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THE SANTIAGO CAMPAIGN.

It is gratifying to learn that several thousand troops have been dispatched to assist in the reduction of Santiago and the capture of Cervera's fleet, and that a second division will follow at an early date. It is stated that the force includes a battalion of engineers, some batteries of light and heavy artillery and several detachments of infantry. Accompanying the troops is a complete engineering equipment. The heavy batteries are supplied with 5-inch siege guns and the light batteries carry 3·2-inch guns.

This indicates that the plan of campaign contemplates the reduction and capture of the forts at the entrance of Santiago Harbor, a step which, as we pointed out last week, is absolutely essential, if it be true that the entrance channel has been thoroughly mined by the Spaniards. It would be taking a needless risk to send our ships one by one through a narrow channel sown with mines. By the capture of the forts we can obtain possession of the cable connections which control the mines, and with the firing station in our hands and the guns silenced, our fleet could enter the inner harbor intact and give battle to Admiral Cervera's ships in the best possible fighting condition.

Since the successful reconnaissance made by Commodore Schley, our squadron off Santiago has been strengthened by the arrival of Admiral Sampson with several powerful ships. The combined fleet before Santiago now includes the first-class battleships "Iowa," "Massachusetts" and "Oregon," the second-class battleship "Texas," the armored cruisers "Brooklyn" and "New York," the protected cruiser "New Orleans," the unprotected cruiser "Marblehead," the auxiliary gunboats "Mayflower," "Eagle" and "Vixen," the auxiliary cruiser "Harvard," the torpedo boat "Porter" and other craft of less importance. The guns in the four battleships, two armored cruisers and the protected cruiser available for an attack on the fortifications are more powerful and probably more numerous than those on the fortifications and the "Christobal Colon." There are mounted in these seven ships no less than one hundred and eight guns of 4-inch caliber and upward, the list including eight 13-inch, six 12-inch, thirty-eight 8-inch, twenty 6-inch, twelve 5-inch, four 4·7-inch and twenty 4-inch. The concentrated fire at close range of this tremendous battery, forty-two of which are rapid-fire guns, aided by an attack by the siege guns of our troops on shore, should make short work of the fortifications, powerful as they are. What was left of the forts would be easily carried by assault from the rear.

The fall of Santiago and capture or destruction of the Spanish fleet in the West Indies would be as decisive and far reaching in its effects as the brilliant victory of Dewey in the Philippines.

SMOKELESS POWDER.

Although the war is not many weeks old, it has been waged long enough to impress upon the combatants many important truths which were understood in a vague way before the conflict, but were never appreciated at their full worth until now. We have drawn attention in a previous issue to the lessons of Manila Bay, chief among which is the vital importance of good marksmanship as the decisive factor in a naval fight. The excellent work of our gunners was nothing more than we all expected; it was in keeping with the traditions of our navy, and in the present war, just as in all those that preceded it, the efficiency of our gun crews is the result of much patient and careful practice at the targets during the ordinary routine of peace maneuvers and cruises.

It is our duty, however, to draw attention to the fact that our ships are laboring under a serious disadvantage in having to use the smoke-producing and obsolete brown powder with which they are supplied, instead of the modern smokeless powder, which is in universal use throughout the world. In every engagement which has taken place, not even excluding the Manila fight, eyewitnesses have noted the fact that our ships were speedily enveloped in dense clouds of smoke produced by the fire of their own guns. The smoke in some cases hung like a pall about the ships, completely shutting out the object of attack from our gunners and preventing them from observing the flight of the projectiles. This was the case at times at Manila, it seriously impaired our work at San Juan, and the same trouble occurred in the recent reconnaissance at Santiago. The objections to brown powder were powerfully illustrated in the last named conflict, owing to the fact that one of the ships, the "New Orleans," was using the smokeless powder (cordite) which has been adopted in the English navy. She was not at any time shrouded in smoke, and eyewitnesses spoke in glowing terms of the accuracy and rapidity of her fire.

