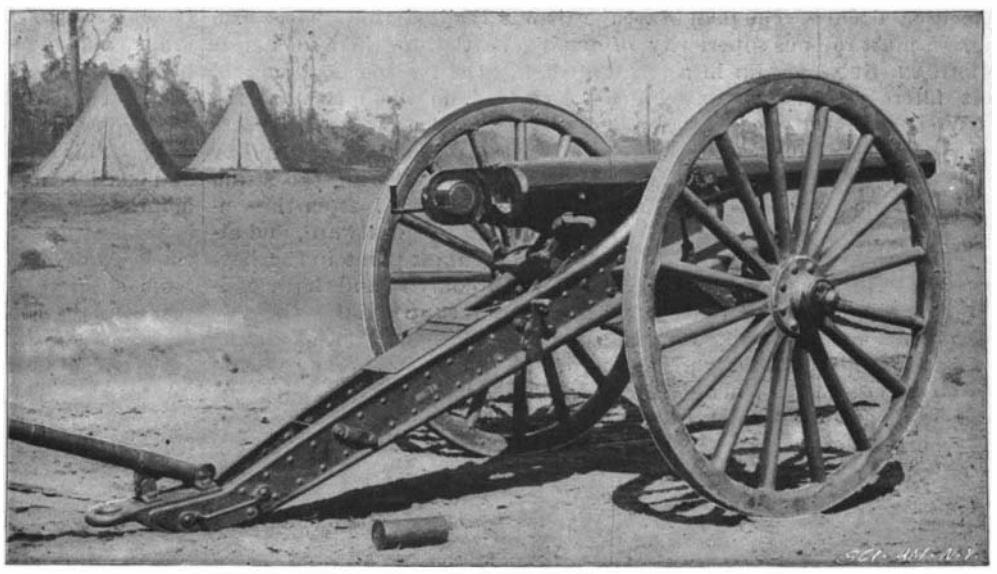
THE 3·2-INCH DRIGGS-SEABURY FIELD-GUN.

In the accompanying illustration we show a 3·2-inch field-gun with Driggs-Seabury improved breech-mechanism, mounted on a carriage designed by Colonel Buffington.

The 3·2-inch gun is a favorite field weapon, and is capable of great execution when firing shrapnel against bodies of troops. The gun weighs 805 pounds, is 7·31 feet long and has a bore 25·20 calibers in length. The shell weighs 13·5 pounds and the charge 3·5 pounds. The muzzle velocity is 1,685 feet per second, the muzzle energy 266 foot-tons, and the penetration through steel 3·8 inches. The breech-mechanism, which is shown swung back clear of the breech in the opened position, is of remarkable compactness and simplicity—two most important features in field artillery. Unlike the naval and coast defense guns, which are always within easy reach of a forge, if not of a machine shop, the field-guns usually go into action at a considerable distance from any extensive repair facilities, and their disablement will probably put them out of action indefinitely. It is of the highest importance that their parts should be few, simple, and easily repaired. The breech-mechanism of the gun under consideration is an improved form of the old Driggs-Seabury mechanism, and as may be seen from the cut, it is remarkably compact and free from complication.



3·2-INCH FIELD-GUN ON BUFFINGTON GUN-CARRIAGE.

Weight of shell, 13·5 pounds; powder, 3·5 pounds; muzzle velocity, 1,685 feet per second; muzzle energy, 266 foot-tons; penetration, 3·8 inches steel.

If the reader will refer to the SCIENTIFIC AMERICAN ARMY AND COAST DEFENCE SUPPLEMENT, he will notice in the chapter on rapid-fire guns that there are usually three distinct motions of the breech-block in opening the breech. It is first rotated to unlock the threads, then withdrawn onto a hinged carrier tray or ring, and finally swung clear of the breech to make way for the next operation of loading. The Driggs-Seabury breech-mechanism embodies an improvement which is designed to do away with the second movement, and reduce the operation to two, namely, the rotation of the block and its withdrawal on the hinged tray. In the old three-motion mechanism, it was necessary to withdraw the block onto the hinged tray on a line with the axis of the gun, because the circular path described by the tray prevented the block from being swung to the right or left directly from its seat in the breech-box. In the new type the breech-box is curved to the circle described by the block, and the withdrawal of the block on the axial line of the gun is thereby rendered unnecessary.

