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On the Future of Naval Attack and Defence

Captain J. H. Selwyn R.N.

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Evening Meeting.

Monday, February 16, 1863.

Captain E. GARDINER FISHBOURNE, R.N., C.B., in the Chair.

LIST of MEMBERS who joined the Institution from 1st January to 16th February.

LIFE.

Russell, H. R., Captain 57th Regiment.

ANNUAL.

Dillon, Hon. A., Depy. Lieut. co. Mayo.	Sidebottom, L., Major Unatt. 17.
Dillon, H., Ens. Rifle Brigade. 17.	Torbet, P. G., Lieut. R.E. 17.
Mayne, J. O., Capt. Roy. Eng. Mad. 17.	Mottram, H. G., 4th Worces. Rifle Vols. 17.
Blowers, W. H., Capt. Bom. Staff. Corps. 17.	Colby, G. P., Capt. 2nd Queen's. 17.
Heathcote, C. T., Capt. Bom. Staff. Corps. 17.	Gledstanes, H. B., Lieut. 75th Regt. 17.
Smith, J. H., Capt. R.E. 17.	Crombie, Alex., Major 72nd Highls.
Mallet Hugh, Capt. late 4th Huss. 17.	Rice, C., Major 72nd Highlanders.
Strachan, J. Lieut. 94th Regiment.	Tanner, T., Capt. 4th King's Own.
Armstrong, C. A., Capt. 10th Regt. 17.	Thrupp, M. E., Ens. 4th King's Own.
Beale, P., Capt. 10th Regiment. 17.	Atkinson, T. G. B., Capt. 94th Regt.
Agg, T. F., Lieut. 16th Lancers. 17.	Trevor, E. A., Lieut. R.E., Bengal.
White, A., Lieut. Queen's Westr. Rifle Volunteers. 17.	Shepherd, W., Rear-Admiral. 17.
Cartwright, R., Lieut. 15th Regt.	Freemantle, E. R., Com. R.N. 17.
Green, G. F., Ensign 14th Regiment.	Trower, C. T., Major 103rd Roy. Bom. Fus.
Owen, G. A., Lieut. 107th Beng. Inf. 17.	Clay, T. S., Lieut. 103rd Roy. Bom. Fus.
Boyce, J., Lieut. 11th Regt. 17.	Hobart, Hon. H. M., Lieut. 103rd Roy. Bom. Fus.
Boulcott, J. W., Lieut. 86th Regt. 17.	Godwin, A. A., Lieut. 103rd Roy. Bom. Fus.
Walker, F. W. E. F., Lieut. Sco. Fus. Gds. 17.	Sawyer, C., Lieut.-Col. 6th Drs. Gds. 17.
Jobling, F. C., Ens. Cey. Rifles. 17.	

ON THE FUTURE OF NAVAL ATTACK AND DEFENCE.

By CAPTAIN J. H. SELWYN, R.N.

My object in reading this paper will be principally to give opportunity for the full discussion of the important subject of which it professes to treat. I could not presume to dogmatize before an Institute of

professional men who must, many of them, be so much more competent than myself to express valuable opinions on the manœuvres and tactics, the instruments and their disposition, which are to make up the sum of future naval attack and defence. But for the humblest member of a profession, as well as for its greatest ornament, it is not only allowable to say, but also it is true wisdom to acknowledge, "I want to know," and therefore I seek to elicit information, which may be alike valuable to the highest and the lowest, to the looker on as well as to the professional man.

That each branch of the subject may receive its due share of consideration, I have thought it best to classify them under several well-defined heads.

The first of these seems properly to be, the means of future manœuvring, or the motive power and its applications which are now, or seem likely soon to be, at our command for that purpose.

The second will comprise the means of attack; and the third, the means of defence, on which we may really and safely rely, while the conclusion will be devoted to the manœuvring proper, or the management of the resources on the ocean.

It is obvious enough that as regards the first subject,—the great thing to be looked for,—is not only the highest attainable velocity of motion, but also the longest attainable duration of this power, or as it is sometimes tersely put in racing language, not only speed but bottom.

Of late years speed has been sought by the more scientific formation of the body to be propelled, and very satisfactory results have in this manner been obtained, though I am far from thinking that as regards men-of-war we have arrived at a *ne plus ultra*; and if, as at present seems probable, we are to carry heavy defensive armour, I am disposed to think that the necessary velocity will have to be produced by a very great increase of beam, with a spherical form of bottom, rather than by that extreme length, which is as 6 to 1 in some modern ships, and has a tendency to render such vessels very unmanageable under sail alone. Under steam too, with the single screw, a greater length of time is required for turning; and the force necessary to be exerted on the rudder-head is such as scarcely any disposition of material will enable us to resist.

A paper which deserved most serious attention was read by Commander Symonds last year before this Institution, on the advantages to be derived from the use of twin screws, and both as regards increase of speed, and almost perfect facilities for manœuvring, I am happy to bear testimony to the confirmation which practice has since afforded of the truth of a great portion of the theory there developed. I may say that I have little doubt that those few points which have not yet received a trial, as regards the rudder, double keels, &c., will be found as satisfactory as was shewn to be the case by the experimental trip of the "Flora," with twin screws and independent engines. On that occasion, a speed of 14 knots was attained by a vessel of 350 tons and 120 horse-power, built for a tug, and consequently with anything but fine lines. She was repeatedly turned *on her centre* by reversing one

set of engines and going a-head with the other, and altogether gave results which astonished and delighted every one present.

But in her, as in all other vessels up to the present time, little comparatively has been done to secure the duration of these results, the most economically-constructed boilers expending all the fuel the ship is able to stow in about 12 or 14 days. Here then is a point where some improvement is most desirable, and I am happy to say I have recently become acquainted with a method of heating water, which promises to do much in this direction. It is not within the limits of such a paper as this, to give a full description of the method employed. It may suffice to say that it is the invention of Mr. A. Longbottom, C.E., and that it proceeds on the principle that if, as is well-known, water may be heated to the temperature of red-hot iron in tubes, without making steam,—no room being allowed for the generation of that gas,—then the greatest heating surface is to be obtained by copying the worm of the still (which affords the greatest cooling surface), and, in the words of the inventor, a vessel of considerable size may be driven across the Atlantic with no more expenditure of coal than would take a locomotive from London to Exeter. I do not claim perfection for this invention, I would not even be understood to pronounce an opinion on its merits, I only say, that “I want to know” if it is not well worth a trial.

For while we are quite ready to acknowledge that steam is and must be, till a new power is discovered, the right arm of our strength, we must not ignore the many difficulties which, in the event of war with an active naval foe, would attend the coaling of our ships with that certainty and ease which we now accept as a matter of course. The capture of half-a-dozen colliers proceeding to Gibraltar and Malta, might paralyze the operations of the Mediterranean Fleet. Therefore economy of coal has even a greater importance than the money and time questions involved, and a supine neglect of it during peace will, as in all other cases, bring its own punishment in the first years of a war.

I turn now with great diffidence to the much-vexed question of the means of attack, and I cannot help saying that I look with grave mistrust at some of the so-called improvements in our naval artillery.

