00	1,98	Mullane	3 950
	" 25#	177,80	76,66	336,20	10,00	AP	3,12	1,00	1,98	Brooke	3 330
	8-in Brooke MLR (2 bands)										
	8-in Brooke SB (2 bands)										
	10-in Brooke SB (2 bands)										
	11-in Brooke MLR (2 bands)										
	11-in Brooke SB (2 bands)										
	8-in 150-pdr	203,20	68,04	353,57	15,00	Shell		2,00			
Armstrong	"	203,20	74,84	381,92	15,00	AP					
	8-in 200-pdr	203,20	90,72	373,38	15,00	AP					
Low Moor	Blakely [conversion] 7-in 110-pdr					Shell					
	"					Bolt					
Blakely	9-in MLR 250-pdr					Shell					
						Bolt					
Blakely	4.5-in MLR					Shell					
Low Moor	Blakely 6-in [conversion] MLR					Shell					
Low Moor	Blakely [contract] 32-pdr SB					Shell					
Low Moor	Blakely [contract] 68-pdr SB					Shot					
Tregedar	Blakely [conversion] 32-pdr MLR										
Low Moor	Blakely [conversion] 6.3-in MLR										
Blakely	7-in MLR 120-pdr										
Blakely	8-in MLR 200-pdr										

Blakely	11-in MLR 375-pdr													
Voruz	Blakely [Patent] 30-pdr [kg.]	171,45	30,00											
	AUSTRALIAN AND NEW ZEALAND COLONIES													
	10"/30 Patterns F & G	254,00	204,11	579,12	10,00	AP	2,88	2,00	4,57		2,73%	BP	7 230	Victoria
Elswick	"	254,00	181,44	614,17	10,00	Common	3,57	2,00	4,57		6,62%	BP	7 480	
	9.2"/25 Pattern B	233,68	172,37	542,85	16,00	AP		2,00	4,0				8 987	Coast Defense
Elswick	"	233,68	172,37	542,85	16,00	Common		2,00	4,0				8 987	
	9.2"/31.5 Pattern G	233,68	172,37	640,08	16,00	AP		2,00	4,0				10 833	Coast Defense
Elswick	"	233,68	172,37	640,08	16,00	Common		2,00	4,0				10 833	
	8"/26 Pattern D	203,20	81,65	573,63	12,50	AP		2,00	3,05	Palliser	1,10%	BP	6 858	Albert, Protector
Elswick	"	203,20	81,65	573,63	12,50	Common		2,00	3,05	Cast Iron			6 858	
	"	203,20	81,65	573,63	12,50	Common		2,00	3,05	Steel Mk. II	8,78%	BP	6 858	
	8"/26 Pattern G	203,20	81,65	615,70	12,50	AP		2,00	3,05	Palliser	1,10%	BP	7 365	Gayundah, Paluma
Elswick	"	203,20	81,65	615,70	12,50	Common		2,00	3,05	Cast Iron			7 365	
	"	203,20	81,65	615,70	12,50	Common		2,00	3,05	Steel Mk. II	8,78%	BP	7 365	
	8"/26 Pattern H	203,20	95,26	569,98	16,00	AP		2,00	4,0	Palliser	1,10%	BP	8 329	Coast Defense
Elswick	"	203,20	95,26	569,98	16,00	Common		2,00	4,0	Cast Iron Mk II	6,43%	BP	8 329	
	"	203,20	95,26	569,98	16,00	Common	3,63	2,00	4,0	Steel Mk III	13,81%	BP	8 329	
	8"/30 Pattern I & L	203,20	95,26	594,36	16,00	AP		2,00	4,0	Palliser	1,10%	BP	8 679	Coast Defense (Australia)
Elswick	"	203,20	95,26	594,36	16,00	Common		2,00	4,0	Cast Iron Mk II	6,43%	BP	8 679	
	"	203,20	95,26	594,36	16,00	Common	3,63	2,00	4,0	Steel Mk III	13,81%	BP	8 679	
	6"/26.3 Pattern D	152,40	36,29	573,03	13,50	AP		2,00	3,05				6 584	Protector
Elswick	"	152,40	36,29	573,03	13,50	Common		2,00	3,05				6 584	
	6"/30.5 Pattern K	152,40	45,36	585,22	12,00	AP	2,88	2,00	3,05	Steel	1,25%	BP	6 756	Gayundah, Paluma, Albert
Elswick	"	152,40	45,36	585,22	12,00	CP	3,44	2,00	3,05	Cast Iron	4,75%	BP	6 756	
	"	152,40	45,36	585,22	12,00	Common	3,63	2,00	3,05	Cast Steel	9,81%	BP	6 756	
	5"/31 Pattern D	127,00	22,68	605,64	15,00	Common		2,00	3,05				7 071	Coast Defense

Elswick	"	127,00	22,68	605,64	15,00	CP		2,00	3,05					7 071	
	12-pdr 8cwt BLR	76,20	5,10	377,65	15,00	Common		2,00	3,05			4,45%	BP	4 105	Victoria
Elswick	9-pdr 6cwt BLR	76,20	3,88	321,56	15,00	Common		2,00	3,05			4,38%	BP	3 291	Albert
	JAPANESE														
	45-cal Type 5 48-cm gun	480,00	1 550,00	800,00	30,00	APC	3,58	4,00	9.3	No. 5				33 210	Coast Defence
	"	480,00	1 750,00	750,00	30,00	APCBC	4,29	6,00	9.3	Type 91	18,50%	1,60%	TN	33 875	
	45-cal Type 5 46-cm gun	460,00	1 375,00	800,00	30,00	APC	3,61	4,00	9.3	No. 5				32 715	#13
	"	460,00	1 460,00	770,00	43,00	APCBC	4,25	6,00	9.3	Type 91				39 550	
	45-cal Type 94 46-cm gun	460,00	1 460,00	780,00	45,00	APCBC	4,25	6,00	8.8	Type 91 No. 0	18,50%	2,32%	TN	40 800	Yamato
	"	460,00	1 460,00	780,00	45,00	APCBC	4,47	6,00	8.8	Type 91 No. 1		2,32%	TN	42 030	
	45-cal Type 3 41-cm gun	409,00	1 000,00	780,00	30,00	APCBC	3,60	3,00	6.3	No. 5				30 200	Nagato, Kaga, Amagi, Kii
	"	409,00	1 000,00	780,00	30,00	APCBC	3,66	4,00	6.3	Type 88				30 200	
	"	409,00	1 020,00	780,00	43,00	APCBC	4,25	6,00	6.3	Type 91	15,50%	1,46%	TN	38 300	
	45-cal Type 41 36-cm gun	355,60	635,04	770,00	25,00	APC	3,30	3,00	6.5	No. 1 w/ Type 1				21 870	Kongo, Fuso, Ise
	"	355,60	635,04	770,00	25,00	CPC		3,00	6.5	No. 1 w/ Type 1				21 870	
	"	355,60	635,04	770,00	25,00	APC		4,00	6.3	No. 2 w/ Type 3				23 970	
	"	355,60	635,04	770,00	25,00	CPC		4,00	6.3	No. 2 w/ Type 3				23 970	
	"	355,60	635,04	770,00	33,00	APC		4,00	6.3	No. 2 w/ Type 3				27 340	
	"	355,60	635,04	770,00	33,00	CPC		4,00	6.3	No. 2 w/ Type 3				27 340	
	"	355,60	635,04	770,00	33,00	APC	3,61	4,00	6.2	No. 5 w/Type 5				28 600	
	"	355,60	635,04	770,00	33,00	APC	3,61	4,00	6.2	No. 6 w/ Type 88				28 600	
	"	355,60	673,50	770,00	43,00	APCBC	4,30	6,00	6.3	Type 91	15,50%	1,65%	TN	35 450	
Canet	32cm/38 (M.1887)	320,00	450,00	700,00	30,00	AP	3,50	2,00	7.5			2,26%	BP	18 000	Matsushima
	"	320,00	350,00	610,00	30,00	Common		2,00	7.5					15 500	
Krupp	30.5cm RKL/25 C/80	305,00	329,00	500,00	13,00	AP	2,70	2,00	5.5	Steel C/81		1,06%	BP	7 288	Chinyen

	"	305,00	329,00	500,00	13,00	Common	2,90	2,00	5.5	C/81		5,76%	BP	7 288	
EOC	30cm/50	304,80	400,00	855,00	25,00	APC	3,30	2,00	8.0	No. 2 w/Type 2	3,23%	4,83%	SH	21 418	Settsu
	"	304,80	400,00	855,00	25,00	APC	3,40	4,00	8.0	No. 2 w/Type 3	4,00%	4,00%	SH	25 305	
	"	304,80	400,00	855,00	25,00	CP	2,00	2,00	8.0	w/Type 2	3,23%	9,07%	SH	21 418	
	"	304,80	400,00	855,00	25,00	CPC	4,00	4,00	8.0	w/Type 3	4,00%	7,50%	SH	25 305	
	45-cal Type 41 30-cm gun	304,80	400,00	810,00	23,00	APC	3,30	2,00	8.0	No. 2 w/Type 2	3,23%	4,83%	SH	19 344	Ibuki
	"	304,80	400,00	810,00	23,00	CP	4,00	2,00	8.0	w/Type 2	3,23%	9,07%	SH	19 344	
	"	304,80	385,56	826,00	18,00	APC	3,30	2,00	8.0	No. 1 w/Type 1	3,35%	1,65%	SH	17 189	
	"	304,80	385,56	826,00	18,00	CPC	3,80	2,00	8.0	No. 2 w/ Type 1		9,41%	SH	17 189	
	"	304,80	400,00	810,00	23,00	APC	3,40	4,00	8.0	No. 2 w/Type 3	4,00%	4,00%	SH	22 551	
	"	304,80	400,00	810,00	23,00	CPC	4,00	4,00	8.0	w/Type 3	4,00%	7,50%	SH	22 551	
EOC & VSM	30cm/45	304,80	400,00	810,00	23,00	APC	3,30	2,00	8.0	No. 2 w/Type 2	3,23%	4,83%	SH	19 344	Kashima & Katori
	"	304,80	400,00	810,00	23,00	CPC	3,80	2,00	8.0	w/Type 2	3,23%	9,07%	SH	19 344	
	"	304,80	385,56	825,00	18,00	APC	3,30	2,00	8.0	No. 1 w/Type 1	3,35%	1,65%	SH	17 189	
	"	304,80	385,56	825,00	18,00	CP	3,80	2,00	8.0			9,41%	SH	17 189	
	"	304,80	400,00	810,00	23,00	APC	3,30	4,00	8.0	No. 2 w/Type 3	4,00%	4,00%	SH	22 551	
	"	304,80	400,00	810,00	23,00	CPC	4,00	4,00	8.0	No. 2 w/Type 3	4,00%	7,50%	SH	22 551	
EOC	30cm/40.4 (Pattern G)	304,80	385,56	731,52	18,00	AP	3,16	2,00	6.55	No. 1		5,00%	SH	14 970	Fuji, Shikishima, Asahi, Mikasa
	"	304,80	385,56	731,52	18,00	CP	3,80	2,00	6.55	No. 1		9,41%	SH	14 970	
	"	304,80	385,56	731,52	18,00	APC	3,30	2,00	6.55	No. 1 w/Type 1	3,35%	1,65%	SH	14 907	
	"	304,80	400,00	725,00	18,00	APC	3,30	4,00	6.55	No. 2 w/ Type 2	3,23%	4,83%	SH	15 000	
	"	304,80	400,00	725,00	18,00	CPC	4,00	2,00	6.55	w/Type 2	3,23%	9,07%	SH	15 000	
Krupp	26cm RKL/35 C/84	263,00	275,00	530,00	14,00	AP	3,50	2,00	5.85			1,16%	BP	8 500	Naniwa, Heien
	"	263,00	275,00	530,00	14,00	Common	3,95	2,00	5.85			3,82%	BP	8 500	
EOC & VSM	25cm/45	254,00	226,80	826,00	18,00	APC		2,00	8.0	No. 1				15 897	Kashima & Katori, Satsuma & Aki
	"	254,00	226,80	826,00	18,00	CPC		2,00	8.0	No. 1				15 897	
	"	254,00	235,00	810,00	23,00	APC		2,00	8.0	No. 2 w/ Type 2				17 831	

	"	254,00	235,00	810,00	23,00	CPC		2,00	8.0	No. 2 w/ Type 2			17 831	
	"	254,00	235,00	810,00	23,00	APC		4,00	8.0	No. 2 w/ Type 3			20 452	
	"	254,00	235,00	810,00	23,00	CPC		4,00	8.0	No. 2 w/ Type 3			20 452	
EOC	25cm/40.3 (Pattern R)	254,00	226,80	700,00	18,00	AP	3,00	2,00	6.8				13 245	Kasuga
	"	254,00	226,80	700,00	18,00	CP	3,80	2,00	6.8		7,55%	SH	13 245	
Armstrong	10"/30 Patterns F & G	254,00	204,11	627,89	12,00	AP	2,88	2,00	4.11	Palliser	1,58%	BP	7 994	
	"	254,00	181,44	665,84	12,00	Common	3,57	2,00	4.11				8 225	
	(cordite)	254,00	204,11	624,84	12,00	AP	2,88	2,00	4.11	Palliser	1,58%	BP	7 944	
Armstrong	10"/26 25-Ton BLR Pattern	254,00	204,11	579,12	12,00	AP	2,88	2,00	4.57		2,73%	BP	7 201	Tsukushi
	"	254,00	181,44	614,17	12,00	Common	3,57	2,00	4.57		6,62%	BP	7 446	
Armstrong	10" 300-pdr MLR	254,00	131,50	414,00	10,00	Bolt	1,59	2,00	2.6				4 096	Adzuma
	"	254,00	133,80	410,00	10,00	Common	2,24	2,00	2.6				4 127	
Krupp	24cm RKL/30 C/84	238,00	215,00	505,00	14,00	AP	3,50	2,00	4.5	C/80	1,74%	BP	7 950	Unebi
	"	238,00	215,00	505,00	14,00	Common	4,47	2,00	4.5	C/80	6,23%	BP	7 950	
Krupp	24cm RK L/22 C/72	235,40	139,00	455,00	14,00	AP	2,38	2,00	2.6	Gruson Chilled	1,04%	BP	6 320	Fuso
	"	235,40	118,60	425,00	14,00	Common	2,46	2,00	2.6		5,90%	BP	5 640	
Armstrong	9"/14 12-Ton MLR	228,60	113,40	408,13	10,00	AP	2,23	2,00	4.57		0,88%	BP	4 147	re-armed Adzuma
	"	228,60	113,40	331,32	10,00	Common	2,60	2,00	4.57		7,40%	BP	3 227	
Krupp	21cm RKL/22 C/72	209,30	89,00	450,00	13,00	AP	2,48	2,00	2.75	Gruson Chilled	1,91%	BP	5 500	Maya, Saien
	"	209,30	78,00	425,00	13,00	Common	2,41	2,00	2.75		8,72%	BP	5 020	
EOC	20cm/45 (Patt S, U, W) No. 2 gun	203,20	113,40	780,00	18,00	AP	3,00	2,00	6.8				13 263	Asama, Yakumo, Adzuma, Idzumo, Nisshin & Kasuga, Takasago, Chitose
	"	203,20	113,40	780,00	18,00	CP		2,00	6.8				13 263	
	"	203,20	113,40	780,00	23,00	APC		2,00	6.8	w/Type 2			14 754	
	"	203,20	113,40	780,00	23,00	CPC		2,00	6.8	w/Type 2			14 754	
	"	203,20	115,30	790,00	30,00	APC		4,00	6.8	w/Type 3			19 737	
	"	203,20	115,30	790,00	30,00	CPC		4,00	6.8	w/Type 3			19 737	
	"	203,20	115,30	835,00	30,00	APC		4,00	6.8	w/Type 3			21 000	
	"	203,20	115,30	835,00	30,00	CPC		4,00	6.8	w/Type 3			21 000	

