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NEW YORK, SATURDAY, DECEMBER 22, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are sharp, the articles short, and the facts authentic, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PLANS OF OUR 20,000-TON BATTLESHIP.

In response to the Navy Department's request for plans for the 20,000-ton battleship authorized by the last Congress, ten designs were submitted. Some of them were drawn by private concerns, and the others by the Bureau of Construction and Repair. The Department favors one of the designs drawn up by its own bureau, and Secretary Bonaparte has, accordingly, recommended its adoption by Congress.

The greatest interest attaches to this ship. It is our answer to the "Dreadnought," a vessel which has come to be considered as the type ship for future battleship construction. Naturally, comparison will be made with that vessel; and in the absence of detailed information as to distribution of weights, and the thousand-and-one elements which go to make up the total efficiency of a ship, it is certain that the Department's plan will be subject to much unfavorable criticism. For, on the face of it, it will appear to the layman that with 2,000 tons more displacement, we are building a ship that is no more powerful than the "Dreadnought."

As a matter of fact, our new ship will be just 2,000 tons, or 11 per cent, more efficient than the British prototype. The same arguments with which, in a recent issue, we urged that the 18,000-ton "Dreadnought" must of necessity be superior to the 16,000-ton "Michigan," will now apply to the question of the relative efficiency of our 20,000-ton new battleship and the 18,000-ton "Dreadnought." Displacement means power, either for attack or defense, and if, as we shall see below, our new ship carries no more guns, and has no greater speed than the British ship, it must inevitably follow that those guns are better disposed, more amply protected, and the security of the whole ship more certainly assured, in the exact proportion of the difference in the size of the two vessels.

Compared with the "Dreadnought," our new battleship, 510 feet long, is 10 feet longer on the water line; has 3 feet more beam, or 85 feet; and is of 20,000 tons displacement, or 2,000 tons more than the "Dreadnought." Her coal bunker capacity is about 400 tons less, and her estimated speed the same. She carries the same armament of ten 12-inch guns; but her secondary battery for repelling torpedo attack is heavier, consisting of fourteen 5-inch rapid-fire guns, as against about twenty 3-inch rapid-firers.

Judging from the fact that the weights allotted to guns and motive power appear to be about the same, it follows that considerably more weight must have been allowed in our new ship to be the most important element of stability and protection. Although the belt armor of the two ships is the same in its maximum thickness, there is no doubt whatever that the Department design calls for a continuation of the maximum thickness of this armor over a greater length of the ship's hull amidships. The belt armor is 8 feet in width with a maximum thickness of 11 inches and its cross section is uniform throughout the length of the belt. Remembering how terribly effective was the heavy gun fire of the Japanese against the unarmored or lightly-armored ends of some of the Russian battleships, our designers are carrying the full thickness of the belt armor much farther forward and aft than has been usual in previous warships which, of course, adds greatly to its weight.

The side above the main belt armor is protected by an upper belt 7 feet 3 inches in width, and of a maximum thickness of 10 inches. This belt also carries its maximum thickness farther fore and aft than has been the usual practice, and serves to afford unusual protection to the substructure of the 12-inch gun mounts. Furthermore, the side of the ship above the second belt is protected by 5 inches of armor, which protects the base of the smoke pipes and the majority of the guns of the 5-inch battery. Particular attention

has been paid to the subdivision of the ship, which has been so worked out that everywhere three separate walls of skin plating will intervene between an exploding mine or torpedo and the magazines.

The guiding principle in working out the hull and the armor plan has been the recognition of the necessity of making the modern battleship more secure against sinking or capsizing, and the larger part of the increased displacement of this ship has been spent in producing a hull that will stand up on an even keel under the prolonged and combined attack of the torpedo, the mine, and of 12-inch batteries of the modern battleship.