The opening and closing lever is hinged at the center of the carrier-plate. The first movement of the lever rotates the block, the rear end of which is threaded into a ring in the carrier-plate. The rotation is accomplished by means of a short lever which is formed at the inner end of the opening lever, where it is hinged to the carrier-plate. The short lever has a ball and socket engagement with the outer end of the breech-block, and as the opening lever is swung across the breech, the breech-block is given one-sixth of a turn. The further motion of the lever causes the breech-block and tray to swing clear of the breech into the position shown in our cut.

The Buffington carriage is constructed of plate steel. To stiffen the axle, it is inclosed between two plates of steel, which are firmly riveted together. The width of the plates is so placed that they take the bending strain of the recoil which would otherwise come upon the axle. The flasks are formed of sheet steel riveted together, and they are so placed as to give great lateral and vertical stiffness to the carriage. The elevation of the gun is accomplished by means of a set of jointed levers known as "lazy tongs," which will be noticed beneath the breech of the gun. The "trail hand-spike," by which the gun is traversed, will be noticed inserted in the trail-piece of the stock where the carriage rests on the ground.

When it is not in use the hand-spike is folded forward against the trail and held in place by a catch. Two gunners can be seated on the axle. Two hundred of these guns are now under construction for the government.

A GROUP OF NAVY PROJECTILES.

The projectiles in use by our navy may be classed as solid shot, shell, and shrapnel. Although some excellent solid shot is still manufactured, such as the Johnson fluid compressed shot, a description of which is given in our COAST DEFENCE SUPPLEMENT, solid shot have given place to shell as the standard projectiles of the navy.

Shell is formed with an interior cavity of considerable dimensions, in which is placed a charge of powder or high explosive. It is provided with a fuse for the ignition of the charge, which is of the percussion or time-fuse type. The former acts at the instant of striking; the latter is set to explode the shell a certain length of time after the shell has left the muzzle of the gun.

Shrapnel is the modern form of the old case shot, which consisted of a large number of balls put up in a case, or envelope, which merely served to hold them together until they left the muzzle of the gun. In the case of shrapnel the envelope is made sufficiently strong to bear the shock of discharge, and a time-fuse is provided.

The best armor-piercing projectiles are now made of chrome steel, the small admixture of chromium serving to impart to the steel a remarkable amount of toughness. The projectiles are cast, forged, and carefully annealed and tempered, the hardening being confined to the point or nose. The latter is ogival in form, the point being struck with a radius which is two or three times the diameter of the shell. The point has to be sharply pointed to insure its penetration of the hard face of the armor; but if it is made too fine, it will lack the necessary resisting power and will be fractured before it can get through. The best proportion of radius is found to lie between two and three times the diameter.

There are two kinds of armor-piercing projectiles: The first is made solid, or practically so, a small core being formed to give the best results in the forging process; the other type is known as semi-armor-piercing. It is formed hollow with a core of moderate dimensions, large enough to hold an explosive charge that will insure the bursting of the thick walls of the projectile. It is made of chrome steel, and requires in its manufacture to be treated with great care to secure the combined hardness and toughness to enable it to pierce solid armor without fracturing and carry its explosive charge intact into the interior of the ship. When such shell is filled with common powder, the heat engendered by passing through the armor is depended on to explode the shell just within the ship; no fuse is used.