	45-cal Type 41 20-cm No. 3 gun	203,20	113,40	780,00	23,00	APC		2,00	6.8	w/Type 2					14 754	Ibuki
	"	203,20	113,40	780,00	23,00	CPC		2,00	6.8	w/Type 2					14 754	
	"	203,20	115,30	790,00	30,00	APC		4,00	6.8	w/Type 3					19 737	
	"	203,20	115,30	790,00	30,00	CPC		4,00	6.8	w/Type 3					19 737	
	"	203,20	115,30	835,00	30,00	APC		4,00	6.8	w/Type 3					21 000	
	"	203,20	115,30	835,00	30,00	CPC		4,00	6.8	w/Type 3					21 000	
	50-cal Type 3 20-cm No. 1 gun	200,00	110,00	870,00	40,00	APCBC	3,81	4,00	5.5	No. 5 (1925)			2,64%	SH	26 670	Furutaka, Aoba, Nachi
	"	200,00	110,00	870,00	40,00	APCBC	3,81	4,00	5.5	No. 6 Type 88 (1928)	15,50%		2,58%	SH	26 670	
	50-cal Type 3 20-cm No. 2 gun	203,20	125,85	840,00	55,00	SAPBC	4,46	6,00	5.5	Type 91	2,50%		2,47%	TN	29 800	'A' Type cruisers
Krupp	17cm RKL/25 C/72	172,60	55,90	472,00	11,00	AP	2,41	2,00	3.2				1,07%	BP	5 025	Fuso, re-armed Ryujo, Kaimon,
	"	172,60	51,00	465,00	11,00	Common	2,79	2,00	3.2				8,24%	BP	5 015	Katsuragi
Krupp	17cm RKL/20 C/67	172,60	55,90	404,00	11,00	AP	2,41	2,00	3.7				1,07%	BP	4 278	Kongo
	"	172,60	51,00	409,00	11,00	Common	2,79	2,00	3.7				8,24%	BP	4 420	
Armstrong	RBL 70-pdr 69cwt	162,60	36,29	424,10	15,00	AP	1,98	2,00	2.6						5 093	Ryujo, re-armed Adzuma
	"	162,60	31,80	453,10	15,00	Common	2,30	2,00	2.6						5 140	
	60-cal Type 3 15.5-cm gun	155,00	55,87	920,00	55,00	SAPBC	4,37	6,00	6.3	Type 91	2,50%		2,06%	TN	27 400	Mogami, Yamato, Oyodo
EOC	15cm/40 (Pattern W)	152,40	45,36	701,04	15,00	Common	3,60	2,00	3.1				8,82%	SH	9 050	
	"	152,40	45,36	701,04	15,00	AP	3,27	2,00	3.1				4,63%	SH	9 050	
	"	152,40	45,36	676,66	15,00	Common	3,61	2,00	3.1	Cast Steel			9,81%	BP	8 760	
	"	152,40	45,36	676,66	15,00	CP	3,44	2,00	3.1	Cast Iron			4,75%	BP	8 760	
	"	152,40	45,36	676,66	15,00	AP	3,27	2,00	3.1	Steel			4,87%	BP	8 760	
	"	152,40	45,36	676,66	15,00	AP	2,88	2,00	3.1	Steel			1,25%	BP	8 760	
EOC	15cm/40 (Pattern Z)	152,40	45,36	762,00	15,00	Common	3,60	2,00	3.1				8,82%	SH	9 770	
	"	152,40	45,36	762,00	15,00	AP	3,27	2,00	3.1				4,63%	SH	9 770	
EOC & VSM	15cm/45	152,40	45,36	850,00	15,00	CPC	3,60	4,00	6.2	Common 1916					13 863	
	"	152,40	45,36	850,00	15,00	APC		4,00	6.2	No. 2					13 580	
	"	152,40	45,36	850,00	15,00	Common	3,61	2,00	6.2	Type 1			8,82%	SH	11 278	
	"	152,40	45,36	850,00	15,00	AP	3,27	2,00	6.2				4,63%	SH	9 770	

EOC	15cm/50 (Pattern DD)	152,40	45,36	762,00	15,00	Common	3,60	2,00	3.1			8,82%	SH	9 770	re-armed Fuso (1900)
	"	152,40	45,36	762,00	15,00	AP	3,27	2,00	3.1			4,63%	SH	9 770	
	45-cal Type 41 15-cm gun	152,40	45,36	850,00	18,00	Common	3,61	2,00	6.2	No. 1		8,82%	SH	11 740	
	"	152,40	45,36	850,00	18,00	AP	3,27	2,00	6.2	No. 1		4,63%	SH	11 740	
	"	152,40	45,36	850,00	18,00	APC		4,00	6.2	No. 2				14 800	
	"	152,40	45,36	850,00	18,00	CPC		4,00	6.2	Common 1916				15 121	
	50-cal Type 41 15-cm No. 3 gun	152,40	45,36	850,00	18,00	Common	3,61	2,00	6.2	No. 1		8,82%	SH	11 740	Kongo, Fuso
	"	152,40	45,36	850,00	18,00	AP	3,27	2,00	6.2	No. 1		4,63%	SH	11 740	
	"	152,40	45,36	850,00	18,00	APC		4,00	5.1	No. 2				14 800	
	"	152,40	45,36	850,00	30,00	CPC	3,75	4,00	5.1	Common 1916				18 888	
	"	152,40	45,36	850,00	45,00	CPC		6,00	5.1	Common 1935		5,86%	SH	21 722	Agano
Krupp	15cm RKL/35 C/80	149,10	51,00	530,00	20,00	AP	3,35	2,00	4.5			1,53%	BP	8 850	Naniwa, Unebi
	"	149,10	51,00	530,00	20,00	Common	4,00	2,00	4.5			4,51%	BP	8 850	
Krupp	15cm RKL/25 C/74	149,10	35,50	495,00	13,00	AP	2,72	2,00	3.7			1,13%	BP	5 594	Kongo, Takao, Maya
	"	149,10	27,70	492,00	13,00	Common	2,66	2,00	3.7			7,22%	BP	5 111	Banjo
Krupp	15cm RKL/22 C/72	149,10	35,50	450,00	13,00	AP	2,72	2,00	2.75			1,13%	BP	5 130	
	"	149,10	27,70	485,00	13,00	Common	2,66	2,00	2.75			7,22%	BP	5 049	
	50-cal Type 3 14-cm gun	140,00	38,00	850,00	20,00	CPC	3,58	4,00	7.0	No. 4	5,00%	5,26%	SH	15 800	Ise, Nagato, Kaga, Kii, Nagara,
	"	140,00	38,00	850,00	30,00	CPCBC	3,93	4,00	7.0	w/ Mods 1 & 2	5,00%	5,26%	SH	18 850	Amagi, #13, Tenryu, Kuma, Sendai,
	"	140,00	38,00	850,00	30,00	CP	3,96	6,00	7.0	Type 2		6,84%	SH	19 100	Yubari, Katori
Armstrong	40-pdr 1.32-Ton BLR	120,65	18,14	480,06	12,00	Common	3,25	2,00	2.44			5,94%	BP	4 760	Tsukushi
Krupp	12cm RKL/25 C/78	120,00	20,00	431,00	15,00	AP	2,68	2,00	2.75			1,00%	BP	5 222	Katsuragi, Takao, Maya
	"	120,00	16,40	475,00	15,00	Common	2,66	2,00	2.75			3,90%	BP	5 273	
EOC	12cm/32 (Pattern M)	120,00	16,33	590,00	15,00	Common	2,88	2,00	2.5			8,33%	BP	6 166	
Krupp	12cm SKL/35 C/86	120,00	26,00	580,00	15,00	AP	3,50	2,00	3.5			0,96%	BP	7 370	Yaeyama
	"	120,00	26,00	580,00	15,00	Common	4,20	2,00	3.5			3,85%	BP	7 370	
EOC	12cm/40 (Pattern P)	120,00	20,41	655,00	15,00	AP	3,02	2,00	3.0	Cast Iron Palliser		2,08%	BP	7 589	
	"	120,00	20,41	655,00	15,00	AP	3,02	2,00	3.0	Steel		4,44%	BP	7 589	

	"	120,00	20,41	655,00	15,00	CP	3,63	2,00	3.0	Cast Steel		10,00%	BP	7 589	
EOC	12cm/40 (Pattern)	120,00	20,41	671,00	15,00	AP	3,02	2,00	4.0	Cast Iron Palliser		2,08%	BP	7 742	
	"	120,00	20,41	671,00	15,00	AP	3,02	2,00	4.0	Steel		4,44%	BP	7 742	
	"	120,00	20,41	671,00	15,00	CP	3,63	2,00	4.0	Cast Steel		10,00%	BP	7 742	
	45-cal Type 10 12-cm gun	120,00	20,41	825,00	75,00	CPC	3,47	3,00	4.9			8,40%	SH	15 880	
	45-cal Type 3 12-cm gun	120,00	20,41	825,00	33,00	CPC	3,47	4,00	4.0			8,40%	SH	15 100	
	"	120,00	20,41	825,00	33,00	CPC		4,00	4.0					15 000	
	45-cal Type 11 12-cm gun	120,00	20,41	825,00	33,00	CPC	3,47	3,00	4.0			8,40%	SH	15 100	
Armstrong	3"/28 BLR	76,20	5,67	520,90	15,00	Common		2,00				4,76%	BP	5 198	
EOC	12-pdr QF (3"/40 Patt. N)	76,20	5,67	673,61	20,00	CP		2,00	2.5			10,50%	SH	7 306	
	" cordite	76,20	5,67	680,00	20,00	CP		2,00				10,50%	SH	7 350	
	40-cal Type 3 8-cm gun	76,20	5,99	680,00	75,00	CP		4,00	3			7,58%	SH	10 800	
	SPAIN														
Vickers	15"/45 Mk. B	381,00	885,00	762,00	40,00	APCBC		6,00	7.62		8,13%	2,03%	T	35 100	Coast Defence
Hontoria	320mm/36.5 M1883	320,00	472,20	620,00	13,50	AP	3,37	2,00	8.0			1,59%	BP	10 900	Pelayo
	"	320,00	398,60	679,00	13,50	Common	3,42	2,00				5,27%	BP	11 510	
	"	320,00	399,86	678,00	13,50	SAP	3,32	3,00				4,38%	BP	11 500	
Ordonez	C.H.S.E. Mod. 1892 de 30.5cm L/35	305,00	380,00	517,00	18,00	AP	3,14	2,00	8.0					10 000	Coast Defence
	"	305,00	380,00	517,00	18,00	CP	3,77	2,00	8.0					10 000	Coast Defence
Krupp	30.5cm RKL/35 C/80	305,00	455,00	532,00	19,00	AP	3,50	2,00	8.0			0,71%	BP	11 400	Coast Defence
	"	305,00	455,00	532,00	19,00	Common	4,00	2,00	8.0			5,34%	BP	11 400	Coast Defence
Krupp	30.5cm MRKL/35 C/87	305,00	455,00	580,00	17,00	AP	3,50	2,00	8.0			0,71%	BP	12 000	Coast Defence
	"	305,00	455,00	580,00	17,00	Common	4,00	2,00	8.0			5,34%	BP	12 000	Coast Defence
Vickers	12"/50 M.1909 Pattern H	304,80	385,55	914,00	15,00	APC	3,28	4,00	6,9	Vickers		2,71%	L	21 000	Espana
	"	304,80	385,55	914,00	15,00	SAPC	3,79	4,00	6,9	Vickers		7,76%	L	21 000	
	"	304,80	385,55	914,00	15,00	CP	4,16	4,00	6,9	Vickers		8,45%	BP	21 000	

	" 1914	304,80	385,55	894,00	15,00	APC	3,28	4,00	6,9	Vickers		2,71%	L	20 300	
	" 1914	304,80	385,55	894,00	15,00	SAPC	3,79	4,00	6,9	Vickers		7,76%	L	20 300	
	" 1914	304,80	385,55	894,00	15,00	CP	4,16	4,00	6,9	Vickers		8,45%	BP	20 300	
	"	304,80	385,55	894,00	15,00	APC	3,35	4,00	6,9	Bofors M/17-21	6,02%	2,89%	T	21 500	
	"	304,80	385,55	894,00	15,00	SAPC	3,80	4,00	6,9	Bofors M/17-21	6,02%	8,39%	T	21 500	
	"	304,80	385,55	894,00	15,00	CP	4,20	4,00	6,9	La Carraca		8,45%	BP	21 500	
Armstrong	C. A. de 30.5cm (No. 1) L/25.5	304,80	323,87	547,00	22,50	AP	2,64	2,00	8.0					11 500	
Armstrong	C. A. de 30.5cm (No. 2) L/25.5	304,80	323,87	577,00	22,50	AP	2,64	2,00	8.0					12 200	
	C. H. de 28cm molelo Barrios	280,00	88,00			Ball	1,00	1,00	8.0						
Krupp	28cm RKL/22 C/74	283,00	240,00	490,00	24,00	AP	2,45	2,00	8.0			1,46%	BP	10 200	Coast Defence
	"	283,00	240,00	490,00	24,00	Common	2,96	2,00	8.0					10 200	
Hontoria	280mm/35 M1883	280,00	315,00	620,00	13,50	AP	3,36	2,00	7.5			1,59%	BP	10 400	Pelayo, Infanta Maria
	"	280,00	265,60	663,00	13,50	Common	3,40	2,00	7.5			5,27%	BP	10 590	Teresa, Emperador Carlos V
	"	280,00	263,11	666,00	13,50	SAP	3,31	3,00	7.5			4,56%	BP	10 600	
Krupp	26cm RKL/35 C/83	263,00	275,00	530,00	22,00	AP	3,50	2,00	8.0			1,16%	BP	11 400	Coast Defence
	"	263,00	275,00	530,00	22,00	Common	4,00	2,00	8.0			3,82%	BP	11 400	Coast Defence
	"	263,00	275,00	530,00	22,00	APC	3,50	3,00	8.0	C/01				12 200	Coast Defence
	"	263,00	275,00	530,00	22,00	SAP	4,00	3,00	8.0					12 200	Coast Defence
Armstrong	10" 300-pdr MLR	254,00	131,50	414,00	10,00	Bolt	1,59	2,00	3.51					4 142	Numancia, Vitoria, Sagunto, Zaragosa, Mendez Nunez
	"	254,00	133,80	410,00	10,00	Common	2,24	2,00	3.51					4 171	
Parrott	10" 300-pdr MLR (/14.4)	254,00	154,22	356,62	15,00	Solid	1,86	2,00	8.0					5 002	Coast Defence
	"	254,00	113,40	416,05	15,00	Hollow	1,71	2,00	8.0					5 453	
Armstrong	C.A. de 254mm Pattern '83 L/26	254,00	204,11	586,00	23,00	AP	2,88	2,00	8.0	Palliser		1,11%	BP	12 200	Coast Defence
	"	254,00	181,44	606,00	23,00	Common		2,00	8.0			1,75%	BP	12 040	
Hontoria	240mm/35 M1883	240,00	199,00	620,00	14,00	AP	3,37	2,00	7.0	Palliser				10 000	Reina Regente
	"	240,00	168,00	674,00	14,00	Common	3,41	2,00	7.0					10 290	

	"	240,00	198,00	647,10	14,00	AP	3,30	2,00	7.0		1,52%	BP	10 600	
	"	240,00	167,00	704,00	14,00	Common	3,31	2,00	7.0		5,39%	BP	10 890	
	"	240,00	167,00	704,00	14,00	SAP	3,31	2,00	7.0		4,49%	BP	10 890	
Guillen	240mm/42 M1896	240,00	150,00	800,00	25,00	AP	2,50	2,00					15 770	Princesa de Asturias
	"	240,00	150,00	800,00	25,00	APC		3,00					15 960	
Ordonez	C.H.S. de 24cm Mod. 1881	240,00	139,00	400,00	16,00	AP		2,00	8.0				6 000	Coast Defence
Ordonez	C.H.S. de 24cm Mod. 1884	240,00	139,00	445,00	19,00	AP		2,00	8.0				7 500	Coast Defence
Ordonez	C.H.S.E. de 24cm Mod. 1891 L/35	240,00	195,00	540,00	20,00	AP		2,00	8.0				11 000	Coast Defence
	"	240,00	195,00	540,00	20,00	Common		2,00	8.0				11 000	Coast Defence
Ordonez	howitzer Mod. 1891 de 24cm	240,00	140,00	349,00	68,00	AP		2,00	8.0				9 000	Coast Defence
Ordonez	howitzer Mod. 1916 de 24cm L/16	240,00	200,00	430,00	55,00	CP		2,00	8.0			T	11 320	Coast Defence
Armstrong	9"/14 12-Ton MLR (250-pdr)	228,60	113,40	408,13	10,00	AP	2,23	2,00	2.0		0,88%	BP	4 197	Vitoria, Zaragosa, Sagunto, Mendez Nunez (1874?)
	"	228,60	113,40	408,13	10,00	Common	2,60	2,00	2.0		7,40%	BP	4 197	
	22cm modelo Barrios	220,00	43,00			Ball	1,00	1,00						
Palliser	22cm MLR (conversion of 28cm Barrios)	220,00												
Ordonez	C.H.S.E. de 21cm Mod. 1891 L/35	210,00	130,00	520,00	25,00	AP		2,00	8.0				10 500	Coast Defence
	"	210,00	130,00	520,00	25,00	Common		2,00	8.0				10 500	Coast Defence
Ordonez	howitzer Mod. 1894 de 21cm	210,00				AP		2,00	8.0				10 000	Coast Defence
	howitzer H.R.S. Mod. 1872 de 21cm	210,00	80,20	256,00	42,00	Common		2,00	8.0		6,23%	BP	5 000	Coast Defence
	mortar Mod. 1864/65 de 21cm	210,00	80,20	256,00	42,00	Common		2,00	8.0		6,23%	BP	5 000	Coast Defence
Armstrong	8"/14.75 9-Ton MLR (180-pdr)	203,20	81,65	408,13	10,00	AP	2,29	2,00	3.05				4 103	Numancia, Vitoria, Arapiles, Mendez Nunez,
	"	203,20	81,65	408,13	10,00	Common	2,67	2,00	3.05		5,39%	BP	4 103	Aragon class
Parrott	200-pdr MLR (/19.8)	203,20	79,38	406,60	15,00	Solid	2,01	2,00	8.0				5 464	Coast Defence
	"	203,20	68,04	438,91	15,00	Hollow	1,87	2,00	8.0				5 621	Coast Defence
Parrott	150-pdr MLR (/17)	203,20	79,38	350,52	15,00	Solid	2,01	2,00	8.0				4 711	Coast Defence
	"	203,20	68,04	378,56	15,00	Hollow	1,87	2,00	8.0				4 922	Coast Defence
Armstrong	8"/26 BLR Pattern B	203,20	81,65	615,70	21,00	AP	2,62	2,00	8.0	Palliser			9 900	Coast Defence

