Protection of Battleships Against Submarine Attack*

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In this Institution we have a meeting ground for the

DESIGN OF A BATTLESHIP
- 335'0" B.P. x 80'0" EX x 38'9"

Fig. 1 RIGGING PLAN.

PROFILE SHEWING SUBDIVISION.

Fig. 2. PLATFORM DECK.

HOLD.

Fig. 3.

SECTION IN WAY OF
MIDSHIP BARBETTE

SECTION IN WAY OF
MACHINERY SPACE

Fig. 4.

BOAT DECK.

statesman, the naval officer, and the ship constructor. The first directs the second, and the third supplies the second with his weapon. We ship constructors are sometimes taken into the confidence of the naval officer, and we try to understand as much as we can of the nature of the onerous duties which he has to perform. We are told that the navy exists to keep the command of the sea, and that command of the sea is necessary for its freedom. To keep the command it is desirable—some say, necessary—to discover and destroy the enemy's forces. Battleships, cruisers, destroyers, submarines, must all be caught and destroyed or captured, and, equally, all must be capable of resisting destruction or capture. In the two dimensions represented by the surface of the sea, with equal powers of vision, getting within destroying distance is a question of speed, and destruction is a matter of superiority of attack over the defense. The dominating weapon of attack has been the gun, and the defense against it has been practically all above water, because there its attack has been made. The torpedo-boat and, later, the destroyer, have delivered their main attack below water, but the attacked ship is held to be quite capable of delivering a counter attack by guns above water, which is an adequate reply to the destroyer. The attack of the submarine is wholly below water, and so far the attacked ship has developed no effective reply of its own. The defense against the gun is armor and other guns. The defense against the destroyer's torpedo is the gun, which is quite ineffective against the submarine. The question of interest at the moment is: What defense can the surface ship have against the submarine's torpedo?

There can be only two forms of defense. First, the destruction of the submarine by other vessels, submarine or others. Second, the protection of the bottom of the surface ships from the effects of under-water attack. The first, the destruction of the submarine, is obviously not the work of a battleship or large cruiser, but must be left to some vessel of the same order of size as the submarine. This destruction must be sought on the surface when the submarine is not submerged, for it seems improbable that a submarine will be able to chase another effectively under the water. In any case, the submarine will be dangerous to the large surface ship until it is destroyed, and, as the means of destruction are not yet

certainly in hand, the question of effectively protecting the battleship against under-water attack seems to be deserving of consideration, unless someone is ready with a real reply to the submarine.

One naturally is first met with the question: What about the weight of such protection? The same question can, of course, be asked in the same attitude of mind about any weights used in a ship for the purpose of attack or defense. What about the weight of armor to keep out shot? The thickness and extent of protection ought to be proportioned to the liability to be hit and the damage done when hit. This principle is given effect to when distributing armor protection over a ship to resist gun fire. What is the relative damage done by a 15-inch

shell and a 21-inch torpedo, and what is the relative liability to be hit by these projectiles? A distinguished gunner told you in this Institution in April that a modern battleship will be destroyed by gun fire in five minutes after fighting range has been reached. The submarine officer will tell you he can get a torpedo into any ship that he can see and can get within the range of his torpedo. The battleship can hit back at his enemy battleship, but can do nothing by himself against the submarine. What is the liability to be hit in the two cases? Can the submarine find the battleship as surely as the enemy battleship can? In other words, what is the relative liability to be hit by the two methods of attack? This is for the naval officer to tell us, if he can. If the relative liability to be hit is sufficiently great to warrant full consideration of the relative damage, we shall also want to know this. Assuming, as one reasonably may, that very serious damage will be done by the explosion of a torpedo, the next question is: What can be done to prevent or seriously to reduce this damage? Subdivision naturally suggests itself as one means of minimizing the effect of this damage, but when all that is possible in this direction has been done, there seems to be no great certainty that a battleship will be still a formidable fighting machine after having received the successful contact explosion of a 21-inch torpedo. Can we do anything in addition to subdivision to preserve the ship for effective fighting purposes?

Armor on the bottom of warships has been proposed by responsible persons. Sir E. J. Reed and General Sir John Crease, R.M.A., during their lives made definite proposals of this character, but they have never been adopted on the outsides of ships, partly for the reason that, previous to the submarine, the torpedo-carrying vessel has been effectively answered by the gun, and partly because the resisting qualities of armor, when submitted to attack by torpedoes, have not been sufficiently well known. The effective advent of the submarine seems to justify a serious consideration of the question of applying armor to the bottoms of ships.

The question of the weight of such armor must be serious, and obviously the addition of such weight cannot be made without some changes and sacrifices. To some it may seem that the readiest way to approach this problem is to clothe the bottom of a 25,000-ton battleship of the latest pattern with armor, and to increase her fullness sufficiently to allow her to carry this armor, letting everything else remain unaltered. The only considerable effect will be to reduce the speed by two knots.

This is a direct and simple issue—is the gain in pro-

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tection worth the loss of speed? This is for the naval officer to decide. The constructor will naturally find difficulties in the way of attaching such armor protection, but he has surmounted difficulties before, and if the naval officer thinks the result worth attaining, the difficulties will doubtless be overcome.