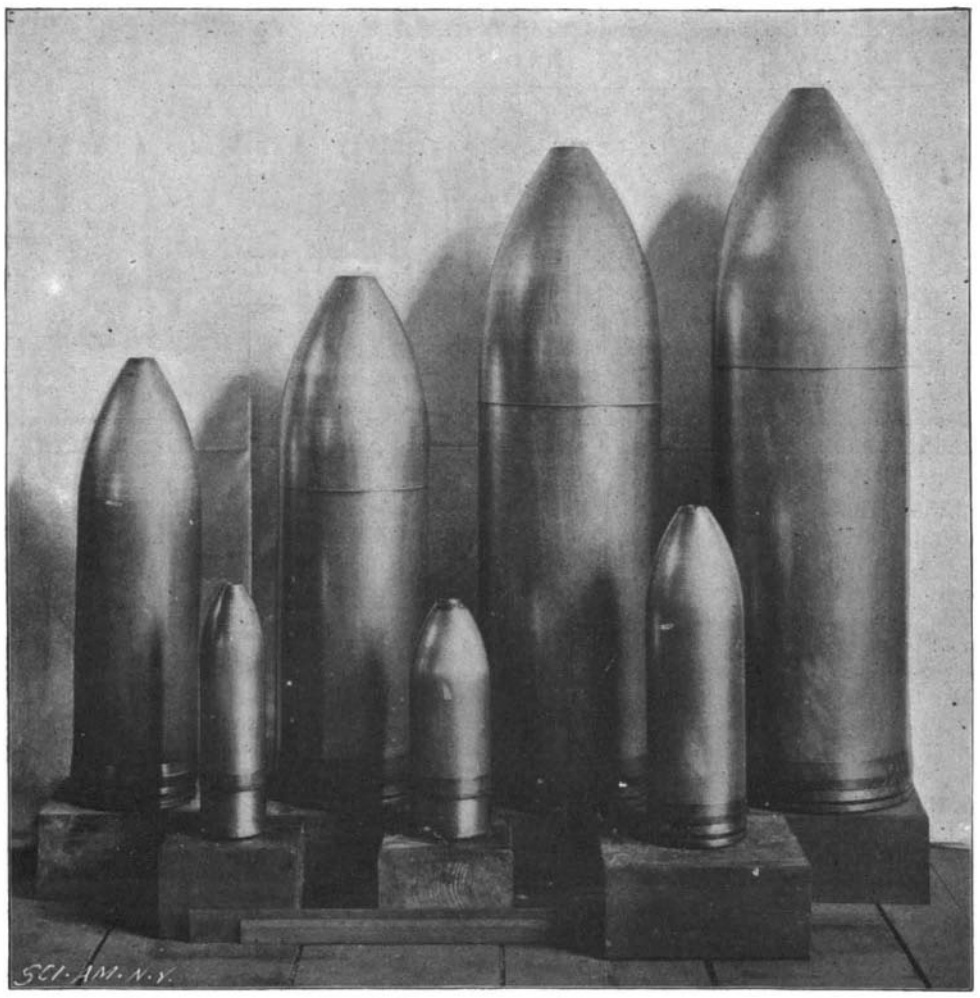
The object at which projectile makers are aiming just now is to make a shell which can carry a charge through the best armor and burst on the inner side of the armor. It is already possible to put solid shot through plate that is as much as one and one-half the diameter of the shot in thickness, and the success of the projectile makers is such as to make it likely that before long a bursting shell can be made to perform the same feat. The Wheeler-Sterling shells are steadily improving in quality, and give promise of equaling the penetration of solid projectiles without breaking up.

It will be evident that penetration of the armor belt by a shell will be vastly more destructive to the ship than penetration by solid shot. The damage wrought by the latter will be confined to its direct path, whereas the zone of destruction of a shell will be almost as extensive, if it is of the larger calibers, as the whole area of the deck on which it strikes. The effects, moreover, will be greatly augmented if a high-explosive bursting charge be substituted for common powder, although the sensitiveness of such charges renders it very difficult to carry them through armor plate and burst them on the inside. Excellent results, however, have been achieved in this direction against armor of moderate thickness.

The group of shells shown in our engraving includes one of each of the sizes used on our warships, from the 4-inch 33-pound shell up to the 13-inch 1,100-pound shell of our largest guns. They are all of the class known as "common shell," and are used against fortifications and earthworks and against the unarmored or lightly armored portions of warships. They are usually formed of cast iron, though sometimes of cast steel, and the interior cavity is large, enabling a big bursting charge to be carried. Unlike the forged chrome steel shell, they are unfit for armor-piercing, not having the necessary strength to carry them through the plates.

The particulars of these shells are given in the following table:

Diameter.	Length.	Bursting Charge.
4-inch.....	1 foot 4 inches.	2 pounds.
5 "	1 " 3 "	3 "
6 "	1 " 9 "	4 "
8 "	2 " 6 "	10 "
10 "	3 " 0 "	22 "
12 "	3 " 8 "	42 "
13 "	4 " 0 "	70 "



8-inch 4-inch 10-inch 5-inch 12-inch 6-inch 13-inch

GROUP OF COMMON SHELL AT THE WASHINGTON NAVY YARD.

It will be noticed that the point of the shell is cut off. It is here that the percussion fuse is inserted. The fuse consists of a hollow threaded brass case, which is screwed into a hole bored through into the interior of the shell. Inside the case is a cylindrical lead plunger, in the center of which is a fulminate and a priming charge. When the gun is fired, the plunger

moves to the rear of the fuse, and at the moment when the shell strikes an obstruction it flies forward, the fulminate striking a small anvil on the fuse cap. This ignites the primer, the flame of which enters the shell and explodes it.

