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Gold Medal Prize Essay, 1906

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GOLD MEDAL PRIZE ESSAY, 1906.

Subject:—

"WHAT IS THE RELATIVE VALUE OF SPEED AND ARMAMENT, BOTH STRATEGICALLY AND TACTICALLY, IN A MODERN BATTLE-SHIP, AND HOW FAR SHOULD EITHER BE SACRIFICED TO THE OTHER IN THE IDEAL SHIP?"

By Lieutenant B. E. DOMVILE, R.N.

Motto:—

"Qui Trop Embrasse Mal Etreint."

INTRODUCTION.

A battle-ship is a vessel capable of taking its place in the main fighting line.

In the present day of large armoured cruisers, the line of demarcation between the battle-ship and the cruiser becomes hard to define, and no attempt will be made to do so.

Formerly the battle-ship was a vessel heavily armed and protected, and of a moderate speed, whereas the cruiser was a fast vessel, of large coal capacity, lightly armed and protected.

Nowadays, naval shipbuilding policy shows a tendency to combine all these qualities, namely, speed, endurance, armament and protection, in one type of large armoured vessel, and the battle-ship and the cruiser are so rapidly approaching one another that there is no fear of being accused of encroaching on cruiser territory whilst discussing the pros and cons of the vital matters dealt with in this essay. Nothing will be said on the subject of the soundness of the policy of possessing one type of armoured vessel in the future, but a ship will be dealt with only on her merits as a battle-ship, as already defined, and her qualities as a cruiser, where speed is a *sine qua non*, will not be considered.

The paper is divided into four parts, which, taken in the sequence mentioned below, will, it is hoped, clearly show the line of argument and the deductions therefrom.

Part I.—In which are separately discussed the values of speed and armament, both tactically and strategically.

Part II.—In which are compared the relative values of these two elements, both tactically and strategically, and in which an attempt

is made to demonstrate the reasons for giving preponderance to one or the other.

Part III.—In which are reviewed the lessons bearing on the subject which may be gleaned from the recent war in the Far East.

Part IV.—In which the subject is approached from the constructor's point of view, involving the consideration of actual weights and measurements, from the perusal of which it may be seen how the same two elements are associated in the intricate *ensemble* of the modern battle-ship, and whence may be deduced the speed and armament which can be reckoned on in the ideal ship.

PART I.

MOBILITY is necessary to war-ships: (1) To convey the armament from place to place—this is the strategic side. (2) To enable the armament to be used to the greatest advantage—this is the tactical side.

The higher the speed the more quickly can the gun-power be removed from one position to another to occupy a fresh strategic or tactical position.

The principal strategic advantages claimed for an admiral whose fleet possesses a superior speed to the enemy are:—

1. That he is enabled to force or to refuse action.
2. That he can choose his time and place for action, if he decides to accept it, having regard to the sun and wind and to the position of his own and the enemy's bases and reinforcements.
3. That he can follow up a victory or flee from a lost field at the conclusion of a battle.

As regards the forcing of an action, it must be borne in mind that it is necessary to get the enemy into the open sea to render it possible, and that if he is unwilling to fight an action, it is unlikely he will have left harbour, unless he is seeking, with an inferior fleet, to make a junction with a friendly fleet, or unless he is forced from his port by some strong military reason, as the Russians were forced from Port Arthur on the 10th August, 1904.

A good example of the strategic advantage of superior speed was afforded in the Grand Manœuvres which took place during the summer of the present year, and in which Sir W. May was enabled to refuse action and to rescue his numerically inferior fleet from the clutches of Sir A. Wilson's fleet. Sir A. Wilson's fleet-speed was less than that of Sir W. May's, though he had a few individual ships as fast as the latter's ships.

The assumption that the faster fleet possesses the choice of time and place for the action is theoretically sound, but in practice is very doubtful.

Battles have a way of being fought near the land, at strategic centres, and thus it happens that the land is as often as not the determining factor. For example, Togo, at Tsushima, had the advantage of the Russians in point of speed, but he joined action under disadvantageous meteorological conditions because he preferred to retain his strategic position between the Russians and their destination rather than let them pass to the northward of him, and then make use of his superior speed to force an action.

I witnessed a very striking example of the disadvantage of position during the Summer Manœuvres of the present year, where one cruiser steaming at 21 knots was enabled to defeat a cruiser of far greater gun power but of a less speed by engaging to leeward, when the latter was able to fight only two of her weather guns on account of the heavy spray breaking over the remainder. On the other hand, the lee guns of the weaker craft were all available.

The advantages of a high strategical speed to enable a victorious fleet to reap the full harvest at the conclusion of a battle are very great, in fact, no case can be imagined in which speed is of greater advantage to a battle-ship. Similarly, the advantage of speed to a beaten fleet is great, in that it is thereby enabled to seek safety in flight.

The advantages claimed and discussed above refer to what may be termed, for want of a better name, "Battle Strategy," that is to say to the strategy immediately preceding the decision to fight or avoid a fight, or immediately after the conclusion of a fight. The advantages under other strategical conditions of being able to steam from place to place at as high a speed as possible are sufficiently obvious to need but slight comment.

The faster a fleet steams the harder will it be for an enemy's scouts to locate it, and the larger will be the number of them required to keep touch with it when found. The enemy's battle fleet will have less time in which to prevent it carrying out its purpose, and if of a lower speed itself will probably be unable to defeat this purpose, whether it be junction with another fleet, arrival at a base, or any one of the hundred and one things which a fleet may require to do in time of war. In any case, a high speed means a shorter time *en route*, and nothing is ever lost by saving time.

Another advantage of a high strategical speed for a battle fleet, and one not very generally recognised, is that the fleet is much more immune from attacks delivered by torpedo craft, for the higher the fleet-speed the smaller is the angle of danger from which an attack may be expected, if it is to have reasonable prospects of success.

A division of destroyers making an attack cannot use a higher speed than 18 to 20 knots for their fleet-speed. In the case of torpedo-boats this speed is reduced to about 16 knots. If the battle fleet speed is 14 knots it is only liable to an effective attack from a direction included in an arc of 45° on each side from right ahead.

We will now turn to the tactical side of the speed question. The tactical advantages of having a speed superior to the enemy's are further to seek than the strategical advantages, and will have to be dealt with at greater length.

We will first see what are the objects at which an admiral wishes to arrive by a successful display of tactics. They may be enumerated as follows:—

(1) To fight the action at the range at which he considers his gun-fire will have its maximum power to damage the enemy relative to the latter's power to damage him.

(2) To bring the maximum gun-fire consonant with the tactical position mentioned in (1) to bear on the enemy whilst at the same time receiving the minimum from him.

(1) Is a question of space; (2) is a question of angular bearings in space, and involves the necessity of knowing the arcs of training of the guns of the two opposing fleets, so that the number of guns which can be fired on any particular bearing may be calculated. In this respect the present battle-ships of the British Navy, and indeed of all Navies, are essentially broadside ships; that is to say, that their maximum gun-fire is developed on the beam. The fire of the heavy guns of the main armament is in most cases lost owing to the guns ceasing to bear at 30° before (or abaft) the beam in the case of the after (or fore) turret. As we shall see when we come to the design of the ideal ship, this maximum development abeam is a necessity.

The position in which the admiral wishes to place the enemy is, therefore, on or near his beam, with the whole broadside of his fleet bearing.

It is now universally agreed that single line of some sort is the only practicable formation in which a fleet of modern battle-ships can be taken into action, though only as recently as last year the French fleet, under Admiral Fournier was trying group formations during its summer manœuvres, apparently without much success.

Single line is more mobile than any other formation, the principal objections to it being that only a certain number of ships can be placed in the line without unduly protracting it and making it unwieldy, and that whatever signals may be necessary take longer in traversing the line, and are more likely to be obscured by smoke, the latter being more particularly the case in line ahead.

In a large fleet a flying division working independently could probably be used with advantage, and a repeating ship out of the line would meet the second objection.

We have now arrived at the conclusion that the admiral wishes to go into action in single line, and since we have previously seen that he wants to fight a broadside action, single line ahead is the most convenient form for his purpose, and one in which his fleet is more likely to keep in station than any other. If the enemy is also in single line ahead, the ideal position in which he would like to find him, is steaming at right angles to his own course, so that he could cross ahead or astern of him and concentrate the fire from the whole of his fleet's broadside on the enemy's end ship whilst receiving only the fire from the chase guns of this ship. This is, however, pre-supposing an inferiority in the enemy's admiral in thus allowing himself to be caught at such a tactical disadvantage, and in approaching a problem of this kind it is necessary to credit each side with equal skill, whether in handling ships, controlling fire, or laying guns. If we take the enemy's fleet to be a "broadside" fleet too, the combat will probably be joined with both fleets steaming parallel to one another in line ahead.

The first thing for the admiral of a fleet to do on being warned by his cruisers of the approach of the enemy's battle fleet, is to endeavour to place his fleet in the best strategic position for the approaching fray, having regard to the weather conditions, the positions of his own and the enemy's bases, and possible reinforcements.

It is hard to define the point at which strategy may be said to cease and tactics to commence. In these days of wireless telegraphy, efficient scouting will portray to the admiral of the battle fleet the position and disposition of the enemy's fleet long before he himself

gets within sight of it. Thus Admiral Togo, speaking of his approach to the Russians before the battle of Tsushima, says:—

> "In spite of the thick mist which confined the vision to within five nautical miles, the information thus received (*i.e.*, by wireless from his cruisers) enabled me at a distance of several tens of miles to form a vivid picture in my mind of the condition of the enemy."

We will, however, consider that tactics commence when the battle fleets sight one another, say at about 20 miles apart; until the fleets arrive in contact we will term these tactics the tactics of the approach.

The tactical object of the approach is to reach the desired position for opening fire without exposing oneself in an inferior tactical position when once within the limits of long-range fire. To discuss this approach in all its possible combinations would require an unlimited amount of space.

The question that concerns us is as to whether superior speed enables its possessor to gain any advantage on the approach. With fleets well handled the answer is in the negative.

On sighting the enemy an admiral should place his ships on a line of bearing which is the same as for the reciprocal of the enemy's course, and then manœuvre them by turning them together so as to arrive in his chosen position. By assuming this formation, even if it leads him to approach in line abreast, he can gradually round his fleet up into very fine quarter line whilst still outside the limits of gun range, and can then make the final closing movement with the whole of his broadside bearing, and turn into line ahead when he has reached his desired position, though the latter movement is contingent on the enemy having also rounded up into line ahead; a larger or smaller turn may be necessary to keep the desired range.