	"	203,20	81,65	585,83	21,00	Common		2,00	8.0				9 490	
Vickers	8"/50 Mk. D	203,20	116,10	885,00	50,00	SAPBC	4,40	6,00					29 750	Canaris Numancia, Tetuan, Vitoria, Arapiles, Zaragosa, Sagunto, <emdez Nunez
	20cm No. 1 modello	200,00				Ball	1,00	1,00						
	20cm No. 2 modello Rivera	200,00				Ball	1,00	1,00						
Palliser	20cm MLR (conversion of 20cm No. 1)	200,00	69,50	395,00	12,00	AP	2,04	2,00	2.0	Palliser			4 406	
	"	200,00	67,50	327,00	12,00	Common	2,57	2,00	2.0	cast iron			3 566	
	"	200,00	71,40	380,00	12,00	AP	2,46	2,00	2.0	steel			4 258	
	"	200,00	69,80	384,00	12,00	Common	2,60	2,00	2.0	steel			4 283	
Hontoria	200mm/25 M 1879	200,00	83,00	585,00	10,00	AP	2,40	2,00	3.0	Palliser			6 300	
	"	200,00	74,00	611,00	10,00	Common	2,59	2,00	3.0				6 320	
Hontoria	200mm/35 M 1883	200,00	97,00	620,00	14,00	AP	3,35	2,00	2.5	Palliser			8 700	Numancia & Vitoria (1900?)
	"	200,00	96,00	623,00	14,00	Common	3,42	2,00					8 700	Alsonso XIII
	"	200,00	114,60	620,00	14,00	AP	3,31	2,00			1,66%	BP	9 400	
	"	200,00	98,00	670,00	14,00	Common	3,35	2,00			5,10%	BP	9 600	
	"	200,00	98,21	669,00	14,00	SAP	3,37	2,00			4,07%	BP	9 590	
Palliser	18cm MLR (conversion of 22cm Barrios)	180,00												Sagunto, Zaragosa
Hontoria	180mm/25 M.1879 No. 1	180,00	61,50	550,00	10,00	AP	2,44	2,00	3.0	Palliser			5 700	
	"	180,00	54,60	576,00	10,00	Common	2,62	2,00	3.0				5 730	
	180mm/16.4 M.1879 No. 2	180,00	61,50	478,00	10,00	AP	2,44	2,00	3.0	Palliser			4 890	
	"	180,00	54,60	490,00	10,00	Common	2,62	2,00	3.0				4 840	
Parrot	Modelo Parrot de 100	162,56	45,36	385,88	25,00	Solid	2,09	2,00	2.53				7 006	
	"	162,56	36,29	431,60	25,00	Hollow	2,09	2,00	2.53				7 087	
Cavali	16cm/15.5 MLR	164,00	29,80	312,00	12,00	Common	2,07	2,00	2.0		4,44%	BP	3 050	
	"	164,00	39,30	269,40	12,00	Bolt	1,76	2,00	2.0				2 620	
Palliser	16cm MLR (conversion of 20cm No. 2)	160,00												Numancia, Vitoria, Arapiles, Zaragosa
Hontoria	160mm/25 M 1879 No. 1	160,00	42,50	498,00	10,00	AP	2,40	2,00	3.0	Palliser			4 900	Arapiles (1879)
	"	160,00	38,00	519,00	10,00	Common	2,60	2,00	3.0				4 925	
	"	160,00	35,50	537,00	10,00	Common							4 910	

	"	160,00	40,00	506,00	10,00	Common							4 880	
Hontoria	160mm/17 M 1879 No. 2	160,00	42,50	455,00	12,50	AP	2,40	2,00	3.5	Palliser			5 200	
	"	160,00	38,00	481,00	12,50	Common	2,60	2,00	3.5				5 290	
	"	160,00	40,00	469,00	12,50	Common							5 255	
Hontoria	160mm/18 M 1879 No. 3	160,00	30,00	455,00	14,00	Common	2,70	2,00	3.0	Palliser			5 000	
Hontoria	160mm/35 M 1883	160,00	60,00	625,00	15,00	AP		2,00	4.0	Palliser			9 000	Alfonso XII, Alfonso XIII, Lepanto, Aragon
	"	160,00	51,00	614,00	15,00	Common		2,00					8 340	
	"	160,00	51,00	618,00	15,00	AP		2,00					8 395	
	" QFC	160,00	51,00	626,00	15,00	AP		2,00					8 500	
	" QFC	160,00	51,00	622,00	15,00	Common		2,00					8 450	
Vickers	6"/50 Mks. T, U	152,40	45,36	900,00	35,00	CPC		4,00	4.5				20 400	Cervera, Nunez, Navarra
Armstrong	15cm/26.1 Pattern '81	152,40	36,29	587,96	11,00	AP	2,37	2,00		Palliser	2,15%	BP	6 040	Velasco, Gravina
	"	152,40	36,29	561,44	11,00	Common	3,12	2,00		Wrought Iron	8,02%	BP	5 780	
Armstrong	15cm/32 Pattern '83	152,40	45,36	630,94	11,00	AP	2,87	2,00		Palliser	3,00%	BP	7 030	Navarra
	"	152,40	45,36	630,94	11,00	Common	3,34	2,00		Wrought Iron	7,41%	BP	7 030	
	"	152,40	45,36	630,94	11,00	Common	3,61	2,00		Cast Steel	9,81%	BP	7 030	
	"	152,40	45,36	630,94	11,00	CP	3,44	2,00		Cast Iron	4,75%	BP	7 030	
	"	152,40	45,36	630,94	11,00	AP	3,27	2,00		Steel	4,87%	BP	7 030	
	"	152,40	45,36	630,94	11,00	AP	2,88	2,00		Steel	1,25%	BP	7 030	
Palliser	150mm/ Mod. 1885	150,00	47,20	503,00	19,33	AP		2,00	8.0				8 321	Coast Defence
Ordonez	C.H.S. de 15cm Mod. 1878	150,00	26,30	475,00	13,00	Common		2,00	8.0		6,65%	BP	5 000	Coast Defence
	"	150,00	26,30	475,00	21,00	Common		2,00			6,65%	BP	6 640	
Ordonez	canon H.S.E. Mod. 1885 de 15cm	150,00	50,00	520,00	23,00	AP		2,00	8.0		0,60%	BP	10 160	Coast Defence
	"	150,00	42,00	550,00	23,00	Common		2,00	8.0		6,19%	BP	10 000	Coast Defence
Rueda	150mm/48.3	150,00	40,00	800,00	25,00	APC	2,73	3,00	8.0		1,25%		13 700	Numancia (1898), Reina Regente (ii)
	"	150,00	39,43	805,00	25,00	SAP	2,76	3,00			3,63%		13 660	
Trubia	C. Ac. De 15cm Tr. Mod. 1903 L/45	150,00	51,00	710,00	25,00	APC	3,78	3,00	8.0		1,47%		13 700	Coast Defence
	"	150,00	51,00	710,00	25,00	CPC	4,31	3,00	8.0		6,37%		13 700	Coast Defence

Krupp	15cm RKL/35 C/80	149,10	38,50	610,00	15,00	AP	2,72	2,00		Gruson Chilled	2,47%	BP	7 800	Castilla
	"	149,10	31,50	632,00	15,00	Common	2,66	2,00			6,03%	BP	7 390	
Skoda	15cm L/40 K/98	149,10	45,50	690,00	17,00	AP	3,18	2,00	3.5		1,89%	BP	10 100	Vitoria (1898)
	"	149,10	45,50	690,00	17,00	Common	3,84	2,00	3.5		8,80%	BP	10 100	
Hontoria	140mm/35 M 1883 [BL]	140,00	39,00	610,00	20,00	AP	3,28	2,00	5.5	Palliser			9 600	Infanta Maria Teresa, Carlos V,
	"	140,00	34,00	653,00	20,00	Common	3,49	2,00	5.5				9 570	Numancia (1898)
	" [QFC]	140,00	39,70	580,00	20,00	AP	3,28	2,00	5.5		1,29%	BP	9 790	Infanta Maria Teresa, Carlos V,
	"	140,00	36,64	603,00	20,00	Common	3,49	2,00	5.5		4,63%	BP	9 800	Numancia (1898)
	"	140,00	35,48	613,00	20,00	SAP	3,30	2,00	5.5		3,43%	BP	9 810	
Guillen	140mm/45 M.	140,00	39,70	736,00	18,00	AP	3,30	2,00	5.5		1,29%	BP	11 370	Rio de la Plata, Estra-madura (originally),
	"	140,00	36,64	766,00	18,00	Common	3,49	2,00	5.5		4,63%	BP	11 330	Pelayo (1898), Asturias
	"	140,00	35,48	778,00	18,00	SAP	3,43	2,00	5.5		3,43%	BP	11 300	
Parrott	Modelo Parrot de 60	134,60	27,22	343,82	25,00	Solid	2,21	2,00	2.53				6 112	
	"	134,60	20,64	402,49	25,00	Hollow	2,09	2,00	2.53				6 326	
Vickers	4.7"/45 Mk. F	120,00	22,00	853,44	80,00	CPC	3,70	3,00	4.4				18 170	Canaris, Nunez
Vickers	4.7"/45 Mk. E	120,00	22,00	850,00	35,00	CPC	3,70	3,00	4.0				17 349	Barcaiztegui
Hontoria	120mm/25 M 1879	120,00	16,40	472,00	11,00	Common	2,66	2,00	4.0				4 400	General Concha
Hontoria	120mm/35 M 1883	120,00	24,10	607,00	25,00	AP	3,22	2,00	2.5		1,41%	BP	9 940	Pelayo, Infanta Maria Teresa
	"	120,00	21,40	644,00	25,00	Common	3,49	2,00			4,44%	BP	9 830	Isla de Luzon, Reina Regente,
	" QFC	120,00	24,10	612,00	25,00	AP	3,22	2,00			1,41%	BP	10 000	Isla de Luzon
	" QFC	120,00	21,40	649,00	25,00	Common	3,39	2,00			4,44%	BP	9 880	
	" QFC	120,00	20,04	671,00	25,00	SAP	3,18	2,00			3,99%	BP	9 805	
Armstrong	12cm/33 Pattern '83	120,00	18,14	609,60	11,00	AP	1,84	2,00		Palliser			5 700	Navarra
	"	120,00	18,14	582,17	11,00	Common	2,69	2,00					5 470	
Krupp	12cm RKL/30 C/83	120,00	23,80	575,00	12,00	AP	2,65	2,00	4.57	Gruson Chilled	1,05%	BP	6 520	Castilla
	"	120,00	16,40	692,00	12,00	Common	2,54	2,00	4.57		6,71%	BP	6 340	
Krupp	10.5cm SKL/35 C/97	105,00	17,40	600,00	30,00	SAP		3,00	5.5		2,01%	BP	10 800	Carlos V, Rio de la Pla-ta, Estramadura
	"	105,00	17,40	600,00	30,00	Common	3,70	3,00	5.5		4,89%	BP	10 800	

	"	105,00	16,00	625,00	30,00	AP		3,00	5.5				10 100	
Vickers	4"/50 Mk. E	101,60	14,42	900,00	15,00	APC	3,20	3,00	4,00		3,47%	T	10 600	Espana, Estremadura (re-armed)
	"	101,60	13,97	900,00	15,00	Common	4,10	3,00	4,00		9,66%	BP	10 600	
	"	101,60	13,98	900,00	15,00	SAP	3,70	3,00	4,00		7,58%	T	10 600	
	"	101,60	14,10	884,00	15,00	SAP		4,00	4,00	Bofors M./17 - 21			11 800	
Trubia	C.A. de C. Garcia Lomas de 100mm/40	100,00	15,00	680,00	18,00	AP		3,00	8.0		2,00%	BP	8 900	Coast Defence
	"	100,00	15,00	680,00	18,00	Common					6,67%	BP	8 900	
Hontoria	90mm/25 M 1879	90,00	7,00	560,00	20,00	Common	2,69	2,00	4.0				6 300	Aragon
Armstrong	8.7cm/27 Pattern '83	87,00	6,40	495,30	20,00	Common	2,66	2,00	3.3		8,42%	BP	5 800	Destructor, Gravina, Velasco, Navarra
Krupp	8.7cm RKL/24 C/76	87,00	6,76	469,00	20,00	Common	2,81	2,00	3.3		2,96%	BP	5 825	Castilla
	"	87,00	7,00	465,00	20,00	Common	2,98	2,00	3.3				5 760	
Nordenfeld	75mm/42.7	75,00	6,64	641,00	20,00	SAP		3,00	4.0		3,42%		8 300	Recalde
	"	75,00	6,64	641,00	20,00	Common		3,00	4.0		3,77%		8 300	
Armstrong	7.5cm/28.7 Pattern '83	75,00	5,21	520,90	20,00	Common	3,39	2,00	4.0		4,35%	BP	6 200	Navarra
Krupp	7.5cm RKL/26 C/83	75,00	4,30	473,00	20,00	Common	2,82	2,00	4.0		4,65%	BP	5 500	Castilla, Aragon
Skoda	70mm/41.5	66,00	4,00	710,00		AP					3,05%			
		66,00	4,00	710,00		CP					5,75%			
Skoda	47mm/43.5	47,00	1,50	710,00		CP					4,00%			
Nordenfeld	57mm/42	57,00	2,68	570,00		AP					2,91%			
		57,00	2,70	570,00		CP					2,41%			
	42mm/41.7	42,00	1,13	603,00		AP					3,36%			
		42,00	1,15	600,00		CP					3,32%			
Sarmiento	42mm/43	42,00	1,13	590,00		AP					3,36%			
		42,00	1,15	590,00		CP					3,32%			
Hotchkiss	57mm/40	57,00	2,66	670,00		AP					4,32%			
		57,00	2,66	670,00		CP					3,20%			
Hotchkiss	37mm/19.3	37,00	0,50	404,00		AP					2,98%			
		37,00	0,47	405,00		CP					13,15%			
Hotchkiss	37mm/20	37,00	0,50	404,00		AP					2,98%			

		37,00	0,47	405,00		CP					13,15%			
Maxim	37mm/26.5	37,00	0,42	549,00		AP					3,08%			
		37,00	0,42	549,00		CP					3,08%			
Hontoria	70mm/15 M.1879 [QFC]	66,00	3,85			CP					13,98%			
	70mm/15 M.1879 [BL]	66,00	2,70	315,00		CP								
	DENMARK													
Krupp	35.5cm RKL/25 C/80	355,00	525,00	537,00	13,00	AP	2,71	2,00	4.0	Gruson	1,30%	BP	8 330	Tordenskjold
	"	355,00	525,00	537,00	13,00	AP	2,71	2,00	4.0		2,40%	BP	8 330	
	"	355,00	525,00	537,00	13,00	Common	3,29	2,00	4.0		4,95%	BP	8 330	
Krupp	30.5cm SKL/45 C/07	305,00	390,00	855,00	13,50	APC	3,20	3,00	5.5	M.1908	2,77%	T	15 855	Niels Iuel (plan)
	"	305,00	333,00	925,00	13,50	CP	3,44	3,00	5.5	M.1908	12,61%	T	15 855	
Krupp	30.5cm RKL/22 C/78	305,00	329,00	475,00	13,00	AP	2,68	2,00	4.5	Gruson Chilled	1,37%	BP	6 920	Helgoland
	"	305,00	282,00	510,00	13,00	Common	2,70	2,00	4.5		5,25%	BP	7 200	
	"	305,00	329,00	510,00	13,00	AP	2,68	2,00	4.5	C/81 Steel	2,55%	BP	7 400	
	"	305,00	329,00	510,00	13,00	Common	3,25	2,00	4.5		5,47%	BP	7 400	
Krupp	26cm MRKL/35 C/86	263,00	205,00	610,00	25,00	AP	2,61	2,00	5.0		1,95%	BP	12 500	Iver Hvitfeldt
	"	263,00	205,00	610,00	25,00	Common	3,16	2,00	5.0		5,61%	BP	12 500	
	"	263,00	205,00	615,00	25,00	AP	2,61	2,00	5.0		1,95%	BP	12 600	Iver Hvitfeldt
	"	263,00	205,00	615,00	25,00	Common	3,15	2,00	5.0		5,61%	BP	12 600	
Krupp	26cm RKL/22 C/76	263,00	205,00	475,00	12,00	AP	2,61	2,00	4.7	Gruson Chilled	1,32%	BP	6 100	Helgoland
	"	263,00	177,50	510,00	12,00	Common	3,16	2,00	4.7		5,35%	BP	6 350	
	"	263,00	205,00	500,00	12,00	AP	2,60	2,00	4.7	Steel	2,54%	BP	6 550	
	"	263,00	205,00	500,00	12,00	Common	3,10	2,00	4.7		5,12%	BP	6 550	
Armstrong	10"/14 18-Ton MLR M.1870	254,00	181,44	417,00	7,00	AP	2,56	2,00	3.35	Palliser	1,10%	BP	3 400	Gorm
	"	254,00	181,44	417,00	7,00	Common	3,03	2,00	3.35		6,61%	BP	3 400	
Armstrong	10"/14.5 18.5-Ton MLR M.1874	254,00	181,44	417,00	7,00	AP	2,56	2,00	3.35	Palliser	1,10%	BP	3 400	Odin
	"	254,00	181,44	417,00	7,00	Common	3,03	2,00	3.35		6,61%	BP	3 400	