ADMIRAL SAMPSON'S REPORT OF THE SANTIAGO ENGAGEMENT.

Admiral Sampson's report of the naval engagement off the south coast of Cuba is too lengthy a document for insertion in these columns, and we must refer our readers to the SCIENTIFIC AMERICAN SUPPLEMENT, where the text of this most interesting and valuable report is given in full. We have prefer[illegible] however, the accompanying set of diagrams, in which the positions of the contending squadrons are shown at four different stages of the battle, and these, together with the following notes of the conflict, will give our readers a very clear conception of the course of this memorable conflict from start to finish.

Before entering into technical details, and by way of preface, we would draw the attention of our readers to the fact that the Admiral's report disposes effectually of the altogether stupid newspaper gossip to the effect that rival jealousies and clashing authority marred the glory of the Santiago victory. From the report of the chief in command down to the report of the captain of the smallest torpedo boat or converted yacht, there is manifest a desire to give the credit of the day's work to the fleet as a whole, and the particular performance of each ship is only considered as part of a prearranged and successfully executed plan. Our sailors have too much pride in the success of the American navy to becloud the hour of victory with petty wranglings as to whether to admiral or commodore, gunner or quartermaster belongs the chief credit of victory.

Besides, as Admiral Cervera aptly remarked on learning that one of his defeated captains had been permitted to retain his sword, "Sailors are always gentlemen." We commend this statement to the consideration of that section of the press which has lately been attempting to prove that this is just what our sailors are not.

It is evident from the report that the blockade was carried out with the greatest diligence and watchfulness. By day our vessels were ranged in semicircles around the harbor mouth at a distance of from four to six miles from the entrance. By night the vessels closed in, three lines being drawn around the entrance as follows: At a distance of one mile, in a semicircle, were three picket launches; at a distance of two miles were three gunboats, the "Vixen" to the westward, the "Suwanee" due south, and the "Dolphin" to the east; and the battleships and cruisers lay outside of these, in the following order from the westward: Armored cruiser "Brooklyn," 9,215 tons, 21·9 knots; second-class battleship "Texas," 6,315 tons, 17·8 knots; first-class battleship "Massachusetts," 10,288 tons, 16·2 knots; seagoing battleship "Iowa," 11,340 tons, 17·1 knots; armored cruiser "New York," 8,200 tons, 21 knots; first-class battleship "Oregon," 10,288 tons, 16·8 knots; first-class battleship "Indiana," 10,288 tons, 15·5 knots. Searchlights were kept playing upon the entrance and the adjoining coasts during the whole night, a system of signals was arranged, and everything possible was done to draw an impregnable blockade about the harbor entrance. After the arrival of Shafter's army, the night blockading distance was reduced to two miles.

It was generally supposed that Cervera would make a dash for the open sea under cover of darkness; but we learn from his own lips that so effective were the precautions of the blockading ships, that he realized the hopelessness of an attempt to break through when the lines were drawn up within two miles of the entrance.

On the morning of the eventful day, the "Massachusetts" had left her station between the "Iowa" and "Texas," and had gone down the coast to Guantanamo for coal, and the flagship "New York" had started in the same direction for Siboney, where Admiral Sampson intended to land, for a conference with General Shafter. These withdrawals, of course, greatly weakened the blockade, and Admiral Cervera determined to make a dash for the open at the hour of general quarters, when the whole ship's crew would be mustered on deck for inspection—the one moment in the whole twenty-four hours when the ships could be "taken aback," as it were.

The plan of escape (it was realized that the enormous superiority of our big battleships rendered defeat certain in a stand-up fight) was for the cruisers and destroyers to steam swiftly from the mouth of the harbor at the moment when the American crews were at quarters, thereby gaining the time which would be consumed in manning the guns, increasing the steam pressure, etc. As each vessel emerged from the entrance it was to turn sharply to the westward, and attempt to break through the weakest point in the line, represented by the cruiser "Brooklyn" and the second-class battleship "Texas." It was supposed that the only ship which could overhaul the Spanish fleet was the "Brooklyn," and orders were given to concentrate upon her the fire of the advancing fleet. With the "Brooklyn" crippled, and the powerful battleships, which would naturally lose much time in getting under weigh, left astern, Cervera expected to make a successful run for Cienfuegos or Havana Harbor.

