This article was downloaded by: [Moskow State Univ Bibliote]
On: 20 December 2013, At: 19:02
Publisher: Routledge
Informa Ltd Registered in England and Wales Registered Number:
1072954 Registered office: Mortimer House, 37-41 Mortimer Street,
London W1T 3JH, UK

Royal United Services Institution. Journal

Publication details, including instructions
for authors and subscription information:
<http://www.tandfonline.com/loi/rusi19>

On the Forms of Ships with Relation to Naval Gunnery

Captain Fishbourne R.N.

Published online: 11 Sep 2009.

To cite this article: Captain Fishbourne R.N. (1857) On the Forms of Ships with Relation to Naval Gunnery, Royal United Services Institution. Journal, 1:1, 78-92

To link to this article: <http://dx.doi.org/10.1080/03071845709415746>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

NEW MEMBERS.

The Chairman then announced that since the last Meeting 14 Officers had become Members of the Institution.

ANNUAL SUBSCRIBERS.

Lieut. R. Crowe, Field Train.	Lieut. Franklin, Roy. Art.
Capt. Vaughan Jones, Unattached.	Lieut. Walker, Roy. Eng.
Capt. Sir W. Wallace, Gren. Gds.	Lieut. G. Phillips, Gren. Gds.
Colonel Campbell, late Renfrew Mil.	Surgeon Murtoogh.
Lieut. F. Woodgate, 2nd Life Gds.	Lieut. Cuninghame, 2nd Life Gds.
Lieut.-Col. Wodehouse, Roy. Art.	Capt. Younghusband, Roy. Art.
Major Davidson, late Bombay Army.	Colonel Clark, Roy. Mil. Asylum.

DONATIONS.

The Report of the Commissioners on the re-organization of the system of Training Officers for the Scientific Corps; presented by H. M. Government.

Manuscript of Sir Erasmus Gower, with Observations on a Passage from England to India in 1782; presented by Lord Radstock.

Hand Book for Field Service; presented by the Royal Artillery Institution.

The Militia, and its Importance as a Constitutional Force; presented by Mr. Haggard.

The Traveller's Library, and Summer Tour in Central Europe; presented by John Barrow, Esq.

ON THE FORMS OF SHIPS WITH RELATION TO NAVAL GUNNERY.

BY CAPTAIN FISHBOURNE, R.N.

THE tendency of the human mind to swing into extremes is such, that it often becomes necessary to call it back from the too engrossing consideration of new discoveries, or of newly disinterred truths, to a consideration of points that may have been and are too often set aside for no better reason than that they are old and appear trite.

This, I contend, has most injuriously been the case in respect of the forms of ships, as compared with the number and character of the guns they carry.

Thus the number and character of guns that any two ships respectively carry are contrasted, and that one which contrasts most favourably in this respect, if she have equal speed, is declared, for

all purposes, to be the best man-of-war; yet, that she is always so is very questionable.

The question involved is important, and one not simply confined to forms of men-of-war, but may, in the present instance, be considered in reference to them. Its importance has never been sufficiently estimated, and it will assume greater value with every improvement in the construction of guns, and with each increase of skill in the mode of using them.

To place two rifles on an equal footing, and to obtain anything like a satisfactory proof of their relative value, it is necessary to fire them from fixed rests,—in fact long range is of value just in proportion as the support from which the gun is fired is motionless.

Now, if this is true as respects guns whose effective projectiles range 600 or 800 yards, how much more important is it with respect to those in which they range 3000 yards or upwards.

As I am about to state heresies, it is right to caution my audience not to take anything on trust; but it may be permitted to refer to the fact that ten years since I advanced what were then deemed heresies in naval construction, yet the form of each new ship approximates more and more towards the lines then indicated, whether as the result of anything I may have said, or not, is of the smallest importance—the country has obtained the benefit; the fact alluded to, therefore, may be passed over with the remark, that, as I was not so wide of the truth then as some architects desired to make out, I may not be more so in the view I shall now set before you.