Armstrong	10"/17.5 20-Ton MLR M.1875	254,00	181,44	444,00	7,00	AP	2,56	2,00	3.35	Palliser	1,10%	BP	3 710	Falster, Oresund, Moen
	"	254,00	181,44	444,00	7,00	Common	3,03	2,00	3.35		6,61%	BP	3 710	
Canet	240mm/43 M1896	240,00	170,00	720,00	13,00	APC	3,00	2,00	3.1		1,41%		10 200	Herluf Trolle
	"	240,00	170,00	720,00	13,00	CPC	3,40	2,00	3.1		6,65%		10 200	
	"	240,00	170,00	720,00	13,00	SAP	3,40	2,00	3.1				10 200	
Bofors	24cm.K./43 M/01	240,00	160,00	755,00	12,00	AP	2,68	2,00	3.1		1,50%	PA	10 227	Olfert Fischer
	"	240,00	160,00	755,00	12,00	CP	3,24	2,00	3.1		6,06%	PA	10 227	
	"	240,00	160,00	755,00	16,00	APC	3,24	4,00	3.1				14 075	
	"	240,00	160,00	755,00	16,00	CPC	3,33	4,00	3.1				14 075	
Bofors	24cm.K./43 M/06	240,00	160,00	805,00	10,00	AP	2,68	2,00	3.1		1,50%	PA	10 000	Peder Skram
	"	240,00	160,00	805,00	10,00	CP	3,24	2,00	3.1		6,06%	PA	10 000	
	"	240,00	160,00	805,00	16,00	APC	2,82	4,00	3.1				15 200	
	"	240,00	160,00	805,00	16,00	CPC	3,24	4,00	3.1				15 200	
Krupp	24cm SKL/40 C/93	238,00	160,00	720,00	13,00	AP	2,74	2,00	3.1		1,50%	PA	10 340	Skjold
	"	238,00	160,00	720,00	13,00	CP	3,32	2,00	3.1		7,06%	PA	10 340	
Armstrong	9"/13.9 12.5-Ton MLR M.1868	228,60	113,40	372,00	7,00	AP	2,23	2,00	2.0	Palliser	0,40%	BP	2 730	Lindormen
	"	228,60	113,40	372,00	7,00	Common	2,60	2,00	2.0		7,41%	BP	2 730	
	"	228,60	113,40	408,00	7,00	AP	2,23	2,00	2.0	Palliser	0,40%	BP	3 050	
	"	228,60	113,40	408,00	7,00	Common	2,60	2,00	2.0		7,41%	BP	3 050	
Krupp	21cm RKL/35 C/86	209,30	108,00	615,00	25,00	AP	2,72	2,00	6.5				11 600	Valkrien
	"	209,30	108,00	615,00	25,00	CP	3,20	2,00	6.5		5,37%	BP	11 600	
Akers	60-pdr 89 cwt SB M./1861	203,80	29,40	452,00	7,00	Shot	1,00	1,00	2.13				2 162	Dannebrog
	"	203,80	20,60	531,00	7,00	Shell	1,00	1,00	2.13		2,67%	BP	2 083	
Armstrong	8"/13.1 8.65-Ton MLR	203,20	75,00	375,00	7,00	AP	2,10	2,00	2.13	Palliser			2 670	Peder Skram, Danmark
	"	203,20	59,50	405,00	7,00	Common	1,95	2,00	2.13		5,71%	BP	2 770	Rolf Krake (re-armed)
Armstrong	68-pdr 95cwt SB	200,00	31,50	481,00	10,00	Ball	1,00	1,00	2.13				2 644	Rolf Krake
	30-pdr 60 cwt SB	162,40	14,40	479,00	7,00	Shot	1,00	1,00	2.13				2 002	Jylland, Tordenskjold
	"	162,40	10,30	556,00	7,00	Shell	1,00	1,00	2.13		2,91%	BP	1 851	
Bronze	24-pdr MLR (15.35cm/20)	153,50	24,80	297,00	7,00	Shell		1,00	1,00		5,40%	BP	1 845	

Finspong	15cm.K./18.9 MLR M.1868	153,50	25,00	328,00	7,00	Common		2,00			7,60%	BP	2 155	
Bofors	15cm.K./45 M/22	149,10	46,70	825,00	30,00	SAPBC	4,40	8,50	4.2				19 635	Niels Iuel (1922)
	"	149,10	45,80	835,00	30,00	APC		4,00					17 800	
Bofors	15cm.K./50 M/06	149,10	51,00	820,00	30,00	APC	3,78	3,00	2.0		1,52%	T	16 377	Peder Skram
	"	149,10	51,00	820,00	30,00	SAP	4,10	3,00	2.0	C/06	6,39%	T	16 377	
	"	149,10	51,00	830,00	30,00	APC	3,78	3,00	2.0		1,52%	T	16 542	
	"	149,10	51,00	830,00	30,00	SAP	4,10	3,00	2.0	C/06	6,39%	T	16 542	
Bofors	15cm.K./43 M/01	149,10	51,00	700,00	30,00	APC	3,78	3,00	2.0		1,52%	T	14 401	Olfert Fischer
	"	149,10	51,00	700,00	30,00	SAP	4,10	3,00	2.0	C/06	6,39%	T	14 401	
Bofors	15cm.K./43 M/96	149,10	51,00	700,00	30,00	APC	3,78	3,00	2.0		1,52%	T	14 401	Herluf Trolle
	"	149,10	51,00	700,00	30,00	SAP	4,10	3,00	2.0	C/06	6,39%	T	14 401	
Krupp	15cm SKL/35 C/88	149,10	51,00	575,00	20,00	AP	3,35	2,00	4.0		1,33%	BP	9 460	Hekla
	"	149,10	51,00	575,00	20,00	Common	4,00	2,00			3,82%	BP	9 460	
Krupp	15cm RKL/35 C/80	149,10	51,00	560,00	20,00	AP	3,35	2,00	5.5		1,33%	BP	9 250	Fyen
	"	149,10	51,00	560,00	20,00	Common	4,00	2,00			3,82%	BP	9 250	
Krupp	15cm RKL/25 C/78	149,10	39,00	476,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 580	Fyen
	"	149,10	31,50	513,00	13,00	Common	2,66	2,00	2.6		6,03%	BP	5 565	
Krupp	15cm RKL/22 C/80	149,10	39,00	470,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 515	
	"	149,10	31,50	515,00	13,00	Common	2,66	2,00	2.6		6,03%	BP	5 585	
Finspong	18-pdr MLR (14cm/20.2) M.1863	138,50	17,50	328,00	7,00	Common	2,34	2,00	2.0		5,71%	BP	2 050	
Palliser-type	18-pdr MLR (13.85cm/17.2)	138,50	17,50	328,00	7,00	Common		1,00	1,00		2,86%	BP	2 050	
Bronze	12-pdr MLR (12.75cm/20)	127,50	13,50	314,00	7,00	Common		1,00	1,00		2,96%	BP	1 900	
Finspong	12-pdr MLR (12.75cm/22.8) M.1862	127,50	13,50	314,00	7,00	Common		1,00	1,00		2,96%	BP	1 930	
Bofors	12cm.K./40 M/32	120,00	20,00	770,00	20,00	SAPBC	3,85	8,50	3.0				12 500	Ingolf
Krupp	12cm RKL/30 C/84	120,00	26,00	525,00	25,00	AP		2,00	3.5	Steel	2,88%	BP	8 930	Iver Hvitfeldt
	"	120,00	26,00	525,00	25,00	Common		2,00	3.5		6,54%	BP	8 930	
Krupp	12cm RKL/25 C/79	120,00	20,00	455,00	13,00	AP		2,00	4.0	Gruson Chilled	1,25%	BP	5 000	Helgoland, Tordenskjold
	"	120,00	20,00	455,00	13,00	AP		2,00	4.0	Steel	3,00%	BP	5 000	

	"	120,00	16,40	495,00	13,00	Common		2,00	4.0		6,71%	BP	5 010	
Krupp	12cm SKL/40 C/92	120,00	20,00	720,00	18,00	SAP		2,00	4.0		3,85%	PA	8 600	Skjold, Gejser, Heimdal
	"	120,00	20,00	720,00	18,00	Common		2,00	4.0		6,35%	PA	8 600	
Krupp	8.7cm RKL/24.1 C/80	87,00	6,85	444,00	7,00	Common		2,00	3.5		2,92%	BP	2 720	
Krupp	8.7cm SKL/40 C/	87,00	9,10	720,00	30,00	SAP	3,78	3,00	4.0	M.1907	3,52%	T	10 710	Gejser, Heimdal
	"	87,00	9,10	720,00	30,00	CP	3,87	3,00			6,59%	PA	10 710	
Finspong	4-pdr MLR (8.35cm/17.48) M.1864	83,50	4,70	370,00	7,00	Common	2,00	2,00	3,0		4,26%	BP	2 220	
Finspong	4-pdr MLR (8.35cm/15.21) M.1872	83,50	4,70	344,00	7,00	Common	2,00	2,00	3,0		4,26%	BP	2 080	
Krupp	7.5cm SKL/55 C/08	75,00	6,80	800,00	30,00	SAP	4,41	3,00		M.1907	4,41%	T	11 340	
	"	75,00	6,80	800,00	30,00	CP	4,51	3,00			4,41%	PA	11 340	
	NETHERLANDS													
Krupp	30.5cm RK L/25 C/80	305,00	329,00	475,00	13,50	AP	2,68	2,00	4,0	C/81 Steel	2,55%	BP	7 000	Coast Defence
	"	305,00	329,00	475,00	13,50	Common	3,25	2,00	4,0		5,47%	BP	7 000	
Krupp	28cm RKL/22 C/74	283,00	255,00	475,00	13,00	AP	2,60	2,00	3.0	Gruson Chilled	1,18%	BP	6 600	re-armed Buffel, Schor-pioen, Bloedhond, Ad-der,
	"	283,00	253,00	475,00	13,00	AP	2,68	2,00	3.0	C/81 Steel	2,57%	BP	6 640	
	"	283,00	216,80	510,00	13,00	Common	2,50	2,00	3.0		5,54%	BP	6 800	& Heiligerlee. Draak, Matador
Krupp	28cm RKL/30 C/84	283,00	345,00	485,00	16,00	AP	3,50	3,00	5.5		2,32%	BP	8 775	Koningin Wilhelmina
	"	283,00	216,00	615,00	16,00	Common	2,55	3,00	5.5		5,56%	BP	9 880	
Krupp	28cm SKL/42.5 C/09 No. 1	283,00	270,00	890,00	15,00	APC	2,90	3,00	5.3	M.1907			16 100	De Zeven Provincien
	"	283,00	270,00	890,00	15,00	SAP	3,10	3,00	5.3		6,79%	T	16 100	
	"	283,00	270,00	890,00	24,00	APC	2,90	3,00	5.3	M.1907			20 100	Coast Defence
	"	283,00	270,00	890,00	24,00	SAP	3,10	3,00	5.3		6,79%	T	20 100	
Armstrong	11"/12.1 24.5-Ton MLR	279,40	242,00	406,00	14,00	AP	2,61	2,00	4.57	Palliser	0,83%	BP	5 703	Koning der Nederlanden
	"	279,40	243,00	405,00	14,00	Common	3,05	2,00	4.57		5,35%	BP	5 692	
Finspong	24cm.K/19 M/69	240,00	144,00	380,00	7,25	AP	2,43	2,00	2,00				3 000	Coast Defence

	"	240,00	120,00	390,00	7,25	Common		2,00					3 040	
Krupp	24cm RK L/25 C/78	238,00	139,00	470,00	12,50	AP		2,00					6 000	Coast Defence
	"	238,00	139,00	470,00	12,50	Common		2,00					6 000	
Krupp	24cm RK L/30 C/80	238,00	215,00	505,00	14,50	AP	3,50	2,00		C/80	1,74%	BP	8 140	Coast Defence
	"	238,00	195,00	530,00	14,50	Common		2,00					5 380	
Krupp	24cm MRK L/35 C/88	238,00	215,00	550,00	17,50	AP	3,50	2,00		C/80	1,74%	BP	10 180	Coast Defence
	"	238,00	215,00	550,00	17,50	Common		2,00		C/80	3,26%		10 180	
Krupp	24cm SK L/40 C/97	238,00	170,00	780,00	20,00	AP		2,00	4.5		1,41%	PA	13 900	Coast Defence
	"	238,00	170,00	780,00	20,00	CP		2,00	4.5		6,65%	PA	13 900	
Krupp	24cm SKL/40 C/99 No. 1	238,00	170,00	820,00	20,00	AP		2,00	4.5		1,41%	PA	14 600	Koningin Regentes
	"	238,00	170,00	820,00	20,00	CP		2,00	4.5		6,65%	PA	14 600	
Krupp	24cm SKL/40 C/01 No. 2	238,00	170,00	850,00	20,00	AP		2,00	4.5		1,41%	PA	15 130	Heemskerck, Tromp
	"	238,00	170,00	850,00	20,00	CP		1,00	4.5		6,65%	PA	15 130	
Armstrong	9"/14 12.5-Ton MLR	228,60	113,00	450,00	10,00	AP	2,23	2,00	2.0	Palliser	0,88%	BP	4 604	De Ruyter, Prins Hem-drik, Buffel, Schorpioen, Heiligerlee, Bloedhond, Adder
	"	228,60	119,00	438,50	10,00	Common	2,73	2,00	2.0		6,72%	BP	4 530	
Krupp	21cm MRKL/35 C/86 No. 1	209,30	140,00	530,00	13,00	AP	3,60	2,00	6.5		1,50%	BP	7 600	Reinier Claeszen
	"	209,30	140,00	530,00	13,00	Common		2,00	6.5		4,00%	BP	7 600	
	"	209,30	140,00	550,00	13,00	AP	3,60	2,00	6.5		1,50%	BP	7 940	
	"	209,30	140,00	550,00	13,00	Common		2,00	6.5		4,00%	BP	7 940	
	"	209,30	140,00	530,00	25,00	AP	3,60	2,00	6.5		1,50%	BP	11 250	Sumatra, Coast Defence
	"	209,30	140,00	530,00	25,00	Common		2,00	6.5		4,00%	BP	11 250	
	"	209,30	140,00	550,00	25,00	AP	3,60	2,00	6.5		1,50%	BP	11 670	
	"	209,30	140,00	550,00	25,00	Common		2,00	6.5		4,00%	BP	11 670	
Krupp	21cm MRKL/35 C/92 No. 2	209,30	140,00	580,00	25,00	AP	3,60	2,00	6.5		1,50%	BP	12 300	Evertsen
	"	209,30	140,00	580,00	25,00	Common		2,00	6.5		4,00%	BP	12 300	
	"	209,30	140,00	580,00	14,00	AP	3,60	2,00	6.5		1,50%	BP	8 860	Koningin Wilhelmina
	"	209,30	140,00	580,00	14,00	Common		2,00	6.5		4,00%	BP	8 860	
Armstrong	7"/15.9 7.17-Ton MLR	177,80	52,00	475,00	12,00	AP	2,17	2,00	2.0	Palliser	1,92%	BP	5 096	Pontianak
	"	177,80	53,00	477,00	12,00	Common	2,59	2,00	2.0		7,55%	BP	5 138	

Krupp	17cm RKL/25 C/72	172,60	60,00	475,00	11,00	AP	2,70	2,00	3.7	Gruson Chilled	1,67%	BP	5 200	Atjeh
	"	172,60	51,00	515,00	11,00	Common	2,79	2,00	3.7		5,88%	BP	5 305	
Krupp	17cm RKL/35 C/84	172,60	78,00	585,00	25,00	AP	3,50	2,00	5.5				11 700	Reinier Claessen, Koningin Wilhelmina
	"	172,60	51,20	720,00	25,00	CP	2,79	2,00	5.5		5,86%	BP	10 904	
	Canon-Obusier 30 (SB)	164,70	15,30	538,70	12,00	Ball	1,00	1,00	2.5					Amstel
Armstrong	70-pdr MLR	162,60	32,52	453,10	15,00	Bolt	1,50	2,00	2.66				5 036	Watergeus, Marnix, Banda
	"	162,60	31,80	453,10	15,00	Common	2,30	2,00	2,66				5 111	
Krupp	15cm RKL/25 C/75 No. 1	149,10	39,00	475,00	14,50	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 980	Alkmaar, Sommelsdijk, Java, Aruba,
	"	149,10	31,50	528,00	14,50	Common	2,66	2,00	2.6		6,03%	BP	6 090	Batavia, Suriname, Coast Defence
Krupp	15cm RKL/35 C/85 No. 2	149,10	51,00	610,00	25,00	AP	3,35	2,00	4.3		1,57%	BP	11 360	
	"	149,10	51,00	610,00	25,00	Common	4,00	2,00	4.3		4,51%	BP	11 360	
Krupp	15cm SKL/35 C/88 No. 1	149,10	45,50	650,00	30,00	AP	3,18	2,00	5.7		1,89%	PA	12 200	Evertsen, Coast Defence
	"	149,10	45,50	650,00	30,00	Common	3,84	2,00	5.7		8,80%	PA	12 200	
	"	149,10	41,00	680,00	30,00	CP	3,01	3,00	5.7	C/01	7,56%	T	12 500	
	"	149,10	41,00	680,00	30,00	HE	3,39	3,00	5.7		9,76%	T	12 500	
Krupp	15cm SKL/40 C/92 No. 2	149,10	45,50	680,00	30,00	AP	3,18	2,00	5.6		1,89%	PA	12 650	Holland, Coast Defence
	"	149,10	45,50	680,00	30,00	Common	3,84	2,00	5.6		8,80%	PA	12 650	
	"	149,10	41,00	725,00	30,00	CP	3,01	3,00	5.6	C/01	7,56%	T	13 100	
	"	149,10	41,00	725,00	30,00	HE	3,39	3,00	5.6		9,76%	T	13 100	
Krupp	15cm SKL/40 C/99 No. 3	149,10	41,00	725,00	30,00	CP	3,01	3,00	5.6	C/01	7,56%	T	13 100	Gelderland, Coast Defence
	"	149,10	41,00	725,00	30,00	HE	3,39	3,00	5.6		9,76%	T	13 100	
Krupp	15cm SKL/40 C/00 No. 4	149,10	41,00	745,00	30,00	CP	2,96	3,00	5.3	C/01	7,56%	T	13 350	Koningin Regentes
	"	149,10	41,00	745,00	30,00	HE	3,31	3,00	5.3		9,76%	T	13 350	
	"	149,10	45,50	750,00	30,00	AP	2,96	3,00	4,0		1,89%	PA	13 660	Coast Defence
	"	149,10	45,50	750,00	30,00	CP	3,39	3,00	4,0		9,29%	PA	13 660	
Krupp	15cm SKL/40 C/05 No. 5	149,10	41,00	850,00	30,00	CP	2,96	3,00	5.3	C/01	7,56%	T	14 700	Tromp, Heemskerck, De Zeven Provincien,
	"	149,10	41,00	850,00	30,00	HE	3,31	3,00	5.3		9,76%	T	14 700	Coast Defence
Bofors	15cm K./50 M/24 No.	149,10	46,70	900,00	29,00	SAPBC	4,40	8,50	5.0				21 200	Java, Sumatra