It is not always that the readiest way of approaching a problem gives the best result. One of the characteristics of our latest battleships is that their forms have a low resistance to forward motion. If a form is produced which is better adapted to fitting and carrying armor, though it may involve greater resistance or less speed, it may on the whole be better to adopt such a form. It may be interesting to give an instance or two of the application of this principle. Admiral Sir Reginald Custance has taken us into his confidence about some of his views on the principles which he thinks should underlie naval design. His appreciation of lower speeds and smaller displacements led me to work out what appeared to me to be a limiting case of his views, but combined with these characteristics was associated in this case an armored protection from torpedo attack. The principal elements of the resulting design were as follows:

Length over all.....	358 ft.
Length between perpendiculars.....	336 ft.
Breadth, extreme.....	80 ft.
Draught of water.....	20 ft.
Displacement in tons.....	13,000
Speed.....	10 knots
Armament.....	six 14 in.; sixteen 5 in.

Thickness of armor:

On side at W. L.	10 in.
Above W. L.	3 in.
Below W. L.	4 in.
On casemate.	2 in.
On barbettes.	12 in.
Thickness of protective deck-plating.	2 in.

This vessel may be considered as one which could not be expected to find the enemy unless he happened to be bottled up somewhere, but could be less careful than an ordinary battleship about coming out of port on account of the fear of submarines. The size and cost of this vessel should be small enough to satisfy the desires of Admiral Sir Reginald Custance, but it is doubtful whether she would be altogether satisfactory to him.

Anticipating some want of faith in this unusual vessel, a second design was produced, having some of the characteristics of the first, but being produced with less disregard of convention. The principal elements are as follows:

Length over all.....	460 ft.
Length between perpendiculars.....	434 ft.
Breadth, extreme.....	80 ft.
Draught of water.....	24 ft.
Displacement in tons.....	16,000
Speed.....	18 knots
Armament.....	six 14-in.; sixteen 5-in.

Thickness of armor:

On side at W. L.	5 in.
Above W. L.	5 in.
Below W. L.	4 in.
On casemate.	2 in.
On barbettes.	5 in.
Thickness of protective deck-plating.	2 in.

This vessel is of about the displacement of the "Lord Nelson," which is, when purpose serves, called a dreadnought. The armament is about the same as the first

Fig. 5.
RIGGING PLAN

DESIGN OF A BATTLESHIP
424'0" BP x 80'0" EX x 42'9"

PROFILE SHOWING SUBDIVISION

Fig. 6.

**SECTION IN WAY
OF BOILERS.**

SECTION IN WAY OF
MIDSHIP BARBETTE

design, but the armor has been reduced so that it will only keep out 6-inch projectiles. Sir Reginald's view is that none of our ships have armor that will do more, and, that being so, this ship may be considered as sufficiently well armored above the water-line. All the sections below the water-line are straight, with a circular arc at the end. This form has been adopted to simplify the armor construction of the bottom. It is fully recognized that such a design outrages the convictions of the economists, to whose ranks I want to belong, because ships of such size do not produce the greatest number of guns for a given expenditure. But if we are to be subjected to the ready loss of ships by submarines, we may have to be prepared to sacrifice some gun power for our expenditure, and get our recompense in the greater number of ships and guns remaining afloat after the submarine has done its work. It is very rash on the part of a mere naval architect to attempt to reach any conclusion on this difficult question. The facts and figures are placed before this Institution, so that those who are competent to form an opinion may have the opportunity of doing so.

With a view of enabling those who do not believe in reducing the upper armor of a ship, nor in such a low speed as 18 knots, another design has been considered in which the bottom is armored, and is of a form similar to the second design, but in which the speed, armor, and armament are of the same order as the dreadnoughts. Such a vessel could take her place in the first or second battle squadron, and would have armored protection against torpedoes. The principal elements are as follows:

Length over all.....	600 ft.
Length between perpendiculars.....	570 ft.
Breadth, extreme.....	91 ft.
Draught of water.....	28 ft. 6 in.
Displacement in tons.....	28,500
Speed.....	21 knots
Armament.....	ten 14-in.; sixteen 6-in.

Thickness of armor:

On side at W. L.	10 in.
Above W. L.	7 in. and 5 in.
Below W. L.	4 in.
On casemate.	2 in.
On barbettes.	12 in.
Thickness of protective deck-plating.	3 in.

Briefly, the points for discussion are as follows:

1. Is 4-inch armor sufficient protection against torpedoes to justify its adoption in battleships of the class of the later dreadnoughts?

2. Is the submarine menace of sufficient importance to justify the adoption of 4-inch armor protection on the bottom?

3. Is the submarine menace of sufficient importance to justify the building of smaller, slower battleships of, say, 16,000 tons displacement, of 18 knots, having six heavy guns each instead of eight or ten as in the larger ships?

4. Is the method of applying armor to the bottom of sufficient value in itself to justify the adoption of a form of ship which offers greater resistance than the ordinary form?

These are some of the points which suggest themselves for discussion. The form and arrangement of existing ships, though not revealed to us by the Admiralty, may be considered, for this purpose, as sufficiently well known to many to make it unnecessary for a third design to have been embodied in this paper. If it should seem to be desirable, further, to consider this question of protecting battleships from submarine attack, it will be necessary to determine by experiment the effect of the explosion of a torpedo upon armor attached to a ship. If the submarine menace is judged to be really serious, the necessity for carrying out such experiments seems to be undoubted.