There has been a good deal of discussion as to the comparative efficiency of English and American men-of-war. One writer went the length of affirming that he would snap his fingers at many Niagaras if he were in the Duke of Wellington and had the power of motion.

Now, the position I take up is this, that rolling motions, in proportion as they are extensive and frequent, so entirely prevent precision of firing, that any vessel that has this fault, whatever may be her number of guns, or the superiority of their construction or calibre, will be unable to defend herself against an enemy very inferior in every respect but the one, viz. that of her motions being very much more limited in extent and rapidity.

This quality depends upon the fact of the greater or less degree of stability that the ship may possess. Stability may be defined to be

that property in a ship by which she resists inclination, or motion round a longitudinal or transverse axis, whatever the disturbing force may be.

Stability is derivable from different causes:—

1st. From the low position of the centre of gravity as compared with the position of the centre of gravity of displacement.

2nd. From the dimensions and form of body, especially of that portion which is subject to immersion and emersion.

But the effects of form must be considered when in motion, whether round an axis or moving horizontally.

This divides itself under three different heads:—

1st. The amount of effect likely to arise, or arising, from a given steady pressure, or the amount of stability at a given angle of inclination.

This has been treated of by Clairbois and other writers, but with more accuracy by our countryman Atwood.

2nd. The amount of effect from a sudden pressure as compared with a steady pressure of equal amount.

This has been treated of by Professor Mozeley in a paper published in the Transactions of the Philosophical Society for 1850.

3rd. The effect produced by a variation of the surface of the sustaining fluid, moving, as it does, the point of suspension.

This last has not been, as far as I am aware, considered by any writer, and constitutes the immediate subject of this paper.

It will be necessary to state only so much of the views of these writers as will suffice to make my argument more intelligible.

The French writers took as the measure of stability the height of the meta-centre, determined for an infinitely small angle of inclination, which was liable to grave error, as it was only an approximate measure, and then only under certain limited conditions, as was pointed out by our countryman Atwood.

The following figure (1) will illustrate this defect.

Stability varying as the cube of the breadth, if the solids of immersion and emersion take the form e, B, f , then Δ, B , the breadth at the load water-line used in the calculation, will place the meta-centre too high, while, if it assume the form d, B, b , the calculation will place it much too low. In the first case the actual stability will be much less, and in the second much more, than the estimate.

Atwood suggested the propriety of estimating the stability or resistance to inclination put forth at a given angle as measured by the contents of the solids of immersion and emersion at that angle, the horizontal distance $x y$ of their respective centres, together with the total displacement.

From these *E F* (Fig. 2) might be determined, and *g*, the position of the centre of gravity, being ascertained, *g o*, or the lever through which the displacement would act in its efforts to right the ship, or

to prevent further inclination, might also be ascertained. *E* is the centre of gravity of displacement when the vessel is upright, *F* is the

same when the vessel is inclined. AB the water-line when the vessel is upright, $b a$ the same when the vessel is inclined.

This Professor Mozeley showed was not sufficient, as it did not embrace all the conditions required; thus, for instance, it did not embrace the question of stability in motion round a longitudinal axis.

He shews that the pressure which would retain a vessel at an inclination of ten degrees, if brought on suddenly, would, owing to dynamic action, incline her to nearly double that, and then occasion a series of oscillations when it did not overturn her.

His paper is a valuable contribution towards an elucidation of the subject, though some of his conclusions are contrary to known facts; he suggests what appears to be a very satisfactory way of estimating the stability, but only in smooth water, viz. by "the work done in raising the body a height equal to the difference of the vertical displacements of its centre of gravity, and of that of its immersed part." When the sea is the cause of oscillation "the work done" is a measure of the ship's instability rather than of her stability.

Though his reasoning is valuable in its place, it does not explain the facts observed, and fails on very important points, but only in common with all other modes of treating the subject.

The point in which they fail is in explaining the observed facts with reference to rolling.