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Bofors	15cm K./50 M/25 No. 7 & No. 8	149,10	46,70	900,00	30,00	SAPBC	4,40	8,50	3.0				21 490	Flores, Soemba, J M Van Nassau
Wilton-Fijencoord	15cm K./50 M/25 No. 9 & No. 10	149,10	46,70	900,00	60,00	SAPBC	4,40	8,50	5.7				24 170	De Ruyter
Wilton-Fijencoord	15cm K./50 M/25 No. 11	149,10	46,70	900,00	60,00	SAPBC	4,40	8,50	4.7				24 170	Tromp
Krupp	12cm RKL/17.5 C/70 No. 1	120,00	18,60	296,00	15,00	AP	2,49	2,00	3.0		1,08%	BP	3 544	Banda, Pontianak, Aru-ba, Batavia, Suriname,
	"	120,00	13,40	290,00	15,00	Common	2,17	2,00	3.0		6,72%	BP	3 233	Ceram, Lombok, Atjeh,
Krupp	12cm RKL/35 C/80 No. 2	120,00	26,00	535,00	25,00	AP	3,50	2,00	3.5	Steel	2,88%	BP	9 050	Koning der Nederlanden
	"	120,00	26,00	535,00	25,00	Common	4,20	2,00	3.5		6,54%	BP	9 050	
	"	120,00	26,00	580,00	25,00	AP	3,50	2,00	3.5	Steel	2,88%	BP	9 625	Sumatra
	"	120,00	26,00	580,00	25,00	Common	4,20	2,00	3.5		6,54%	BP	9 625	
Krupp	12cm SKL/40 C/ No. 1	120,00	23,80	680,00	30,00	AP	2,85	2,00			2,10%	PA	11 400	Holland
	"	120,00	23,80	680,00	30,00	SAP	3,10	2,00			5,46%	PA	11 400	
Krupp	12cm SKL/40 C/ No. 2	120,00	23,80	680,00	30,00	AP	2,85	2,00			2,10%	PA	11 400	Gelderland
	"	120,00	23,80	680,00	30,00	SAP	3,10	2,00			5,46%	PA	11 400	
Bofors	12cm.K./50 M/11 No. 3	120,00	23,80	805,00	30,00	AP	2,85	2,00			2,10%	PA	12 870	Noorbrabant (1914 re-armament)
	"	120,00	23,80	805,00	30,00	SAP	3,10	2,00			5,46%	PA	12 870	
Bofors	12cm. K./50 M/24 No. 4	120,00	24,00	900,00	30,00	SAPC		10,00	4.4				19 500	Evertsen
Wilton-Fijencoord	12cm/50 Nos. 5, 6, 7	120,00	24,00	900,00	30,00	SAPC		10,00	4.4				19 500	Van Galen, Van der Zaan
	"	120,00	24,00	900,00	45,00	SAPC		10,00	4,4				21 650	Van Kinsbergen
Wilton-Fijencoord	12cm/45 No. 8 (M/36)	120,00	24,00	835,00	85,00	SAPC		10,00	5.0				20 000	BC designs
Uchatius	12cm/17.5 BLR (Bronze)	120,00	13,40	290,00	12,00	Common	2,00	2,00	4.57		5,97%	BP		Prins Hendrik, Buffel
	12cm/35 BLR (Bronze)	120,00	26,00	550,00	12,00	AP	3,50	2,00			0,96%	BP	6 112	
	"	120,00	26,00	550,00	12,00	Common	4,20	2,00			3,85%	BP	6 112	
Krupp	10.5cm SKL/50 C/10	105,00	18,20	883,00	20,00	APC	3,80	4,00	3.7	M.1906			13 410	Brinio
	"	105,00	18,20	883,00	20,00	SAP	4,10	4,00					13 410	
Krupp	10.5cm SKL/35 C/86	105,00	18,00	580,00	25,00	CP	4,36	2,00	4.4				9 230	Borneo, Koetei, Nias
Uchatius	7.5cm/17.5 BLR (Bronze)	75,00	4,30	292,00	12,00	Common	2,40	2,00			4,65%	BP		
Krupp	7.5cm SKL/40 C/91	75,00	5,85	680,00	30,00	CP	3,90	2,00	4.8				8 760	Evertsen, Koningin Regentes, Tromp,

	"	75,00	6,35	640,00	30,00	SAP	4,00	4,00	4.8				10 120	Heemskerck, Holland, Koningin Wilhelmina
Krupp	7.5cm SKL/55 C/10	75,00	5,85	900,00	30,00	APC	3,30	4,00	3.5	M.1911			12 380	Fret, Sumatra, De Zeven Provincien
	"	75,00	5,85	900,00	30,00	SAP	3,70	4,00	3.5	M.1911			12 380	
Krupp	7.5cm SKL/30 C/12	75,00	5,85	605,00	30,00	SAP	3,70	4,00	3.4	M.1911			9 300	'G' & 'Z' class TB
	NORWAY													
Armstrong	10.6"/12.5 18.2-Ton MLR No. 1	267,00	174,50	395,00	7,50	AP	2,16	2,00	2.5	Palliser			3 249	Skorpionen, Thor
	"	267,00	143,50	373,00	7,50	Common	2,07	2,00	2.5				2 923	
Armstrong	10.6"/13.8 19.7-Ton MLR No. 2	267,00	178,50	440,00	10,00	AP	2,20	2,00	4.5	Palliser			4 656	Uller, Brage
	"	267,00	143,50	468,00	10,00	Common	2,07	2,00	4.5				4 718	
Armstrong	10.6"/16.7 21.7-Ton MLR No. 3	267,00	203,50	472,00	12,00	AP	2,51	2,00	4.5	Palliser			5 957	Vidar
	"	267,00	143,50	470,00	12,00	Common	2,07	2,00	4.5				5 375	
Krupp	26cm RKL/22 C/76 No. 1	263,00	205,00	480,00	16,50	AP	2,61	2,00	4.5	Gruson Chilled			7 500	Sleipner
	"	263,00	177,50	485,00	16,50	Common	2,66	2,00	4.5				7 250	
Krupp	26cm RKL/30 C/84 No. 2	263,00	275,00	525,00	12,00	AP	3,50	2,00	4.5	Gruson Chilled	1,16%	BP	8 380	Gor
	"	263,00	275,00	525,00	12,00	Common	3,95	2,00	4.5		3,82%	BP	8 380	
EOC	9.45"/50 Pattern E	240,00	189,94	883,92	15,00	APC	3,25	4,00	4.88				17 300	Nidaros
Krupp	21cm MRKL/35 C/86	209,30	140,00	550,00	25,00	AP	3,60	2,00	5.5		1,50%	BP	11 550	Aegir
	"	209,30	140,00	550,00	25,00	CP		2,00	5.5		4,00%	BP	11 550	
Armstrong	8.2"/43.8 Pattern B & C	209,00	142,00	700,00	15,00	APC		2,00	5.18				11 370	Harald Haarfagre, Norge
Palliser	20cm/13.1 8.66-Ton MLR	200,00	75,00	420,00	12,00	AP	2,20	2,00	2.0				4 700	
	"	200,00	60,00	375,00	12,00	Common	2,28	2,00	2.0		5,00%	BP	3 990	
Palliser	6.6"/17 4.9-Ton MLR	167,00	49,80	405,00	12,00	AP	2,50	2,00	2.0				4 500	
	"	167,00	37,50	436,00	12,00	Common	2,20	2,00	2.0				4 460	
Palliser	6.1"/16.8 3.4-Ton MLR	155,00	26,80	340,00	12,00	Common	1,95	2,00	2.0				3 400	
Finspong	24-pdr MLR (15.5cm/22)	155,00	25,00	360,00	12,00	Common		2,00					3 600	
Krupp	15cm RKL/25 C/75	149,10	39,00	480,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 625	Sleipner

	"	149,10	31,50	534,00	13,00	Common	2,68	2,00	2.6			6,03%	BP	5 760	
Krupp	15cm SKL/40 C/92	149,10	51,00	625,00	15,00	AP	3,60	2,00	4.0			1,18%	PA	8 686	Viking
	"	149,10	51,00	625,00	15,00	CP	4,30	2,00	4.0			5,49%	PA	8 686	
	"	149,10	51,00	625,00	15,00	SAP	4,10	3,00	4.0	M.1907		6,39%	T	9 126	
Armstrong	5.9"/45.8 Pattern FF	149,10	45,00	800,00	15,00	CP	3,38	2,00	6.75					10 806	Norge
	"	149,10	45,00	800,00	15,00	SAP	3,62	3,00	6.75					11 036	
EOC	5.9"/50 Pattern I	149,10	45,00	883,92	15,00	CPC	3,65	3,00	6.75					12 094	Nidaros
	"	149,10	45,00	883,92	15,00	SAP	3,62	3,00	6.75					12 094	
Krupp	12cm RKL/25 C/ No. 1	120,00	20,00	455,00	13,00	AP	2,68	2,00	4,0			1,25%	BP	5 000	
	"	120,00	16,40	495,00	13,00	Common	2,66	2,00	4,0			6,71%	BP	5 010	
Krupp	12cm RKL/35 C/ No. 2	120,00	26,00	550,00	25,00	AP	3,50	2,00	4,0	Steel		2,88%	PA	9 250	
	"	120,00	26,00	550,00	25,00	Common	4,20	2,00	4,0			6,54%	PA	9 250	
Bofors	120mm/44.1	120,00	21,00	800,00	45,00	SAPC		8,50	4.0					19 300	Olav Tryggvason
Bofors	101.6mm/40	101,60	14,10	775,00	30,00	SAP	3,70	3,00	3.7					13 440	Sleipner, Odin, Froya
Armstrong	12-pdr QF Pattern N (3"/40)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59			9,15%	BP	7 245	
Armstrong	12-pdr QF Pattern (3"/50)	76,20	5,67	865,63	30,00	CP	3,72	2,00	2.59			9,15%	BP	9 784	
	OTTOMAN EMPIRE / TURKEY														
Krupp	35.5cm MRKL/35 C/89	355,00	635,00	610,00	25,00	APC	3,41	4,00	8.0	M.1911?				17 400	Coast Defence
Vickers	13.5"/45 Mk. A	342,90	635,04	731,52	20,00	APC	3,88	4,00	6.7				L	20 810	Resadiye
	"	342,90	635,04	731,52	20,00	CPC	4,86	4,00	6.7				L	20 810	
Armstrong	12"/12 25-Ton MLR	304,80	272,16	396,08	10,00	AP	2,26	2,00	5.18	Palliser				4 290	Peiki Shereef
	"	304,80	225,44	435,26	10,00	Common	2,18	2,00	5.18			7,44%	BP	4 639	
EOC	12"/45 Pattern W	304,80	385,56	822,96	13,50	APC	3,30	4,00	7.54				L	17 260	Sultan Osman I
	"	304,80	385,56	822,96	13,50	CPC	3,90	4,00	7.54				L	17 260	
Krupp	28cm MRKL/35 C/85	283,00	231,50	680,00	25,00	AP	2,50	2,00	5.0			1,51%	PA	14 185	Abdul Kadir
	"	283,00	240,00	680,00	25,00	Common	2,96	2,00	5.0					14 185	
	"	283,00	240,00	680,00	25,00	APC	2,60	3,00	5.0	M.1901	7,75%	3,60%	PA	14 940	

	"	283,00	240,00	680,00	25,00	SAP	2,90	3,00	5.0					14 940	
Krupp	28cm MRKL/40 C/90	283,00	240,00	745,00	25,00	APC	2,60	3,00	5.0	M.1901	7,75%	3,60%	PA	15 678	Torgud Reis
	"	283,00	240,00	745,00	25,00	SAP	2,90	3,00	5.0					15 678	
Krupp	28cm SKL/50 C/09	283,00	302,00	870,00	22,50	APC	3,20	4,00	6.5					23 260	Yavuz
	"	283,00	302,00	870,00	22,50	SAP	3,50	4,00	6.5					23 260	
Armstrong	10"/15 18-Ton MLR	254,00	181,44	415,58	10,00	AP	2,60	2,00	3.35	Palliser				4 513	Messudieh
	"	254,00	180,53	416,66	10,00	Common	3,02	2,00	3.35			5,03%	BP	4 523	
Krupp	24cm MRK L/35 C/86	235,40	132,50	530,00	20,00	AP		2,00	5.0			2,26%	PA	9 000	Coast Defence, Osmanieh
	"	235,40	119,50	490,00	20,00	CP		2,00	5.0			5,69%	PA	8 090	
	"	235,40	160,00	630,00	20,00	APC	2,90	4,00	5.0			1,50%	PA	11 700	
Vickers	9.2"/46.7 Mk. T	233,68	173,27	785,00	15,00	AP	3,00	2,00						13 380	re-armed Messudieh
	"	233,68	172,37	785,00	15,00	CP	3,80	2,00						13 380	
Armstrong	9/13.9 12.5-Ton MLR	228,60	116,12	438,91	10,00	AP	2,28	2,00	2.0	Palliser				4 569	Osmanieh, Assari Tew-fik, Assari Sjevket,
	"	228,60	113,40	432,64	10,00	Common	2,60	2,00	2.0			7,60%	BP	4 468	Avni Illah, Fetjo Bulend, Idjalieh, Hamidieh
Krupp	21cm RKL/35 C/86	209,30	108,00	615,00	25,00	AP	2,70	2,00	6.5					11 900	Assari Tewfik
	"	209,30	108,00	615,00	25,00	CP	3,20	2,00				5,37%	BP	11 900	
Armstrong	8"/14.75 9-Ton MLR	203,20	81,65	408,13	10,00	AP	2,29	2,00	3.05	Palliser				4 103	Osmanieh, Lufti Djelil
	"	203,20	81,65	316,08	10,00	Common	2,67	2,00	3.05			5,39%	BP	3 007	
Armstrong	7"/16 6.5-Ton MLR	177,80	52,20	465,00	12,00	AP	2,18	2,00	2.0	Palliser		0,87%	BP	5 095	Assaor Sjevket, Lutfi Djelil, Idjalieh,
	"	177,80	52,60	463,00	12,00	Common	2,57	2,00	2.0			7,76%	BP	5 078	Messudieh
Krupp	17cm RKL/25 C/74	172,60	60,00	475,00	11,00	AP	2,70	2,00	3.7	Gruson Chilled		1,67%	BP	5 290	Medjidieh
	"	172,60	51,00	515,00	11,00	Common	2,79	2,00	3.7			5,88%	BP	5 415	
Bethlehem	6"/44	152,40	47,63	685,80	20,00	APC	4,00	7,00	3.8					14 369	
Vickers	6"/45 Mk.	152,40	45,36	762,00	15,00	AP	2,88	2,00	3.0	Steel		1,25%	BP	9 986	re-armed Messudieh
	"	152,40	45,36	762,00	15,00	AP	3,27	2,00	3.0	Steel		4,87%	BP	9 986	
	"	152,40	45,36	762,00	15,00	CP	3,44	2,00	3.0	Cast Iron		4,75%	BP	9 986	
	"	152,40	45,36	762,00	15,00	Common	3,61	2,00	3.0	Cast Steel		9,81%	BP	9 986	
EOC	6"/45 Pattern	152,40	45,36	792,48	15,00	AP	2,88	2,00	4,57	Steel		1,25%	BP	10 360	Abdul Hamid
	"	152,40	45,36	792,48	15,00	AP	3,27	2,00	4,57	Steel		4,87%	BP	10 360	

	"	152,40	45,36	792,48	15,00	CP	3,44	2,00	4,57	Cast Iron	4,75%	BP	10 360	
	"	152,40	45,36	792,48	15,00	Common	3,61	2,00	4,57	Cast Steel	9,81%	BP	10 360	
EOC	6"/50 Pattern	152,40	45,36	844,30	20,00	CPC		3,00	6.09		8,66%	BP	12 526	Sultan Osman I
Vickers	6"/50 Mk. M	152,40	45,36	914,40	15,00	CPC	3,60	3,00	6.25		5,69%	L	13 636	Resadiye
Krupp	15cm RKL/22 C/	149,10	39,00	470,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 615	
	"	149,10	31,50	515,00	13,00	Common	2,66	2,00	2.6		6,03%	BP	5 705	
Krupp	15cm RKL/25 C/75	149,10	39,00	495,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 730	Osmanieh, Hifzi Rahman
	"	149,10	31,50	536,00	13,00	Common	2,68	2,00	2.6		6,03%	BP	5 890	
Krupp	15cm RKL/35 C/80	149,10	51,00	560,00	20,00	AP	3,35	2,00	5.5		1,33%	BP	9 460	Idjalieh
	"	149,10	51,00	560,00	20,00	Common	4,00	2,00	5.5		3,82%	BP	9 460	
Krupp	15cm SKL/40 C/06	149,10	41,00	840,00	30,00	SAP	3,01	3,00	3.8		7,56%	T	14 570	Assari Tewfik, Avni Illih, Fethi Bulend
	"	149,10	41,00	840,00	30,00	HE	3,39	3,00	3.8		9,76%	T	14 570	
Krupp	15cm SKL/45 C/09	149,10	45,30	835,00	30,00	APC	3,70	4,00	4.0			T	18 446	Yavuz, Midilli
	"	149,10	45,30	835,00	30,00	SAP	4,10	4,00	4.0			T	18 446	
Krupp	12cm RKL/25 C/78	120,00	20,00	455,00	13,00	AP	2,68	2,00	4.0	Gruson Chilled	1,25%	BP	5 090	Hifzi Rahman
	"	120,00	20,00	455,00	13,00	AP	2,68	2,00	4.0	Steel	3,00%	BP	5 090	
	"	120,00	16,40	495,00	13,00	Common	2,66	2,00	4.0		6,71%	BP	5 120	
Krupp	12cm SKL/40 C/97	120,00	20,00	720,00	18,00	SAP	3,06	3,00	3.8		3,85%	PA	8 860	Assari Tewfik
	"	120,00	20,00	720,00	18,00	CP	3,05	3,00	3.8		6,35%	PA	8 860	
Bethlehem	4.7"/45	120,00												Medjidieh
EOC	4.7"/50 Pattern	120,00	20,41	801,63	15,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	9 178	Abdul Hamid/Hamidieh
	"	120,00	20,41	801,63	15,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	9 178	
	"	120,00	20,41	801,63	15,00	CP	3,63	2,00	4.57	Steel	10,00%	BP	9 178	
Krupp	10.5cm SKL/35 C/86	105,00	18,20	580,00	25,00	Common	4,36	2,00	4.4				9 475	Osmanieh
Krupp	10.5cm SKL/35 C/91	105,00	17,40	600,00	30,00	SAP		4,00	3.1	M.1907	2,30%	PA	11 100	Torgud Reis
Krupp	10.5cm SKL/40 C/97	105,00	17,40	840,00	30,00	SAP	3,30	3,00	4.4		2,01%	PA	14 060	Berk I Satvet
Krupp	10.5cm SKL/45 C/12	105,00	17,40	710,00	30,00	SAP		4,00	4.4		2,01%	T	13 140	Midilli
Canet	100mm/50	100,00	16,00	740,00	25,00	SAPC	3,20	2,00	3.7				10 940	Preveze
Krupp	8.8cm SKL/30 C/89	88,00	7,04	670,00	20,00	SAP	2,80	2,00	3.7		4,85%	T	7 195	Torgud Reis

