Correspondence.

Marginal Efficiency in Warships.

To the Editor of the SCIENTIFIC AMERICAN:

I wish to say a few words regarding a subject which I do not think has received the attention it deserves among naval architects. I refer to marginal efficiency in warships, which we may define as the ability of a ship to maintain her fighting efficiency against improvements in armor and ordnance. Fighting efficiency is here limited to the ability to give and withstand hard blows. Hence all-around efficiency must include marginal efficiency, speed, bunker capacity, seaworthiness, etc.; and it follows that, other things being equal, the ship with the highest marginal efficiency is the best type of fighting craft and the most economical investment. We may illustrate the practical working of the theory from past experience.

Ten years ago we placed 8-inch B. L. rifles on the "Oregon," while contemporaneous foreign craft carried no medium-caliber guns larger than the 6-inch. To-day, owing to the introduction of the Krupp process, the latter weapons cannot penetrate casemate armor of moderate thickness at the ordinary battle ranges, but the "Oregon's" 8-inch guns, with smokeless powder charges, are still equal to the task. The "Oregon's" marginal efficiency was good, while the foreign ships had none. With this illustration as a basis, we may proceed to define the limits within which marginal efficiency holds good.

I think we may safely assume that the narrower the theory, the easier will be its practical application. Hence I propose to limit it simply to side armor and guns of medium caliber. Nearly all first-class, armored ships mount two or four guns of from 9 to 12 inches bore. Furthermore, water-line protection has advanced so far that "it is only by luck or by indirection that a modern battleship can sink another by gun fire alone." For these reasons we may banish belt armor and the heaviest turret guns to the broad realms of all-around efficiency. Since the province of gun fire is practically confined to the destruction of gun positions and gun crews, the protection afforded the major portion of the factors is of the greatest importance. This "major portion" is undoubtedly concentrated behind the side armor above the belt, and its offensive power is centered in the medium-caliber guns of the main battery. Here, then, marginal efficiency comes into play.

As regards ordnance, I would set the highest marginal limit at the 8-inch, 50-caliber rifle; and the lowest at the 6-inch, rapid-fire of 3,500 foot-seconds muzzle energy. To exceed this limit involves an excess of weight and clumsiness on the one hand and a deficiency of penetrative power on the other. For correlative reasons I would set the maximum thickness of side armor at 7½ inches (Krupp) and the minimum at 6 inches. On a given displacement, of course, it is necessary to strike a balance somewhere between these limits of ordnance and protection, and the skill of the naval architect will appear in his ability to do this. If, for the same weight that gives us a battery of sixteen 6-inch rapid-firers protected by 6 inches of armor, we may have eight 7-inch guns protected by 7 inches of armor, it is apparent that in a duel at a range of 2,000 yards the 7-inch aggregation would be victorious, and hence would have the greater marginal efficiency. From this it will be seen that the improvements which govern marginal efficiency are not limited to new inventions, such as, for instance, smokeless powder and Krupp armor. Structural changes are of importance. The introduction of the so-called "box battery" has nullified the marginal efficiency of the English ships which carry their guns in a number of single casemates. Similarly, ships which offer no protection against shells that might enter and burst underneath their gun positions cannot be said to possess marginal efficiency. Such vessels, however, are not necessarily inefficient, for "et tu quoque" tends to equalize matters.

Protected cruisers have no marginal efficiency. The present type of armored cruiser has little, if any. It might easily be obtained in this class of vessels by improvements on the design of the "Vittorio Emanuele." If, by raising that ship's displacement to 14,500 tons, she could be provided with sufficient side armor to obviate the bursting of 6-inch shells underneath the turrets on the main deck, her marginal efficiency would be excellent. A comparison of such a craft with our own "Tennessee" emphasizes what has been said above, namely, that with other things equal, the ship with the highest marginal efficiency is the best fighting machine and the most economical investment. In this case "other things" would be just about equal. But at the ordinary fighting ranges the "Vittorio Emanuele's" 8-inch shells would go crashing through the "Tennessee's" 5-inch side armor, while the latter ship's 6-inch rapid-fires would be absolutely ineffective against the Italian's gun positions. Moreover, the "Vittorio Emanuele's" 8-inch rifles give her a substantial margin of power as an offset to the next improvement in armor. The same cannot be said of the "Tennessee's" 6-inch rapid-firers.