Three objects seem to have been sought, alike by Sir W. Armstrong and Mr. Whitworth, besides a host of other non-professional inventors, or rather advocates of certain forms of artillery. I have yet to learn that there is much which can properly be called invention in most of these systems, more especially as in the Isle of Man, round Peel Castle, are to be seen rifled ordnance to the number of 30 or 40, which have been consigned to the ignoble duty of posts, half-buried in the earth. We must hope that one or two of these, or at any rate, a full description of them will be obtainable for this Institution, they are supposed to have been cast in the time of Cromwell. Extreme accuracy, long range, and penetration as distinct from destruction of iron plates, these seem to have been obtained, while much that was far more likely to be useful has been left uncared for; not only so, but points of acknowledged importance have been given up, and we are

told to be content with long range instead of initial velocity, with segment shell, instead of spherical case, with weapons that cannot bear the rough usage of those elements we ourselves must always be called upon to face; guns which, in the event of the ship getting ashore, must be put into oil-skin before being tumbled overboard to lighten her. Science, too, has been set at nought in the shot, and her teaching that iron in contact with lead is always destroyed by galvanic action in water, still more in salt water, is either ignored or studiously kept in the back ground.

Again, penetration of iron plates of enormous thickness (when considered with reference to the carrying power of ships) has certainly been lately obtained, but a broadside of 68-pounders, concentrated, as can always be done, would probably *destroy*, not penetrate an iron plate of similar size at a similar distance, owing to their initial velocity (as must always be the case with spherical bodies) being considerably greater. And here I would remark, that it seems strange that any doubt should have existed, that any experiments should have been deemed necessary to establish the fact, that of bodies of a similar weight, of the same substance, similarly propelled, the spherically formed one as it will have the greatest area, will also have the highest initial velocity and, *ceteris paribus*, the shortest range. It will also have the greatest contents, whether of molten iron or bursting charge, and, therefore, as a shell, no other form can be advantageously substituted for it, unless, indeed, in a case such as long range being absolutely required, when its advantages in other respects are no compensation for its deficiencies in this. This, therefore, is a point on which a compromise should be sought; but, if I have to protect a disembarkation, or the reverse, it will be small consolation to be told that my rifled gun will hit a field officer three miles off, if from it I cannot, on occasion, fire a shrapnel shell that will annihilate a troop of cavalry at a thousand yards. I had far rather knock a plate off an armoured ship than penetrate it with any number of pretty little round holes; and, above all, I strongly value the capability of standing any usage that may be unavoidable in the rough conflict of the elements with the comparatively feeble works of man on the ocean or in the field.

If such objections were simply an invidious fault-finding, without any probability of means being discovered to obviate these inconveniences, to eliminate these errors, then indeed I had better have been silent, I ought not to have complained. But it has been ably shown how we may obtain a sufficiently long range, without sacrificing that initial velocity which forms so important a multiple of the weight of the shot, in estimating the effect; how, we may secure a considerable degree of accuracy without losing the rough-and-ready character of the weapon—how to make guns that will fire any description of projectile, spherical or elongated, that may be suited to the particular case, and, at the same time, strong enough, without resorting to highly expensive twisted or *built-up* barrels—how, in short, it is not necessary that to obtain a very large measure of the advantages sought, we should give up any of those already attained. Need I say

that I refer to the systems proposed, and, to a very great extent demonstrated, by Commander Scott, R.N., and Captain Blakely, R.A., two practical men, who knew what was to be sought, and, therefore, soon found how to seek it—who had seen and studied the use of the weapon they wished to improve, and who knew therefore what they could, and what they could not, give up or obtain. They did not seek, as the principal object, a range and accuracy which alone were practically valueless. They did not imagine that ships were always steady, or that the destruction of a single man justified the expenditure of fifty pounds' worth of powder and shot; and more, they did not profess breech-loading and mechanical fits, and then shunt into muzzle-loaders and transcendental curved bores. But I gladly quit a part of my subject which has cost the public brains so much cudgelling, and the public purse some four and a half millions, hoping that the next generation may thereby be made wise enough to believe professional men on professional points, unless just cause can be shown to the contrary.

We are now to consider the question of defence against the formidable attack which, whatever may be justly said of the comparative merits of the various systems proposed, it is fully evident we must prepare to guard against in any future war. Is it possible by any weight of armour which, on the present system of iron plates, we can carry, to keep out the shot, not to say shell, which will be directed against us? Are we prepared to stand a dig under water? a kick on the bottom from a ram, or even a butt on the ribs from a 14-knot steamer? It seems very doubtful whether guns will come into play at all at close quarters, for by many and constantly recurring examples, we may learn that of two vessels coming into collision, the one run into is often sent to the bottom, with comparative impunity to the other.

But passing over this for the present, let us examine the effect likely to be produced on armour plates, such as at present exist, by a concentrated broadside at 200 yards of a vessel carrying 68-pounders on the maindeck. Strange it is, that even now, with all the experiments which iron-plate committees have tried, they have never, so far as I can learn, tried this, so that we have still to theorize on the subject.

I find that four 100-pounder shot fired, not together, but consecutively, broke through into the cupola of Captain Coles; that several shot together, as regards the place of striking, injured the plates very much, that on one occasion when six guns were fired as a salvo, the effect was enormously greater, as might have been expected, than when the same guns were fired consecutively; but on no occasion can I find that anything like even a heavy corvette's broadside was concentrated and fired at an armour plate.

Now, this is the very first expedient or experiment which would probably be tried in war, and till we can say that it has been fairly examined into, we really know nothing of the true value of armour. Therefore I say again, "I want to know." I fully believe, that such broadsides so delivered would, in a very few minutes, strip the ship

attacked, of almost the whole of her costly defence. True, she might be doing the same thing, and, therefore, inflicting as much damage as she was called upon to suffer. But this ought to be rescued from the region of conjecture, we ought to *know* what to expect on such a subject.

A most interesting metal has now come into practical use, which is known as aluminium. Its cost is certainly an objection at present to extensive experiments, but need be no bar to a consideration of its theoretically valuable qualities, none indeed to experiments on a small scale, which, I believe have not yet been made. About the metal itself there are these peculiarities:—Its melting point is not high, it melts at the bright red-heat of iron, it is very soft, almost as much so as lead, but what is of most importance, it is of remarkably low sp. gr., approaching to wood. Now, an experiment might easily be tried as to its power of resisting bullets, and if it approached to lead in this respect (supposing the resistance offered by that metal be not due to high sp. gr., more than to softness) it would be well worth while to consider how the supply would or might be increased, in answer to such a demand; for the source from whence aluminium is derived (the cryolite of Greenland and the clay shales) is for all practical purposes unlimited, and the only reason for its high price is the small quantity which can be sold at a profit. Here again it would be well to know—it is folly to remain ignorant.

As regards the system of defence advocated by Captain Cowper Coles, while I admire it on an unsinkable raft and in gunboats, I confess to have many doubts of the economy of putting a ship of 3,000 tons to carry six guns, big though they be; and of the wisdom of a system which relies on no saucy gun-boat getting under your bow or stern, where you are totally unable to fire at her. I think for its real development it requires an entirely different form of vessel, and is then most applicable to coast defence, where it would undoubtedly be of great value.