All calculations on the subject proceed on the supposition that a ship is a species of compound pendulum, and subject only to disturbing forces acting horizontally, such as the wind on the sails; one class supposes a relatively fixed point of revolution, and that to be the centre of gravity, though ships do *not* revolve round their centres of gravity, as has been so generally supposed; the other supposes a vertical motion of this point, but only in proportion to the angle of inclination, and to the size and form of the immersed and emerged solids, the *effect of a horizontal force*.

The latter alone is correct, but then only in perfectly smooth water. Each writer overlooks the fact that the normal state of the sea is motion, hence called "the troubled sea," and that the rolling motions are due with scarce an exception to this rather than to any horizontal impulse whether of wind or wave.

I do not mean to say that there is not the slightest analogy at any time between the oscillations of a ship and those of a pendulum, but that there is a manifest difference in the fact that the latter has a fixed point of suspension, and in that the oscillations are produced by a horizontal force which moves the pendulum from the perpendicular, while the former has a moving point of suspension, which is the direct occasion of the oscillations of a ship.

The facts observed not being explainable on the principle of considering a ship's motions strictly analogous to a pendulum, establishes that some other hypothesis is required.

Professor Mozeley, alluding to the *Canopus*, *Bellerophon*, and *Vanguard*, says "the latter should therefore be the least stable of the three." p 635. Yet this we know is not the fact as respects a horizontal force—the only kind he treats of.

Again he says, alluding to vessels of the *Canopus* and *Vanguard* type, "the former roll more quickly than the latter, but do not roll so far, so that, unless some special provision be made for that end, stability in rolling may not, and will not, probably, be obtained, except at the expense of quick rolling." p. 638.

These conclusions are consistent with the supposition of the strict analogy to a pendulum, but they are contrary to fact. For vessels of the *Canopus* type do *not* roll faster than those of the *Vanguard* type.

Thus the *Rodney*, of the former type, rolled only eight times, while the *Albion*, of the latter, at the same time and place nearly, and under similar circumstances, rolled thirteen times; yet the *Rodney* rolled through an arc of only 27° , while the *Albion* rolled through 49° . Similar facts were observed of the *Canopus* and *Vanguard*, and other vessels of their respective types.

Professor Mozeley treats the question as one solely dynamic, and as a question of relative stability at a given angle of inclination, and supposes that a ship may have greater absolute stability while she may have less relatively to a given angle of inclination.

This may be represented by the following diagrams, in which *a*, *b*, may represent the absolute stability of *Vanguard*, and *c*, *a*, that of *Canopus*; but, as each increment of stability put forth at each additional angle of inclination may be greater in the *Canopus* type,

therefore at 5, 6, or 7° of inclination of each class, the stability of the *Canopus* type would be greatest.

This no doubt may occasionally obtain, but does not under the circumstances in the class of forms he gives, for, as I have shewn, he states that the *Canopus* type is of a more stable form than the *Vanguard* type; yet we know that in smooth water the reverse is the fact, though no doubt, as Professor Mozeley shews, if both were inclined to indefinitely large angles, vessels of the *Vanguard* type would be first upset.

The defect in his reasoning is from treating the greater or less arcs that ships roll through as a dynamic question simply, when in reality it should be viewed as a statical question primarily, in which no doubt dynamics subsequently, and increased action, are involved in an amount proportionate to the statical action.

Waves are the cause of rolling motion, and they are the result of a vertical motion of the particles of water which constitute them—they only have a horizontal motion, not the water, except to a very limited extent, and only occasionally.

This vertical motion commences at and is greatest at the surface, and vanishes altogether at limited depths, varying according to the height of the wave above the mean level; consequently that form of vessel in which the area of load waterline is greatest as compared with her total displacement, will, in proportion, be subject to more rapid and more extensive motions,—will, in fact, be more sensitive to every agitation of the sea, and afford a less stable platform for guns.