Marginal efficiency demands that we should be as forehanded as possible in the matter of improvements. For this reason it would seem to be a short-sighted policy which limits the length of our present 7-inch guns to 45 calibers. In the natural course of ordnance development, the 50-caliber, 7-inch rifle is bound to appear. We should increase the marginal efficiency of the "Connecticut" and "Louisiana" by giving them guns of this length of bore. Furthermore, it would be expedient to banish the 6-inch rapid-firer from the batteries of our armored cruisers; for, according to our assumed standard of efficiency, that weapon constitutes the lowest marginal limit, and against adequate protection its rapidity of fire is of no avail. It is poor economy to build ships costing about $7,000,000 apiece, only to have their fighting powers heavily discounted by a comparatively slight advance in the development of armor and ordnance.

In conclusion, it would be well to note that the submerged torpedo is a powerful auxiliary to marginal efficiency. In the last stages of a hard-fought engagement, a fast battleship might resolve herself into a torpedo boat, and in this manner accomplish what she could not do by weight of gun fire alone. The absence of torpedoes on our latest ships renders them particularly liable to this form of attack. It is earnestly to be hoped that in future designs the defect will be remedied.

PAUL D. ERMMONS.

285 Meridian Street, East Boston, Mass., February 2, 1903.

The Naming of Battleships.

To the Editor of the SCIENTIFIC AMERICAN:

I have not seen in your paper, or any other, any reference to the absurd blunder made in naming the four coast defense monitors recently built for the navy after the States.

It is also a mistake though not so bad a one, to name the eight armored cruisers now building for the States.

The result is that only eight or nine names of States are left for future battleships, and these will be used up in two or three years at the present rate of building.

As none of the armored cruisers have been launched, it is not too late, I suppose, to have their names changed to that of large cities, corresponding to the "New York" and "Brooklyn."

In the case of the monitors the Indian names like our present monitors would have been admirably suited to them.

Is it not possible to correct both these blunders by immediate agitation?

J. PICKERING.

Salem, Mass., March 10, 1903.

The "Esmeralda" and the "Charleston."

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your last issue remarks on cruisers by Mr. Daniel M. Coffin, Jr., in which he compares the Elswick-built "Esmeralda" to the U. S. S. "Charleston;" and I would like to say that while I am a very great admirer of Armstrong's designs, yet to a certain extent some of their vessels seem to me to partake of the nature of "freak" ships. I perfectly agree with your remarks on the subject, viz., that to rightly compare two vessels one must not only take into consideration the four great essential qualities, speed, radius of action, gun power and defensive armor, but, also, as you say, we must take account of stores, ammunition, gun mountings, ability to handle ammunition quickly. I might add structural strength and the best possible model for the best possible ship in a seaway.

One vast superiority the "Charleston" would have over the "Esmeralda" would be her ability to fight her batteries in a heavy sea, affording as she does a much steadier platform for her guns; whereas the "Esmeralda" must in a seaway be a very wet ship. A ship with the proportion of beam to length of the "Charleston" class would be, or ought to be, a much more weatherly ship than the "Esmeralda." Then again, as you have pointed out, most of the "Charleston's" heavy guns are behind armor, whereas the "Esmeralda's," all being in open battery, in a close action would soon be completely disabled, even by common shell. Speaking of British ships being undergunned, I must admit that they all, or at least some types, are. But in the line of armored cruisers, I don't think it can be said that the "Black Prince" and "Duke of Edinburgh" class are. These ships are the first that have been designed by Mr. Watts, the new chief designer, since the resignation of Sir William White, and they show a marked change. Their dimensions, etc., are as follows: Length on water line, 500 feet; beam, 73 feet; mean draught, 26 feet; displacement, 13,500 tons; speed with 24,000 indicated horse power, 22½ knots. They are to be armed with six 9.2 B. L. 45-caliber guns, ten 6-inch Q. F. guns, besides the usual number of 3-inch and machine guns, placed as follows: one each 9.2 fore and aft on the axis of ship in an armored turret; the other four on each bow and quarter in turrets, and the ten 6-inch in a central battery. The armor on turrets will be 7-inch Krupp. The side armor of central battery extends in width from 5 feet below water line to the main deck, thus forming a continuous protection for 6-inch guns with splinter bulkheads between. It can thus be seen that these are very powerful ships, and cannot be called under-gunned. I might also say that the battery is all quick-firing, as three rounds per minute have easily been fired from 9.2-inch guns under strictly service conditions, and as many as four and five rounds per minute have been obtained.