The announcement that the design calls for only ten 12-inch guns will produce disappointment among those people, lay and professional, who delight in the spectacular; but this battery will be more powerful, or, rather, more effective, than that of the "Dreadnought," for the reason that all of the guns will be mounted along the central axis of the ship, and will be available on either broadside. This will enable our new ship to oppose to a ship of the "Dreadnought" type a broadside 25 per cent more powerful. At the same time this is done at some sacrifice of end-on fire, which will consist of four 12-inch, as against the six 12-inch of the "Dreadnought."

After all is said and done, it is certain that the Department plan will be criticised on the ground that the battery is not sufficiently powerful for the ship. We understand that among the designs submitted by private concerns was one for a battleship 540 feet in length carrying fourteen 12-inch guns; but, of course, if the greater portion of these guns are mounted in broadside turrets, six of them may be masked when in action by the corresponding six on the opposite beam, and the total broadside available may be no greater than that of the Department's plan, in which the ten guns, being mounted on the longitudinal axis, are available on either broadside.

SANDY HOOK COAST DEFENSES.

The invitation by the United States government to the members of the American Society of Mechanical engineers to pay a visit to that most sacred of all government reservations, Sandy Hook, was a greatly appreciated courtesy to one of the most distinguished and influential technical bodies in this country. The invitation was extended in connection with the recent convention of the society, and as usual, the government treated its guests exceptionally well, \$8,000 being appropriated for the practical exhibition of the working of the many elements of defense in the way of guns, mines, mortars, etc., which render Sandy Hook one of the most formidable of our seacoast defenses. The seven hundred guests of the government were taken down to Sandy Hook in a special train of ten cars, and the first stop was made at the southerly end of the Proving Grounds for the purpose of visiting the great 16-inch army gun, the largest and most powerful rifle in existence. This piece is still mounted on the temporary trial carriage on which it was proved some two or three years ago. The gun weighs 130 tons and fires a shell weighing 2,450 pounds with a velocity of slightly over 2,300 feet per second, and an energy of about 80,000 foot-tons, over 600 pounds of smokeless powder being necessary to secure these results. Although it is not likely that the gun will be re-duplicated, the piece will be permanently mounted at Sandy Hook, and will form a very valuable element in its defenses. It may be remarked in this connection, that the recent determination of the Ordnance Board to abandon the manufacture of guns of high velocity in favor of larger guns of low velocity, lends a new significance to the 16-inch gun, and if it should be decided to adopt for this piece the 2,000-foot-second velocity, which is to be the service velocity of the future, the 16-inch gun will become in a sense rejuvenated, and may be considered to have before it a long period of future usefulness. Two or three hundred yards to the east of the big gun, the visitors were shown two targets representing the side armor, backing, and framing of our latest armored cruisers and battleships, which have lately been erected for the purpose of testing their resisting power to the attack of modern shells. It was noticed that the targets, instead of facing the guns, have been built with their face at a sharp angle to the line of fire; and it was explained that this was done in order to test the resisting power of the armor when struck by shells delivered at an angle 20 degrees from the normal. As a matter of fact the majority of the projectiles which reach a ship strike her obliquely; comparatively few of them are delivered normal to the plate.

The visitors were next taken down to the massive concrete emplacements upon which the various guns which are submitted for proof are tried out. Here, two rounds were fired at a velocity of 3,000 feet per second from one of the latest type of 6-inch rapid fire guns mounted on a barbette carriage. The small interval of time before the shell struck the water, over a mile away, afforded a dramatic illustration of what is meant by a muzzle velocity of 3,000 feet per second. Then followed five rounds from a 15-pounder, semi-automatic,

