

SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS CHEMISTRY, AND MANUFACTURES.

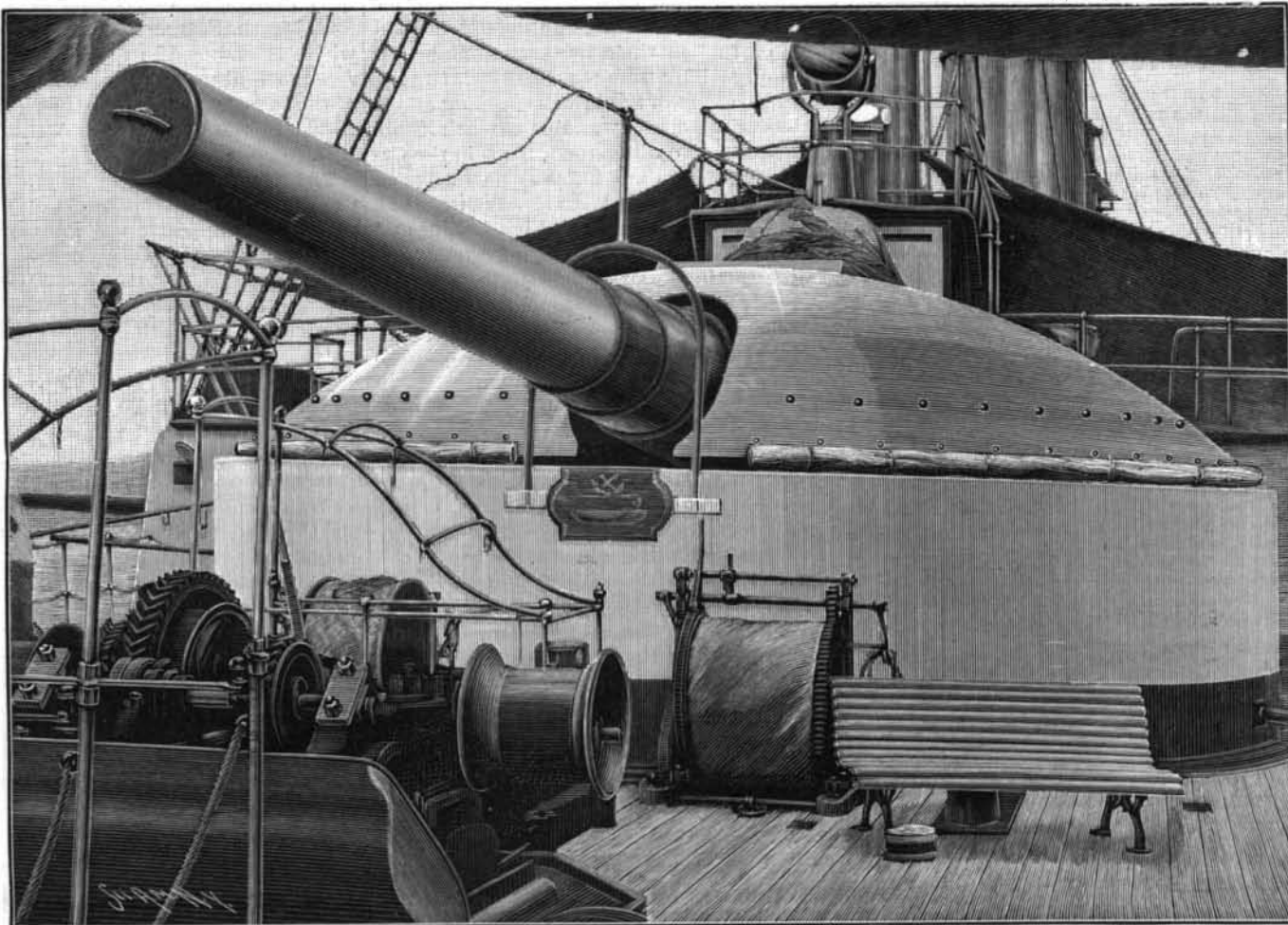
Vol. LXXVIII.—No. 22.
ESTABLISHED 1845.

NEW YORK, MAY 28, 1898.

[\$3.00 A YEAR.
WEEKLY.]

THE SPANISH "CAPE VERDE" FLEET.