W. R. SHUTE.

Halifax, Nova Scotia, February 4, 1903.

Further Information on Muirhead-Lodge Wireless Telegraphy System.

An interesting attempt to prove the efficacy and practicability of the wireless telegraphic system invented conjointly by Prof. Oliver Lodge and Dr. Muirhead is being made by the Eastern Extension Telegraph Company, of England, which has equipped its two new cable vessels to be dispatched to the southern seas with this apparatus. These two cable steamers, named "Patrol" and "Restorer" respectively, have been specially designed to accomplish the work concerning the up-keep of the enormous stretches of cable laid and to be laid between the continents of Asia and Australia. They will not return to England until they have been absolutely worn out and are unfit for further service, when they will be relegated to the scrap heap. The ships are strongly constructed in view of the exceptional nature of their employment, and their equipment is of the latest and most approved design. Each ship is provided with four huge tanks with a capacity of nearly 28,000 cubic feet, to contain the cable, and very powerful gear is furnished for picking up a broken and damaged line, and for paying out. The ships are replete with numerous instruments for testing purposes, while by an ingenious arrangement the position of a break, although considerably distant from the position of the ship, can be gaged to within fifty yards.

The object of the wireless telegraphic installation is to enable the vessels to exchange communication with cable stations. By means of this equipment it will be able to stop ships on their way home from repairs, and direct them to whatever point they are required, thereby not only saving expense but enabling communications to be re-opened in a shorter time than would be possible if the ships were not provided with this apparatus. It may be mentioned that the Eastern Extension Cable Company already has a permanent wireless telegraphic installation at Porth Curnow, its chief land station in Cornwall. It is proposed that the "Patrol" shall be stationed at Singapore, and the "Restorer" at Adelaide, at which ports the company has depots for the storage of cable. The tanks of both vessels are fully loaded partly with spare cable to be landed at the depots, and also with a cable to be laid for the Netherlands government between Balikpapau, in Dutch Borneo, and the Island of Celebes. The cable is about 650 miles in length.

Proposed Railway in Crete.

The autonomous government of Crete has decided to build a railway of 100 kilometers in length from Candia to the interior provinces on the plains of Messara. The road will serve the purpose of transporting the products of the interior to the port of Candia. Three European engineers have been engaged to make the necessary surveys and topographical drawings. Their work will be completed by the end of March. The road will be built in accordance with the data thus collected. It may be that some American engineer may care to undertake the building of the road. He can obtain the necessary information by addressing the firm of Richard G. Krüger, Candia, Crete.

The Current Supplement.

The leading article of the current SUPPLEMENT, No. 1421, is an illustrated description by H. A. Crafts of the flood reservoir at Fossil Creek. Mr. J. D. Geddes continues his description of photography as applied to illustration and printing. The paper by Messrs, Hutton and Petavel on high temperature electro-chemistry is likewise continued. Fabry and Perot recently communicated to the Académie des Sciences a paper on a source of intense monochromatic light. The paper is translated. Fred. T. Jane presents another installment of the Naval War Game, describing a torpedo action off Key West involving mutual destruction. W. S. Blatchley and W. H. Sheak give an account of Trenton Rock petroleum. The strange animal discovered by Sir Harry Johnston in the heart of Africa, and called by naturalists "Okapi," seems to have been known to Egyptians, if Prof. Wiedemann is to be believed. The Professor has ingeniously compared the living okapi with Egyptian conventional pictures of gods, and has shown that the head of the god Set is a copy of that of the okapi. Prof. Wiedemann's article is published in this SUPPLEMENT. The Consular Notes and Selected Formulæ and Trade Notes and Recipes are also published.

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