Krupp	8.8cm SKL/45 C/09	88,00	9,93	750,00	25,00	SAP	3,80	3,00	4.3	M.1907	6,40%	T	11 040	Yavuz
Krupp	8.7cm RKL/24 C/82	87,00	6,76	444,00	20,00	CP	2,80	2,00	4.4				5 630	Assari Tewfik, Assari Shevket, Avni Illah, etc.
Krupp	8.7cm SKL/40 C/92	87,00	9,10	720,00	30,00	SAP	3,20	3,00	4.0	M.1907	3,52%	PA	11 070	Abdul Kadir
	"	87,00	9,10	720,00	30,00	CP	3,87	2,00			6,59%	PA	10 133	
Krupp	7.5cm SKL/30 C/12	75,00	5,85	605,00	30,00	SAP	3,80	4,00	3.5	M.1911			9 612	
	ARGENTINA													
Bethlehem	12"/50	304,80	394,63	883,94	15,00	APC	3,70	4,00	7.6				20 142	Rivadavia
Armstrong	10"/32.5 27.5-Ton BLR M/89	254,00	204,11	640,00	13,50	AP	2,88	2,00	5.1		2,73%	BP	9 563	Patagonia
	"	254,00	182,00	593,00	13,50	CP	3,35	2,00	5.1		6,60%	BP	8 404	
EOC	10"/40 Pattern P	254,00	226,80	700,00	18,00	AP	3,21	2,00	7.39				13 110	Pueyrredon, General Garibaldi, General Bel-grano
	"	254,00	226,80	700,00	18,00	CP	3,90	2,00	7.39		7,55%	BP	13 110	
Armstrong	10"/12.6 12.5 Ton MLR (300-pdr)	254,00	150,50	418,50	11,00	AP	2,53	2,00	2,5	Palliser	2,52%	BP	4 635	La Plata
	"	254,00	129,00	429,00	11,00	Common	2,35	2,00	2,5		6,40%	BP	4 594	
Krupp	24cm MRKL/35 C/86	238,00	160,00	650,00	15,00	AP	2,74	2,00	4.0		1,50%	PA	10 100	Independencia
	"	238,00	160,00	650,00	15,00	CP	3,32	2,00	4.0		7,06%	PA	10 100	
Krupp	21cm MRKL/35 C/86	209,30	98,50	645,00	25,00	AP	2,48	2,00	5.8		1,27%	BP	12 400	Veinticinco de Mayo
	"	209,30	98,50	645,00	25,00	Common	2,41	2,00	5.8		3,05%	BP	12 400	
Armstrong	8"/26.1 11.5-Ton BLR Pattern A	203,20	81,65	573,63	11,00	AP	2,62	2,00	4.57	Palliser			6 286	Almirante Brown
	"	203,20	81,65	573,63	11,00	Common		2,00	4.57				6 286	
Armstrong	8"/45 Pattern U	203,20	95,26	810,77	15,00	AP	3,57	2,00	5.18				11 214	Buenos Aires, San Martin
	"	203,20	113,40	762,00	15,00	AP	3,00	2,00	5.18		0,90%	BP	11 722	
Armstrong	8"/29.6 12.5-Ton BLR Pattern E	203,20	95,26	595,28	11,00	AP	2,62	2,00	2.5				6 898	La Plata (re-armed)
	"	203,20	95,26	595,28	11,00	Common		2,00	2.5				6 898	
Vickers	7.5"/52 Mk.	190,50	90,72	950,00	45,00	SAPBC	4,17	4,00	6.7				27 300	Almirante Brown
Armstrong	6"/30.5 BLR Pattern K	152,40	45,36	585,22	15,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	7 700	Patagonia
	"	152,40	45,36	585,22	15,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	7 700	

	"	152,40	45,36	585,22	15,00	CP	3,44	2,00	4.57	Cast Iron	4,74%	BP	7 700	
	"	152,40	45,36	585,22	15,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	7 700	
Armstrong	6"/40 Pattern	152,40	45,36	670,30	15,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	8 737	Nueve de Julio
	"	152,40	45,36	670,30	15,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	8 737	
	"	152,40	45,36	670,30	15,00	CP	3,44	2,00	4.57	Cast Iron	4,75%	BP	8 737	
	"	152,40	45,36	670,30	15,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	8 737	
Armstrong	6"/45 Pattern	152,40	45,36	792,48	15,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	10 198	Buenos Aires, Garibaldi class
	"	152,40	45,36	792,48	15,00	CP	3,44	2,00	4.57	Cast Iron	4,75%	BP	10 198	
	"	152,40	45,36	792,48	15,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	10 198	
	"	152,40	45,36	792,48	15,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	10 198	
Bethlehem	6"/50	152,40	47,63	853,44	15,00	APCBC	4,00	7,00	3.8				15 498	Rivadavia
Vickers	6"/50 Mk. W	152,40	45,36	900,00	45,00	CPC		6,00	5.3				23 500	La Argentina
Canet	150mm/50 M.1896	150,00	40,00	800,00	15,00	AP	2,70	2,00	4.57				10 175	Almirante Brown (re-armed)
	"	150,00	39,40	806,00	15,00	CP	3,30	2,00	4.57				10 112	
Armstrong	4.7"/23.5 BLR Pattern	120,00	23,60	485,00	12,00	SAP	3,15	2,00	4.57	Palliser	4,45%	BP	5 358	Almirante Brown (re-armed)
	"	120,00	16,70	487,00	12,00	Common	2,96	2,00	4.57		5,99%	BP	4 810	
Krupp	12cm SKL/40 C/88	120,00	23,80	680,00	30,00	AP	3,20	2,00	3.9		2,10%	PA	11 400	Veinticinco de Mayo
	"	120,00	23,80	680,00	30,00	CP	3,86	2,00	3.9		5,46%	PA	11 400	
Canet	120mm/50 M.1896	120,00	22,00	840,00	15,00	AP	2,90	2,00	4.57				9 633	Almirante Brown (re-armed)
	"	120,00	22,00	840,00	15,00	CP	3,60	2,00	4.57				9 633	
EOC	4.7"/40 Pattern P	120,00	20,41	544,37	15,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	6 469	Independencia, Nueve de Julio, Garibaldi class, Patria
	"	120,00	20,41	544,37	15,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	6 469	
	"	120,00	20,41	544,37	15,00	CP	3,63	2,00	4.57	Cast Steel	10,00%	BP	6 469	
	"	120,00	20,41	647,70	15,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	7 465	
	"	120,00	20,41	647,70	15,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	7 465	
	"	120,00	20,41	647,70	15,00	CP	3,63	2,00	4.57	Cast Steel	10,00%	BP	7 465	
EOC	4.7"/45 Pattern Y	120,00	20,41	783,34	20,00	AP	3,02	2,00	4,11	Steel	4,44%	BP	9 974	Buenos Aires
	"	120,00	20,41	783,34	20,00	AP	3,02	2,00	4,11	Cast Iron Palliser	2,08%	BP	9 974	

	"	120,00	20,41	783,34	20,00	CP	3,63	2,00	4,11	Cast Steel		10,00%	BP	9 974	
Vickers	4.7"/45 Mk. E	120,00	22,00	850,00	35,00	CPC	3,70	4,00	4.0					16 689	Mendoza, Corrientes Rivadavia, Catamarca, La Plata, San Luis,
Bethlehem	4"/50	101,60	15,00	853,44	20,00	APC	3,40	4,00	7.6					12 887	Mendoza
	"	101,60	15,00	853,44	20,00	SAP	3,80	4,00	7.6						
	"	101,60	15,00	853,44	20,00	CP	4,00	2,00	7.6					10 907	
Vickers	4"/50 Mk. P	101,60	14,06	914,40	90,00	CP	3,80	6,00	8.3					18 200	La Argentina
OTO	4"/45	101,60	13,75	875,00	85,00	CP		3,00	7.5					14 611	Almirante Brown
EOC	12-pdr QF (3"/40 Pattern N)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59			9,15%	BP	7 245	
	BRAZIL														
Vickers	15"/45 Mk. B	381,00	884,97	762,00	20,00	APC	3,94	4,00	7.62		8,13%	2,03%	T	22 970	Riachuelo (Plan)
	"	381,00	884,97	762,00	20,00	CPC	4,94	4,00	7.62					22 970	
EOC	14"/45 Pattern A	355,60	635,04	800,10	20,00	APC	3,30	3,00	6.84					21 498	Rio de Janeiro (Plan)
	"	355,60	635,04	800,10	20,00	CPC		3,00	6.84					21 498	
Krupp	30.5cm SKL/45 C/07	305,00	445,00	865,00	12,00	APC		3,00	8,0	1908				19 000	Coast Defence
	"	305,00	445,00	865,00	12,00	CP		3,00	8,0	1908				19 000	
Whitworth	12"/22 39-Ton MLR	304,80	317,52	492,05	14,00	AP	2,64	2,00	5.11	Palliser				7 365	Independencia
	"	304,80	278,96	524,04	14,00	Common	2,70	2,00	5.11			6,50%	BP	7 617	
EOC	12"/45 Pattern L	304,80	385,56	853,44	18,00	APC	3,30	2,00	6.55		3,33%			18 022	Minas Gerais
	"	304,80	385,56	853,44	18,00	AP	3,16	2,00	6.55					18 109	
EOC	12"/45 Pattern W	304,80	385,56	822,96	13,50	APC	3,30	4,00	7.54					17 035	Rio de Janeiro
	"	304,80	385,56	822,96	13,50	CPC	3,90	4,00	7.54					17 035	
Whitworth	10" 20.7-Ton MLR	254,00	334,75	373,38	14,00	AP	3,36	5,00	3,0			4,74%	BP	6 954	Javary
	"	254,00	199,13	464,21	14,00	Common	3,47	5,00	3,0			5,47%	BP	9 326	
Armstrong	9.2"/31.4 Pattern C	233,68	172,37	640,08	15,00	AP	3,12	2,00	4.72					10 301	Riachuelo
	"	233,68	172,37	640,08	15,00	CP	4,11	2,00	4.72			8,68%	BP	10 301	
Armstrong	9.2"/31.4 Pattern G	233,68	172,37	629,41	15,00	AP	3,12	2,00	4.72					10 106	Aquidaban
	"	233,68	172,37	629,41	15,00	CP	3,80	2,00	4.72			8,68%	BP	10 106	

Whitworth	9" 14.7-Ton MLR	228,60	243,13	347,17	10,00	AP	3,34	5,00	3,0			4,66%	BP	3 906	Sete de Setembro
	"	228,60	145,15	430,99	10,00	Common	3,47	5,00	3,0			5,63%	BP	5 033	
Whitworth	8" MLR	203,20													Independencia
Whitworth	7"L/17.5 7.5-Ton MLR	177,80	68,04	363,93	10,00	Common	3,46	5,00	3,0			7,07%	BP	3 863	Barrozo, Brasi;, Lima Barros, Bahia, Mariz e Barros
	"	177,80	86,18	380,70	10,00	AP Shell	2,52	5,00	3,0					4 204	
	"	177,80	68,40	427,33	10,00	Shot	2,58	5,00	3,0					4 735	
Whitworth	120-pdr L/22.5 MLR	162,56	49,90	423,37	10,00	Common	3,32	5,00	3,0					4 556	
	"	162,56	68,49	379,78	10,00	AP Shell	2,62	5,00	3,0					4 165	
	"	162,56	53,30	430,38	10,00	Shot	2,63	5,00	3,0					4 714	
Armstrong	6"/32 Pattern M	152,40	45,36	597,41	15,00	AP	3,27	2,00	4.57	Steel		4,87%	BP	7 850	Almirante Tamandare, Benjamin Constant
	"	152,40	45,36	597,41	15,00	AP	2,88	2,00	4.57	Steel		1,25%	BP	7 850	
	"	152,40	45,36	597,41	15,00	CP	3,44	2,00	4.57	Cast Iron		4,75%	BP	7 850	
	"	152,40	45,36	597,41	15,00	Common	3,61	2,00	4.57	Cast Steel		9,81%	BP	7 850	
EOC	6"/50 Pattern DD	152,40	45,36	792,48	20,00	AP	3,27	2,00	4.57	Steel		4,87%	BP	11 688	Barrozo
	"	152,40	45,36	792,48	20,00	CP	3,44	2,00	4.57	Cast Iron		4,75%	BP	11 688	
	"	152,40	45,36	792,48	20,00	Common	3,61	2,00	4.57	Cast Steel		9,81%	BP	11 688	
	"	152,40	45,36	792,48	20,00	AP	2,88	2,00	4.57	Steel		1,25%	BP	11 688	
EOC	6"/50 Pattern	152,40	45,36	844,30	15,00	APC		3,00	6.09					12 321	Rio de Janerio, Riachuelo
	"	152,40	45,36	844,30	15,00	CPC		3,00	6.09			8,66%	BP	12 321	
Vickers	6"/50 Mk. S	152,40	45,36	883,92	15,00	APC		3,00	3.05					12 920	Javary
	"	152,40	45,36	883,92	15,00	CPC		3,00	3.05			7,50%	BP	12 920	
Armstrong	5.5"/ Pattern	139,70						2,00	4.72						Riachuelo, Aquidaban
Whitworth	70-pdr L/23.6 MLR	127,00	22,79	405,23	10,00	Common	3,18	5,00	3,0					4 075	Tamandare, Silvado, Cabral
	"	127,00	36,74	332,84	10,00	AP Shell	2,95	5,00	3,0					3 491	
	"	127,00	22,29	422,48	10,00	Shot	2,31	5,00	3,0					4 240	
	"	127,00	31,75	358,14	10,00	Shot	3,29	5,00	3,0					3 750	
Bethlehem	5"/38 Mk. 12	127,00	25,03	790,96	85,00	SAPC	4,15	5,25	4.42	Mk. 38 S C	14,00%	3,70%	D	16 474	Marcilio Dias, Acre
	"	127,00	24,49	800,10	85,00	CPBC			4.42	Mk. 32 S C	8,00%	4,60%	D	16 507	
	"	127,00	22,68	830,58	85,00	APC	3,30	4,00	4.42					15 995	

Armstrong	40-pdr 1.32-Ton BLR (/22)	120,65	18,37	480,06	12,00	CP	3,25	2,00	2.44		5,86%	BP	4 799	Almirante Barrozo
Armstrong	4.7"/32 Pattern M	120,00	16,33	590,50	15,00	CP	2,88	2,00	4.57				6 208	Almirante Tamandare, Benjamin Constant
Armstrong	4.7"/40 Pattern P	120,00	20,41	544,37	20,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	7 694	Republica, Tiradentes
	"	120,00	20,41	544,37	20,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	7 694	
	"	120,00	20,41	544,38	20,00	CP	3,63	2,00	4.57	Steel	10,00%	BP	7 694	
	"	120,00	20,41	647,70	20,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	8 773	
	"	120,00	20,41	647,70	20,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	8 773	
	"	120,00	20,41	647,70	20,00	CP	3,63	2,00	4.57	Steel	10,00%	BP	8 773	
EOC	4.7"/50 Pattern AA	120,00	20,41	801,63	15,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	10 315	Barrozo
	"	120,00	20,41	801,63	15,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	10 315	
	"	120,00	20,41	801,63	15,00	CP	3,63	2,00	4.57	Steel	10,00%	BP	10 315	
EOC	4.7"/50 Pattern CC	120,00	20,41	914,40	15,00	AP	3,02	2,00	4.57		4,44%	BP	10 055	Minas Gerais, Bahia
	"	120,00	20,41	914,40	15,00	CP	3,63	2,00	4.57		10,00%	BP	10 055	
Vickers	4"/40 Mk. M	101,60	14,06	676,66	30,00	CPC	3,80	3,00	4.0				11 162	Para class
Vickers	4"/45 Mk. N	101,60	14,06	853,44	40,00	CPC	3,80	3,00	4.0				14 545	Carioca
Whitworth	32-pdr L/24 MLR	91,44	9,07	356,01	10,00	Common	3,39	5,00	3,0				3 391	Barrozo
		91,44	11,79	325,53	10,00	Shot	3,29	5,00	3,0				3 185	
Armstrong	3.5"/40 Pattern	88,90	9,07	594,36	20,00	CP	2,98	2,00	2.66				7 270	Sampaio
	"	88,90	9,07	737,62	20,00	CP	3,73	2,00	2.66				8 400	
EOC	12-pdr QF (3"/40 Pattern N)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59				7 353	
	CHILE													
EOC	14"/45 Pattern A	355,60	719,40	754,38	20,00	APC		4,00	7.32	Mk. Ia	3,87%	L	21 891	Almirante Latorre
	"	355,60	719,40	754,38	20,00	CPC		4,00	7.32		6,57%	BP	21 891	
	"	355,60	719,40	754,38	20,00	CPC		4,00	7.32		6,64%	BP	21 900	
	"	355,60	723,49	754,38	20,00	APC		4,00	7,32	Mk. IIIa	2,35%	S	21 900	
Armstrong	10"/26 25-Ton BLR Pattern	254,00	204,11	579,12	10,00	AP	2,88	2,00	4.57	Palliser	1,58%	BP	7 230	Arturo Prat
	"	254,00	181,44	614,17	10,00	Common	3,57	2,00	4.57				7 480	