The center of interest in the present war is quickly shifted. One week it lies off the south coast of Florida as our blockading fleet moves to the investment of Cuba; the next week it is found off the coast of Africa, where we see the Cape Verde fleet gathered for its long voyage to the relief of the Spanish army; then it flies to the antipodes and we watch the fateful conflict of Manila; and before we have had time to estimate the full value of the victory, the startling news comes that the Cape Verde fleet, which was supposed to be at Cadiz, is in the West Indies, replenishing its bunkers and get-



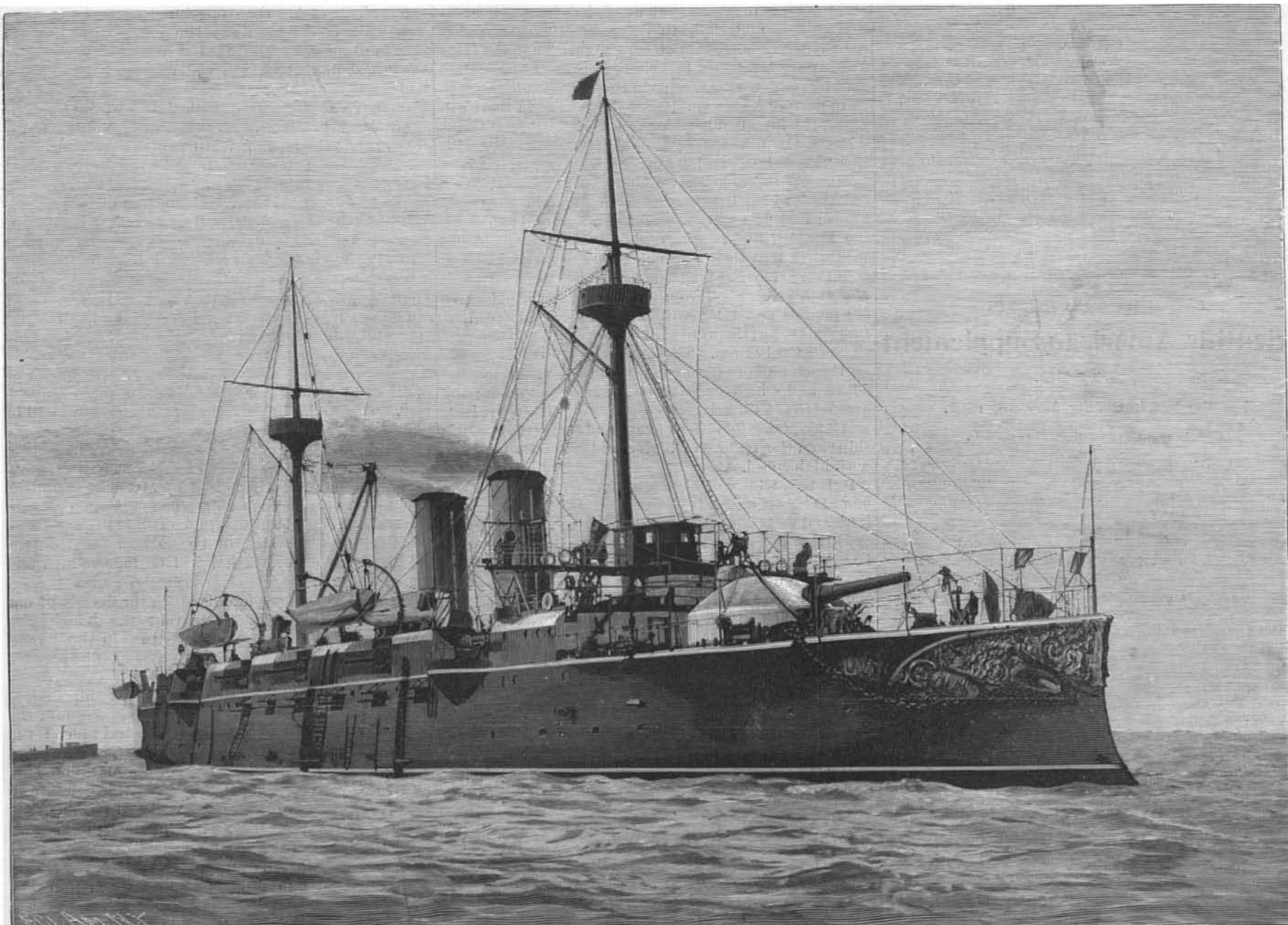
THE FORWARD 11-INCH RIFLE OF THE "VIZCAYA."