Besides armour, there are some other methods of meeting naval attack which require mention; among these is the defence of rivers against gun-boats, which the American war has taught us must by no means be neglected in such countries. So long as gun-boats are constructed with comparatively thin iron bottoms, a most formidable means of defence will be obtained by copying the snags and sawyers, hidden foes of ordinary river boats which nature teaches us are greatly to be feared. In a thickly timbered country, with, or even without iron shoes and spikes, these may easily be laid in a river in such numbers, and in such places, as to render it almost a certainty that the enemy (who has no chart of their whereabouts) will run upon them, and, of course, the heavier the boat with armour, the more would be the damage done. They have the advantage (or disadvantage) that as the river rises or falls, so do they also, always keeping the points down stream, and just awash. Nets, too, as Commander Symonds was one of the first to state publicly, will always be formidable as auxiliary means of defence, detaining screw ships in narrow passages under fire, and, perhaps, causing them to run aground in a tideway.

As regards the defence and attack at sea, that will more properly come under the separate head with which I now propose to conclude this paper, premising that throughout I have considered it as, and intended it to be, one to invite discussion of the points referred to, not to exhaust the arguments or facts connected with them. For of both of these, I know the members of this Institution to be in possession of a far larger store than I could hope to offer, and waiting only the opportunity I seek to give, for its publication.

Supposing war with a naval power were declared to-morrow, how should we manage our new means of attack and defence, comprising a power of motion at will in any direction, the use of which we never had any opportunity of fully testing during the late war, and a range and accuracy of projectile which, at that time, we had not fully attained. Our weak point is not so much our liability to invasion, which might be met in part by a coast telegraph, and would not probably be of any permanent injury, though fearful enough to the defenceless population at first, but in our wide-spread commerce; we could not afford for a day to see the command of the sea pass from our hands. The Americans have learnt how commerce leaves the flag and ownership which is liable to predatory attack at sea. The "Alabama" (to take an example) has caused more annoyance in New York than all the Confederate generals. She no sooner sees an American sail than she chases it, and her speed soon places it in her power. No soul can tell her place on the ocean, for she is not limited by the accidents of wind and weather, and she can as easily avoid a formidable foe as catch an unresisting prey. True eagle of the ocean, her captain may truly say with Byron, as far as his enemies are concerned :—

"These are our realms, no limits to our sway,
Our flag the sceptre, all who meet obey."

It follows then, that for whoever obtains and keeps the empire of the ocean there are now more than ever immense advantages in prospect, but for those who rely, as England does, more on their commerce than on any other source of prosperity, there are also immense dangers to be feared. We cannot pay too dearly for any means of securing that speed and bottom of which I first spoke, and without which, brave hearts, good guns, and triple armour are alike useless. We shall never be able again effectually to blockade a port. The silent screw will take advantage of a dark night or fog, and will slip to sea to harry the commerce and distress the finances of her enemy, till a faster ship than herself is enabled to force on a combat, which, like a privateer of old, she will decline until that moment arrives. So much for the light cavalry of future naval warfare. As for the tactics of a fleet, I can only say that I think, far from assembling in large numbers, and so, united, fighting an action on the old system of line-of-battle and line-a-head, the true tactics to be initiated by the weaker as a rule, is a trial of speed and bottom. If, for instance, a fleet wished to go out of a blockaded port, and then to damage the enemy more effectually by separating than they could ever do by remaining together; it would be easy to secure a time when many of the

blockading fleet having been under steam to keep position, their supply of coal would be lessened, and they would therefore be on unequal terms for engaging in such a chase as that of Nelson to the West Indies.

If, again, the fleets did meet, a very short trial of speed would draw out the faster ships from the others, and they might be overcome in detail, or failing that, if they kept together, the hostile fleet might leave them "alone in their glory," and pursue more profitable occupations than that of seeing whose skin was the hardest. Not till we had cut off every port at which an enemy's steamer could coal, should we put an end to this annoying state of things. Therefore such islands as the Ionian are not to be given up carelessly. It might be said, this applies as much to one fleet as the other—as much to other commerce as our own. True enough, if we have no more slow ships than our neighbours, which has not always been the case. True, if others depended as much as we do on commerce, but in any case new modes of action will come with new means, and it would be well to think of what we shall do before the time comes for doing it.

The question between ships and stone walls is remarkably changed by the new means of offence. It must now never be forgotten, that a ship is a small, moveable target, and a fort a large fixed one, that every shot from a ship may, probably will, hit at a distance from whence she may defy, under steam, any gun in the fortress to touch her; that walls and magazines may be damaged and blown up by such an attack, and that no iron casing on the sea face will prevent the distant fire from overtopping the ramparts and plunging into the barracks and dockyards. I confess I am one of those who think, that to a peculiar class of vessel, unsinkable by rams, and of moderate speed, must the defence of our sea coast be principally committed, to the exclusion of those enormous forts whose contract brick would in some cases be a poor defence against any form of rifled gun, and whose extent only ensures that no enemy will ever come near them while he can find a sandy bay anywhere else, though they must be garrisoned for fear they should prove places of strength, not against, but for the enemy. As frigate and corvette actions will probably play a most important part in any future naval war, I think forethought on the manœuvres then to be employed will be especially necessary and useful, and if no other member turns his attention to this point, I shall be happy to try to gather facts and probabilities together for that purpose, and at some future day lay them before the Institution.

I will now close my paper by thanking you for the patient hearing which you have given me, hoping that what I have put as doubts will receive their solution from those who can better furnish us with facts and illustrations bearing on the subject, so that I and others may, by the operation of this most useful Institution, become acquainted with the best professional opinions on points so nearly and highly interesting to all of us.

THE CHAIRMAN: It will be more convenient for all parties that the discussion should be confined to the division which Captain Selwyn has adopted in his paper.

The first part of the paper relates to motive power; if any gentleman wishes to make any remarks upon that subject we shall be glad to hear him.

Commander SYMONDS, R.N. : It is a source of peculiar gratification to me to have had this opportunity of hearing the remarks that I made on a previous occasion, with respect to the double screws, so spoken of by my friend Captain Selwyn, in whose company I had the opportunity of witnessing experiments with two screws on a recent occasion, especially as there were several doubts expressed on reading my paper, at this Institution, as to the fact of two screws having that most extraordinary steering and manœuvring power which I then described.

Captain Selwyn has made use of one word which is a slight mistake, I think. It was not a "theoretical" deduction of mine, but it was the result of practice some five or six years ago, which brought me to the conclusion that the use of two screws in a ship of war would be found most advantageous. On that occasion I witnessed much greater results in a little vessel of 100 tons, than were ever seen in the "Flora." The "Flora," although obtaining very great results, was not by any means a vessel well suited to the trial of the principle. In the first place, she was built with a very deep gripe, and in the next, she was remarkably high out of the water, with very high deck cabins, and there was a larger area of resistance to turning in her, probably, than in almost any vessel that has had two screws fitted. Still the results, as Captain Selwyn said, were very remarkable. She, on many occasions (tried both ways), turned on her centre. That was really a point that surprised me, because I found in the vessel that I saw tried before, that she turned on a point about one-third from the screw; whereas in this case the vessel certainly turned on her centre. The speed attained by these two screws was considerably greater than is generally obtained from a similar vessel with a similar proportion of power. There is no doubt that she did obtain a speed of fourteen knots an hour. Therefore, one of the arguments used against the use of two screws, on the occasion I refer to, falls to the ground.