Assuming that the admiral in command of the fleet of inferior speed is not desirous of avoiding an engagement, he can take up no position during the approach which will give him a superior distribution of fire, but he can and will see that the faster fleet does not obtain an advantage over him in this respect. This he does by turning so as to prevent his enemy from approaching him from any position except one near his beam so as not to run the risk of being enfiladed. This turning movement is at once conformed to by the admiral of the faster fleet so as not to be taken at a disadvantage himself. The final approach of two well-handled fleets, even if of unequal speed, will consist in a gradual closing in to gun range, with the fleets in very fine quarter line and parallel to one another. The approach will be made with the fleets abeam or nearly abeam of one another, so that the whole of the guns on the broadside will bear. Since the admiral of the faster fleet cannot possibly prevent his adversary from turning so as to keep him abeam, he gains no advantage from his speed on the approach.

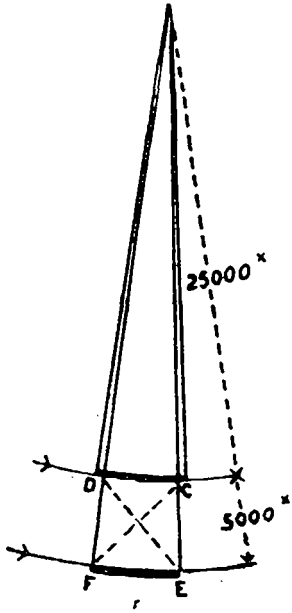
So much for the approach. We will now suppose that one admiral (A) has arrived in his chosen position for opening fire, both for distance and bearing, and that he has an advantage over the enemy (B) in point of speed, and will proceed to see how, if at all, he may turn it to good account. It may be taken for granted that neither side will indulge in any complicated manœuvres once fire has been opened on account of the difficulties they produce in controlling the gun-fire

There are two methods of procedure open to A:—

1. He may reduce speed to that of B, trusting to superior fire to give him the victory in an encounter which has now resolved itself into an artillery duel.
2. He may allow his fleet to draw ahead of B's fleet, in which case, to avoid passing out of range, he will alter course in succession towards B so as to keep all his broadsides bearing, and try to draw across B's bows to attain the ideal position previously mentioned and known as "crossing the T," at the same time putting the after guns of B's broadsides out of bearing and therefore out of action. B counters this move by turning his ships away in succession, so as to keep A's fleet on the same relative bearing, and avoid the risk of his fleet being enfiladed; the battle again resolves itself into an artillery duel, in which the two opponents are circling round on arcs of circles whose radii vary as their speeds.

We will now see if the faster fleet can claim any appreciable advantage in this concentric circle action.

DIAGRAM I.—SCALE, 1 INCH = 10,000 YARDS.



To investigate this matter a diagram has been drawn to scale showing two fleets abreast of one another and 5,000 yards apart. The faster fleet is steaming at 18 knots, and the slower at 15 knots. Each fleet consists of 12 ships at 2-cable intervals, and there is thus 4,400 yards between the leading and rear ships in either fleet.

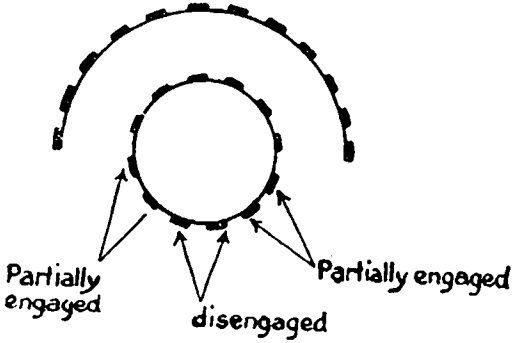
The course of the ships at any time is along the tangent to the circle at that point.

If each ship fires at her opposite number in the other line, no advantage accrues to either fleet, since each ship is firing within a degree or two of her beam.

If concentration of fire on the leading ship in each line is required, the rear ship F of the faster fleet will be firing 38° before her beam, whilst the rear ship D of the slower fleet will have to train her guns 47° before her beam, and this difference of 9° represents the maximum advantage which any one ship in the faster fleet possesses over any one ship in the slower fleet. This advantage, though possibly sufficient in the present case to make the difference between the after guns being out of bearing or not, is practically negligible, as it is excessively unlikely that concentration of fire to such an extent would be required. The case which is demonstrated is a very favourable one for the faster fleet, since it is evident their advantage increases with the number of ships in each line, the shortness of the range, and the diminution in speed ratio. To take an extreme case: If the speed ratio is 1 :2 and the range so short that the slower fleet will occupy the whole circumference of its circle, it is evident that nearly half its ships will be disengaged.

This case is shown in Diagram II.

DIAGRAM II.—SCALE, 1 INCH = 2,000 YARDS.



However, the first-mentioned case is a very favourable one in practice, as the range is not likely to be much less than 5,000 yards, the speed ratio less than 5 :6, or more than 12 ships to be placed in any line. We may safely say that for all practical purposes speed is of no advantage for enabling the admiral of the faster fleet to attain the second object of a successful display of tactics mentioned above, that is to say, a relative preponderance of gun fire.

Now let us suppose that for one reason or another the admiral (B) of the slower fleet considers that it would be to his advantage to fight at a lesser or greater range.

If the former, he will either lead off along the tangent to the circle, or will attempt to close more rapidly by turning together towards A's fleet, using an angle of turn not large enough to put his after guns out of bearing. It is quite evident that it is open to A to checkmate this move directly he discovers it by making a similar turn. If he does not wish to prevent it, and continues on his course,

he at once commences to draw ahead, and B has to turn away to avoid being enfiladed.

Should B wish to increase the range, he will turn his ships away either together or in succession. Here again it is open to A to prevent this move; if he does not do so, but continues on his course, he will draw ahead as before, but in this case B will not be placed at any disadvantage since the fleets are opening, and if this course is pursued, both fleets will pass out of gun range, without either obtaining any advantage in distribution of fire.

If A wishes to alter the range at any time, it is always open to him to do so by making a suitable turn, and regulating his speed so as to keep the bearing constant. These movements B is powerless to prevent since he has the disadvantage in speed. We therefore see that superior speed does enable its possessor to control the range at which he will fight, or to realise the first object of a successful display of tactics. The slower fleet can open, if permitted to do so, without placing itself at any disadvantage, but directly it attempts to close it drops astern and has eventually to turn away again to avoid being enfiladed. Superior speed does not, however, enable its possessor to realise the second object of a successful display of tactics, that is to say a better tactical distribution of fire. With equal skill in handling the fleets on both sides, this can only be obtained by a better arrangement of the gun positions on one side or the other.

It has been mentioned previously in the course of the discussion that a large battle fleet would probably have to be divided into two parts, on account of its unwieldiness and tendency to straggle if handled as one unit; one part would form the main battle line, and the second part a flying division.

Opinions differ as to the largest number of ships which can be conveniently handled in one line, but twelve is about the limit. The question naturally arises, to what use would this flying division be put, and would a high speed be of advantage to it? The use to which it would be put would depend entirely on the relative strength of the opposing fleets. The enemy's line would, of course, be opposed by at least an equal number of ships. If he employed a wing division too, the two wings would naturally fall to one another's lot, and speed would only be of advantage in so far as has been already shown to be the case for the main fleets. If, on the other hand, the enemy had his whole strength in one line, then the wing division, acting independently would endeavour to seize a favourable opportunity, to envelop his head or rear, and to place him under a cross fire. Under these circumstances a high speed would undoubtedly be an advantage.

With numerically equal opposing forces, to have one portion of the fleet of a higher speed, and to detach it to make an enveloping movement, has been tried in the Mediterranean this year, and shown to be of no use. It has been demonstrated that such ships are better kept in the main line.

The tactical advantage of speed when regarded as an actual velocity, and not in its relation to the enemy's speed, is that less time is given to the enemy in which to make up his mind how to counter any particular move, and this is an undoubted advantage to the initiator of this move.

We will now turn to the values of armament strategically and tactically

They may be briefly summarised as follows, as we will not consider the distribution of the armament at this point:—

1. Strategically.

The strategical value of being of a more powerful armament than the enemy is that concentration is forced on his fleets to a greater extent than would be the case if his ships were equally gunned to our own.

2. Tactically.

Superior armament enables us to hit the enemy harder and faster than he is hitting us, unit for unit. It also enables a fleet to be of equal offensive strength to an enemy, but more mobile by reason of containing a smaller number of units.

In the above discussion on the merits of speed and armament, the gun armament only has been mentioned, whereas there are in reality three types of offensive weapon in a modern ship—the gun, the torpedo, and the ram—of which by far the most important is the gun.

As regards the torpedo, it is a most deadly weapon in its proper sphere, the torpedo craft; it is, however, difficult to see to what use it is going to be put in a battle-ship—it is, in fact, more a potential menace than an actual danger. The common argument in favour of its retention is, that it will keep the opposing fleets at a distance outside its effective range—say 3,000 yards—and will render an attempt to ram dangerous; but in the present state of naval artillery the opportunities of using it would be so few and far between, and the results so uncertain, that the large percentage of the displacement given up to torpedo flats, etc., would be far better utilised in increasing the gun armament and its protection. Not that it is likely that future actions will be fought at nothing but long ranges, as will be seen later; but it is probable that in the mêlée of close action the chances of launching a successful torpedo are likely to be very few indeed. Of course, the doings of other nations have to be watched in this, as in all other matters, but everything considered, one submerged flat with two tubes, one on or near each beam, should suffice. At present battle-ships carry four or five tubes, and have at least two large flats. Two eminent Frenchmen, to wit, M. Lockroy and M. Bos, are strongly in favour of the abolition of torpedoes in battle-ships. Incidentally it is doubtful whether, in torpedo warfare, any advantage will be conferred on the adversary possessing superior speed, since the whole point of torpedo firing is that the ship must be turned at such an angle that the tube bears on the enemy. This is a question of angular movement; and angular velocity is independent of linear velocity. The question of getting to torpedo range naturally lies, as we have seen, with the faster fleet.

It is not proposed to discuss the ram, as it may said to be obsolete, and it is not being fitted in the most modern ships. The use of it is a danger as much to the ship ramming as to the ship rammed, and ramming would probably only be attempted by a ship in extremis, but retaining the use of her motive and directive power.

The late Admiral May said:—"No superiority of speed makes it easier to ram an opponent. A ramming encounter is a most risky performance, and when both sides have torpedoes, a fatal result is almost certain; but which side will get the worst of it is almost a toss-up."