Weight of shell 694 pounds; velocity, 2,084 feet per second; muzzle energy, 24,030 foot-tons; muzzle penetration, 28.7 inches of iron.

ting otherwise ready for its campaign of diversion and relief of the blockaded island of Cuba.

Unless it is sunk or captured by our squadrons, the Cape Verde fleet is likely to fill a large page in the record of the Spanish-American war, for it happens to combine several qualities which are essential to successful fleet maneuvers. In the first place it is homogeneous, three of the armored ships being sister vessels and the fourth so nearly like them that, for tactical and maneuvering purposes, the four ships are identical. The three torpedo boat destroyers are also identical in armament and general

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ARMORED CRUISER "VIZCAYA," OF THE "CAPE VERDE" FLEET. (ALSO "MARIA TERESA" AND "ALMIRANTE OQUENDO.")

DISPLACEMENT, 7,000 tons. HORSE POWER, 13,000. SPEED, 21 knots. ("Teresa," 20-25 knots; "Oquendo," 20 knots.) ARMOR: Belt, 12 inches; deck, 8 inches; barbettes, 10½ inches. ARMAMENT, two 11-inch, ten 5½-inch rapid-fire, two 9-pounders, eight 6-pounders, four 1-pounders, two machine guns. TORPEDO TUBES, six (two submerged). COAL CAPACITY, 1,200 tons. COMPLEMENT, 500.

THE SPANISH "CAPE VERDE" FLEET.

(Continued from first page.)

design, two of them being of 28 knots speed and one of 30 knots. The similarity in the ships is of great value in enabling the fleet as a whole to steam at any desired speed or move in any desired formation, instead of the faster ships having to wait for some slower vessels or the more powerful having to shield the weaker units when forming the line of battle. The disposition, arc of training and power of the batteries being almost identical in all the ships, a fighting position which is the best for one ship is the best for all the fleet. It is a well recognized fact in naval warfare that this homogeneity in a fleet is in itself a considerable source of strength, just as a fleet made up of ships of miscellaneous types and having various speeds must accommodate itself to the slowest and weakest units or permit them to be destroyed piecemeal by the enemy.

It is evident that the ships of the Spanish fighting line were designed with a view to fighting at a considerable distance from their home base. To this end they possess three prime requisites: Seaworthiness, habitability and a large coal supply. They stand high out of the water, they have abundance of berthing space between decks, and they are credited with a coal supply of 1,200 tons, or enough to carry them for 10,000 miles at a 10-knot speed. The fleet, therefore, has the characteristics which mark, or should mark, the ships of a nation with extensive colonial possessions, and which are conspicuously present in the British navy, whose nine battleships of the Prince George class can carry 2,250 tons of coal, or sufficient for them to steam for 19 days at a speed of about 15 knots an hour. It should be mentioned, however, that, although the theoretical radius of the "Vizcaya" type of ship is 10,000 knots, it is not likely that in actual service it is so large. The auxiliary engines on board probably consume from 8 to 10 tons of coal per day, and this is to be deducted from the amount available for the main engines.

Of the four armored cruisers in the Cape Verde fleet the "Christobal Colon" is undoubtedly the most formidable both in armor and armament. She is one of six similar ships built or building at Sestri Ponente, in Italy. Two of these, the "Giuseppe Garibaldi" and "Varese," are being built for the Italian navy; two, the "Garibaldi" and the "San Martino," form part of the Argentine navy; the other two are the "Christobal Colon" and the "Pedro d'Aragon," now under construction for Spain at the Italian yard. The most striking feature in these ships is the unusual amount of side armor which they carry, in which respect they are only surpassed by the French "Dupuy-de-Lome," which is entirely covered from stem to stern with 4 inches of steel. The "Dupuy-de-Lome" was designed after the French experts had proved the terrific destructiveness of shells containing high explosives, and realized the necessity of preventing their bursting within a warship. The "Christobal Colon" is not so completely covered as the "Dupuy-de-Lome," but her armor is thicker and of Harvey steel. In the first place she has a complete waterline belt of 6-inch Harvey steel. Above this and extending for about two-thirds of her length amidships is another belt of 6-inch steel which reaches to the upper deck. At each end of this belt are transverse bulkheads of the same thickness which extend clear across the ship and join the side walls of armor, thus constituting a great oblong fort or citadel. Within the shelter of this citadel is a powerful battery of ten 6-inch rapid-fire guns, five on each broadside. Each of these guns can be fired five or six times a minute, and the 100-pound shells have a muzzle energy of 4,645 foot tons and are capable of penetrating 21 inches of iron at the muzzle.