Although the "Flora" was so successful, both in her manœuvring as well as in her propelling power, still I did not consider her the type of a twin-screw steamer, suitable for a man-of-war. She is a single-keeled vessel. I should say in the first place, that the shafts of the "Flora's" screws come immediately from the counter, and at a distance of some ten or fifteen feet they are supported by V brackets, which are very well calculated to foul; moreover, I think the vibration that was perceptible on board of her was increased very considerably by having the screw at the end of so long a lever. In addition to vibration, they are obviously liable to a variety of accidents.

For these reasons, I have (on the occasion before referred to), recommended another method of fitting the two screws on a principle which has been for a long time advocated by my friend Mr. Richard Roberts, the celebrated mechanical engineer, and which I have assisted him in applying to war ships. Instead of carrying the shaft out from the quarter, if you observe, as in this model, there is a trunk which is connected with the counter by a web of iron, and the screw fits immediately to the end of this trunk, so that literally the trunk and the web form a portion of the hull, thus adding to the strength rather than detracting from it; this, in addition to the two cellular keels, will give a very considerable amount of strength to the ship's bottom, and also will have the very great advantage on taking the ground of keeping her upright, and protecting the bottom from rocks or snags.

I shall not farther dilate upon this plan, except with reference to the action of these two screws. I must observe, I quite coincide with Captain Selwyn, that although not entirely disagreeing with the cupola principle, still, I beg leave to say, this is another way of arriving at the end that Captain Coles professes to attain by his cupola. I think very probably his cupolas will be of great service in some cases; but at sea, where you want to bring your guns to bear rapidly, nothing can be so certain as the action of two screws. We must bear in mind, that it is quite possible we may have to use both our broadsides at the same time. In a vessel with two screws you may retain your broadside guns, and, if you have an enemy on each side, you will find them very useful; whereas with the cupola ship, having only her five guns, she will have a very short supply of guns to fight both sides with. I firmly believe at sea, that the broadside guns may be brought to bear much more rapidly with the two screws than by any mechanical means that can be applied to a cupola.

I think many professional men agree with me on that point. Moreover, a capota ship, having only one screw to manœuvre her, is just as liable to be run down by another ship, without being able to avoid it, as an ordinary single screw steamer. Now, I conceive the two screws will enable you to receive the blow of a ram in a glancing direction, because the action of the screw is instantaneous. We know perfectly well, that in the smartest ship, the action of the helm is not immediate; it takes some little time to gather its effect; whereas by the slightest reduction or increase of speed on one of the screws the ship is acted upon instantaneously. The great agent in this case is the independent and separate engine. We have very often heard of two screws being applied to ships in years gone by, but they were comparatively of little use, being geared together. However, since the introduction, which I believe is due to my friend Mr. Roberts, of the separate and independent engine to the screws, they are turned at will, in either direction, and the manœuvring, which I have described, is rendered possible, which it was not before. There is this advantage also in having the independent engine, as we saw illustrated in the trial of the "Flora." When to leeward in one of the bends of the river, with a strong wind and lee tide, one of the engine bearings heated. Had it been a single screw ship we should inevitably have gone on shore, but, by increasing the number of revolutions of the other screw, she came off at one-third less speed than with both.

There are various other points which, if time allowed, I might bring to your notice, but I think at the present moment I ought to confine myself to the remarks that I have made.

THE CHAIRMAN: Has any other gentleman any remarks to make upon the subject of motive power?

Admiral Sir GEORGE SARTORIUS: I am very much pleased to see a young man like Captain Selwyn occupying himself upon a subject of such deep importance to his profession and to his country, and bringing to our notice the necessity of applying to practical men to correct the theories of those who are not practical. For I believe, that half the mischief that has occurred, has arisen from neglecting the opinions of practical men.

With respect to the subject of motive power, the application of the two screws is a most important one to sailors. It gives us what is of the highest importance—the facility of guiding a vessel with much greater ease than we could do with the rudder, and under circumstances when the rudder could never act. If we succeed in casting very heavy guns, and I have expressed my opinion on the subject, in a pamphlet published a few months ago, it will be by means of two screws that we shall be able to use the heaviest guns by making the ship herself the gun-carriage. This anticipation of mine is very fortunately realised in the clever and ingenious manner in which the two screws will be applied. Whether it will be on Captain Symond's system, or on the system applied to the "Flora," does not matter.

Captain SELWYN: That is Captain Symonds' system. Mr. Roberts' and Captain Symonds' system are applied in the "Flora."

Commander SYMONDS: Our system of the independent and separate engines.

Admiral Sir GEORGE SARTORIUS: For us in the navy it is a most important discovery. It enables every offensive power we can make use of to be much more readily managed. We can have the largest guns put on board ships which are themselves made the gun-carriages. The pointing of the gun will be given by the screw of the vessel. The raising and depressing of the gun will, of course, be done inside, but the difficulty of training such great guns will be overcome by the screws. In that way, the ship will form a ram, a most powerful battery, and probably that will be the type which our future vessels of war will assume. I can say nothing more with regard to motive power. In the observations, Captain Selwyn has made, I heartily concur; there is hardly a point that I disagree with him upon, except that I think he attaches too much importance to the ship as against a battery.

Lieutenant NEWENHAM, R.N.: I would speak with regard to the fuel employed in ships-of-war. That is a very essential part of the motive power. If any gentleman is in the habit of going up and down the river frequently, he will see in the river steamers an immense quantity of smoke issuing from the funnels. Now, I need not tell you, that when that occurs, there is an immense quantity of fuel wasted. If, therefore, we can devise any plan whereby the fuel may be economised, that will

be a great advantage, especially for ships-of-war, where the ships have to be a long way out at sea, and a long way off any means of getting a fresh supply of fuel. It is quite true if engineers are properly instructed they can so trim their fires that the smoke need not escape, that in fact you may burn the fuel with great economy, and that no other arrangements need be employed than a proper mode of stoking. But we know practically that this is impossible to be done. The Peninsular and Oriental and the other large steam-boat Companies have given this question a great deal of consideration, and they find it perfectly impossible to make stokers economise fuel. I believe even premiums have been offered to them as rewards for endeavouring to work with a small quantity of fuel, still without any successful result under ordinary circumstances.

Now civil engineers know very well exactly how much water a pound of coal ought to evaporate. That is a fixed point which is perfectly well-known. Then the question is, "Can we obtain any other fuel than coal which will give us the results that we wish to obtain, and which will put it almost beyond the power of the stokers and engineers, or engine drivers to waste the fuel in the way they do at the present moment?" You will see that that is a very important question. I think it may be done. From experiments I have seen carried out, I think if certain kinds of coke were employed we should arrive at a result which would be very satisfactory. We know that coke is employed in locomotive engines, but it has been employed there almost because it was absolutely necessary, even considering the immense extra expense that it occasions. But it is quite possible to make coke, for instance, from peat, by a process that has been recently patented, and which seems to offer very extraordinary results. I believe some experiments have been lately tried upon a coke that was made under Butler's process, in which he condenses and chars the peat only to a certain extent, and he has been enabled, I believe, with something like 12 cwt. of this patent peat coke to do as much work as nearly double the quantity of coal under the ordinary system.

The CHAIRMAN: Could you give any estimate of the weight of coke per cubic foot, because that will be one of the difficulties, as compared with coal?

Lieutenant NEWENHAM: The value of this coke, if I am rightly informed, is something like 12s. a ton, not more.