rapid-fire gun, and three rounds of shrapnel from a 3-inch field gun which were timed to explode above the water at about 1,000 yards range. As the shots were fired to leeward before a 35-mile gale, the sound of the exploding shells could not be heard, and the only evidence that the heavy rain of fragments was being duly scattered was the appearance above the water of a little white ball of smoke, looking for all the world like a puff ball hanging in mid-air. Other tests at this battery consisted of the firing of a 4.7-inch siege gun, mounted on a long recoil carriage; and a 2.38-inch field gun; and ten rounds from one of the famous 1-pounder pom-pom automatic guns. From the spectacular point of view, the most interesting exhibition was the firing, with full charge, of a 10-inch rifle mounted on one of the Buffington-Crozier disappearing carriages. This mount, whose design is chiefly due to Gen. Crozier, of the Board of Ordnance, who was present to receive the guests, is now the standard type of mounting for all the heavy guns of the United States coast defenses. The shell struck the water at a range of about 2½ miles, throwing high into the air a huge geyser of water. Ricocheting, it took another great leap of fully a mile and a half, when it struck again, throwing up another large column of spray, before it finally passed out of sight.

The party then passed on down the beach to the formidable fort known as Battery Richardson, where a large number of 12- and 10-inch guns are mounted on the Buffington-Crozier disappearing carriage. After a 12-inch gun had been raised into battery, traversed, and returned to the loading position, Gen. Murray, mounting the parapet of the emplacement, delivered an address in which he contrasted the best firing results obtained in target practice a few years ago with those of the present year. Five years ago the best results that could be obtained with the 12-inch gun were one shot in 3 minutes, and the percentage of hits was 50 at a range of from 4,000 to 4,500 yards. During the intervening years, thanks to the admirable system of fire control (that is, the method of locating the target, and ranging the guns), the work of our gunners has improved so greatly that last year more than half of the guns fired made a record of 100 per cent in hits, the range has been increased to 4,000 yards, and the average time between shots reduced to one minute.

The visitors then passed on down through the fort to another emplacement, where they were treated to an exhibition of sub-caliber target practice, in which a rifled tube, representing a 1-pounder gun, is placed centrally within the bore of a 10-inch rifle, and all the motions of unlocking a breech, loading, closing the breech, sighting, etc., are gone through exactly as though a full-weight shell and powder were being used.

Considerations of expediency prevent any detailed description of Fort Richardson, and it must suffice to say that the provisions for the safe storage of the powder and shells, the arrangement of the lifts for bringing the ammunition up to the guns, etc., are thoroughly up-to-date and render this fort one of the most complete and formidable of its kind in the world.

All systems of defense of the entrance to the harbors include, in addition to the heavy guns for the attack for armored vessels, provisions for sowing the channels with the deadly submarine mine. The submarine defenses of the Sandy Hook channels are particularly complete. They are arranged on the electrically-controlled system, and have been carried out on the lines which have been illustrated from time to time in the various issues of the SCIENTIFIC AMERICAN. By this system it is possible to discriminate in the treatment of friend and foe. When a ship strikes a floating mine, an electrical contact is made which gives notification to the operator within an armored casemate on the shore. If the ship be a friendly vessel, it is allowed to pass on; but if not, the operator immediately throws a switch and explodes the mine.

From the mining casemate the visitors were next taken to the hidden mortar batteries, from the crest of which they looked down 60 or 70 feet into a series of huge rectangular pits, at the bottom of each of which were four short, massive, rifled mortars, capable of throwing a 12-inch shell to the extreme range of 7 miles. For the benefit of the visitors, a salvo of four guns was fired with reduced charges, the guns having an elevation of about 50 degrees. At the word of command there was a reverberating crash, and instantly the eye was able to follow the skyward sweep of the four projectiles which, keeping the same relative four-square position in which they left the muzzle of the guns, could be seen soaring into the blue, drawing together under the effect of perspective, and diminishing until they were lost to sight. A few seconds later, after they had described a vast curve, whose highest point was a mile and a half above the earth, a cloud of spray thrown up from the ocean some three miles distant from the shore marked the point at which they fell. The exhibition closed with the firing of shells loaded with high explosive or with black powder, and the explosion of a powerful land mine. The latter lifted what appeared to be a veritable mountain of sand, earth, and broken