Placed within the shelter of the citadel, one forward, one aft, are two barbettes of 6-inch steel which protect the turning gear of two 10-inch guns, which are the most powerful weapons carried by the ship. They throw a 500-pound shell with a muzzle energy of 14,430 foot-tons, which can penetrate over 20 inches of iron at 1,000 yards. Above the 6-inch battery is another rapid-fire battery of six 4.7-inch guns, each capable of firing 7 or 8 shells per minute, which are good for a muzzle penetration of 15 inches of iron. These guns are protected by shields of Harvey steel. It will be seen that the armament is not only extremely powerful, but unusually well protected. The secondary rapid-fire battery consists of ten 6-pounders and ten 1-pounders, with two machine guns in the tops. There are also four Whitehead torpedo tubes, protected by 6 inches of armor. The speed is 20 knots and the coal carrying capacity 1,000 tons. It should be mentioned that, in addition to the belt and citadel armor, the "Colon" is further protected as to her vitals by a 1½-inch deck, a cofferdam of water-excluding cellulose and the arrangement of her coal. Of the four ships of the Cape Verde squadron, she easily stands first in all round fighting efficiency.

this might stop and burst the shells, it would not burst them on the outside of the ship, as would the 6-inch side armor of the "Christobal Colon."

The armament is powerful, though not equal to that of the "Colon." Its lack of armor protection however detracts greatly from its efficiency. There are two armor-piercing 11-inch guns, one forward and one aft, which fire over 10½-inch steel barbets carried on the main deck. The barbets communicate with the magazines below the protective deck by means of thick armored tubes, as shown in the diagram, which will serve to protect the ammunition on its way up to the breech of the guns. Apart from the tubes, however, there is nothing but the thin ½-inch plating of the ship's sides to prevent shells from being burst beneath the barbets. It would not take many such shells, even from rapid-fire guns, to cut away the plate framing and girders that support the great weight of the barbette gun and turning gear and tumble the whole structure into the hold of the ship. The same thing is true of the amidships battery of ten 5½-inch rapid-fire guns on the same deck. High explosive shells bursting beneath them would break up the deck and inevitably put them out of action. Four of the 5½-inch guns are carried on

sponsons, which extend out from the sides of the ship and enable the guns to be trained fore and aft. On the gun deck below are eight 6-pounder and eight 1-pounder rapid-fire guns and in the tops on the fighting masts are two machine guns.

The 11-inch gun shown in our front page engraving is a very formidable piece capable of penetrating the belts and gun positions of our battleships at the ordinary fighting range. It is a 35-caliber weapon of the Hontoria type and weighs about 36 tons. With a charge of 352 pounds of powder it fires an armor-piercing shell of 694 pounds with a velocity of 2,034 feet a second. The shell has a muzzle energy of 24,000 foot-tons and is capable of perforating 28½ inches of iron at the muzzle. This weapon, therefore, approaches the 12-inch rifle Mark I of our navy, which has a foot-ton energy of 25,985 and a penetration of 30.8 inches.

The curious domelike structure above the gun is a light shield a few inches in thickness which is bolted to the carriage and rotates with the gun, the barbette being stationary. The shield is too thin to stop the heavier rapid-fire shells, which it would only serve to intercept and cause to burst inside. The Chinese removed the light shields of a similar kind from their guns on the "Chen Yuen" before the battle of the Yalu, considering the gun crews would be in less danger

without them; though the Japanese, who now are the owners of this ship, have replaced them, probably making them thicker and of better steel.

The four cruisers of the Cape Verde fleet are all liberally supplied with torpedo tubes, the "Colon" having four and the other three ships six, two of which are submerged. The above-water tubes, owing to the terrible risk of having the torpedoes hit and exploded on the ship itself, are not likely to be used; but the underwater tubes are very dangerous weapons, and if the swift Spanish ships should steam in to close range, they might even the fortunes of a losing fight by sinking one or more of the enemy.