The CHAIRMAN: But coke is very light, and would occupy a very large cubical space as compared with coal?

Lieutenant NEWENHAM: Not necessarily so. The question is as to the amount or tonnage. Suppose you take 100 tons of space in a vessel, how many miles or knots can you get out of that tonnage of fuel. That I take to be the question. It is not a question as to the cost of it. I was going to say, that so far as I can understand it, this coke offers advantages on every side. First of all, it is less costly than coal; secondly, it will have more power, a given weight will do a good deal more work.

The CHAIRMAN: Would a cubic foot of coke generate as much steam as a cubic foot of coal?

Lieutenant NEWENHAM: Oh, certainly, considerably more.

A MEMBER: May I ask one question? I wish to ask the gentleman who spoke last whether it does not require to increase the draught when burning coke instead of coal?

Lieutenant NEWENHAM: It requires very much less draught; that is a very curious thing. It is a remarkable thing. I am glad the gentleman has reminded me of it, because it appears that you can burn this coke or any kind of peat coke with a very much less draught than the ordinary coal; in fact, you could reduce the smoke stack of a steamer to about within ten feet of the deck, which I apprehend would be an important thing in sea-going vessels.

The CHAIRMAN: As I was present when Captain Symonds read his paper, I can confirm what he said about the difficulties that were raised, and the statements that were made by shipbuilders, that the double screw had been tried and failed; but really the more I hear and the more I see, the more I am inclined to mistrust the statements that are made about experiments having been tried. I find that a very small difference makes the whole difference between success and absolute failure. When it is stated that a thing has been tried, we want to get the whole of the details, because somehow

or other, whether for want of the capability of observing in the persons who made the experiments, or some other reason, they are pronounced to be failures, when they are not so, and to be successes when they are far from being so. This subject of coke is a very interesting one. If it be true, as stated, that a cubic foot of coke will generate an equal quantity of steam with a cubic foot of coal or more, it is an important subject, because one of the great difficulties of ship-building is the enormous changes in the draught of water occasioned by the great consumption of coal, and consequent reduction of weight. The failure of the "Sidon" was due to that. They sought a large quantity of stowage for her coals, and, overlooking the consequences that must necessarily arise from the mode by which they obtained it, they spoilt the ship; this might have been avoided by a little forethought. I must confess, with respect to the double screw, I, myself, thought it would not give the very great results that seem to have been realised by the vessel alluded to; and if she realised these great results at 14 miles an hour, I take it that the result she will realise at sea, will be relatively greater, arising out of the fact of the increase of surface which two screws afford, as against one. The great disadvantages of sea-going screw vessels of course in long voyages with head seas is, that the screw travels very fast, and they burn as much coal when they are not going a-head as when they are going at a very great speed; this is a very serious objection to the screw. The paddle has that advantage over it, and we may expect to find vessels with double screws making economical sea-going packets, which is not the case now, for when these vessels are subject to a head wind or a head sea, they burn an immense quantity of coals without making any progress.

The second part of the paper is on the subject of offence which will comprise the means of attack. Has any gentleman any remark to make upon the subject of attack and the means of attack?

Captain YONGE, R.A.: In case no other gentleman will favour the meeting with any remarks upon the subject, I should like to throw out a hint which I think is lost sight of by Captain Selwyn, and by a great many naval officers, in treating this question of naval attack. I know I am treading on dangerous ground, and I candidly confess it is not a point which I have considered to any great extent, but I think the great mistake made by the officers of the naval profession is the notion that they will always be able to find an enemy who will allow them to close with them. Now we all know, I think it was at the battle of Trafalgar, after sundry orders had been given, Nelson said that no captain could do very wrong who laid himself alongside a ship of the enemy. That was all very well in those days, when there were reasons for going alongside an enemy's ship. I leave altogether the question of the natural desire of the sailor to come to close quarters, but looking at it merely as a case of matériel, the guns they had at that period were not guns that would enable them to do any damage at any but short ranges. The favourite gun of the period was the carronade, a gun of very large calibre. The shot had great smashing effect, and the charge that was used was a very small charge indeed,—I think for some of the larger 32-pounders something like 2lbs. or 1lb. 10 ounces. It is impossible to do any damage with that shot and with that charge except at very close quarters. Then, again, it is no disparagement to the service, to say that in those days there was very little attention paid to naval gunnery. A gun was loaded and a gun was fired, and if it hit, so much the better, but I think that the science of gunnery entered very little into the details of naval actions. I am not prepared to say at what ranges those single actions or duels of the navy have been fought, but I think it will be found that if our then opponents, the Americans, had the opportunity of keeping us at a long range, they did so. They had long 18-pounders and other guns of comparatively long range, and they never allowed, if they could possibly help it, a British ship to close with them; and they commenced by dismantling the rigging, and then in detail doing all the damage they possibly could with deliberate long shots and steady gunnery. I think those days will never come again, in which naval officers can bring their ships alongside the enemy in the same way they did before.

Therefore, starting with that impression where "the wish is father to the thought," naval men find that a very good gun for these short ranges is the old 68-pounder, in fact, the old smooth bore gun, throwing a very heavy shot, and which has, as is well known, very great initial velocity. This is a point on which I think

many mistakes are made—in speaking of *initial velocity*. One would imagine that the shot struck its object immediately on leaving the muzzle of the gun; that is true *initial velocity*, but people lose sight of the fact that in the case of round shot it rapidly loses that velocity. The range of 600 yards is a very convenient one pitched upon. You hear of 3, 4, 5 and 600 yards, but hardly anything beyond. That is a very convenient range for the gun now in question. Therefore at that range they say very truly that a smooth-bore gun has very nearly as much effect as a rifled gun; but go a little farther—I think it is not quite fair to stop there and say, “We shall engage at 600 yards and no farther.” There are two parties concerned in that question. You will have to see whether your enemy will let you come within 600 yards. If he have a good rifled gun, throwing a large shot at a thousand yards, and can make good practice at that long range, he will not allow you to come within 600 yards. Therefore I think Captain Selwyn, in the commencement of his lecture, was rather hard upon the rifled gun, in throwing it over and ignoring it in future actions. Captain SELWYN: I did not by any means throw over rifled guns, only some peculiar forms of rifled guns.

Captain YONGE: My impression is, you mentioned that rather extreme case of hitting an officer at three thousand yards off as an instance to show that a rifled gun was of no value, considering that as an instance in which you stated that a long range was of comparatively little importance. I think a rifled gun will be of consequence for the simple reason that the enemy will not allow you to close. That is one very great consideration in the case of ships attacking each other. I think a ship which has a gun which will hit at the longest range, has a very much better chance of success, either of driving its enemy off, or of doing damage, than the one which is obliged to close before it can bring its guns to bear. Therefore, the improvement in guns is very important in order to keep pace with the improvement in armour-plates. In the case of broadsides I do not know how far the experiments at Shoeburyness did go into the question, but I think on one occasion there were four or five guns fired together as a salvo. In the days of wooden ships, when a shot made a hole in a ship, the consequence was, if you had a broadside, you had some forty or fifty holes made, and very considerable damage was done. You could not plug fifty holes as easily as you could plug one, but in these days you cannot make a hole at all. I think it is as difficult to make one single hole as it is to make fifty, therefore a broadside is no longer of such value as it was formerly. You can no longer with 68-pounders send a ship to the bottom; you may break her plating, but nothing more. That is not so satisfactory, I fancy, as it would be if the ship should go to the bottom before anybody had time to look about him. All I want to advance is that the long-ranging gun, of course a powerful one, is a very important item of consideration in such questions as these, and it has hardly received the prominence which it deserves in the very interesting paper read by Captain Selwyn.