PART II.

We now come to the second portion of the subject which treats of the relative values of speed and armament as factors in a battle-ship's constitution.

In the first place it must be borne in mind that we have considered the individual merits of speed and armament from a theoretical or paper point of view, and that the conclusions we arrived at are likely to be modified in practice where the human element is introduced, without, however, affecting the broad principles of the argument.

For example, there is nothing harder than judging accurately the course of a hostile fleet, and it is very unlikely that absolute parallelism of the lines will be obtained. Again, the smoke and dust of an action will temporarily obscure the movements of the two fleets from one another; so, in general, the initiator of a tactical move will probably reap the tactical advantage to be obtained from this move.

We have seen in Part I. the strategic advantages claimed for a fleet capable of maintaining a high sea-speed, and these advantages are undoubted, to say nothing of the feeling of security which is lent by the knowledge of having "the legs of your opponent."

The possession of a high speed, and of the fuel to carry its owner a reasonable distance, necessarily involves some sacrifice in other directions, and the question is where is the Rubicon on the other side of which the sacrifices involved commence to outweigh the advantages?

A correspondent, writing in the *Times* of the 20th September, 1906, on this vexed question, states his case very clearly, and his views are entirely concurred in. He argues that the margin of superiority in speed within practical limits, which can only be obtained by increasing the size and cost of ships, is not sufficient to give such a correspondingly large increase in strategic value over the distances likely to be covered by our fleets in time of war, as would justify the increase in size and cost which this margin of superiority demands. In other words, a margin of speed of three knots, which a twenty-one knot fleet possesses over an eighteen knot fleet (and which represents a gain of 4 hours in every 24 hours, or in every 500 miles), is not a sufficient gain, when taking into consideration the limits of the strategical waters likely to be affected, to justify the increase in cost and size. Strategical advantage is more likely to be gained by a skilful disposition of forces acting on interior lines, and by rapid and accurate information of the enemy's movements than by a high speed of the main fighting line. Over long distances strategic advantage is more likely to be gained by the side possessing the best Intelligence Department, and the greatest facilities for coaling *en route*, than by the side which has the faster ships.

Since coal consumption varies, as the square of the speed and the horse-power as the cube, the weight of engines and boilers necessary to get the power, and the cost and amount of fuel necessary to get a sufficient radius of action, increase so rapidly at the highest speeds, that the line has to be drawn somewhere. We will consider this point again later, after consideration of the tactical side of the question.

We have seen that the extra speed of one fleet does not enable it to secure a tactically better position except in as far as the actual distance of combat is concerned.

Of what advantage is this power of controlling the range? Speed is not a weapon, it is a means of conveying the weapon—the gun—

from one place to another. How, then, is this power to be wielded to the best advantage? There is no contesting the fact that the range between the two fleets is the same for both, and it is difficult to see how a range can be found which will benefit one fleet more than another, though there need be no hesitation in saying that if this advantage in speed is used for the purpose of keeping a very long range, both fleets might just as well have stayed in harbour. Battle-fleets go to sea to come to some definite conclusion regarding one another, and, as we shall see presently, when considering the results of the late war, everything points to the fact that to successfully consummate this purpose the two opponents must arrive at some medium range—say 5,000 yards or thereabouts.

The difference in range was the main reason for the difference in the results of the battles of the 10th August, 1904, and of Tsushima, 1905.

One line of argument is, that the admiral whose fleet contains the greater number of heavy guns, will use any advantage of speed that he may possess to keep the range long, so as to inflict more damage on the enemy with his more far-reaching and accurate weapons than he will himself receive from the enemy's weapons of lighter calibre and inferior accuracy. If he does this he will probably succeed in his object, and will only himself suffer from shots which may be described as lucky or unlucky according to the point of view. All experience goes to show that the damage inflicted at these ranges will be of a superficial and not a vital nature, and, the percentage of hits growing rapidly smaller as the range increases, it would be necessary to carry an enormous supply of ammunition to get in enough blows to reduce the enemy to any appreciable extent, to say nothing of the doubtful policy of expending a large amount of ammunition, and a correspondingly large sum of money in cost of ammunition and wear to guns for such a small return.

The efficiency of fire depends not only on its precision but also, and above all, on time, or, in other words, the rate of hitting. When the projectiles are falling like hail on the hulls of vessels, they completely paralyse the occupants—blind them—prevent them from retaliating, repairing their damages, or manœuvring with sangfroid.

On the contrary, when the hitting is comparatively slow, which will happen at the long ranges, the *personnel* is enabled to pull itself together, leaks are repaired, and incipient fires are extinguished.

What did Rodjestvensky complain of at Tsushima? Not of the speed of the Japanese, but of the blinding hail of the storm of projectiles. It cannot be too strongly realised that it is the defeat of the *personnel* which is looked for, rather than the total sinking of the enemy by gunfire—a very unlikely, if not impossible, result. It may be said that an equal precision and rapidity of fire for both sides were preconceived in the argument—it was, but that does not affect its validity.

Another great lesson to be learnt from the recent war—and one not fully realised before—is the enormous loss of speed due to damage to funnels.

Suppose the faster fleet seeks safety in flight, it is nearly certain that its injured members will be overtaken by the faster craft of the slower fleet, and they must either be abandoned to the pursuers or rescued from their clutches by turning round to their aid and thus sacrificing the advantage of speed. Any delay is always in favour

of the pursuing fleet, as it is being constantly reinforced by its stragglers as they come up.

On the other hand, should the faster fleet utilise its speed to force close action, its relatively superior motion will in no way affect the result of the combat since it cannot give it a superior tactical distribution.

Thus the advantage of ordering the range of combat would seem to be an advantage only in name, and, as far as tactics are concerned, superior speed has no power to decide the fate of the day. Nothing but the gun and the state of efficiency of the *personnel* will have anything to say in the matter.

In discussing the value of armament it is necessary to consider the type of weapon we are going to put into our ships—whether they are going to be "Dreadnoughts" with only guns of the largest calibre, "King Edwards," with guns of three types, large (12-inch), medium (9·2-inch), and small (6-inch), or "Formidables," with the majority of the guns of small calibre.

This is the rock on which expert opinion is split even more than on the question of speed versus armament.

A fleet of "Dreadnoughts" in combat with a fleet of "Formidables," would presumably desire to maintain a long range action, so as to neutralise the effect of their adversaries' light artillery, by which means their heavy metal would obtain the greatest relative advantage, though, as we have seen, the effects would probably not be vital, the waste of ammunition would be large, and no definite result would be arrived at. To enable them to maintain this range they would require a higher tactical speed, or at least an equal tactical speed to their opponents. The fleet of "Formidables," on the other hand, would desire to close so as to obtain as great an advantage as possible for the majority of their guns. All history confirms the fact that this fleet will get their way, and, for a simple but convincing reason, which was mentioned when discussing the tactical value of speed. They are very likely to have caused damage to the funnels of some of the "Dreadnoughts" by their more numerous projectiles, even at the long range, as the laws of chance guarantee that some of these will reach the mark. The ships thus struck will undoubtedly suffer a loss of speed which will entail a reduction of the fleet speed, unless the laggards are going to be deserted. As pointed out before, the fleet wishing to close always has the advantage caused by any delay, as their stragglers can pick up their places in the fighting line again.

If, then, as is highly probable, the "Formidables" have their way and decrease the range, will the shower of projectiles they will pour in from their smaller guns be sufficient to paralyse the efforts of their powerful adversaries and prevent them from driving home their deadly blows? It is most probable that it will. After all, the only really competent judges are the Russians, and they all seem to be of this opinion. We ourselves can only form our judgments from target practice, and anyone who has seen a well concentrated 6-inch fire, and especially such a fire when the shots which are not hitting are falling short, must have been struck by the fact that it would be very hard to make a successful reply from guns which from their nature require a very deliberate aim.

A strong argument in favour of the retention of the small gun is, that all practice up-to-date goes to show that the 6-inch gun, though firing a projectile of less velocity and higher trajectory than does

the 12-inch gun, obtains a greater percentage of hits to rounds fired than the big gun obtains. When we take into consideration the fact that it fires five or six times as rapidly, it is well to pause for thought before giving it the go-by. The reason for the small gun being more accurate is found in this greater rapidity of fire. Since the range is, in all probability, constantly changing, when once found, it is easier to keep for a gun firing rapidly than for a gun firing at longer intervals, which may be thrown off in these intervals by an ill-judged change of range, and must be spotted for afresh after every round, instead of the immediate adjustment of a smaller error in the case of the more rapid firing weapon. Of course, it may be argued that in the "parallel fleet" action, the range will be constant, but anyone with any experience of range-keeping will know that such is not the case, and that the range is constantly undergoing changes quite large enough to throw off the fire at a long range. Another great point in favour of the light gun is, that in rough weather, or even when the motion is only slight, it becomes very difficult to accurately lay a gun controlled by power, and the fire from it is liable to become very slow and uncertain. In any case, the gun has to be fired as the roll of the ship brings the sights on, as it is impossible to keep it laid during the roll. This introduces all sorts of errors, to say nothing of the uncertain interval for which the gunlayer must allow between the pressing of his firing key and the departure of the projectile, a matter about which he learns very little in the piping times of peace, as most of his practice generally takes place in calm water. If he does happen to fire in bad weather he does not do much damage to the target. On the other hand, the 6-inch gun can be kept laid continuously unless the motion is very violent.

The figures which were quoted just now when discussing the rate of fire, are for fine weather practice. How much more, then, in bad weather, will the hand-worked gun have the advantage? In fact, there need be no hesitation in saying that in a seaway a "Dreadnought" would be worsted by a battle-ship having a battery of 6-inch guns of high command, with a few 12-inch guns to put the finishing touches at a short range, when the *personnel* is cowed and its nerve shaken by the hail of despised 6-inch shell. Is it, then, advocated that our battle-ships should be armed with nothing but the light guns? By no means. The heavy guns are necessary to penetrate the vitals of the enemy when the 6-inch gun has paralysed his fire by its persistence at the same time that it has been destroying his communications, wrecking his gun sights, and inflicting other damage of a more or less serious nature.

In what proportions are they, then, to be mixed? In the first place there should be only two calibres of guns in a battle-ship; one type of the heaviest—say the 12-inch—and the other of the heaviest that can be easily and rapidly worked by hand, namely, the 6-inch with its 100 lb. projectile, which is as much as a man can comfortably handle. The medium gun, such as the 9·2, has no place in a battle-ship, and only multiplies the types of gear required. It is an excellent weapon for the main armament of a cruiser, and should be confined to that type of vessel.