Accompanying the cruisers and acting as very useful scouts are three torpedo boat destroyers of the latest design and of exceptional power and speed. Two of them, the "Furor" and "Terror," which were built on the Clyde in 1896, are sister boats, 220 feet long, 22 feet beam, of 5½ feet draught and 380 tons displacement. They have engines of 6,000 horse power and are capable of 28 knots speed. They carry 100 tons of coal and, contrary to the popular opinion, can cruise for several thousand miles at 10 knots without replenishing their bunkers. They have two torpedo tubes and carry a crew of 67 men. The "Pluton," built last year on the Clyde

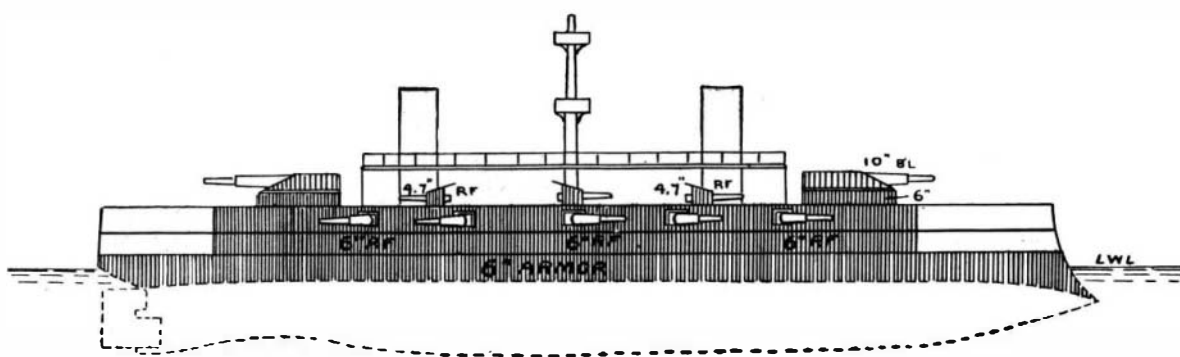
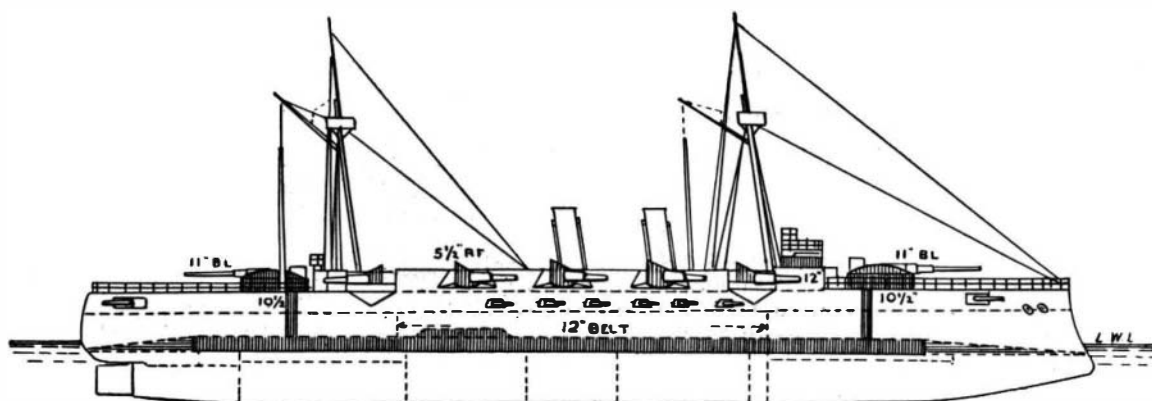
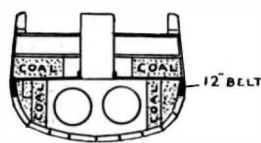


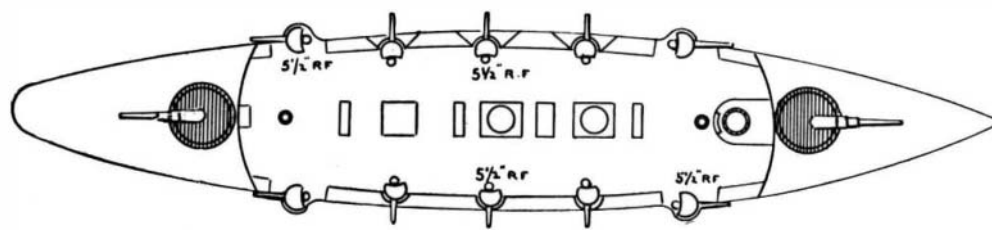
DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISER "CHRISTOBAL COLON."