Admiral SIR GEORGE SARTONIS: I must agree upon one or two points with the last speaker, and disagree with him upon others. The gentleman said that the carronade was the favourite piece of artillery with us in my young days. We always looked upon it with a great deal of contempt. Every ship, both two-deckers and three-deckers, had long guns on the lower deck, and long guns on the main-deck, and very few guns indeed on the quarter-deck. Our brigs, and small vessels of that kind, were obliged to adopt the large diameter which the carronade gave, because they could not carry the long guns, and the very light long guns were inferior in practice to the carronade. I also agree with him that gunnery was entirely neglected. In a brig that I commanded, I had the ship's company of a frigate, that had been four years together, put on board her. The very first time I came to exercise the crew, one man lost three fingers, and another four, in firing a carronade. In a line-of-battle ship that I was in at the battle of Trafalgar, the only one throughout the whole of the navy, with the exception of the ship commanded by Lord Exmouth, then Captain Pellew—she was one of the very few, perhaps one of the four or five, that had been constantly exercised at her guns—at the battle of Trafalgar a line-of-battle-ship ran alongside, her yard got entangled with our main rigging, and in the course of six-and-thirty minutes, from the extreme rapidity of our firing, we managed to knock away all her masts, and to kill and wound 436 of her men. Had we not been well-exercised at our guns, I think the Frenchman would have got the advantage of us. We had actually

our engine playing on her broadside to put out the fire caused by the flame of our guns. With regard to rifled guns, I confess I am inclined to side with Captain Selwyn. I heard one of the officers on board the "Excellent," observe, that when they were firing at a mark, there being no wind, and the tide keeping the vessel perfectly steady, they were sure of hitting it, but immediately the wind was a little too strong for the tide and the vessel moved about, although the water was nearly as smooth as this room, there was a considerable difference in the correctness of the aim. Now just imagine what would be the case in an action at sea, firing long shot. The slightest motion disarranges the aim of the gun, and no action ever has been decided, or will be decided by long shot at sea. We have also found that in every action of the enemy, whether with the Americans or with the French, the shot of the largest diameter carry the day. We have hardly an instance of an English 12-pounder frigate, that was not taken or beaten off by a French 18-pounder frigate, and in the American combats the Americans had 24-pounders to our 18-pounders. Therefore, the diameter of the shot is of the utmost importance, because the largest shot makes the largest hole, and it makes a great many more splinters. I do not say it may not occasionally occur that a gun of a long range may be of use in bringing to a chase, or in perfectly smooth water, when combined with military operations on the shore; but for all practical purposes, the gun of largest diameter, with the highest initial velocity, will be the kind of gun which will be of the most service in naval warfare. But rifled guns, to be able to have an extreme range, must be of a very small diameter, and the oblong shot will do very little mischief. They make gimlet-holes without doing much mischief to the ship, either to the mast or rigging or to the hull. But I think the development of artillery has far exceeded already the use of the armour-plate. I think we have gone beyond the thickness of armour-plates that can be made use of for any practical purpose. I think we never can have—and the very information we have received to-day proves what I have mentioned before in my little pamphlet—that we never can have any more blockading. If it is a military port—I do not mean a commercial port—there are so many advantages on the side of the blockaded coming out suddenly and falling on the blockading squadron, that it will be almost impossible practically to blockade. The question now of the deepest interest to us, and on which must hinge all the subjects we have been treating of, is what is to be the form of vessel we are to have for our future warfare. The largest diameter of shot is a great importance, but then what kind of vessel are we to make use of? The question of attack and defence apply to each other. The largest shot, whether for attack or defence, is important, and also the kind of vessel we are to have at sea for the purpose of carrying those guns. These are the points which I earnestly hope all my friends here, both military and naval, will turn their attention to. We have not yet got that form; we have not yet come to the extreme development which artillery is capable of, and until we have done that it is hardly of any use theorising as to particular shot or particular guns. Let us find out which is the kind of gun best fitted to carry the largest shot, and what is the largest shot which may be made use of for practical purposes. That, I trust, younger heads than mine will do.

Rear-Admiral Sir EDWARD BELCHER, C.B.: I consider that the fastest ship has the greatest advantage of coming up with her enemies, and if we are to pursue the system of the ram, and to use the important power that we have of running over our adversary, and also of using our bow guns, I think that the rifled gun and the long shot will enable you probably to cut away your enemy's stercage, before you come to the point of coming alongside; which plan, I think, now will be obliterated from our mode of attack. I disagree with the idea of the projecting prow below water, because, if I had to engage an enemy, to chase him, and come up with him by sheer running; if I attempted to run my bow under his stern, he running from me, I must run my nose under water, and, therefore, I object to that form of bow. I prefer the bow cut away, similar to the steamers that we had in the Arctic expedition. I know that one of these vessels running against a body of ice, calculated as an inert matter to weigh about seventy or eighty thousand tons, ran her bow up on the ice without any particular shock, did not even spoil the crust of the port wine. She failed probably in the first charge, she retreated, tried it again, at a distance of half a mile, probably effected a crack, and the third time entered the crack, lifted herself bodily on the top of it, and separated the ice. Now, if a vessel of 350 tons, with merely common iron-shod bows can do that,

I consider the same vessel getting a fair run at his adversary's beam, and lifting one-third of his weight over his adversary, would be able to press him down into the water with the super-imposed weight. I am thoroughly satisfied as to the result, from all I have known of ships running into each other, particularly in the case of the "Révolutionnaire" running into one of our line-of-battle ships at Naples; it was not even running into her, but merely from a chop of the sea, she cut her down to the water's edge, without any running at all. Now, if that frigate, merely by a chop of the sea, could cut down a line-of-battle ship to the water's edge, I am perfectly satisfied, that if she had gone at her with her full force, she would have destroyed her; and I am perfectly convinced, when we come to fight these vessels, if we can only get a chance of running at them either at the bow or the stern, by imposing the whole weight of your vessel on the top of the enemy, you will either turn him over, and he will not be able to recover, or you will go right over him and send him to the bottom. There are no instances that I have known of any vessel of half the tonnage of her opponent running against the other without putting her absolutely under water; and if our vessels are strengthened enough at the bows, I have no doubt we shall succeed in dealing in that way with the enemy. As to running alongside and boarding them with those turret roofs, it would be madness. Science must perform all the duties before you come alongside to fight them, and then you will be just in fact like two men in armour, whichever happens to find the weakest point may take the adversary. With respect to the vessel which we see before us, I may state, that when I was on secret service reporting on the Channel Islands, we found that all the batteries had calculated where a ship *could come*, and they gave me a steamer to satisfy the artillery and engineer officers who were with me, where we could put a ship. We used to run the steamer, the "Alban," in, drop her anchor over the stern, and run her nose right into the sand and stick her there, and then turn round and say, "What are you going to do, Colonel?" "Oh, we can't do anything, the batteries are not built for this; there are no guns to look at you." Now, this vessel before us (pointing to a model of Captain Symonds double screw ship) would fight that battery. On her two keels she will rest upright, and fight her action. She would be another battery; and, therefore, I advocate these double keels, these flat bottomed vessels, which are perfectly capable of going into shallow water and attacking a battery, for the battery cannot sink her because she is aground. Again, there is no chance of destroying the steering of these vessels; the rudder is in the fore part of the screw, and there is no chance of a shot getting down and injuring it. It was found in the case of the "Flora," that she could be steered steadily by the screws alone; she did not require any rudder at all. Now with respect to Captain Coles' turret. Captain Coles we will say has five guns on his upper deck, and those five guns will not be fired more than once in five minutes; probably with the power that the screw gives you, with the means of making the vessel the gun carriage, and steering to the greatest nicety, you may work your three guns on either side with the greatest ease and the greatest rapidity; when the turret guns could not be fired more than once in five minutes, you may keep up a succession of firing at every thirty seconds; therefore I consider a vessel built upon the plan proposed by Captain Symonds, with a rounded head, would have another great advantage. I dislike centre guns altogether, because I think they would blow up the deck, but with three guns on one side, and three guns on the other, with a very slight yawing, you might destroy any enemy that might be chased.