The plan was well conceived, and had these 20-knot ships been manned by American gunners and engineers, the probability is that two at least, and possibly the whole four, would have got away. As it was, execrable Spanish gunnery and poor Spanish stoking on the one hand, and excellent American marksmanship and good work in the engine room force on the other, notably in the case of the "Oregon," rendered the attempt one of the most pitiable failures recorded in history.

According to Sampson's report, the speed of the cruisers on issuing from the channel was only 8 or 10 knots, and the fastest ship of the four, the "Colon," a vessel which in proper hands should have been good, even with her foul bottom, for 17 or 18 knots, was only able to make an average of 13·7 knots during her run of 48 miles up the coast. Foul bottoms alone do not account for this falling off, and in default of any other explanation, it must be set down to the notorious incapacity of the Spanish as engineers.

High speed as a necessary element in the construction of warships loses none of its value because of the Santiago engagement. This is evident, moreover, from the fact that the "Brooklyn," with only two out of her four engines coupled up, was eventually able to work up to 16 knots an hour and overhaul the fleeing Spaniard, and the "New York," which was also using half her engine power and was 7 miles from the harbor when the chase started, was close up and rapidly gaining when the "Colon" surrendered. The most impressive evidence of the value of speed is afforded by the battleship "Oregon." Built on the Pacific coast at the Union Iron Works, she has always proved to be a very efficient vessel. On her trial she exceeded the contract speed of 15 knots by 1·8 knots, and the fleetness which she then showed has apparently never left her. She steamed rapidly through the fleet, easily passing the "Texas," 17·8 knots, and the "Iowa," 17·1 knots, and under forced draught gradually overhauling the "Colon." As the average speed of the latter was 13·7 knots, it is probable that the average of the "Oregon" for her fifty mile run was fully 14 knots an hour. This is only one knot below her contract speed, and considering the fact that she had been for many months in the water without cleaning her bottom, it is a splendid performance, and speaks volumes for the efficiency of her machinery and engine and boiler room staff.

We draw particular attention to the accompanying diagrams showing the armor protection of the two types of cruiser as represented by the "Colon" and the "Vizcaya." They fully explain the early defeat of the "Vizcaya," "Teresa," and "Oquendo" and the comparatively small damage inflicted on the "Colon." In the three ships destroyed so early in the action, the side armor is all concentrated in a thick belt which only rises two or three feet above the waterline for two-thirds of the ship's length amidships. Above this belt there was nothing but the thin plating of the hull, which served merely to set off the percussion fuses of the shells and caused them to burst between decks, slaughtering the men and setting fire to the woodwork. Every shell that was fired, including small 6 and 1-pounders, was effective, and it was the hail of projectiles from these little weapons that drove the Spaniards from the guns and sent the ships hurrying for the shore.

Now the "Colon" has her armor better disposed: Instead of having it all concentrated in a thick, partial belt at the waterline, which, as the battle showed, is but seldom liable to be hit, her armor was spread out in a thinner 6-inch sheet over the whole waterline and over the whole main and broadside battery up to the main deck. This 6 inches of Harvey steel was capable of stopping all but the 8, 12, and 13-inch shells, and rendered her safe against the shells of the secondary batteries. Even when she was struck by large projectiles they often failed to penetrate, the worst damage being done to the unarmored ends.

We have always greatly admired the "Cristobal Colon" and "Dupuy de Lome" (French) type of ship, and we sincerely hope that the value of thinner but more widely distributed armor will not be lost upon our naval constructors.

The wretched gunnery of the Spaniards is shown by the fact that not a single shot was delivered that did any serious injury to our ships, although the fight was at close ranges and they carried 11-inch guns, which were fully capable at these ranges of penetrating our heaviest armor. Not one of the larger shells appears to have reached the mark. Several of our captains in their reports speak of a storm of shells passing by them and generally overhead. It has invariably been the habit of the Spaniards to fire too high, and we doubt if many of the excitable dons ever changed an elevation when once the fight was fairly on.