SIDE ELEVATION



CROSS SECTION



DECK PLAN

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

The other three ships, "Vizcaya," "Maria Teresa" and "Almirante Oquendo," were built at Bilbao, Spain, and launched in 1890 and 1891. Their principal dimensions, etc., are as follows: Length, 340 feet; beam, 65 feet; draught, 21½ feet; displacement, 7,000 tons; speed, about 20 knots for the "Teresa" and "Oquendo" and 21 knots for the "Vizcaya." The water line for over two-thirds of the length is protected by a belt of steel 12 inches thick and 5½ feet deep, part of it being below and part above the water line. At each end of the belts a transverse bulkhead of steel of the same depth extends across the ship to prevent a raking shot from entering the engine and boiler rooms. At the top of the belt and bulkheads, or about two feet above the water line, is a steel deck 3 inches in thickness, which is level between the bulkheads, but curves down to meet the stern and stem (see diagram) below the water line. So far, so good, as regards armor protection. The weak point in this respect is the fact that the sides of the ship above the belt are entirely unprovided with armor. There is thus a space the full depth of two decks, or say about 15 feet, which is penetrable by the smallest shells. It is true there are several feet of coal stowed in the wake of the engines and boilers on the berth deck above the belt, and while

is 5 feet longer, $3\frac{1}{2}$ feet broader and of about the same draught. Its displacement is 400 tons, and its engines of 7,000 horse power drive it at a speed of 30 knots an hour. The three boats are, therefore, two-thirds the length of the big cruisers and are good seaworthy vessels capable of going anywhere with the fleet. They are heavily armed, carrying two 12-pounders, two 6-pounders and two 1-pounders, and would be capable of sinking any torpedo boats they might overtake.

Such is the Cape Verde fleet, whose speed and wide radius of action have already earned for it the title "elusive." Incapable of meeting our battleships in action with any hope of success, its admiral appears to be content with threatening our communications and giving assistance to the beleaguered island by acting as a diversion to the fleets of Admiral Sampson and Commodore Schley. The question of the capture or destruction of the Cape Verde fleet is first and last a question of coal supply, for it will be the scarcity of this that will ultimately drive the Spanish admiral to an active engagement or send him back to Cadiz.

Science Notes.

M. Vallot's observatory on the top of Mont Blanc is to be moved from the Rochers des Bosses, where it now stands, to a rocky point at the same altitude, as the piling up of the snow in its present position interferes with scientific observations. The removal will be difficult, as the whole structure will have to be taken piece by piece on the backs of workmen to the new site at a height where any physical exertion is exhausting. It is hoped that the transfer will be completed in one season.

According to the Bulletin de la Société Française de Physique, M. Crénuieu has devised an ingenious means of producing elliptic sound vibrations in air. By the interference of the longitudinal vibrations of two organ pipes, placed at right angles, and vibrating under the influence of two diapasons with the proper difference of phase, an elliptic motion was set up at the intersection of the tubes, and its existence was made evident by means of delicate quartz fibers which followed all the movements of the air.

Prof. Theobald Fischer contributes a short paper to Petermann's Mittheilungen on the "moraine-amphitheater" of the Lake of Garda, says Nature. The form of the moraine deposits on the inner or Italian side of the Alps differs markedly in type from that on the outer or German side. In the former type, of which the Lake of Garda affords an excellent example, the deposits are laid down in concentric ramparts which turn their convex side to the plains; while in the latter we find the familiar expanded fan shape at the mouths of the valleys. Dr. Fischer avails himself of the very excellent maps and models furnished by the Italian service.

A rather remarkable accident with chloroform is reported from the Catholic Hospital at Herne, Westphalia. It appears that a man had to be operated upon at once for a gunshot wound, and the operation being difficult, the time extended to about four hours. The illuminant in the room was gas, and it is supposed that it decomposed the chloroform with evolution of chlorinated vapors, with the result of incapacitating the two surgeons and so seriously injuring the sisters in attendance that one died on the second day, and the lives of the others were in great danger. The matter is of special interest, because operations have to be performed occasionally without preparation, and it would seem, from this experience, that only the incandescent electric lamp can be safe.