Armstrong	10"/30 Patterns F & G	254,00	204,11	627,89	12,00	AP	2,88	2,00	4.11	Palliser	1,58%	BP	8 975	Esmeralda
	"	254,00	181,44	665,84	12,00	Common	3,57	2,00	4.11				9 186	
	(cordite)	254,00	204,11	624,84	12,00	AP	2,88	2,00	4.11	Palliser	1,58%	BP	8 921	
EOC & VSM	10"/45 Pattern S & Mk. A	254,00	226,80	792,48	13,50	AP	3,21	2,00	7.39				13 196	Constitucion
	"	254,00	226,80	792,48	13,50	CP	3,90	2,00	7.39		7,55%	BP	13 196	
Canet	240mm/36 M.1887	240,00	144,00	760,00	12,00	AP	2,40	2,00	5.4				10 112	Capitan Prat
	"	240,00	144,00	760,00	12,00	CP	2,90	2,00	5.4				10 079	
	"	240,00	170,00	760,00	12,00	APC	2,70	2,00	5.4		1,41%	M	10 388	
	"	240,00	170,00	760,00	12,00	CPC	3,00	2,00	5.4		6,65%	M	10 368	
Armstrong	9"/15.3 12-Ton MLR	228,60	116,12	432,82	10,00	AP	2,28	2,00	2.0	Palliser			4 785	Almirante Cochrane
	"	228,60	113,40	432,64	10,00	Common	2,60	2,00	2.0		7,40%	BP	4 759	
Armstrong	8"/30 13.5-Ton BLR Pattern L	203,20	95,26	670,56	7,50	AP	2,62	2,00	2.74				6 384	Almirante Cochrane (re-armed)
	"	203,20	95,26	670,56	7,50	Common	3,31	2,00	2.74				6 384	
Armstrong	8"/25.6 Pattern E	203,20	95,26	621,30	11,00	AP	2,62	2,00	2.74				7 315	re-armed Huascar
	"	203,20	95,26	621,30	11,00	Common	3,31	2,00	2.74				7 315	
Armstrong	8"/39.9 Pattern P	203,20	95,26	744,32	15,00	AP	3,57	2,00	5.18				10 473	Blanco Encalada, Esmeralda
	"	203,20	95,26	744,32	15,00	Common	3,45	2,00	5.18				10 473	
	"	203,20	113,40	612,04	15,00	AP	3,00	2,00	5.18		0,90%	BP	9 273	
	(cordite)	203,20	95,26	783,34	15,00	AP	3,57	2,00	5.18				11 013	
	"	203,20	95,26	783,34	15,00	Common	3,45	2,00	5.18				11 013	
	"	203,20	113,40	722,07	15,00	AP	3,00	2,00	5.18		0,90%	BP	11 071	
Armstrong	8"/45 Pattern S	203,20	95,26	858,62	15,00	AP	3,57	2,00	5.18				12 044	Chacabuco
	"	203,20	113,40	787,00	15,00	AP	3,00	2,00	5.18		0,90%	BP	12 128	
Armstrong	8"/45 Pattern T	203,20	95,26	784,86	15,00	AP	3,57	2,00	6.8				11 038	O'Higgins
	"	203,20	95,26	784,86	15,00	CP	3,45	2,00	6.8				11 038	
	"	203,20	113,40	743,71	15,00	AP	3,00	2,00	6.8		0,90%	BP	11 429	
EOC & VSM	7.5"/50 Pattern A & Mk. B	190,50	90,72	822,63	15,00	Shot	2,90	2,00	4.11				12 734	Constitucion
	"	190,50	90,72	822,63	15,00	AP	3,70	2,00	4.11		4,37%	BP	12 734	
	"	190,50	90,72	822,63	15,00	APC	2,90	2,00	4.11		4,37%	BP	12 734	
	"	190,50	90,72	822,63	15,00	CP	3,70	2,00	4.11		8,25%	BP	12 734	

Armstrong	RBL 70-pdr 69cwt	162,60	32,52	424,70	15,00	Bolt	1,50	2,00	3.51				4 805	Abtao
	"	162,60	36,29	424,10	15,00	AP	1,98	2,00	3.51	Palliser			5 070	
	"	162,60	31,80	453,10	15,00	Common	2,30	2,00	3.51				5 025	
Armstrong	6"/26.1 BLR 4-Ton Pattern B	152,40	36,29	587,96	12,00	AP	2,32	2,00	4.57	Palliser	2,12%	BP	6 280	Arturo Prat
	"	152,40	36,29	519,00	12,00	Common	2,53	2,00	4.57		6,25%	BP	5 591	
Armstrong	6"/30 Pattern I	152,40	36,29	637,03	13,00	Common	3,12	2,00	4.57		6,25%	BP	6 981	Esmeralda
	(cordite)	152,40	36,29	697,99	13,00	Common	3,12	2,00	4.57		6,25%	BP	7 570	
Armstrong	6"/40 Patterns W & Z	152,40	45,36	762,00	15,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	9 838	Blanco Encalada, O'Higgins, Esmeralda
	"	152,40	45,36	762,00	15,00	CP	3,44	2,00	4.57	Cast Iron	4,75%	BP	9 838	
	"	152,40	45,36	762,00	15,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	9 838	
	"	152,40	45,36	762,00	15,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	9 838	
Armstrong	6"/50 Pattern DD	152,40	45,36	792,48	20,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	11 688	Ministro Zenteno
	"	152,40	45,36	792,48	20,00	CP	3,44	2,00	4.57	Cast Iron	4,75%	BP	11 688	
	"	152,40	45,36	792,48	20,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	11 688	
	"	152,40	45,36	792,48	20,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	11 688	
EOC	6"/50 Pattern TT	152,40	45,36	883,92	15,00	CPC	3,92	3,00	4,27		8,66%	BP	12 924	Almirante Latorre
Canet	150mm/36 M.1884	150,00	40,00	770,00	15,00	AP	3,00	2,00	5.75				9 830	Presidente Errazuriz
Armstrong	RBL 40-pdr 35cwt (/22.4)	120,65	18,60	354,79	15,00	Bolt	2,17	2,00	2.59				4 498	Abtao
	"	120,65	20,40	338,60	15,00	AP	2,68	2,00	2.59	Palliser			4 215	
	"	120,65	18,37	359,66	15,00	Common	2,92	2,00	2.59		6,17%	BP	4 344	
Armstrong	40-pdr MLR (/16)	120,65	18,37	491,95	12,00	Common	2,87	2,00	2.5		8,18%	BP	4 799	Almirante Cochrane
Armstrong	40-pdr 1.32-Ton BLR	120,65	18,37	480,06	12,00	Common	3,25	2,00	2.44				4 753	re-armed Huascar
Canet	120mm/36 M.1884	120,00	22,00	715,00	15,00	AP	3,00	2,00	5.75				8 413	Presidente Errazuriz
		120,00	22,00	715,00	15,00	CP	3,60	2,00	5.75				8 332	
Canet	120mm/45 M.1887	120,00	22,00	850,00	15,00	AP	3,00	2,00	3.6				9 726	Capitan Prat
	"	120,00	22,00	850,00	15,00	CP	3,60	2,00	3.6				9 621	
Armstrong	4.7"/40 Pattern P	120,00	20,41	655,32	15,00	AP	3,02	2,00	4.57	Steel	4,44%	BP	7 638	Chacabuco, Almirante Simpson
	"	120,00	20,41	655,32	15,00	AP	3,02	2,00	4.57	Cast Iron Palliser	2,08%	BP	7 638	
	"	120,00	20,41	655,32	15,00	CP	3,63	2,00	4.57	Steel	10,00%	BP	7 638	

Armstrong	4.7"/43.9 Pattern Y	120,00	20,41	783,34	15,00	AP	3,02	2,00	4,11	Steel	4,44%	BP	8 860	O'Higgins
		120,00	20,41	783,34	15,00	AP	3,02	2,00	4,11	Cast Iron Palliser	2,08%	BP	8 860	
		120,00	20,41	783,34	15,00	CP	3,63	2,00	4,11	Steel	10,00%	BP	8 860	
Vickers	4.7"/45 Mk. E	120,00	22,00	810,00	35,00	CPC	3,70	4,00	3.8				14 877	Serrano
EOC	4:/40 Pattern S	101,60	14,06	701,04	25,00	CP		3,00	3.66				10 635	Almirante Lynch
Armstrong	12-pdr QF Pattern N (3"/40)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59		9,15%	BP	7 245	
	CHINA													
Armstrong	12.5"/16 38-Ton MLR	317,50	362,88	412,09	12,00	AP	2,66	2,00	4.57				5 331	Fei Ting
	"	317,50	362,88	412,09	12,00	Common	3,11	2,00	4.57				5 324	
Krupp	30.5cm RKL/25 C/80	305,00	329,00	500,00	13,00	AP	2,70	2,00	5.5		1,06%	BP	7 250	Ting Yuen
	"	305,00	329,00	500,00	13,00	Common	2,50	2,00	5.5		5,47%	BP	7 250	
Vavasseur	12-in MLR													
Armstrong	11"/12 25-Ton MLR	279,40	241,77	400,65	12,00	AP	2,61	2,00	4.57		2,81%	BP	5 001	Hoi Tung Hung
Armstrong	11"/13 26.5-Ton MLR	279,40	241,77	426,72	12,00	AP	2,61	2,00	4.57		2,81%	BP	5 001	Lung Hsiang
Armstrong	11"/23 35-Ton MLR	279,40	241,99	552,83	12,00	AP	2,62	2,00	4.57		0,83%	BP	7 425	Chen Tung, Chen Chung
	"	279,40	242,99	551,69	12,00	Common		2,00	4.57		5,36%	BP	7 417	
Krupp	26cm RKL/22 C/76	263,00	205,00	500,00	13,00	AP	3,50	2,00	3.5		1,95%	BP	6 908	Ping Yuen
	"	263,00	205,00	500,00	13,00	Common	3,20	2,00	3.5		5,61%	BP	6 908	
Armstrong	10"/15 18-Ton MLR	254,00	181,44	415,58	12,00	AP	2,60	2,00	3.35				5 114	Chien Sheng
	"	254,00	180,53	416,66	12,00	Common	3,02	2,00	3.35		6,66%	BP	5 117	
Armstrong	10"/26 25-Ton BLR Pattern	254,00	204,11	579,12	10,00	AP	2,56	2,00	4.57		1,58%	BP	7 161	Chao Yung
	"	254,00	181,44	588,61	10,00	Common	3,57	2,00	4.57		7,87%	BP	7 021	
Krupp	21cm RKL/30 C/84	209,30	140,00	545,00	13,00	AP	3,53	2,00	5.2		1,79%	BP	7 780	Chih Yuan
	"	209,30	140,00	545,00	13,00	Common	4,28	2,00	5.2		3,93%	BP	7 780	
Krupp	21cm RKL/22 C/72	209,30	89,00	450,00	13,00	AP	2,48	2,00	2.5	Gruson Chilled	1,91%	BP	5 480	Chi Yuan, Kai Che, King Yuan, Nan Thin
	"	209,30	78,00	425,00	13,00	Common	2,41	2,00	2.5		8,72%	BP	5 000	
EOC	8"/45 Pattern S	203,20	95,26	858,62	15,00	AP	3,57	2,00	5.18				11 848	Hai Tien

	"	203,20	95,26	858,62	15,00	Common		2,00	5.18					11 848	
Skoda	20.3cm/50 K/16	203,00	125,00	850,00	30,00	APC	3,59	4,00	6.2					22 003	planned large cruiser
	"	203,00	125,00	850,00	30,00	CPC	3,82	4,00	6.2					22 003	
Armstrong	7"/15.9 MLR	177,80	51,98	474,88	12,00	AP	2,18	2,00	3.0			1,92%	BP	5 125	King Ch'ing, Huan Tai
	"	177,80	52,98	437,98	12,00	Common						7,55%	BP	4 776	
Krupp	17cm RKL/25 C/74	172,60	60,00	475,00	11,00	AP	2,70	2,00	3.7	Gruson Chilled		1,67%	BP	5 200	Tiong Sing
	"	172,60	51,00	515,00	11,00	Common	2,79	2,00	3.7			5,88%	BP	5 305	
Armstrong	6"/26.1 BLR	152,40	45,36	525,89	15,00	CP	3,44	2,00	3.1	Cast Iron		4,75%	BP	6 891	Chih Yuan
	"	152,40	45,36	525,89	15,00	Common	3,44	2,00	3.1	Cast Iron		7,25%	BP	6 891	
EOC	6"/50 Patterns NN & WW	152,40	45,36	914,40	20,00	AP	3,27	2,00	6.25	Steel		4,87%	BP	12 955	Chao Ho
	"	152,40	45,36	914,40	20,00	AP	2,88	2,00	6.25	Steel		1,25%	BP	12 955	
	"	152,40	45,36	914,40	20,00	Common	3,60	2,00	6.25	Steel		9,81%	BP	12 955	
Vickers	6"/50 Mk. M	152,40	45,36	914,40	20,00	AP	3,27	2,00	6.25	Steel		4,87%	BP	12 955	Ying Swei
	"	152,40	45,36	914,40	20,00	AP	2,88	2,00	6.25	Steel		1,25%	BP	12 955	
		152,40	45,36	914,40	20,00	Common	3,60	2,00	6.25	Steel		9,81%	BP	12 955	
Bethlehem	6"/50	152,40	47,63	853,44	20,00	APC	4,00	7,00	6.25					17 857	Fei Hung
Krupp	15cm RKL/35 C/80	149,10	51,00	530,00	13,00	AP	3,35	2,00	4,0			1,33%	BP	6 780	Ting Yuen, Chi Yuan, King Yuan, Ping Yuen,
	"	149,10	51,00	530,00	13,00	Common	4,00	2,00	4,0			3,82%	BP	6 780	Pao Min
Krupp	15cm SKL/40 C/92	149,10	51,00	625,00	15,00	AP	3,60	2,00	3.8			5,49%	PA	8 014	Tung Chi
	"	149,10	51,00	625,00	15,00	CP	4,30	2,00	3.8			6,27%	PA	8 014	
Krupp	15cm SKL/40 C/97	149,10	45,50	839,00	30,00	AP	3,18	2,00	3.8			1,89%	PA	14 987	Hai Yung
	"	149,10	45,50	839,00	30,00	Common	3,84	2,00	3.8			8,80%	PA	14 987	
	50-cal Type 3 14-cm gun	140,00	38,00	850,00	30,00	CPC	3,58	4,00	7.0		5,00%	5,26%	SH	18 599	Ning Hai
Vavasseur	5.5-in MLR														
Armstrong	40-pdr 1.32-Ton BLR (/22)	120,65	18,14	480,06	12,00	Common	3,25	2,00	2.44			5,94%	BP		
Krupp	12cm RKL/35 C/80	120,00	26,00	530,00	25,00	AP	3,50	2,00	3.5			2,88%	BP	8 990	Chao Yung, Nan Thin, King Ch'ing, Huan Tai Kai Che, Kuang Chua, Pao Min, Tung Chi
	"	120,00	26,00	530,00	25,00	Common	4,20	2,00	3.5			6,54%	BP	8 990	
Krupp	12cm SK L/35 C/87	120,00	23,80	650,00	30,00	AP		2,00				2,10%	PA	10 020	Kuang Yi
	"	120,00	23,80	650,00	30,00	Common		2,00				5,46%	PA	10 020	