The CHAIRMAN: Has any other gentleman any remark to make upon the subject of attack? It is a very large field of enquiry. We are far from having arrived at the best form of gun. I do not think that even Captain Yonge will tell us that we have got a satisfactory land gun, much less a sea gun.

Captain YONGE: I hardly ventured to say that any particular gun or any form of rifled gun was better than any particular gun in the service. I wanted merely to point out what I thought are the advantages of a rifled gun when we have it. If it be not granted that we have it, I think the service gun is a very respectable gun indeed. I cannot agree entirely with what we have heard from Sir George Sartorius, why English ships had been beaten off by the enemy, the 18-pounder being beaten off by the 24-pounder, the 24-pounder by the 32-pounder and so on, on the supposition that the heavier gun was the more successful *owing to its larger calibre*.

In these small calibres, I fancy there is about half an inch difference in the various sizes. Thus the 21-pounder has half an inch greater calibre than the 18-pounder, and the 32 half an inch greater than the 24. I do not think that that, *per se*, is the cause of the damage, simply because of the greater *calibre*. I grant you there was greater weight, and the shot reached its destination with a greater momentum. That I concede, but what I maintain is, that that same increased momentum will now be reached, not in the yard-arm range, as in the case mentioned, but at ranges beyond 600 yards—the same momentum which is now gained by the 68-pounder at a short range. The 68-pounder is a heavy shot. It starts with a high initial velocity, but it rapidly loses it, and at a point considerably under 600 yards, the velocity falls below that of the rifled shot which sustains its velocity, and ultimately delivers the shot with far greater momentum at the long range. I think it is hardly fair to take away from the rifled gun, the principal merit which it possesses. It would be as fair to challenge Tom Sayers to fight, and then ask him to tie his hands behind his back. It is not fair to take away from the rifled gun its *spécialité*, and take away from it its long range, and not only its long range, but its minute accuracy, which is the point touched upon. Whatever gunnery may be at sea, there can be no doubt as to the superiority of the rifled gun on land, and I believe the same relative superiority will be obtained at sea over the smooth-bore gun; for instance, we have very much more accuracy on land with the rifled gun. I maintain that the naval profession will be able also to have the increased accuracy at the increased range with their rifled gun, and will deliver as good a shot with it as they can now at 4, 5, or 600 yards with the smooth bore. They will certainly require a little care in its management, but to load their guns and discharge them is not merely the business of gunners. If a weapon be given them, capable of doing some considerable damage, it is only fair to ask that the ordinary and simple precautions should be taken, which will insure the due handling of the gun. Therefore, I think, the case instanced by Sir George Sartorius of the heavier shot driving off a vessel which had a lighter one will still be met, not so much by guns of larger calibre simply, but by guns, which, in addition to the advantage that calibre had in former days, and the consequent greater weight, will throw their shot with greater accuracy and, though not with a high initial velocity, with a velocity that will be maintained to the last. In the case of the carronade, they say in my branch of the profession, that it was intended solely for the navy. I know in the case of fortresses, it has been used in flanks, but the occasions are very few indeed. They are of various calibres, from 68 pounds downwards, and of various lengths. I always understood they were made with a special flash-rim, and cast in a particular way for naval purposes, that there should be no particular damage done in the waist of the ships. My impression was that a carronade was a naval gun made to enable a ship when alongside an enemy, to engage him yard-arm to yard-arm, but if the enemy did not like to encounter at close quarters, he kept at a long distance and dismantled the rigging. For my part if I were fighting a battle, and had a good gun, I would make it my business to keep the enemy as far off as possible.

Captain SELWYN: I must again beg to be allowed to rise, most emphatically to deny, because it may be important in the future course of the argument, that I ever undervalued the rifled gun. It is only those forms of rifled guns which give us long range and accuracy as their *only* valuable qualities, which I deprecate.

Sir EDWARD BELCHER: I have just one word to say with reference to carronades. At the Nile they had 68-pounder carronades on board the French "Guillaume Tell," afterwards the "Malta," she carried those 68-pounders to the end of her days, and during the siege of Gâcta we used our 68-pounders at an angle of 45, with great success, and extraordinary range, firing 18-inch shells. During the 13 weeks we used our 68-pounders, no accident occurred to them, and they threw their shells beautifully.

Commander SCOTT, R.N.: I think there have been some remarks made with respect to the rifled gun, which lead me to think the subject is very much misunderstood. The gentleman who rose before has kindly told the navy that they did not quite understand what weapon they required.

Captain YONGE, R.A.: I do not remember that I made any such remark.