At a meeting of the New York Academy of Sciences, on January 24, Mr. E. L. Thorndike, of Columbia University, gave an account of a long series of interesting experiments on comparative psychology. These experiments were made upon cats, chickens, dogs, monkeys and other animals, and were supplemented by the experience of professional animal trainers. According to a report in Science, cats were placed in boxes with doors so arranged that they could be opened from the inside in various ways, in one set of experiments by pressing a latch, in another by pulling a cord, by pulling a hook attached to a cord, or by turning a button. Again the arrangement was more complicated, and two or three separate movements had to be combined in order to release the door and let the animal out to reach the fish placed outside the cage. Curves were given showing the rate at which the kittens learned the various tricks, the time taken to get out becoming gradually shorter. The trick was always learned by accident; one lucky hit would prepare the way for another. There was no trace of rational inference. Seeing another animal do the trick a hundred times was no help. Nor was it possible to teach the trick by taking the kitten's paw and putting it on the latch, and so opening the door, no matter how often it was repeated. A habit once formed artificially will overpower natural instincts. A chicken that had been compelled to jump from a box to the floor in a roundabout way by a cardboard placed in its way, felt unable to jump down to its food directly when the card was taken away.

Electrical News and Notes.

Prince Victor Emmanuel of Naples is said to be an expert electrician. He experiments on all its applications to light, sound, motive power and photography, and was one of the first persons in Italy to investigate the Roentgen rays.

It is reported that a huge central station will be constructed in Saxony to supply electricity throughout the kingdom; 168 towns will be connected with the station.—Electrotechnische Rundschau.

Twelve thousand mail cars of the German railroads are now lighted by electricity, storage batteries being employed. The light has given full satisfaction and is also said to be cheaper than the gas light used hitherto.—Umland's Wochenschrift.

The Western Electrician has paid great attention to the electrical aspects of the war and has published several columns each week devoted to this subject. A report from Hong-Kong brought by the steamer "Gaelic" states that the night before this vessel left Hong-Kong, Commodore Dewey gave an exhibition of electric light signaling. The Commodore is particularly interested in this branch of naval tactics, as he was at the head of the naval commission which authorized and formulated the method and code. The signals of the war vessels in the harbor of Hong-Kong were answered almost instantaneously from the other ships anchored at various distances.

It would be suicidal for a vessel to enter New York Harbor at night under the present regulations. All the channels of the harbor are planted with contact mines, which, while harmless in the day time, would explode at night by contact. Patrol boats enforce the orders of the authorities and protect the mines and cables from the knives and nets of the shad fishermen or those who are disposed to destroy the mines out of sympathy with the Spaniards. A large number of mines have been placed in our harbors on the Atlantic and the Gulf coast. One or two of the mines which have been cut away from the cables by the propeller of a boat or otherwise have been blown up by the engineers as an object lesson, and the result showed that they are in perfect order. Mines have also been placed in Long Island Sound.

The lack of a trans-Pacific cable under American control was greatly felt after the victory of Manila. The ordinary rate from Chicago to the Philippine Islands is \$2.41 a word.

During the bombardment at Matanzas, on April 27, the electrical ammunition hoists and the turning gear of the New York worked admirably. This news is specially gratifying to those who contended that the electrical transmission of power on shipboard is as reliable as it is convenient and economical.

An elaborate signal service system along the southern coast of New England, with thirty-four stations, is manned by New York militia. If a patrol boat should sight one of the enemy's ships approaching Long Island Sound, she would immediately put in under full steam for a coast life saving station on the southern Long Island shore and signal the militiamen stationed there of the approach of the invading ship. The news would at once be sent on by telephone to Fire Island, Quogue or Montauk Point, whichever station was nearest. These stations are in direct telegraphic communication with the Navy Yard at Brooklyn. As soon as the message was received by telephone at one of the three signal stations named, it would be immediately transmitted to the Navy Yard.

It is said, for the first time in the experience of an army in actual service, the commanding officers of the United States troops will have complete outfits for maintaining telegraphic communications with the various brigades and regiments that go to make the divisions and corps of the army. General Greely also has equipped and has ready for service his field telegraph outfit.

The War Department has decided to erect sets of the "telephotos" at the fortifications at Boston, New York, Fort Monroe, Key West and San Francisco, so that news, instruction and general communications may be transmitted by night as well as by day between the army fortifications which will be in telegraphic communication with Washington and the fleets or vessels of the navy which may be under the guns of the forts or in adjacent waters. It is the intention of the government to equip other stations along the coast with these signals. The inventor has devised a small automatic auxiliary engine connected to a dynamo of sufficient size to supply the lights of the "telephotos." This could be installed at a small cost and could be run without requiring the services of a skilled engineer or attendant.