Krupp	12cm SKL/40 C/88	120,00	23,80	680,00	30,00	AP	3,20	2,00	3.9		2,10%	PA	11 400	
	"	120,00	23,80	680,00	30,00	CP	3,86	2,00	3.9		5,46%	PA	11 400	
EOC	4.7"/45 Pattern Y	120,00	20,41	783,34	20,00	AP	3,02	2,00	4.11	Steel	4,44%	BP	9 974	
	"	120,00	20,41	783,34	20,00	AP	3,02	2,00	4.11	Cast Iron Palliser	2,08%	BP	9 974	
	"	120,00	20,41	783,34	20,00	CP	3,63	2,00	4.11	Steel	10,00%	BP	9 974	
Skoda	12cm/45 K/14	120,00	23,80	800,00	30,00	CPC	4,20	4,00	5.1		8,82%	T	13 564	planned large cruiser
Blakely	4.5-in MLR													
Krupp	10.5cm SKL/40 C/	105,00	17,40	840,00	30,00	SAP		3,00	4.4				13 578	Hai Yung, Fei Ying
Armstrong	4"/14.8 BLR	101,60	11,34	359,66	15,00	Common		2,00			11,50%	BP	4 141	
Canet	100mm/45 M1896	100,00	13,00	765,00	15,00	CP	3,60	2,00	3.6				8 398	Chien An
Skoda	10cm/50 K/11	100,00	13,75	900,00	30,00	CP	4,20	4,00	3.9	K/09	12,36%	T	14 451	planned Scouts
Armstrong	25-pdr QF Pattern (3.75"/40)	95,25	11,34	612,65	20,00	AP	3,03	2,00	2.66				7 614	Fei Ting
	(cordite)	95,25	11,34	722,38	20,00	CP	3,79	2,00	2.66				8 300	
Armstrong	12-pdr BLR (3"/28)	76,20	5,67	487,68	12,00	Common	3,65	2,00	4.57		4,76%	BP	4 398	Lung Hsiang, Chen Tung, Chen Chung
	40-cal Type 3 8-cm gun	76,20	5,99	680,00	75,00	CP		4,00	7.0		7,58%	SH	10 688	Ning Hai
Krupp	7.5cm RK L/25 C/80	75,00	4,30	473,00	15,00	Common		2,00			4,65%	BP	4 507	
Krupp	7.5cm SKL/30 C/12	75,00	5,85	605,00	30,00	SAP	3,70	4,00	3.5	M.1911			9 300	Chang Feng
	GREECE													
Bethlehem	14"/45	355,60	635,04	762,00	15,00	APC	3,53	4,00	7.6				18 237	Salamis
Canet	340mm/45 M1912	340,00	540,00	795,00	13,00	APC	3,18	2,00	6.2	M.1912	4,07%		15 384	Basileus Konstantinos
USN	12"/45 Mk. 5	304,80	394,63	822,96	15,00	APC	3,40	4,00	5.94				18 726	Kilkis
Canet	274mm/34 M1884	274,40	216,00	657,00	12,00	AP	2,40	2,00	9.3				9 349	Psara
	"	274,40	180,00	720,00	12,00	Common	2,40	2,00	9.3				9 608	
Canet	274mm/28 M1881	274,40	216,00	550,00	12,00	AP	2,40	2,00	6.5				7 525	Psara
	"	274,40	180,00	607,00	12,00	Common	2,40	2,00	6.5				7 923	
Krupp	26cm RKL/30 C/84	263,00	275,00	520,00	13,00	AP	3,50	2,00	2.5				7 975	Ambrakia
	"	263,00	205,00	602,00	13,00	Common	3,20	2,00	2.5		5,61%	BP	8 770	

EOC	9.2"/45 Pattern H	233,68	172,37	822,96	25,00	AP	3,27	2,00	7.5					18 000	Averoff
	"	233,68	172,37	822,96	25,00	CP	3,80	2,00	7.5					18 000	
	"	233,68	172,37	822,96	25,00	APC		3,00	7.5					19 000	
	"	233,68	172,37	822,96	25,00	CPC		3,00	7.5					19 000	
Armstrong	9"/13.9 12.5-Ton MLR	228,60	116,12	438,91	12,00	AP	2,28	2,00	2.0					5 217	Bassileos Georgios, Basilissa Olga
	"	228,60	113,40	432,64	12,00	Common	2,60	2,00	2.0			7,60%	BP	5 100	
Krupp	21cm RKL/22 C/75	209,30	98,50	450,00	13,00	AP	2,48	2,00	2.0			1,22%	BP	5 985	re-armed Basileos Georgios
	"	209,30	79,00	425,00	13,00	Common	2,41	2,00	2.0			5,95%	BP	5 350	
USN	8"/45 Mk. 6	203,20	117,94	838,20	20,00	APC	3,56	4,00	7.92					19 172	Kilkis
EOC	7.5"/45 Pattern B	190,50	90,90	844,00	30,00	AP		2,00	6.5			9,23%	BP	17 800	Averoff
	"	190,50	90,90	844,00	30,00	CP		2,00	6.5					17 800	
	"	190,50	90,90	844,00	30,00	APC		3,00	6.5					18 700	
	"	190,50	90,90	844,00	30,00	CPC		3,00	6.5					18 700	
USN	7"/45 Mk. 2	177,80	74,84	822,96	15,00	APC	3,37	5,00	5.11	Mk. 6	8,80%	2,60%	D	15 216	Kilkis
	"	177,80	74,84	822,96	15,00	CPC	3,70	5,00	5.11					15 216	
Krupp	17cm RKL/25 C/74	172,60	53,50	490,00	11,00	AP	2,41	2,00	3.7	Steel		1,12%	BP	5 300	re-armed Basilissa Olga, Nauarchos Miaoulis
	"	172,60	51,30	504,00	11,00	Common	2,79	2,00	3.7			4,48%	BP	5 380	
Krupp	17cm RKL/20 C/	172,60	53,50	404,00	11,00	AP	2,41	2,00	3.7	Steel		1,12%	BP	4 325	re-armed Basilissa Olga, Nauarchos Miaoulis
	"	172,60	51,30	409,00	11,00	Common	2,79	2,00	3.7			4,48%	BP	4 340	
Armstrong	RBL 70-pdr 69cwt	162,60	36,29	424,10	15,00	AP	1,98	2,00	3.5					5 163	Basilissa Olga
	"	162,60	31,80	453,10	15,00	Common	2,30	2,00	3.5					5 130	
Bethlehem	6"/44	152,40	47,63	685,80	20,00	APC	4,00	7,00	3.8					14 369	Salamis
Bethlehem	6"/50	152,40	47,63	853,44	20,00	APC	4,00	7,00	6.25					18 457	Helle
Canet	150mm/36 M1887	150,00	40,00	800,00	15,00	AP	2,70	2,00	6.5			1,25%	M	10 503	Psara
	"	150,00	39,40	806,00	15,00	CP	3,30	2,00	6.5			3,63%	M	10 440	
Krupp	15cm RK L/26 C/	149,10	39,00	476,00	13,00	AP		2,00	2,6	Gruson Chilled		1,28%	BP	5 685	
	"	149,10	31,50	513,00	13,00	Common		2,00	2,6			6,03%	BP	5 685	
Krupp	15cm RKL/30 C/83	149,10	51,00	495,00	20,00	AP	3,35	2,00	4,0			1,33%	BP	8 430	Ambrakia
	"	149,10	51,00	495,00	20,00	Common	4,00	2,00	4,0			3,82%	BP	8 430	

Rheinmetall	12.7cm SKC/34	128,00	28,00	830,00	30,00	SAPBC	4,40	8,60	4.4				18 052	Vasileos Georgios
OTO	120mm/50 M.1931	120,00	23,49	920,00	35,00	SAP	4,40	4,00	6.2				18 721	Hydra
Bethlehem	4"/40	101,60	15,00	853,44	20,00	APC	3,40	4,00	7.6				13 348	Salamis, Helle, Aetos
	"	101,60	15,00	853,44	20,00	CP	4,00	2,00	7.6				11 278	
Armstrong	20-pdr BLR (/16)	95,25	9,53	426,72	15,00	Common	2,96	2,00	2.66		5,65%	BP	4 841	Basileos Georgios
Armstrong	20-pdr BLR (/26)	95,25	9,53	494,08	20,00	Common	2,96	2,00	2.66		5,65%	BP	5 390	Achelaos
Canet	90mm/22 M1881	90,00	8,00	455,00	15,00	Common	3,15	2,00	9.3				5 187	Psara
USN	3"/50 Mk. 6	76,20	5,90	822,96	20,00	AP		2,00	4.65				8 561	Kilkis
	"	76,20	5,90	822,96	20,00	CP		2,00	4.65				8 561	
	PERU													
Armstrong	10" 300-pdr MLR	254,00	131,50	414,00	12,00	Bolt	1,59	2,00	3.51	Palliser			4 696	Huascar
	"	254,00	133,80	410,00	12,00	Common	2,24	2,00	3.51				4 739	
Armstrong	8"/14.75 9-Ton MLR	203,20	81,65	408,13	12,00	AP	2,29	2,00	3.05	Palliser			4 661	re-armed Independencia
	"	203,20	81,65	408,13	12,00	Common	2,67	2,00	3.05		5,39%	BP	4 655	
Armstrong	7" MLR	177,80	52,00	475,00	12,00	AP	2,17	2,00	2.0	Palliser	1,92%	BP	5 143	Independencia
	"	177,80	53,00	477,00	12,00	Common	2,59	2,00	2.0		7,55%	BP	5 185	
Voruz	Blakely [Patent] 30-pdr [kg.]	171,45	30,00											
Armstrong	70-pdr MLR	162,60	32,52	453,10	15,00	Bolt	1,50	2,00	2.66				5 086	Independencia
Armstrong	6"/26.1 BLR M.1881	152,40	36,29	587,96	13,00	AP	2,32	2,00	3.05				6 570	
	"	152,40	36,29	587,96	13,00	Common	2,80	2,00	3.05				6 570	
Vickers	6"/50 Mk. J	152,40	45,36	903,73	35,00	AP	2,88	3,00	6.0		1,25%	BP	16 217	Almirante Grau
	"	152,40	45,36	903,73	35,00	AP	3,27	2,00	6.0		4,87%	BP	16 217	
	"	152,40	45,36	903,73	35,00	Common	3,61	2,00	6.0		9,81%	BP	16 217	
Armstrong	RBL 40-pdr 35cwt (4.75"/22.4)	120,65	18,60	354,79	15,00	Bolt	2,17	2,00	2.59				4 527	Huascar
	"	120,65	20,40	338,60	15,00	AP	2,68	2,00	2.59				4 242	
	"	120,65	18,37	359,66	15,00	Common	2,92	2,00	2.59		6,17%	BP	4 375	
Armstrong	12-pdr QF Pattern N (3"/40)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59		9,15%	BP	7 353	Almirante Grau

PORTUGAL

Krupp	26cm RKL/20 C/74	263,00	187,00	435,00	11,00	AP	2,38	2,00	4.5		1,28%	BP	5 100	Vasco da Gama
	"	263,00	167,00	460,00	11,00	Common	2,49	2,00	4.5		4,67%	BP	5 295	
EOC	8"/39.9 Pattern P	203,20	95,26	783,34	15,00	AP	3,57	2,00	4.5				11 183	Vasco da Gama (re-armed)
	"	203,20	95,26	783,34	15,00	Common	3,45	2,00	4.5				11 183	
Armstrong	7"/16 6.5-Ton MLR	177,80	52,20	465,00	12,00	AP	2,18	2,00	2.0	Palliser	1,92%	BP	5 095	Rio Lima, Tamega
	"	177,80	52,60	463,00	12,00	Common	2,57	2,00	2.0		7,76%	BP	5 078	
Armstrong	70-pdr MLR	162,60	31,80	453,10	15,00	Common	2,30	2,00	2.0			BP	5 126	Tejo
Armstrong	6"/26 Pattern B	152,40	36,29	587,96	13,00	AP	2,32	2,00	4.57	Palliser			6 661	Bengo, Zambezi, Vouga, Liberal
	"	152,40	36,29	519,00	13,00	Common	2,53	2,00	4.57				5 941	
EOC	6"/45 Pattern	152,40	45,36	853,44	15,00	AP	3,27	2,00	4.57	Steel	4,87%	BP	10 910	Dom Carlos I
	"	152,40	45,36	853,44	15,00	CP	3,44	2,00	4.57	Cast Iron	4,74%	BP	10 910	
	"	152,40	45,36	853,44	15,00	Common	3,61	2,00	4.57	Cast Steel	9,81%	BP	10 910	
	"	152,40	45,36	853,44	15,00	AP	2,88	2,00	4.57	Steel	1,25%	BP	10 910	
Canet	150mm/45 M.1896	150,00	40,00	800,00	15,00	AP	2,70	2,00	4.57		1,25%	M	9 795	Sao Gabriel, Rainha Dona Amelia
	"	150,00	39,40	806,00	15,00	CP	3,30	2,00	4.57		3,63%	M	9 740	
Krupp	15cm RKL/25 C/75	149,10	39,00	480,00	13,00	AP	2,72	2,00	2.6	Gruson Chilled	1,28%	BP	5 730	Vasco da Gama
	"	149,10	31,50	530,00	13,00	Common	2,68	2,00	2.6		6,03%	BP	5 850	
Krupp	15cm RKL/35 C/88	149,10	51,00	575,00	15,00	AP	3,60	2,00	4.0		1,33%	PA	8 230	Diu
	"	149,10	51,00	575,00	15,00	Common	4,30	2,00	4.0		3,82%	PA	8 230	
Krupp	15cm SKL/40 C/92	149,10	45,50	840,00	15,00	AP	3,18	2,00	4.0		1,89%	PA	11 450	Adamastor
	"	149,10	45,50	840,00	15,00	Common	3,84	2,00	4.0		8,80%	PA	11 450	
Armstrong	5"/25 Pattern	127,00	22,68	533,40	13,00	Common	3,38	2,00	2.66				5 862	Alfonso D'Albuquerque
Armstrong	40-pdr 1.32-Ton MLR	120,65	18,37	480,06	12,00	Common	3,25	2,00	2.44		8,18%	BP	4 851	Tejo, Rio Lima, Tamega
EOC	4.7"/45 Pattern	120,00	20,41	792,48	15,00	AP	3,02	2,00	3.0	Steel	4,44%	BP	9 086	Dom Carlos I
	"	120,00	20,41	792,48	15,00	AP	3,02	2,00	3.0	Cast Iron Palliser	2,08%	BP	9 086	
	"	120,00	20,41	792,48	15,00	CP	3,63	2,00	3.0	Steel	10,00%	BP	9 086	
Canet	120mm/45 M.1887	120,00	22,00	850,00	15,00	AP	3,00	2,00	3.6				10 050	Sao Garbriel

	"	120,00	22,00	850,00	15,00	CP	3,60	2,00	3.6				9 941	
Vickers	4.7"/50 Mk. G	120,00	22,00	915,00	45,00	SAPC		5,00	3.66				19 355	Douro, Velho, Alfonso de Albuquerque, Nunes
Krupp	10.5cm SKL/35 C/86	105,00	18,00	580,00	25,00	CP	4,36	2,00	4.0				9 474	Dom Luiz, Diu, re-armed Tamega
Krupp	10.5cm SKL/40 C/97	105,00	17,40	840,00	20,00	SAP	3,30	3,00	4.4				11 853	Adamastor
Coventry	4"/50	101,60	14,06	914,40	30,00	SAP		3,00	4.42				14 397	Guadina
Canet	100mm/27 M.1881	100,00	14,00	560,00	15,00	Common	3,90	2,00	3.6				6 781	Zambezi, Vouga, Liber-al, re-armed Tejo, Rio Lima
Canet	100mm/45 M.1896	100,00	13,00	760,00	15,00	CP	3,60	2,00	3.6				8 613	Tejo, Patria
EOC	3.5"/40 Pattern	88,90	9,07	737,62	20,00	CP	3,73	2,00	2.66				8 856	Beira
Krupp	8.7cm RKL/24 C/	87,00	6,80	444,00	20,00	Common	2,81	2,00	3.5		2,90%	BP	5 564	Bengo
EOC	12-pdr QF Pattern N (3"/40)	76,20	5,67	673,61	20,00	CP	3,72	2,00	2.59		9,15%	BP	7 467	Liz, re-armed Vasco da Gama
	YUGOSLAVIA													
Skoda	14cm L/56 K/37	140,00	39,80	880,00	45,00	SAPBC	4,22	10,00	4.4				23 400	Dubrovnik
Skoda	12cm L/46 K/37	120,00	24,00	850,00	35,00	SAPBC	4,14	10,00	3.8				20 800	Beograd
Skoda	9cm L/45 K/12	90,00	10,20	770,00	30,00	CPC	4,20	3,00	4.4				11 634	
Skoda	8.4cm L/55 K/29	83,50	10,00	800,00	85,00	CPC	4,90	10,00	4.4				17 610	Dalmacija
Skoda	7.5cm L/30 K/	75,00	6,50	500,00	30,00	CP	4,71	4,00	3.1				8 420	T-4
	FINLAND													
Bofors	25cm. K./45 M/32	254,00	225,00	850,00	45,00	APC	3,84	5,00	5.0				30 300	Ilmarinen
	"	254,00	225,00	850,00	45,00	SAP	4,36	5,00	5.0				30 300	
Bofors	10cm. K./50 M/32	105,00	16,00	800,00	85,00	CPC		10,00	5.2				18 200	Ilmarinen
Obuchov	102mm/60 M.1908	101,60	17,50	823,00	30,00	CP	5,00	4,00	3.0		13,71%	T	15 365	Hameenmaa, Klas Horn, Sisu
	"	101,60	17,50	823,00	30,00	CP	5,00	4,00	3.0		12,00%	T	16 095	
Obuchov	75mm/50 M.1891	75,00	4,91	823,00	30,00	CP	3,36	2,00	3.0	M.1907	10,59%	T	9 100	S1, S2, S5, Louhi, Filin, Ruotsinsalmi, Otso

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ОБРАЗОВАНИЮ

ГОСУДАРСТВЕННЫЙ КООРДИНАЦИОННЫЙ ЦЕНТР ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ

ОТРАСЛЕВОЙ ФОНД АЛГОРИТМОВ И ПРОГРАММ

СВИДЕТЕЛЬСТВО ОБ ОТРАСЛЕВОЙ РЕГИСТРАЦИИ РАЗРАБОТКИ

№ 7032

Настоящее свидетельство выдано на разработку:

База данных по морской артиллерии
«Database of Naval Guns»

зарегистрированную в Отраслевом фонде алгоритмов и программ.

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Авторы: **Grawford K.R., Митюков Н.В.**

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ИЗВЕЩЕНИЕ

О ГОСУДАРСТВЕННОЙ РЕГИСТРАЦИИ В «НАЦИОНАЛЬНОМ ИНФОРМАЦИОННОМ ФОНДЕ НЕОПУБЛИКОВАННЫХ ДОКУМЕНТОВ» РАЗРАБОТКИ, ПРЕДЪЯВЛЕННОЙ В ОТРАСЛЕВОЙ ФОНД АЛГОРИТМОВ И ПРОГРАММ:

База данных по морской артиллерии
«Database of Navel Guns»

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