Facts illustrative of the truth of this will at once occur to the

minds of my audience, more particularly those who have ever belonged to a flat-bottom vessel of little draught,—the extent and rapidity of the motions of such vessels under certain states of sea are nearly intolerable. But to those who have not had such experience, and further to illustrate the case, we may assume two sections, which may be taken as characteristic of the general form of

each. Let it be supposed that two waves of equal dimensions are passing across these sections, their crests having passed along the dotted line in the figures.

I have already stated that the motion of the particles of water constituting the waves was vertical; consequently, the forces these vessels are subject to under the hypothesis are the vertical action of the wave, acting through two-thirds ab and $a'b'$ (the half-breadth) respectively, tending to cause rotation, and the resistance to immersion offered by the other side, acting through two-thirds cd and $c'd'$, but, as in Fig. 3, the levers through which these forces causing and resisting rotation are equal, rotation takes place only because the force which tends to produce it is greater than that which resists it; not simply so in the case of Fig. 4, for not only is the disturbing force greater, but this greater force acts through double the lever, ab being nearly double that of cd ; the weight of the bodies represented by Figs. 3 and 4 being equal, and the power applied to Fig. 4 much greater, much more rapid motion must result in her case. Further, whether we suppose the ships homogeneous solids are similarly stowed, the centre of gravity of Fig. 4 would be much higher than that of Fig. 3, and for that reason also would incline more; in other words, her centre of gravity would require to be raised a less quantity than that of Fig. 3 before she were overthrown.

These figures shew the tendencies rather than the actual circumstances that occur, but the argument remains untouched by this; and, as these tendencies give the direction and an estimate of the motions which do occur, it appeared the most simple if not the most correct way of shewing the causes, and illustrating their consequences.

If a line be drawn in each from the centre of gravity to the outer edge of the immersed half-breadth, it will be seen that Fig. 3 will require to be inclined through a much larger angle than Fig. 4, before a perpendicular from that centre would be brought without the base of support,—in fact, Fig. 3 would require to be much more inclined, before it would be overthrown, than Fig. 4.

But now we have to deal with an important dynamical question, which, in its effects, aggravates the faults already dwelt on, for, when the disturbing force is more than is necessary to give the initial velocity, the excess of this force over the resistance to motion is accumulated under the form of *vis viva*; now the excess in Fig. 4, as we have shewn, would be greater than that in Fig. 3 in the inverse ratio of two-thirds of the cubes of their respective half-breadths. But the effect of this *vis viva* is to continue the motion communicated, after the immediate disturbing force has ceased to act in the original direction, then the wave having passed the centre it would tend to set up a new action in the opposite direction.

Where these oscillations of the ship synchronise with those of the wave, the former will increase, and this synchronism will more nearly occur in proportion as stability is due to displacement at the load-water line, that is, when the disturbing forces are greatest, and the motion is least subject to any retarding influence, such as a low centre of gravity, and greater displacement where the water has least motion.

We have an illustration of the existence of a force such as I have described the *vis viva* to be, in the common custom adopted in rolling irregular shaped bodies by a limited power, that of oscillating the body backwards and forwards, and when the arc of oscillation is brought to a maximum to give it a final push, the result of which often establishes the fact of accumulated power.

Captain Nolloth mentions in his journal, published in the

Nautical Magazine, that it is more than probable that the fate of the *Nerbudda* was another illustration of the principle stated above, which was very possible, for she was of the type of Fig. 3; had very little ballast, and left Algoa Bay with a badly sprung main-mast.

The action of the masts is rather favourable in limiting the arcs in rolling, for, as the vessel rolls, they, by their inertia, tend to lay behind and to generate independent oscillations which prevent those of the vessel from synchronizing with those of the wave; if then her masts went and she were broadside on to the sea, a very possible contingency under such circumstances, the more probable as the seas there are such that vessels are often prevented from answering their helm even with considerable way on, her oscillations will have increased each roll till she has rolled over; if on the edge of the bank, all the more probable, as she would have experienced a walled sea, with a strong current running to windward, all tending to the same fatal result. Similar results nearly occurred to the *Star*, the *Raleigh* (sloop), the *Racer*, and the *Maggie*, all of a similar type, which shows the necessity of giving them more ballast and the propriety of not building any more like them.