We shall see the number of guns we can mount in the ideal ship when we come to Part IV., but the proportion of the heavy guns to the light ones should be about 1 to 2, say 8 12-inch and 16 6-inch. No guns of a smaller calibre than the 6-inch should be carried, for the

following reasons:—As at present fitted, the light quick-firing guns and their mountings (not being in any way protected), are almost certain to be damaged or destroyed when the ship takes part in a day action of any magnitude.

To suitably protect them with armour would involve a lot of additional weight and space. The 6-inch guns themselves should be used to repel torpedo craft, half charges being employed to save wear to guns. In this respect there is a great future for time-fused shrapnel shell.

The 6-inch guns should be fitted with as large a type of sub-calibre gun as possible, probably a 12-pounder could be carried; these latter should be stowed at the bottom of the ammunition trunks, or other suitably protected spot, and could be used in some of the 6-inch guns by night, if thought desirable, as well as for day practices. This arrangement would be in every way suitable, as the 6-inch gun is a very handy weapon to lay and train by night. If it is thought necessary to carry more light guns on their own mountings, the latter would have to be rendered easily movable so that they could be stowed below during the day-time.

In designing a ship it is necessary to remember that if prominence is given to one of the factors that go to make up the whole, one or more of the others must suffer unless the size of the vessel is increased. This is very often lost sight of.

If, for example, a high speed is wanted, something else must be sacrificed.

What is that something going to be? Is it gun power? Then your high speed will be of use to you only to run away with. Is it armour? Then your ship is more vulnerable. Is it fuel? Then one of the necessaries of your cherished speed is cut down—a necessary which grows in ever-increasing ratio with the speed. If you can give up none of these things, the only thing left to do is to increase the size of the ship. Where, then, are you going to stop? Are you going to sacrifice numbers to size and have fewer ships? No. What, then? Money is the answer. If you want everything, speed, gun-power and numbers, you must pay for it, and so the Budget goes on growing and the ships increasing in size till it is difficult to see where the end will be.

Captain Mahan, in an article in the *National Review* for May, 1906, says:—"I am, however, distinctly of the opinion that the Will-o'-the-Wisp of higher speed is the chief cause of the present vicious circle, in which naval officers, uneasily conscious that fighting power must not be unduly sacrificed, seek refuge from the dilemma by increasing size."

He goes on to suggest that the only way of limiting the size of ships is by International agreement, and it would certainly seem, from Sir Edward Grey's speech in the House, on the "Burden of Armaments," that something of this sort would be submitted to the Hague Conference. Æsop's fable of the fox and the hen is irresistibly brought to mind, and in any case, there would probably be some difficulty in enacting a penalty from the Power who breaks the rule, and it would lead to endless quibbling. At the same time, it seems to be the only way out of a dilemma, which will go on increasing the size of its horns until, in Captain Mahan's words, "the representatives of the people will intervene, and, as usual, under such

circumstances, will do something more radical than beneficial, unless anticipated by well-weighed professional suggestion."

A great cause of the increased size of ships is the necessity of having as much gun-power as possible in a limited length of line. We have seen that a long line of ships becomes unwieldy, and in practice the number that can be conveniently handled is limited, say, to twelve ships. These ships must carry as large a number of offensive weapons as possible, which leads to big ships.

If, for the same original cost and cost of upkeep, two ships could be built of the same defensive powers and speed as one big one, but each with one half the offensive power, they would have a considerable advantage in fighting the big ship, as they could obtain concentration of their fire whilst forcing dispersion on that of the enemy. If the length of the line were not limited, we should doubtless see a larger number of smaller ships for this reason.

It is hoped that enough has been said to render the argument clear to the reader, and possibly convince him of its soundness. The gist of it will be briefly recapitulated before proceeding to discuss the design of the ideal ship.

The objective of the battle fleet must always be the enemy's fleet; the primary object in designing a ship must, therefore, be to give her as powerful a weapon of offence as possible. Speed, as I have before stated, is not a weapon of offence, it merely serves to convey the weapon of offence—the gun—from place to place. If, then, there is a question of sacrifice of either one or the other, speed must go to the wall. It is undoubtedly an advantage for the gun to be transferred from point to point as quickly as possible, but no amount of rapid movement will compensate for lack of striking force at the other end, especially since speed cannot procure any appreciable advantage for the application of the striking force. In the school of thought, of which the "Dreadnought" is the outcome, a high speed and a powerful armament are both obtained at the price of a big ship. The main armament consists solely of 12-inch guns, and for reasons already given it would be preferable to leaven these by a number of 6-inch guns.

The gun, now as ever, is going to decide the modern battle. It is not by clothing ships in impenetrable armour and giving them a high speed, with which presumably to keep a long range, that victory will be obtained. The most powerful method of defence is offence, and there can be no advantage that can be obtained by a high speed to compare with that ensured by a well directed fire, from as large a number of guns of the proper calibres as can be conveniently placed in the ships. It pays better to defeat men than armour—to capture the ship than to sink her. The moral effect of a vigorous attack well pushed home must always be enormous, and the *morale* of a fleet that wishes to maintain a long range must undoubtedly be inferior to that of a fleet in which a decisive combat is sought, an object which can only be consummated by getting to medium ranges.

The problem we have to face in designing our ideal ship is, briefly stated, as follows:—

We know approximately, from previous designs, the weights which are available for providing the ship with guns, ammunition and motion to carry the guns for a certain distance, in any given tonnage, the other components which go to make up the total weight of the vessel being

fixed at the minimum consonant with safety and comfort. The variables with which we have to deal are, therefore:—

Weight of guns and their protection.
Weight of ammunition.
Weight of engines and boilers.
Weight of fuel.

The problem before us is what percentage of the available weight to allot to each. The first thing, therefore, to decide on is the tonnage we wish to limit ourselves to. Theoretically, there is no limit to the size of the ship—if we have ships of 20,000 tons, why not ships of 40,000 tons? In practice the size of ships is limited by their cost, and to a certain extent by their handiness, draught and other similar considerations. At present there is a tendency to increase the size, a policy in which Great Britain is leading the way. Of course, one is always haunted by the thought that if you had a bigger ship you could carry more guns, but it is thought that a ship of 18,000 tons is quite a large enough basket in which to put the eggs at our disposal, and it is hoped that other Powers will not continue the "one bigger, one better" policy.

Into this ship should be placed as large a number of guns as possible within reasonable limitations, of the calibres and in the proportions already mentioned, with an adequate supply of ammunition. Engines and boilers, for a certain minimum speed, should next be allowed for, together with a sufficient supply of fuel to take the ship a certain minimum distance at economical speed. The remaining available tonnage should be taken for the provision of as adequate an armour protection as possible.

As regards the amount of ammunition that should be carried, the present allowance should be largely increased, as the recent war shows that it is not enough. 150 rounds each for the 12-inch guns, and 300 rounds each for the 6-inch guns should prove sufficient, and that is nearly double the present supply. The 12-pounders should be allowed 300 rounds each. The reduction in the torpedo armament previously mentioned will meet this extra stock of ammunition. In laying down a minimum speed to be allowed for, precedent and the doings of other Powers must be considered. It is thought that a full speed of nineteen knots is a sufficiently high speed for a battle-ship, giving as it does a useful fighting speed of sixteen knots for between two-fifths and three-fifths of the total horse-power. Of course, it may be said: "If armament is all-important, why not cut down the speed to a very low limit, say 5 knots, and cram in more guns?" The answer to this is, that there is a happy mean in all things, and in war-ship building as in any other competition you must be guided by the movements of the other competitors, and to so handicap yourself in point of speed would be foolish. It has been indicated where the line should be drawn, viz., nineteen knots.

Similarly, in selecting the amount of fuel to be carried, the doings of other nations, as well as the number and capacity of coaling stations, and the service on which the ship is likely to be employed, must be considered. Fuel fixes the endurance limit of the modern ship in the same manner as the supply of water and provisions fixed the endurance limit of the sailing-ship. In the way of coaling stations, Great Britain is exceptionally well off. At present the tendency is

to increase the distance which a ship can traverse without replenishing her bunkers, and a distance of 8,000 miles should be allowed for.

The capability of mounting the guns that our tonnage allows for depends on:—

1. The amount of right-ahead and right-astern fire that is desired.
2. The command (*i.e.*, the height above water) which it is necessary to give the guns to ensure their fighting value in all weathers.
3. The amount of clearance between guns on account of blast from the discharge of other guns.

It is evidently easier to provide a larger amount of fire on the broadside than right ahead or astern, since the ship is five or six times as long as she is broad. Similarly the effects of blast are more severely felt as the target approaches the keel line of the ship, except in the case of guns mounted in the middle line at the ends of the ship, where the blast is felt by the men stationed in the broadside gun-positions when they are trained far beyond the beam.

A large amount of end-on fire is not necessary in a battle-ship, though it is desirable in a cruiser, which is more likely to be engaged in chasing or being chased, an employment that will probably be confined, in the case of the battle-ship, to the end of a general action. Right-ahead fire is desirable, but, to provide it, numbers should not be sacrificed which might have been mounted on the broadside. For example, in the "Dreadnought" the provision of right-ahead and astern fire for the broadside turrets prohibits the possibility of mounting any other guns on the broadside.

Everything, therefore, points to the necessity of having a broadside fleet, and if this is decided, the necessity of large end-on fire becomes less, since the fleet is going to manœuvre in single line, more of the right ahead order than the abreast.

At the same time the broadside guns should be given as large an arc of fire as possible, at least, sixty degrees on each side of the beam, except in the case of guns which assist in the end-on fire, where, unless they are mounted in turrets, an arc of training of forty-five degrees beyond the beam is sufficient, since a larger arc necessitates too large an opening of port.

The big guns in the centre line should be capable of being trained forty-five degrees beyond the beam.

PART III.

In trying to draw conclusions from recent warfare, as to the respective merits of speed and armament, it will only be necessary to refer to the Russo-Japanese War, there being no other war in which the modern capital ship took any large part on both sides.

In this war there were two notable capital ship actions, known as the battles of the 10th of August and of Tsushima.

It is not proposed to discuss the faulty strategy of the Russians at the commencement of the war, it being beside the point, but the following were the principal mistakes which led up to the battle of the 10th August:—

1. The division of the fleet between Port Arthur and Vladivostok.
2. The selection of Port Arthur instead of Vladivostok as the base of the battle fleet.
3. Port Arthur having once been selected, the subordination of the efficiency of the battle fleet to the defence of the port.