The great 60-inch search light which was used at the World's Fair now guards the approaches to the harbor at Norfolk, Va., the latter being protected by means of submarine mines. A modern battery of rapid-fire guns for use against torpedo boats and light-draught gun-boats have greatly increased the efficiency of the fort.

THE TRANS-MISSISSIPPI AND INTERNATIONAL EXPOSITION AT OMAHA.

The greatest exposition of America's resources and the products of a nation's thrift ever witnessed, with the single exception of the World's Fair at Chicago in 1893, will take place on the banks of the Missouri in the summer and fall of 1898, at Omaha, Neb. It was at first intended to make the exhibition a regional one, devoted to the products, arts and industries of the States west of the Mississippi River, but this plan expanded as the work progressed, and all the States were invited to take part in it. Then there was some attempt to make it international in character, the foreign flavor being dear to American hearts at American fairs, as is just and natural, and this attempt has been quite successful, as several countries will participate. The work of preparation is well under way, and there is satisfactory assurance that every building will be completed and every exhibit in place when the gates are opened to the public on June 1. The exhibition will continue open until November.

Anyone who visited either of the Paris expositions will readily concede that, although no nation surpasses the French in artistic capacity and perhaps none equals that country in the development of landscape gardening, it is a fact that from an exterior point of view all of the exhibitions held there have been singularly unattractive. The first two expositions were held in the Palais de l'Industrie and were completely housed under a single roof, and there was no special attempt at beautifying the grounds immediately about the Exposition building. And the same was true, in a degree, of the World's Fair in 1889. The space was so valuable that the whole thing was crowded, and there was little opportunity for any display of landscape gardening.

It was reserved for Chicago, in 1893, to make landscape gardening a feature of the World's Fair; and no one who was privileged to see that dream of beauty will doubt the wisdom of the effort.

Profiting by the experience of the Columbian Exposition, Omaha proposes in the forthcoming Trans-Mississippi Fair to pay special attention to scenic effect. The situation of the grounds lends itself in a remarkable way to such an endeavor. There is a splendid plateau covering two hundred acres, breaking off sheer into the gorge which constitutes the valley of the Missouri River. The outlook from the top of this bluff, which has been provided by nature, is magnificent and inspiring beyond expression. Throughout a stretch of a mile the visitor may stand and with his eyes sweep that beautiful valley, with the bluffs of Iowa beyond, for a great distance. At his feet the river bank and stretching southward the busy outskirts of the city of Omaha are seen. Beyond sweeps the majestic river, laden with steamboats and all forms of passenger and freight craft—a typical scene—while in the distance are the marshland bottoms backed by the imposing mesas of the adjacent State.

But this is all natural and God-given. It is to that which art is developing—the exposition grounds proper—that the visitor will turn with chief interest. The landscape gardening on what is known as the Bluff Tract promises to be most imposing. A vast quantity of flowers, shrubs and trees will be set out so as to form a beautifully shaded garden spot. There will be labyrinthic, graveled walks, the more conventional geometric flower beds, hedgerows and lovers' nooks, all in such profusion and with such a wealth of verdure that one may walk by the hour in the serene belief that he is far from the madding crowd in the fastnesses of Nature itself. But in sharp contrast will be the Court of Honor, over the way. Here the long lagoon, dotted by lazy gondolas, weaving in and out and under the graceful arches of the bridges; the picturesque fountains playing in the bright sunlight, the walled sides of the water flanked by the greenest of grass plats, with here and there a pedestaled Apollo or laughing faun, a Bacchus or the struggling Laocoon or the classic figure of the Venus de'Medici, backed by the imposing line of stately buildings and graceful arches and colonnades—all these will make up a picture of amazing beauty and impressiveness. It will not be a "White City." The artists have hit upon a color scheme which will relieve the scene from the hard glare of monotonous concrete, so trying to the eyes at Chicago. The buildings are to be done in neutral tints of Pompeian red and brown and ocher. This is daring and at first thought would seem incongruous. But careful tests have been made, and all now agree that it will be a great improvement. It will really be suggestive of Sienna marble, and will be most harmonious and effective.

The marvelous progress that has been made in the grounds has effectually dispelled any fears that the buildings would not be ready in time or that the opening might be delayed. The experience gained from former expositions has enabled contractors and workmen to erect and complete exposition buildings much more rapidly than was possible even five years ago, and the task of installing exhibits will be a comparatively easy matter, as every inch of space is shown on plans drawn for the purpose of facilitating the work. The governing board has acted wisely in employing a firm of Boston architects to make the general plan of the