moves to the rear of the fuse, and at the moment the same direction for Siboney, where Admiral Sampwhen 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 SUP-PLEMENT, where the text of this most interesting and valuable report is given in full. We have prelowever, 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

picket launches; at a distance of two miles were successful run for Cienfuegos or Havana Harbor. three gunboats, the "Vixen" to the westward, the "Suwanee" due south, and the "Dolphin" to the east; ships been manned by American gunners and engiand the battleships and cruisers lay outside of these, | neers, the probability is that two at least, and possibly in the following order from the westward: Armored cruiser "Brooklyn," 9,215 tons, 219 knots; second-class crable Spanish gunnery and poor Spanish stoking on battleship "Texas," 6,315 tons, 17.8 knots; first-class the one hand, and excellent American marksmanship battleship "Massachusetts," 10,288 tons, 16.2 knots; and good work in the engine room force on the other, seagoing battleship "Iowa," 11,340 tons, 17.1 knots; notably in the case of the "Oregon," rendered the atarmored cruiser "New York," 8,200 tons, 21 knots; tempt one of the most pitiable failures recorded in at close ranges and they carried 11-inch guns, which first-class battleship "Oregon," 10,288 tons, 16.8 knots; history. 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 up to 16 knots an hour and overhaul the fleeing "Texas," and had gone down the coast to Guantanamo

son 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 secondclass 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 un-

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 thy mile run was folly 14 knots an hour. This is only one knot below light incomed, and considering the fact that she that see for many months in the water without clearly or bottom, it is a splendid performance, and specific the state of the second of the seco efficiency of her machineny. Satzengine and boiler

room staff.

We draw particularity finite colle; accompanying diagrams showing their area projections of finite two types of emissions. 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 camage inflicted on the "Colon." In

the three ships destroyed so early in the action, the side armor is a rot centrated in a thick belt which only rises two or three as above the water-line to two birds of the ships, length amidships. Above this belt there was nothing but the thin plating of the both period served generated set of the percussion 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 projec-

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 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 car-

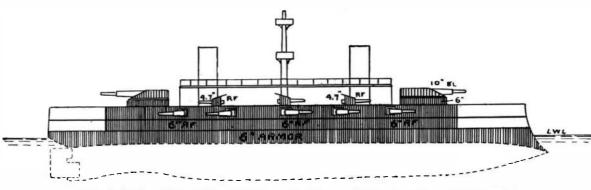


DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISER "CRISTOBAL COLON."

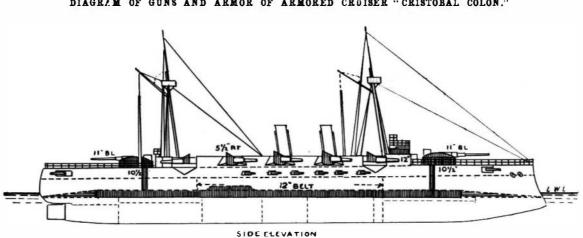
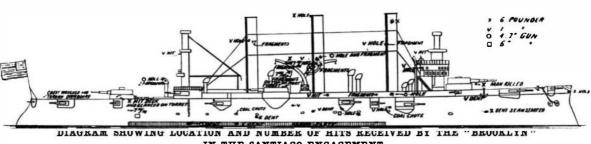


DIAGRAM OF GUNS AND ARMOR OF ARMORED CRUISERS "VIZCAYA," "MARIA TERESA," AND "OQUENDO."



IN THE SANTIAGO ENGAGEMENT.

distance of one mile, in a semicircle, were three der weigh, left astern, Cervera expected to make a tiles they often failed to penetrate, the worst damage

The plan was well conceived, and had these 20-knot the whole four, would have got away. As it was, exe

According to Sampson's report, the speed of the crusiers 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 Spaniard, and the "New York," which was also using for co l, and the flagship "New York" had started in half her engine power and was 7 miles from the harbor ried guns of these calibers.