Of these 2 is open to discussion. At first sight Port Arthur would appear to occupy the better position for preventing the Japanese from entering the Yellow Sea, but it must be remembered that whichever port was chosen, there would the Japanese fleet be drawn; the latter could not start the transport of their huge army till the Russian fleet was reduced. A battle had to be fought at one place or the other, and afterwards the victorious fleet could go where it wished. In case of defeat, Vladivostok offered more security, was much more difficult to blockade, and had more accommodation for reinforcements. The port is now kept open in all seasons. Vladivostok should have been chosen for these reasons, but it is always easy to be wise after the event.

The Russians, having chosen Port Arthur, should certainly have taken some steps to secure the Elliott Islands, which formed an ideal advanced base for the Japanese, of which Togo took full advantage.

When the Russians at last left Port Arthur, on the 10th of August, 1904, they had only one object in view, and that was to avoid the enemy and make good their escape to Vladivostok, there to await in peace reinforcements from home.

The last thing they wanted was to fight an action, and this is not the spirit in which battles are won. The sortie had become unavoidable, on account of the fire to which the ships were exposed in the anchorage.

Another strong reason for making the sortie was provided by news from St. Petersburg, that the Japanese battle-ships, owing to foul bottoms, could steam no more than thirteen knots. This, needless to say, was incorrect, and is an instance of the mistake of trying to direct war from headquarters.

It would have been preferable to have tested the intelligence by feinting a sortie, and seeing how long it took Togo to come up. Instead, a day was chosen on which the state of the tide prevented the big ships from leaving the port before 8 a.m., though the destroyers and small craft commenced to leave at about 5 a.m. Togo, warned by wireless telegraphy, of the activity shown by the enemy, was enabled to leave his base in the Elliott Islands at 7.30 a.m. Here we have a very good instance of the strategic value of speed, since Togo, knowing that he had the advantage of his adversary in this respect, could lie snug in his well-chosen hiding place, secure in the knowledge that he could always prevent his enemy from getting far on their way to Vladivostok without interference.

About noon, the Russian fleet, consisting of six battle-ships, four cruisers, and some torpedo craft, steering to the S.E., sighted the Japanese First Division, consisting of four battle-ships and two armoured cruisers, on their port bow, steering to the S.W., at a distance of eight or nine miles, while the second Japanese Squadron, consisting of four cruisers, of which only one was armoured, was at a considerable distance on their starboard quarter. These were the

two most important Japanese Divisions, and Witgeft, the Russian Admiral, had a great opportunity of keeping them apart by attacking the First Division.

Though, on account of its superior speed, it could have avoided close action, it would still have been forced to retreat in a direction away from its reinforcements. The Russians would also have had the advantages, already pointed out, which belong to a fleet engaged in a stern chase. This opportunity Witgeft lost through his determination to proceed at all costs to Vladivostok, and, by hauling to the northward, enabled Togo to cross his bows, join his other division, and, owing to his superior speed, overhaul the Russians and open fire about 5.30 p.m., at 7,300 metres.

Fire had been opened once or twice before during the day, at ranges outside 8,000 metres, but, with the exception of a shell which burst on one of the "Askold's" funnels, no results were arrived at, except that a considerable amount of ammunition was thrown away at the long range.

Both fleets were steaming in parallel lines to the eastward, the Japanese being to the southward with their two divisions in line ahead. The Russians, for some reason best known to themselves, had placed their cruisers under the lee of the battle-ships on the port beam of the latter. Fire was opened when the two flag-ships, which were leading, came abreast of one another. Togo, instead of using his speed to close the enemy and obtain some definite advantage, preferred to keep a long range, with the result that from 5.30 to 6.30 no change took place. Both fleets concentrated their fire on the flag-ships, which were occasionally hit by the rain of projectiles, though no serious damage was inflicted.

The Japanese drew slightly ahead. At 6.30 a shell bursting killed Admiral Witgeft, and the signal to transfer the command to Prince Oukhtomsky, in the "Peresviet," was not taken in, probably owing to the smoke obscuring it. The "Cesarevitch," continued to lead the fleet on the same course through lack of other orders. At 7.30 a 12-inch shell exploded in her conning tower, and jammed her helm, the ship turned to port, carrying confusion into the line of cruisers, and, continuing to circle, passed round the rear of the battle fleet and approached the enemy, getting to a range of about 4,000 yards. The "Retvisan" followed to support her, and Prince Oukhtomsky, at last taking command, fled with the rest of the battle fleet in disorder for Port Arthur. The actions of the cruisers and destroyers do not concern us.

Togo, sticking to his long range policy, neglected the golden opportunity of cutting the "Cesarevitch" and "Retvisan" off from their main body. They were, however, subjected to a murderous fire for a short time, before the former succeeded in getting her steering gear into order and went after the remainder of the battle fleet, accompanied by the "Retvisan," but was, however, easily out-distanced by the latter on account of the injuries to her funnel which she had sustained, and which caused a coal expenditure of six times the normal. After dark, the "Cesarevitch," under the command of the second officer, shaped course for Vladivostok, and was subjected to several torpedo attacks, but escaped uninjured, though she did not fire, but trusted to the darkness to hide her.

The captain, Ivanov, who had been wounded, presently took charge of the ship again, and decided to take her to Tsing-Tau, where

she arrived safely the next morning and was disarmed. The remaining five battle-ships reached Port Arthur in safety, after sustaining several torpedo attacks, which produced no result.

What was the net result of the day? Of eighteen Russian vessels engaged, only one can be said to have been destroyed by gunfire as the result of this action, namely, the cruiser "Novik," which was blown up and deserted by her crew on the Japanese coast some days' later, after an attack by the cruisers "Chitose" and "Tsushima."

Of all the Russian ships, the "Cesarevitch" suffered the most damage. She had been the sole object of the enemy's attack during all the latter part of the day, first when flying the flag of Admiral Witgeft, and afterwards when the injuries to her steering gear caused her to approach the Japanese line. All the early reports represented her as being in the most pitiable condition. In reality, not a single armour plate was pierced, not a gun was dismounted, her rudder and engines were intact, and she had only eight killed and twenty-two wounded—far less than the "Mikasa's" casualties. The only serious injury was that to one of her funnels, and the only other shots worth counting were those which killed the admiral and jammed the steering gear.

There was no reason why she should not have proceeded on her way to Vladivostok—she had plenty of ammunition and enough coal. In fact, with mutual support there was no reason why the whole Russian fleet should not have accomplished their object, instead of returning to the death-trap they had left, or being disarmed in neutral ports. To explain their defeat, it is no good to count up the number of ships and guns engaged on either side, since to neither can the victory be ascribed. It was the moral factor which decided the day. The element of disorganisation, which had been maturing in the Russian fleet ever since the first surprise on the 8th of February, had by now assumed large proportions. To this cause, and to this cause alone, can be attributed the actual far-reaching results.

What, then, are the lessons we can learn from this battle? We see that a fight conducted at a long range leads to no conclusive results, and only to the useless expenditure of a large quantity of ammunition. The arrangements for controlling the fire in both fleets were very crude, and an enormous advance has been made in this direction since that date, but the results obtained from this control are not sufficiently good to make it probable that a decisive action will be fought at a long range, to say nothing of the fact that these results are made at a moored target, and not at a target that is travelling fast and firing back at you. It is probably owing to this large expenditure of ammunition that the Japanese relinquished the pursuit when they did, instead of following up their advantage, and they would have been unable to renew the combat on the next day if the Russians had elected to continue their journey to Vladivostok. This also points to the fact that a larger amount of ammunition should be carried than is now the custom.

We see the advantage that Togo reaped from having a faster fleet. His superior speed enabled him to await his reinforcements, and then pursue and force action on the reluctant Russians, and also to select his range. Whether he selected it rightly or wrongly is a matter of opinion; his was not, however, a policy which would have recommended itself to Nelson, had he lived in these days, but savours more of the French tactics in the days of Rodney.

The Japanese undoubtedly lost an opportunity in not cutting off the "Retvisan" and "Cesarevitch," as their speed would have enabled them to do, thus forcing the remainder to definitely abandon them or turn and reinforce them, but, as just mentioned, it may have been lack of ammunition which forced Togo to forego his prey. He was undoubtedly influenced in his reluctance to close the enemy by the knowledge that he had no reserve of ships to fall back on, and so he relied on superior gunnery to win him a victory, which was, however, given him by the incompetence of the Russians, and their failure to appreciate the fact that the only hope of future salvation for their country lay in their crippling the Japanese fleet, even if, in doing so, they themselves were annihilated. Anything would have been better than an ignominious return to their shell-swept port of departure.

We now turn to the second and bigger fight of this war, known as the Battle of Tsushima, or of the Sea of Japan; in which Togo showed himself a master of strategy and tactics, and manœurved his fleet in striking contrast to anything he had previously done.

It was this battle that settled the doom of the Baltic Fleet, which had arrived so close to its destination without being assailed during its voyage of many thousands of miles.

As regards the strategy preceding the battle, a glance at the map will show that in selecting Mesampho Bay in the Korean Straits, in which to await his enemy's approach, Togo had chosen a very advantageous position, and possessed what are known as interior lines. Vladivostok was bound to be the goal of the Russian fleet since the fall of Port Arthur, and, to get there, they had to enter the Sea of Japan, either by one of the channels between Japan and Korea, or by passing outside the island of Nippon to attempt the passage of the Tsugaru Strait, or the more round-about route through Perouse Strait. Had they decided on either of the two latter courses, Togo, warned by his cruisers, would have had plenty of time in which to convey his large fleet from his point of vantage to the threatened channel, without having to make use of his superior speed. A good strategical disposition, therefore, on interior lines, enabled him to make certain of meeting his foe without any great effort. Now, had the advantage of speed rested with the Russians to any considerable extent, Togo might have been compelled to take up a position in the Sea of Japan further to the northward, so as to avoid all chance of the enemy getting round outside the islands and through one of the northern Straits, before he could get up to meet them. A high speed would have been of great advantage to the Russians under these circumstances, for, had the preponderance been such as to compel Togo to desert the narrow part of the Strait for the more open sea to the northward, they would have had a better chance of getting to Vladivostok by the direct route, using their superior speed to avoid combat, which, now as before, was evidently their sole desire, and which, as pointed out then, is not a spirit conducive to winning victories. The objective of a battle fleet is the battle fleet of the enemy, and, if it is not strong enough or self-confident enough to meet it, it had far better have stayed at home.