How it comes that our ships, with the one exception mentioned, are supplied with old fashioned powder when powder of a far more efficient type has been in use in other navies for five or six years is a question that we are unable to enter into fully at this time. There has been a reluctance on the part of our authorities to supply the ships with high explosive powder, because of its dangerous character; but of late years improved powder of this class has been carried on foreign warships in all climates and weathers with perfect safety, and the time has surely arrived when we can venture to adopt that form of smokeless powder which our experts have determined to be the best.

The advantages of the smokeless over the old type are many and valuable. The discharge of a brown powder, especially in the larger guns, is accompanied with enormous volumes of dense, opaque smoke, whereas the smokeless powder produces only a faint mist or haze, which is quickly dissipated. The one produces a large amount of residue which fouls the gun, the other produces but little residue and leaves the gun practically clean for the next round. The smokeless powder is far more powerful weight for weight, the charge of brown powder for our 12-inch gun weighing 425 pounds, whereas the charge of cordite for the 12-inch wire gun weighs only 167½ pounds. Smokeless powder burns very slowly, giving off its gases gradually, maintaining a fairly even pressure throughout the whole bore of the gun, thereby enabling a high muzzle velocity to be obtained with a comparatively low maximum pressure in the gun; whereas the brown powder burns more quickly, producing a less uniform pressure throughout the travel of the projectile in the bore. Fifteen tons to the square inch is the limit of pressure which our guns are designed to stand in service. With brown powder this pressure is reached at the instant of firing, the charge is less gradually converted into gas, and as the projectile travels along the bore the pressure rapidly falls, owing to the increased volume of the space behind the shot. With the smokeless powder, a much higher velocity may be obtained without exceeding the normal pressure of fifteen tons. This is due to the fact that the powder burns more slowly, more gas being given off as the shot travels along the bore. The pressure is maintained at a high level up to the time that the projectile leaves the muzzle, and consequently the velocity is proportionately increased. The muzzle velocity of the 6-inch gun on the "Massachusetts," which uses brown powder, being 2,080 feet per second, whereas the 6-inch gun on the "New Orleans," using smokeless powder, has a muzzle velocity of 2,642 feet per second.

By the introduction of smokeless powder the muzzle velocity of our guns could be raised from 400 to 500 feet per second without exceeding the safe maximum pressure for which the guns were designed. Increased velocity means a more level trajectory and a greater penetration. When to these advantages are added a smokeless discharge and the ability of the gunner to take note where the projectile strikes, the immense superiority of the smokeless powder is manifest.

Excellent smokeless powders have been produced in comparatively small quantities by our government experts; but the private manufacturers have not as yet turned out successful smokeless powder in large quantities. If they apply themselves to the task in good earnest, they can undoubtedly equal or surpass the products of European factories. It is to be hoped that a healthy rivalry will spring up in this important industry, and that before long an efficient, stable and thoroughly reliable smokeless powder will be in general and exclusive use in the heavy guns of both our army and navy.

THE CENTRIFUGAL METHOD OF COLLECTING PLANKTON, THE BASIS OF FOOD SUPPLY FOR AQUATIC ANIMALS.

The Rhode Island Experiment Station is carrying on investigations, not only on land, but also on water farming, since in the near future increasing attention must be given to all possible sources of food supply for man.

As indicated by his annual report for 1897, Dr. Field has been experimenting upon reliable methods for determining the relative economic value of water areas (i. e., of ascertaining how many fish, crabs, oysters, clams, etc., any given particular area of water can sustain). This is of special interest to Rhode Islanders as a relatively large area of the State is shallow water particularly adapted to aquiculture, i. e., marine farming.

The conditions governing the occurrence and growth of the microscopic plants and animals which constitute the fundamental food supply of the edible marine fish and shell fish are manifold, and necessitate local observations and records. Yet the conditions warrant this labor, for in its scientific and economic aspects the question is one of great importance. It has been shown that water areas under cultivation yield per acre a far larger quantity of nitrogenous food for man than does a corresponding area of land.

The writer points out that attempts to collect the matter in suspension in samples of water, for strictly accurate determination, either by biological methods with nets and filters, or by chemical means, have been prolific of errors, and that practically little advance has been made, chiefly owing to inadequate methods of collecting, the average error being at least fifty per cent.

By the use of a special, large centrifugal machine,