We cannot close without paying a tribute to the at Champs Elysées, which site also was chosen for the noble qualities displayed by our seamen in the endeaver te save the survivers frem the burning and expleding vessels. The work was full of the most serious risk; but the men in the rescue beats never faltered until the last living Spaniard had been taken off. This is one of the brightest features of the whole story, and the terrific fierceness of the onslaught of our ships is only equaled by the splendid heroism with which the work of rescue was carried out.

### Paris Exhibitions.

The first Paris exhibition was held in the year 1798; it comprised the modest total of 110 exhibitors. and the expenditure was in prepertien, only 60,000 francs. The exhibition buildings were of wood and decorated and were located on the Champ de Mars, about the same place as the great exhibition of 1889. The number of medals distributed was 25! The second exhibition was three years later, in 1801, held in the courtyard of the Louvre, and comprised 220 exhibitors, which put the former

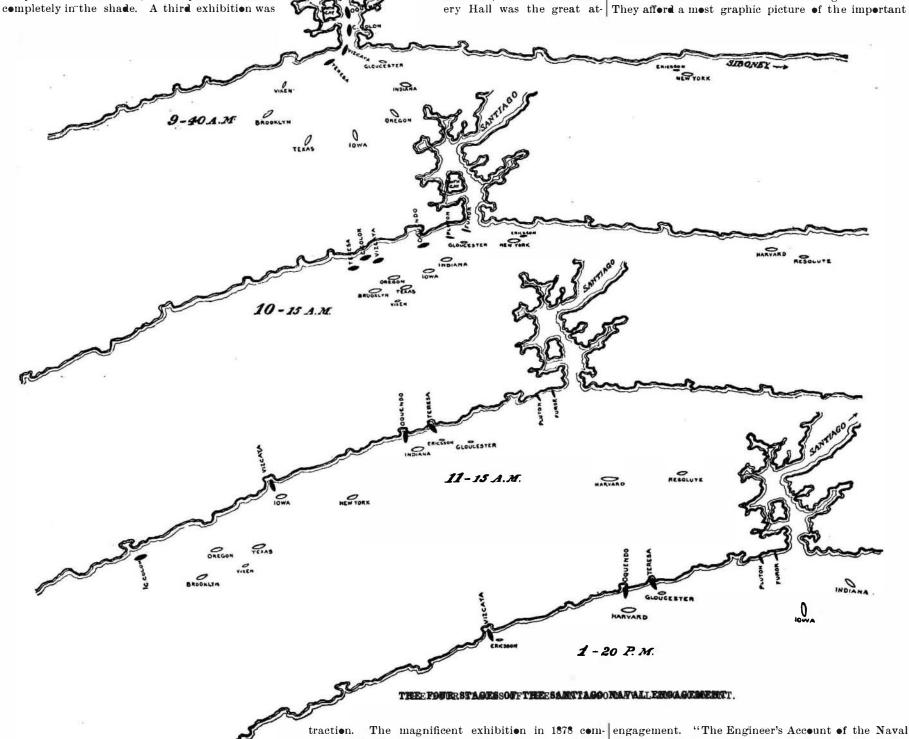
exhibition in 1849. The state grant on that occasion rese to 600,000 francs, and the buildings covered an area of 22,000 square meters. The first world's exhibition proper was opened in the Industrial Palace in the year 1855, when the state grant had risen to 11,500,000 francs and the area covered to 168,000 square meters. There were 23,954 exhibitors, and the number of visitors reached 5,160,000 persons. This exhibition gave an immense impetus to trade and industry. The next was held in 1867, for which 10,000,000 francs were subscribed, and there were 52,000 exhibitors, of whom 16,000 were French. It lasted from April 1 to November

> 3. covered an area of 687,000 square meters, and resulted in a surplus of 2,719,000 visited by an immense numno less than 57 princes. It de Mars, and the Machin-

8,000 tons. Asia has two tin areas-Hunan, in China, estimated by some of the best authorities to produce 10,000 to 20,000 tens a year, but proved by efficial figures to yield less than 2,500 tons, and the Straits Settlements and adjacent principalities, yielding 58,000 tens yearly, the richest yield in the world. Africa has n• kn•wn tin mine; N•rth America n• payable mine; South America only one tin area, Bolivia and Peru, yielding less than 4,000 tens a year, and Australasia, the youngest, contributes about 6,000 tons a year.