There is no doubt that, if Port Arthur had fallen before the Baltic Squadron had sailed from Europe, it would never have made its disastrous journey. It would have been more instructive to the world at large if the heterogeneous collection of vessels composing

Rodjestvensky's Squadron had possessed an advantage in speed over the Japanese, and Togo had, in consequence, been set a harder problem. The Russian Admiral had made up his mind that he would have to fight, but hoped to reach Vladivostok after some losses on both sides. He, therefore, on leaving the Yangtze, did not attempt to avoid the enemy, and, on the morning of 27th May, 1905, was proceeding leisurely with his whole fleet at 10 knots, heading for the Eastern Korean Strait. The battle-ships were in two columns with the cruisers and torpedo craft on their flanks and rear. The day was foggy, and vision limited to a distance of four or five miles. At 10 a.m., when abreast of Ikishima, they first saw the enemy's cruisers on either hand, and a change in the disposition of the fleet was then made, which became as follows, course, north-east:—

In the right or starboard column were the four powerful battle-ships "Kniaz Suvaroff" (flying Admiral Rodjestvensky's flag), "Borodino," "Alexander III.," and "Orel." In the left or port column were the battle-ship "Oslabya," the two old battle-ships "Navarin" and "Sissoi Veliky," and the armoured cruiser "Admiral Nakhimoff," then the battle-ship "Imperator Nicolai I.," the three coastguards and four cruisers bringing up the rear. The auxiliaries and scouts were behind and between these two columns. The object of assuming this extraordinary formation is beyond comprehension, unless the original idea was to use the four fast modern battle-ships as a flying division with a roving commission, the remainder forming the main fighting line.

Togo, being apprised by wireless of the exact position and formation of the enemy, formed his first and third division (consisting of four battle-ships and eight armoured cruisers) into single line ahead, and steered a south-westerly course, so as to appear to have the intention to pass the Russian fleet on opposite courses, port hand to port hand, at extreme gun range; but, instead of doing this, he turned to the eastward by a nicely calculated turn and pressed obliquely on the head of the Russian left column. He turned his fleet at extreme gun range, so that the Russians could not take advantage of him on the turn when his position was tactically weak, the head of his column being exposed to the whole Russian broadside. Actual speed, regarded as a simple velocity and not relative speed, was obviously an advantage in this manœuvre, as the higher the speed the less the time that was given to the Russian admiral to counter it by turning away to the eastward himself, which he did not immediately do, as he was apparently engaged in getting into single line ahead by placing his starboard column at the head of the port column. The concentrated fire of the Japanese ships soon finished off the "Oslabya," which bore out of line to starboard.

By this time the Russians would seem to have got into some straggling form of line, and were heading to the eastward parallel to the Japanese line, the two fleets being between 4,000 and 5,000 yards apart. The superior speed of the Japanese ships caused them to draw ahead and so to turn in succession towards the Russians and threaten the head of their line. Rodjestvensky countered by turning away to the southward to avoid being enfiladed, so that both fleets were gradually turning on concentric circles. In this case, however, the Japanese had a marked tactical advantage as their compact line was opposed to the long and straggling Russian line, so that their broadsides were only immediately confronted by those of about half the

number of ships. In fact, the advantage corresponded to that obtained in the old days by "doubling the line," except that the Russians were only engaged on one side. At 3 p.m., after nearly an hour's firing, we find the two fleets heading to the S.E. The fate of the day was decided, the "Suvaroff," "Alexander III.," and "Oslabya" being *hors de combat* and out of the line, the remainder of the fleet, now led by the "Borodino," having no other object but flight. At this hour a fog bank obscured the field of action, and this, aided by the smoke, enabled the Russians to turn unperceived in succession to the northward, probably in the hope of picking up the three wounded battleships and supporting their admiral. Unfortunately for them the fog lifted in time to enable Togo to turn and save his rear from being threatened and again we find the two fleets on parallel lines, and the same manœuvre being repeated, the Russians being forced to the westward to avoid being enfiladed.

The remaining phases of the day's fight are of no special value for drawing conclusions as regards the merits of speed and armament in the modern battle-ship. The issue was decided in the first hour, after which the Russian fleet became more or less of a rabble, and *sauve qui peut* was the order of the day. Here a high speed was, however, an advantage to Togo's ships in enabling them to speedily overtake and capture or destroy the flying remnants of the Russian fleet on this and the following days.

The "Borodino," which for four hours' intermittent fighting bore the brunt of the attack, sank at 7 p.m. The "Orel" was captured the next day when Nebogatoff surrendered, so that of the five modern battle-ships the Russians lost four by sinking and one was captured. With the rest of the fleet we are not concerned.

To what causes are we, then, to ascribe the enormous difference between the result of this action and that of the 10th of August?

In the first place Togo's great advantage was due to a well conceived and executed tactical move, whereby he was enabled to concentrate his fire on the head of his enemy's weaker column, and sow in it the seeds of demoralisation whilst sheltered himself from the fire of their best ships. The reason for the tremendous difference in damage done to the ships was that Togo profited by his previous experience and decided to fight at a closer range, rightly trusting to his vigorous onslaught to be his best weapon of defence, and not to the inert armour plates which covered his sides. The Russians opened fire at about 8,000 yards, whilst the Japanese were turning, but the latter did not reply till the range was about 6,500 yards, and rapidly decreasing, so that a fair percentage of shots might be expected to hit.

The range during the critical period, that is to say between 2.30 and 3 p.m., was between 4,000 and 5,000 yards.

They found this a more profitable method of expending ammunition than that which they employed on the 10th of August, where a large portion of the contents of the magazines and shellrooms were expended on a no more responsive foe than the ocean. As regards the calibres of the guns engaged, the numbers of heavy guns were about equal on both sides, but the Japanese had many more 6-inch guns, and it was undoubtedly to these weapons that the victory was principally due. At the former battle there were no fires of any consequence—now all the Russian ships on which fire was concentrated burst into flames. The reason for this is to be found in the difference

in the rate of hitting on the two occasions. On the 10th August hits were few and far between, and incipient fires could be extinguished; at Tsushima the shell were falling like hail, and the disorganised *personnel* could not cope with the flames.

The actual cause of the sinking of the four battle-ships seems to have been their overloaded condition, which caused the tops of the armour belts to be only just above the water-line. Water was thus allowed to enter through holes in the side above the belt, and, once having entered, it made rapid headway. This is only a conjecture, formed from the condition of the "Orel" on her arrival in Japan, when, though badly damaged and presenting a lamentable appearance, she had no holes through her side armour, but was very deep in the water, owing to a heavy deck cargo of coal.

The water, being confined to the water-tight compartments on the engaged side of the ships and causing them to list heavily, was obviously the reason for their turning turtle on sinking. It is uncertain whether the immunity which the side armour enjoyed was due to the inability of the Japanese shell to pierce on account of an over-sensitive fuze, or to the poor shooting from the heavy guns in the lumpy sea which prevailed, and the narrow portion of the belt showing above water. It is very probable, however, that the shooting from the heavy guns was poor, seeing what their capabilities are in fine weather and under the most favourable conditions. The Japanese losses were no more than on the 10th of August, the "Mikasa's" less than on the former occasion. This shows how effectually their own fire, aided by the bad gunnery of the Russians, protected them from injury.

The Russians did not lack bravery, but their discipline, moral tone and general efficiency were greatly inferior to those prevailing in the Japanese fleet; the formation of their fleet, and their neglect to throw out scouts was, of course, inexcusable. They laboured under a great disadvantage, in that they were receiving their baptism of fire at the hands of seasoned veterans, confident in their own powers of gaining the victory.

The following is a brief summary of the principal conclusions concerning speed and armament which may be drawn from our study of these two battles:—

1. A high speed is of advantage in assuming a sound strategical position for a fight, in forcing an unwilling enemy to fight, and in preventing him from escaping at the end of the battle and thus robbing you of the complete fruits of victory. If, on the other hand, he compasses your defeat, you can make use of your speed to preserve you for another day. A fleet can largely counter-balance an inferiority in speed by working on interior lines and by good scouting.

2. A high speed is of advantage in executing quickly a tactical move, and not giving the enemy long in which to make up his mind. A high relative speed is of advantage in regulating the distance at which an action is fought, provided this advantage is pursued in the right direction, that is to say in keeping the range short and not long. An advantage in speed does not, however, ensure any practical gain in the tactical distribution of fire. It was the bad station and general disorganisation of the Russians which gave the Japanese their superiority in distribution of fire at Tsushima.

3. A large volume of rapid and well-directed fire is necessary to demoralise the enemy and prevent him from replying with steadiness

and accuracy. This necessitates a gun laid and loaded by hand; at the same time a large calibre gun, firing a shell capable of carrying its bursting charge through thick armour, is necessary to penetrate to the enemy's vital parts, while the light gun fire prevents him from successfully replying.

4. To ensure a sufficiently rapid rate of hitting, the action must be fought at a decisive range, that is to say within 6,000 yards. Long range actions will principally advantage the manufacturers of ammunition.

PART IV.

In this part of the subject we are going to take a look at the actual weights involved in the construction of a modern battle-ship, with a view to seeing what we may expect in the ideal ship. It does not purport to be a lesson in ship construction, which is a subject better left to those who make a lifelong study of it. It is only desired to give the amateur some rough idea of the considerations involved.

The designing of a war-ship would be an almost impossible task were it not for the experience and *data* gained from previous ships.

The total displacement of a completed design is made up of the following items:—

I. *General Equipment.*

This comprises water, provisions, officers' stores, crew and effects, masts, rigging, etc., anchors, cables, warrant officers' stores and net defence.

II. *Armament.*

This includes the weight of guns, shields, gun mountings, ammunition, torpedoes and torpedo-tubes.

III. *Machinery and Engineer's Stores.*

IV. *Coal.*

It is the practice to include a certain weight of coal in the designed displacement of war-ships. This weight is called the legend weight, and is roughly about one-half of the full sea-going stowage. All official steam trials for speed are carried out at the draught corresponding to this legend condition.

V. *Armour and Protection.*

This consists of:—

a. Weight of vertical armour (exclusive of that on barbettes or turrets, casemates, protective plating, conning tower, and ammunition tubes).
b. Weight of protective plating on sides.
c. Weight of protective deck plating, including armoured shutters and gratings.
d. Weight of backing, exclusive of that on barbettes or turrets.
e. Weight of barbettes or turrets, with their armour and backing.
f. Weight of casemates complete.
g. Weight of conning tower and communication tube.
h. Weight of ammunition tubes complete.

VI. *Weight of Hull.*

This comprises:—

a. Weight of hull proper, including framing of barbettes or turrets, etc.

b. Weight of sheathing.

c. Weight of ballast.