We have seen that two vessels of similar capacity, differing only in form and distribution of weight, but only so far as their different form entails, are very different in the most essential quality of a man-of-war, that of stability under the ordinary condition of the sea, and that therefore the efficiency of a man-of-war may turn more on the form than upon the weight of broadside she throws.

I may mention a fact illustrative of the different degrees of steadiness in two steamers, both paddle-wheel. Horses could not be carried in the *Hermes* without their being packed so close side to side that they should support each other, having their rumps against the bulwark, and trusses of pressed hay secured to spars placed against their chests, yet the *Birkenhead* carried them without even battens on the decks, while those of the *Hermes* were matted and, battened also. But to return to the case of the *Niagara* and *Wellington*. The disparity in the number of their guns prevents the possibility of drawing a direct comparison between them as they are; yet, in very bad weather, the *Niagara* would prove herself an equal. For

First. The *Duke*, under such circumstances, could not avail herself of her lower-deck guns, and possibly not of those on her middle deck; and

Secondly. All her other guns would be much less effective from her rolling so much more than the *Niagara*.

But there is no reason why a vessel of the *Niagara's* dimensions should not carry main-deck guns, and be a steadier ship in consequence, in which case she would be a formidable adversary under any circumstances of weather, and should not now be despised, even by vessels of much greater nominal power.

It is manifest, that, under the circumstances of the *Rodney* rolling 20° one way and 27° the other, she could only have used her lower-deck guns occasionally, and then not without great care and some danger, as 15° or 16° inclination would bring the cills of these ports into the water, while it is equally manifest that the *Albion* could not have used hers at all, and thus, though she were a 90-gun ship, she would practically have been reduced to a 60, and then, owing to her more rapid and more extensive motion, would not have been equal to any 40 of the *Rodney's* guns; even the latter would be inferior to a 50-gun frigate of similar form at comparatively close quarters, and vastly inferior at a distance (which those in such a vessel could always choose), as each of her guns would be more effective than each of those of the *Rodney*, because of her motions not having the weight of the second deck and guns.

The *Niagara*, with her present armament, but under the circumstance of weather, when these vessels were rolling, one 19° and 27° , and the other 32° and 49° , the former 8 times, and the latter 13 times in a minute, would possibly have destroyed either, but could undoubtedly have done so by the *Albion*.

The effectiveness of each gun, under the circumstances, would be in the inverse ratio of the number of degrees they roll through in a minute. Thus—

The *Rodney's* would be $19 + 27 \times 8 = 368$ to

In *Albion* „ $32 + 49 \times 13 = 1053$,

or the effectiveness of a gun in the *Rodney* would be to a similar gun similarly situated in the *Albion* nearly as 3 to 1.

In estimating the value of upper-deck guns, it should be borne in mind that the day is gone by when ships can run alongside each

other and pound away for hours, for the power and practice of gunnery is such, that, unless the ship's motions are very great, a few minutes at close quarters will suffice to settle the action—or one of the contending parties, if not both. It must also be borne in mind, that a good gun in a bad ship will be no more effective than a good rifle in an unsteady hand—the gun and the ship must be held as inseparable in any estimate that may be come to, as are the rifle and the man with his greater or less capabilities to use it: a blockhead will produce in the average as good results with “Brown Bess” as with an Enfield: no better results can be obtained in a ship whose motions are rapid and extensive, whatever may be the goodness of the guns or skill of the gunners. The disadvantage of these bad qualities are such, that if the opponents on the one side are without them, and all other things be equal, the action must be decided in *their* favour almost before they arrive within point-blank range.

Now upper-deck guns are not of much value for distant firing, nor of much value when close, when the object is much below them; and yet the effect of their weight, and that of the deck which carries them, is to increase a ship's rolling, and thus diminish the effectiveness of all guns below them—now, in proportion as a battery is more nearly *à fleur d'eau*, is it effective; and in the same proportion also, other things being equal, is the weight of its guns and deck less injurious in its effect on the motions of the ship; consequently, all upper-deck batteries should be sacrificed in part or wholly to perfect the most effective.