The "Brooklyn" was hit most frequently of all the ships, as was to have been expected, seeing the attack was concentrated on her at the beginning of the fight and she was under continuous fire altogether for nearly four hours. The accompanying diagram, which is reproduced from the official drawings accompanying the report, will prove of great interest. It shows that the brunt of her fighting took place with the "Colon." The 6-inch and 4·7-inch shot holes could only have been made by this vessel, as she was **the only ship that carried guns of these calibers.**

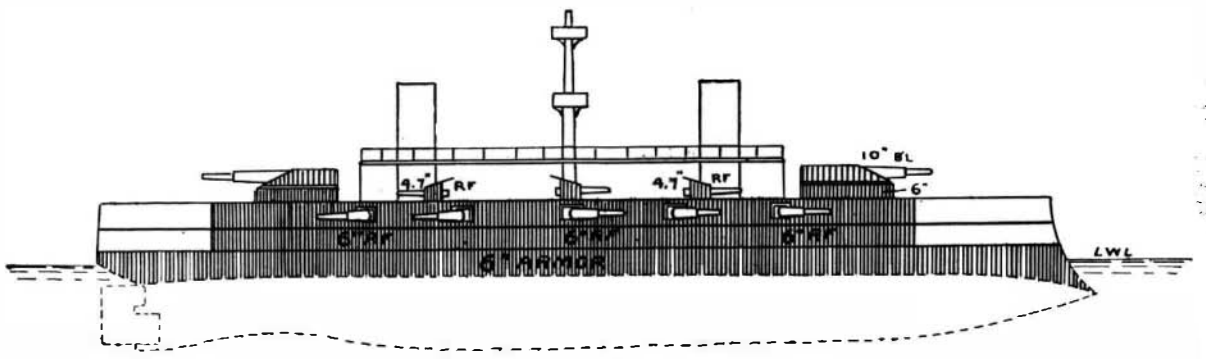
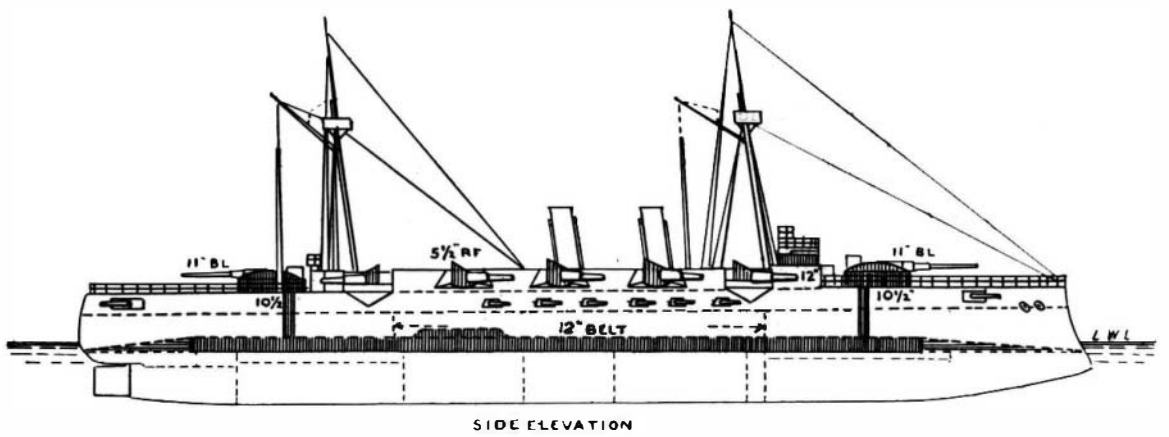


DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISER "CRISTOBAL COLON."



SIDE ELEVATION

DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISERS "VIZCAYA," "MARIA TERESA," AND "OQUENDO."

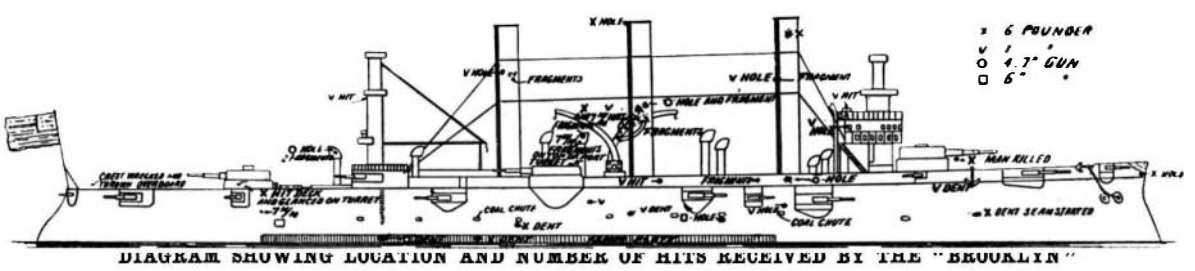


DIAGRAM SHOWING LOCATION AND NUMBER OF HITS RECEIVED BY THE "BROOKLYN" IN THE SANTIAGO ENGAGEMENT.