VII. *Board Margin.*

This is a margin allowed to cover alterations or additions to the design made during the progress of building.

These details have been mentioned to show the manifold considerations which embarrass the war-ship designer; we have only to deal with those constituents mentioned under headings II. and III., and, in a lesser degree, those under IV. and V., and can therefore start by considering the other factors as of a constant value.

It must be clearly understood, however, that all these constituents are largely interdependent. At the outset the dimensions, form and displacement, are undetermined, yet upon them depend the power which the engines must develop to give the desired speed, the weight of the hull and the weight of certain parts of the equipment. It should also be borne in mind that weight saved in any of the features of the design has a far greater influence on the design than the actual weight thus saved. For instance, suppose it is decided to carry fewer rounds of ammunition per 6-inch gun, so as to decrease the weight by a hundred tons. The ship thus lightened requires less horse power to give her the designed speed, and, therefore, smaller engines, and less men to work them. A smaller ship will then be sufficient, which will weigh less than the ship as originally designed, and require less horse-power. Thus these factors act and re-act on one another until we find that, by saving a hundred tons on ammunition, we have probably saved two hundred or three hundred tons on the whole design.

The following is a table of the legend weights for three recent types of British battle-ship, from which we can draw several valuable conclusions.

Table of legend weights (percentages) of whole of items shown under the various headings:—

—	I.	II.	III.	IV.	V.	VI.	VII.
Formidable... ...	5·2	11·6	10·2	6·2	29·0	37·5	0·3
King Edward VII.	4·2	15·7	11·3	5·8	25·5	36·0	1·5
Dreadnought ...	5·0	19·0	16·7	5·6	20·6	33·1	—

The figures of the "Dreadnought" are only approximate.

Sir W White, in his Manual of Naval Architecture, gives the weight of hull in a modern battle-ship and cruiser as 38 per cent. of the total weight of the ship complete; but it will be seen by inspection of the above table that the percentage of the displacement taken up by the hull has been capable of reduction, partly owing to the increase in the size of ships, which naturally decreases the percentage of the weight of hull (except in the case of a vessel of light scantling,

such as a destroyer), and partly to improvement in material and construction. He, however, points out in his recently delivered Cantor lectures that the limit of reduction in scantling is not yet reached, but that it will be determined eventually by considerations of durability and provision against local straining or corrosion, and, as a consequence, the economy of structural weight does not follow strictly the increase in strength of the material used.

The tonnage, main armament (total and available on the broadside), full speed and approximate cost when finished of the three above-mentioned types of ships are as follows:—

——	Tonnage.	Speed.	Main Armament.	Broadside.	Cost.
Formidable	15,000	18	Four 12-inch Twelve 6-inch	Four 12-inch Six 6-inch	£ 1,100,000
King Edward VII.	16,350	19	Four 12-inch Four 9·2-inch Ten 6-inch	Four 12-inch Two 9·2-inch Five 6-inch	1,500,000
Dreadnought ...	18,000	22	Ten 12-inch	Eight 12-inch	1,800,000

It will be seen that the initial cost of two "Dreadnoughts" is about the same as that of three "Formidables."

Now, from the table of legend weights we can see the percentages of the displacement allotted to the armaments in the three types of ship, and can, therefore, get the actual weights taken up by these armaments, which are as follows:—

——	12-inch.	9·2-inch.	6-inch.	Torpedo tubes.	Total Tonnage.
Formidable	4	—	12	4	1,740
King Edward VII.	4	4	10	4	2,570
Dreadnought	10	—	—	5	3,420

That is to say that the "King Edward VII.," for about 50 per cent. more tonnage than the "Formidable," carries four more 9·2-inch guns and two less 6-inch guns, whilst the "Dreadnought," for about double the tonnage of the "Formidable," carries six more 12-inch guns, and 12 less 6-inch guns (*i.e.*, none at all).

It will also be noted that the tendency has been to steadily increase the percentage of the displacement given up to the armament.

As regards the torpedo armament, the percentage of the displacement given up to it is very small, but a large amount of valuable space is occupied by the submerged flats, which, as pointed out before, would be better employed in holding additional ammunition for the heavy guns.

Turning to the ideal ship, which is to carry 12-inch guns and 6-inch guns in the proportion of 1 to 2, and whose torpedo armament is to consist of two torpedo tubes in one flat, it will be seen by a careful inspection of the above tables that if the ship carries eight

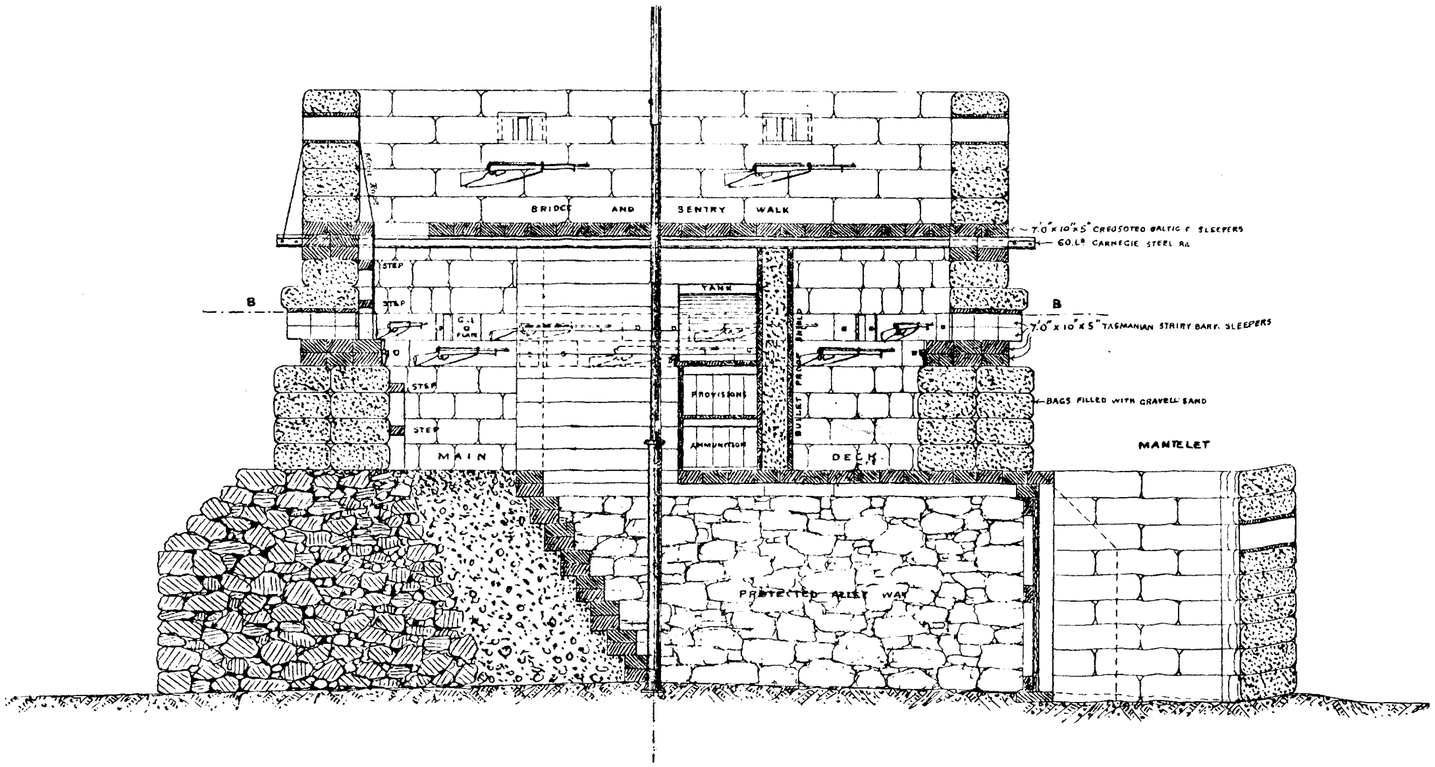
12-inch and sixteen 6-inch guns, and is to have a speed of 19 knots, she will have to be about 18,000 tons, and will require about 3,500 tons to carry these guns and two torpedo tubes, allowing for a largely increased supply of ammunition, viz., about 150 rounds per gun for the 12-inch instead of 80, and 400 rounds for the 6-inch instead of 200. This seems to be as large a number of guns as can be conveniently placed in one ship without unduly increasing her size.

It is proposed that the 12-inch guns should be mounted in pairs with a high command; one pair to be mounted at each end of the ship on the middle line, and one pair amidships on each broadside. The end pairs of guns to have an arc of fire of 270 degrees (*i.e.*, from right ahead or astern to 45 degrees beyond the beam on either side), and the broadside pairs of guns to have an arc of training of 120 degrees (*i.e.*, 60 degrees on either side of the beam).

The 6-inch guns to be mounted in double casemates in two tiers, similar to those mounted in the "King Alfred" type of British cruiser, the end guns having an arc of training of 135 degrees (*i.e.*, from right ahead or astern to 45 degrees beyond the beam), and the eight midship guns an arc of training of 120 degrees (*i.e.*, 60 degrees on either side of the beam). Two pairs of double casemates to be fitted on either side of the midship 12-inch turrets. The floors of the casemates are not to coincide with the upper and main decks, as is the present custom, but are to be raised about four feet above these decks, so as to give the guns a higher command, and to enable the lower tier of guns to be fought in moderate weather, an impossibility with the main deck guns of many classes of ships now afloat. In really heavy weather the upper deck guns would be the only ones of any use, and, as I previously pointed out, power-worked guns are of little good in a seaway. The ideal ship would have to be a few feet longer than the "Dreadnought," to give sufficient spacing between the guns. She would have in the broadside six 12-inch and eight 6-inch guns to oppose to the eight 12-inch of a "Dreadnought," and she ought to stand a better chance than the latter in an artillery duel. No amount of target practice can prove this contention; until the target commences to shoot back at us, we shall not know how we stand. In the meantime, we have only got the results of the recent war to help us, and they all go to prove that the incessant rain of smaller projectiles will go far towards preventing a ship armed only with heavy power-worked guns from suitably replying, and will, at any rate, disconcert its more deliberate fire.