#### The Current Supplement.

The current Supplement, No. 1179, contains many articles and documents of great importance. Several pages are taken up by the "Official Reports of the Defrancs. The exhibition was struction of the Spanish Fleet off Santiago," being reports by Admiral Sampson, Commodore Schley, Capber of persons, including tain Evans, of the "Iowa," Captain Clark, of the "Oregon," and Lieut.-Commander Wainwright, of the was located on the Champ "Gloucester." These reports are of the highest historical and technical interest and are given in full.



held the fellewing year on the same spot, the number of exhibitors having risen to 540. Napoleon the Great opened the fourth exhibition, held at the Place des Invalides in the year 1806.

There were 1,422 exhibitors, and several grand fetes were held in connection with it. Number five of Paris exhibitions was held in the year 1819, in the Louvre Palace, the number of exhibitors being 1,622. The sixth was held in 1823, but was not of much importance. Number seven was also held at the Louvre, in 1827, under the reign of Charles X., but, like its predecessor, it was on a more modest scale. The eighth, however, held during the reign of Louis Philippe, at Place de la Concorde, was a great success, the exhibitors numbering 2,447. This figure had increased to 3,381 at the exhibition held in the year 1839 at Champs Elysées, and to 3,960 exhibitors at the one held five years later, also

prised the Champ de Mars, Quai d'Orsay, and the Battle at Santiago" gives a characteristic view of the newly erected Trocadero. There were 52,835 exhibi- fight by our esteemed London contemporary. "James ters, of whom about half—25,872—were French. The Watt and the Discovery of the Composition of Water" visiters numbered 16,100,000, but still there was a is an interesting and valuable paper. "Is There Any deficit of 38,000,000 francs on account of the expensive buildings, many of which were intended to be permanent. The last Paris exhibition, of 1889, far outshone its predecessor, the number of visitors being 32, 500,000, or more than twice that in 1869, while the number of exhibitors had risen to 45,486, of whom 30,122 were French, and no doubt this splendid record will be beaten by the one of 1900.—Engineering.

# The Scarcity of Tin Ore.

The fact that tin, of all the metals in common use, is only sparingly distributed throughout the world is again called attention to by an Australian geologist, Mr. B. J. Skertchley, who has published a monograph upon the subject. While the known gold fields of the world cover more than 1,500,000 square miles, the tin fields have an area of less than 12,500 square miles. Thus, for every square mile of tin ground there are 132 square miles of gold-bearing country. There are seven tin districts in Europe, producing about 8,300 tons yearly, of which the Cornish mines yield about

Excuse for Collisions at Sea?" is the subject of a letter to the editor by Mr. Hermann Herberts. It discusses means for detecting the presence of a vessel or iceberg and shows how their movements may be followed.

## Contents.

(Illustrated articles are marked with an asterisk.)

Armer, verueal versus inclined... \$6
Battleships, higher speed fer our new... \$2
Collisions at sea, prevention of... \$2
Current Supplement, the... 91
Exhibitions, Paris... 91
Exhibitions, Paris... 91
Field glass, an improved type of Zeiss\*... \$4
Field-gun, the 32-inch Driggs-Seabury\*... \$9
Generator. the Criterion automatic acetylene house\*... \$4
Gun carriage from "Maine"\*... \$8
Hospital ships, our\*... \$8
Hospitals, the ancients'... \$6
Insulator, a new\*... \$4
Inventions recently patented... 91
Iron, our progress in the manufacture of... \$7
Jubilee, the approaching scientific... \$3

"•us.... "•reg•n's" brave men in the "Oregon's" brave men in the
firersom, the.

Philippines, a unique map of...

Philippines, a unique map of...

Plotegraph of the hely shroud
by electric light...

Projectiles, a group of navy\*.

Rapid transit in Paris.

Rifles, danger in new hunting.

Santiago engagement, Admiral

Sampson's report of the\*.

Spain's losses on the sea.

Steam motor, a new\*.

Tin ore, the scarcity of.

Trolley line, a military. Trelley line, a military....
Waterloo and City Electric Railway, opening of the......