Commander SCOTT: Not entirely in those words. I will say, then, on the other

side, that we have had a gun given us by the army, which is certainly not what we require for the navy; and, moreover, with respect to the very gun that has been thus introduced, we know there are great diversities of opinion, even in the army; and that at the present instant there is a committee sitting to inquire into its merits, though, in fact, the merits of the gun and its demerits have been very long since known and pointed out. It is only necessary to look at the field-pieces returned from Shorncliffe to see the effect of powder upon such delicate weapons. We have had similar guns tried in the naval service, and the vent-pieces have been blown out (which we were told arose from their not being screwed up) and accidents have happened, in which the men were dangerously wounded. Surely then, these guns are not the right weapons for us to have in naval warfare? The only time in which the gun was really used in naval warfare, was in a boat expedition at New Zealand, and on that occasion it is reported that the vent-piece blew out, wounding four or five men, killing one of them. On another occasion the face of an officer was damaged, and the whiskers of the men rather closely shaved, and in fact as a naval gunner said, "It is a very dangerous gun." There are also specialties in connection with rifling, so as to enable us to use rifled naval guns as smooth-bores, which are very material, and which will, if examined, serve to explain why a particular kind of rifled gun may be considered good on land, and yet prove not to be good at sea. For instance, the present 110-pounder service rifled gun has a moveable breech-piece, which requires two primings—that is, the lower part of the vent-piece is first primed, and when this vent-piece is placed in the gun a tube has to be put in on its top, and thus on discharge the gun hangs fire from two ignitions, and the shot is afterwards detained until it cuts its way through the grooves in the gun. The difference between this gun and the smooth-bore is therefore somewhat similar to that between the old flint lock and the new percussion-musket, and this hanging fire is a very material disadvantage in naval warfare. Another point that has been overlooked, which perhaps ought to be more clearly shown, is that, besides the first detention, peculiar to the Armstrong, its shot, in common with all rifled shot, is further detained until it unthreads itself from the grooves. Besides this drawback, all who are conversant with rifled weapons know well, that after the first graze you cannot tell where the projectile will go; whereas a round ball, after striking the water goes straight onward and still does damage. Take, for instance, the results given by the Horsfall gun, a ball from which at 800 yards ploughed up the ground in front of the target, and then went on and smashed its edge. Nobody present could afterward doubt the smashing effect of the round ball up to 800 yards; but we are told that actions are to be fought at long distances. But can they be fought out at long distances? To see if actions can be decided at long distances, let us examine the effect produced by the rifled gun of the service upon armour-plates, and what do we find, that its shot's indentation at 200 yards is only about an inch and three quarters; but, if at 200 yards you cannot do more damage than this to an iron-clad, how are you going to decide an action at 1,000 yards? You must remember, that we are not now dependant upon sails, as we were in the olden time, so that unreeling the gear, would be a very profitless task, for it would not pay for the shot fired. Nobody disputes the value of rifled guns under special circumstances, but the question is, are we to give up that simplicity of loading and handling which we have with the round ball, and which are so essential for close quarters, for the mere attainment of longer ranges, which cannot materially influence the fate of a battle?

Captain YONGE: And accuracy, because I think in the Horsfall gun you instance it yourself.

Commander SCOTT: If you will allow me to go on, I shall be very happy to refer to that point. We all know that accuracy is part of the qualities of a rifled gun; it is common to all of them. Long range is also common to all rifled guns, great accuracy mainly depends upon the nicety of the shot's fit; for instance, Whitworth's gun, as is well-known in its early competition with Sir William Armstrong's was not nearly so accurate as it now is, because the shot have been since that trial planed, and been altogether very much better fitted. But to return to the service rifle gun; if, at the distance of 200 yards, it cannot do material damage to a plated ship, surely it will not do it at a longer range; therefore if you have armour-clad ships, this gun will produce no material effect. The real fact is that it cannot, and we had

Sir William Armstrong in this very Theatre, saying, that a 6-ton smooth-bore gun would produce about the same effect as an 8-ton rifled gun. His words were to the effect that if "you are to have a rifled gun to fire 35 lbs. of powder, the charge necessary to produce an effect upon an armour-clad, it must weigh 8 tons; whereas if it were to be a smooth-bore gun, it need only be 6 tons. Bearing in mind what has been said, that you cannot carry very heavy guns in our present ships built for light pieces, and you certainly cannot use them at all in any vessel unless it is in the mid-ship part, for you would not have breadth elsewhere to fight them, the addition of the 2 tons required for each rifled gun, would be so considerable, that I believe it will be found that the use of the rifle projectile will have to be supplemental to the round ball firing. Most of those present are well aware that Mr. Whitworth in stating the reason why his gun (which was purchased for a thousand pounds, and put on board the "Stork" gunboat) split, was that the shot slipped away from the powder charge, and was fired with a space between them. Now this is a thing that will constantly occur when firing in a hurry, for the elongated shot will not be pressed close home, and when the gun is run out against the side of the ship, or the ship is rolling, a similar rifle shot—one which cannot have anything placed in front of it—will start, and the gun become damaged. I would further remark with respect to the rifled guns in the service, that some time since it was said in this Theatre that if a high initial velocity were requisite for naval weapons, the Armstrong guns could attain it by firing charges of one-fourth the weight of their shot, and that they could stand such charges. They were tried with a 110-pounder, and the gun was reduced to a wreck. This powder charge of one-fourth the weight of the shot was then tried with the shunt-gun, the shunt-shot being reduced from 146 lbs. to 93 lbs., and fired with nearly 25 lbs. of powder. That gun went also, and it was returned into store, but whether it has been repaired or not, I do not know. These results showed that the guns would not stand such high charges. In order, however, to show the value now put upon a high initial velocity, I may mention that there is a short lead-coated shot being made, which is of the same weight as the 68-pounder round ball, and that it is fired out of the Armstrong rifled gun with 16 lbs. of powder instead of the usual charge of 14 lbs. in order to attain the same velocity, and to do as much damage against a plate as the 68-pounder round ball. I think I need not say more as to the strain upon the rifled gun or its effect, or speak of the flaws which occur in the inner tubes of the rifled guns, from the great strain thrown upon them, but revert to powerful smooth-bore guns. There is an immense advantage gained by using heavy guns, as you will perceive from the contents of the table given, which is compiled upon the assumption that five 32-pounder shot fired at a plate did not effect quite so much damage as one 68-pounder.* I have taken this data from the results of actual experiments at Portsmouth, and gone on with the calculations, and shown that seven 150-pounders, fired with 40 lbs. of powder each, are nearly equal to one 330-pounder fired with 80 lbs. of powder at a cost of only 3l. 8s. each discharge. In the case of the seven 150-pounders, the cost is 11l. 10s., but if the number of 68-pounders required to produce a similar effect were fired, and the men necessary to work them employed, the cost would be 490l., and therefore the advantage gained by using heavy guns, both in the cost of material and number of men required to work them, is really very great indeed; and when you come to fire the heavy shot required to produce the best effect, the difficulty would be great in loading, and be very much increased with elongated shot, especially when in a hurry. In such a case, in order to secure the projectiles being forced home, you must have a round ball, and in my belief it is essential to have a large calibre of gun, and to carry such ordnance only in the midship part of our new ships. With reference to the mode, however, of working these heavy guns upon the broadside, and which is rather a question of defence, I will reserve my remarks.

The CHAIRMAN: The subject is not exhausted; perhaps it will be convenient to adjourn the meeting till to-morrow night. The subject of guns is important, and there is a great deal to be discussed besides, as, for instance, iron plates and the modes of applying them, manœuvring, &c.

The meeting was then adjourned till next evening.

* See Table, p. 31.

TABLE I.
Comparative Power and Cost of Ordnance of different Calibres.

No.	Guns.	WEIGHT.			Cost.		No. of Men.		No.	Gun.	WEIGHT.			Cost.		No. of Men.	
		Guns.	Powder.	Shot.	Powder and Shot.						Guns.	Powder.	Shot.	Powder and Shot.			
		Tons.	lbs.	lbs.	£ s.						Tons.	lbs.	lbs.	£ s.			
5	32-prs.	14½	50	160	2 1	65	=	1	68-pr.	4½	16	68	0 14	17			
10	68-prs.	47½	160	680	7 0	170	=	1	150-pr.	12	40	150	1 13	*16			
7	150-prs.	84	280	1050	11 10	112	=	1	330-pr.	26	80	330	3 8	*16			
350	68-prs.	1662½	5600	11200	490 0	5950	=	5	330-pr.	130	400	1650	17 0	*80			
20	68-prs.	95	320	1360	14 0	340	=		"Warrior's" Broadside.								
17½ "Warrior's" Broadides		= Broadside of Scott's Fortified Vessel.															

* Number of men to work these guns in the manner proposed by Commander Scott.