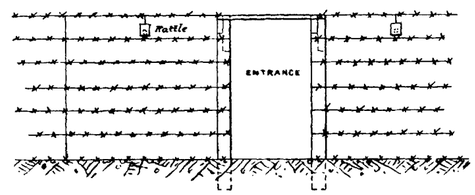
In right ahead or right astern fire the ideal ship has only two 12-inch and four 6-inch guns to oppose to the six 12-inch guns of a "Dreadnought," but, as pointed out before, end-on fire in a battle-ship is not considered to be of such paramount importance as to justify the sacrifice of guns on the broadside, which is the tendency in the "Dreadnought." In the latter, in order to clear the way so as to allow the broadside 12-inch guns to fire in line with the keel, the broadside has to be kept clear of all other ordnance. If it were possible to mount more guns, the blast would be prohibitive when firing near the ends of the ship. In a cruiser end-on fire is of paramount importance, and, if necessary, the broadside fire should be sacrificed to it; the reason being that a cruiser is more likely to fight her actions when chasing and being chased than is the battle-ship, whose object is to meet and defeat her counterpart in the enemy's fleet.

GROSS SECTION



WIRE ENTANGLEMENT

ELEVATION



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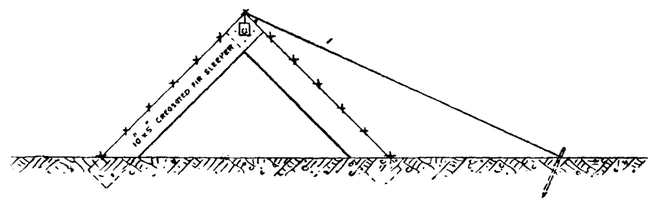
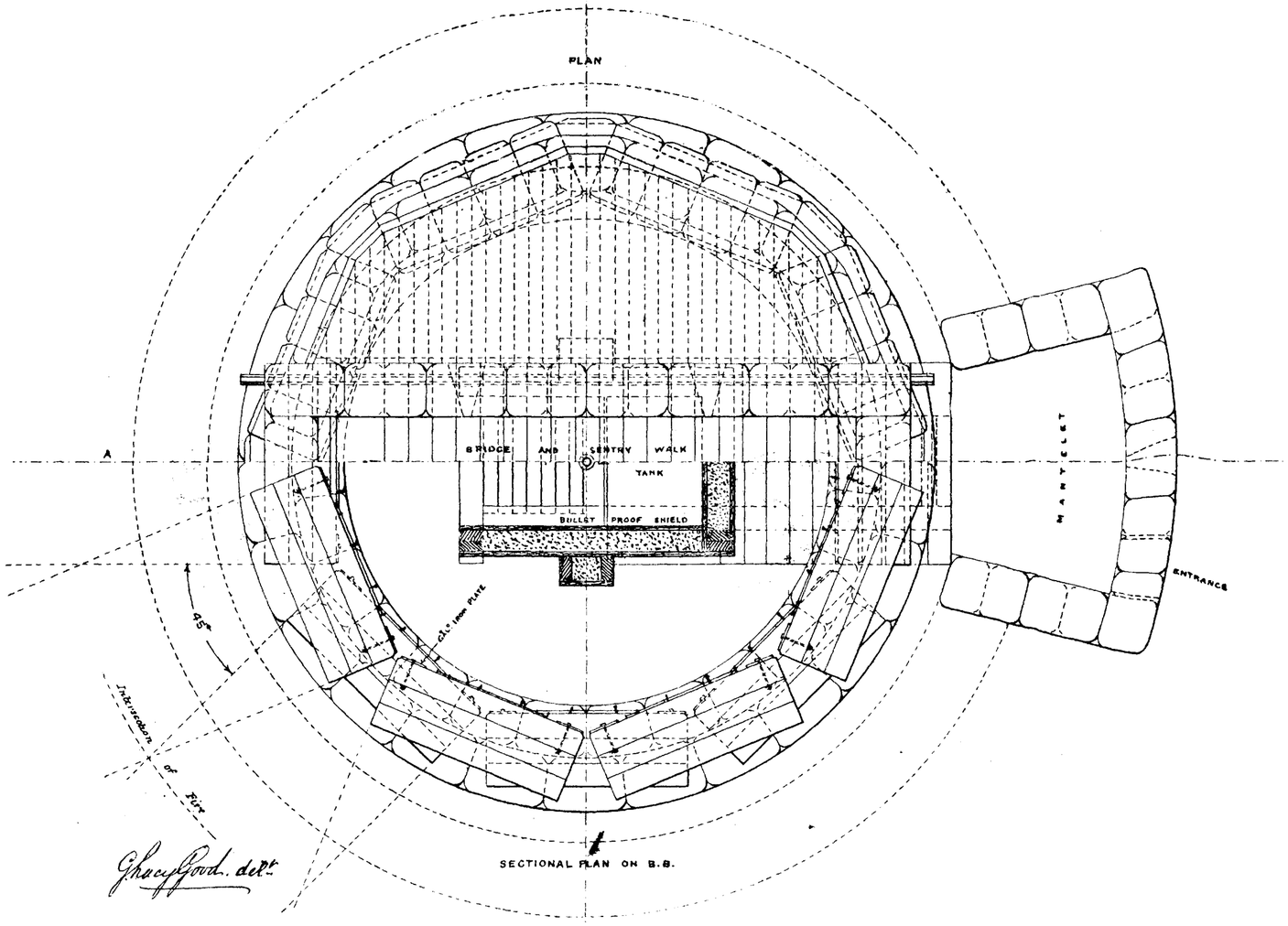


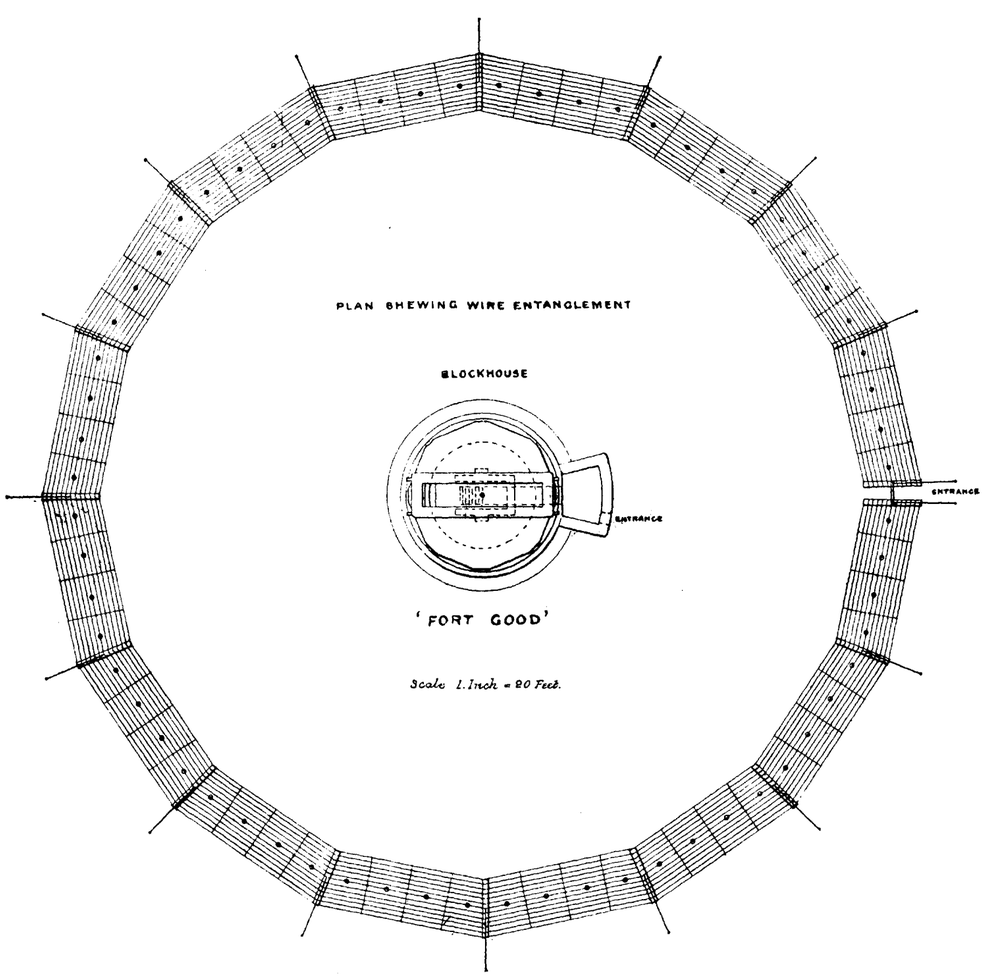
Scale ¼ Inch = 1 Foot.

PLAN



PLAN SHEWING WIRE ENTANGLEMENT

BLOCKHOUSE



'FORT GOOD'

Scale 1 Inch = 20 Feet.

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To get some idea of the legend of weights for the ideal ship, we will begin by putting down the percentages of the displacement allotted to factors outside the scope of this essay. Thus, allowing 5 per cent. for general equipment, 34 per cent. for weight of hull, and 6 per cent. for legend weight of coal, we are left with 55 per cent. of the displacement to allot to the provision of speed, armament, and protection. We have seen that the armament will require about 3,500 tons or 19·5 per cent. The protection will absorb about 22 per cent. of the remaining displacement, if it is on similar lines to that given to the "Dreadnought," with 6-inch armour on the casemates; this broadside armour would render the ideal ship one of the most powerful protected vessels afloat.

We have now got 13·5 per cent. of the displacement left to allot to machinery and engineer's stores. This should be sufficient to give an 18,000-ton ship a speed of 19 knots, with turbine propulsion.

The legend of weights for the "Dreadnought" and the ideal ship will, then, compare as follows, using the same headings as in the previous table:—

——	I.	II.	III.	IV.	V.	VI.	VII.
Ideal ship	5·0	19·5	13·5	6·0	22·0	31·0	—
Dreadnought ...	5·0	19·0	16·7	5·6	20·6	33·1	—

The cost of both types of ship would be about the same.

This, then, is the solution of the problem which we set out to solve.

Give the ship as great an offensive power as possible on the tonnage to which you wish to limit her size; give this armament and the ship in general an adequate protection, depending on the degree of efficiency of the ordnance of the day, give her fuel to carry her 8,000 miles at economical speed, and a full speed of 19 knots.

Armament is the first consideration in a battle-ship, to which everything else must give way. If necessary, the inert defence, the armour, must be pared so as to allow the weapon of defence, the gun, to be conveyed at a sufficiently high velocity from place to place.

Speed is a very desirable attribute in a battle-ship, both strategically and, to a lesser extent, tactically, if applied in a proper manner, but it is not going to decide battles nowadays any more than it did in the days of the sailing-ship. These are going to be won, as heretofore, by the gun, and by the skill with which it is controlled.