No doubt it is a mistake in the *Niagara* that her guns should be so high, but this is true of all steam-vessels that have only upper-deck guns; but this mistake obtains to a greater extent in two and three decked ships, as their rolling motions must be greatly increased by the weight of their upper decks.

It has been said, and not altogether without some truth, that large ships cannot compete with a number of gun-boats, and yet the bare assertion cannot be accepted as fact, for it may be safely affirmed that, except in the smoothest water, accuracy of fire from gun-boats so small and so formed as ours are, is out of the question—an estimate of them on this point may be obtained from a comparison of the effect of size alone.

The motions of vessels geometrically similar, with all their weights, that of hull included, similarly disposed, are as the squares of their lengths—the greater ship having the less motion.

Thus the motions of the *Duke of Wellington* would be only one-fifth those of one of the gun-boats, and those of the *Great Eastern* only one thirty-fifth of the same.

Nevertheless floating batteries could be designed, that, from their absolute steadiness of gun-platform, with four or six guns, would be more than a match for any of our block-ships; and, from their small draft of water, could take shelter from attacking ships, while, for the same reason, they could defend the shoal parts of our coasts, where block-ships could be of little or no service, and would cost vastly less than the latter.

But this opens the important question as to whether the three-decked ships are not a costly mistake. I confidently affirm that they are; for grant even much less dimensions than those of the *Duke of Wellington*, and a ship might be produced that should possess the qualities of speed, &c. possessed by her in a far higher degree, whether under sail or steam, and, though carrying a much smaller number of guns, would be as effective in smooth water, and vastly more effective in the ordinary conditions of the sea, and more effective in narrow seas, while she would have the further advantage of costing much less, both for a first outlay, and for current expense. No doubt her undue size, and that of others similar, is partly the result of having to use up timber that was cut out for ships like the *Queen*, on which they are certainly improvements, and the two-decked ships are still greater improvements on the *Albion* and *Vanguard*; but it will take many years to eradicate from our navy the evils introduced into it by designs of this type and form; and, notwithstanding the letter I somewhere read, urging alterations in the *Albion*, it is matter of rejoicing that no money is to be wasted in attempts to improve her, for she is radically bad.

For ten or fifteen years we were going in a wrong direction, and we shall probably take as many to return.

Ten years since Sir George Cockburn was anxious to introduce into our navy vessels of the form from which the idea of the *Niagara* was taken, but was prevented by some of his less discerning

colleagues; but, now that it has been adopted by the Americans, I am told that it is, or has been, recommended for adoption in our navy as something new and valuable. This form, however, is gradually creeping into our navy, and eventually must when understood become general. Her Majesty's new yacht is, in fact, of that form.

The *Diadem* is a step in the right direction; but her guns are too high, the full extent of which evil we shall not arrive at a knowledge of till the suggestions offered by Lord Hardwicke in the House are adopted generally—that of “testing the gunboats by target-practice at sea,” and comparing them with other vessels under similar circumstances of weather.

Generally, it would be sufficient to make a careful series of observations on the turns and angles of roll of ships of different forms, together with the effect produced on them by adding or taking out weights, and, if observed with respect to large and expensive ships, all the more important. I may add, that this information would not be confined in its value to men-of-war, but would be of use, if made available, to all the ship-builders in the country. These observations for the most part might be made at anchor in any tolerably open roadstead, and need not entail much expense, and none certainly as compared with their value.

I am greatly mistaken if such ships as the *Exmouth*, and many others, would not prove to be very inefficient in a seaway, from their rapid and extensive rolling motions.

I am convinced that it would be established that the efficiency of every man-of-war would be increased by an addition to its present quantity of ballast, and that vessels of the *Vanguard* type would benefit most by such an addition, and should receive a greater proportion than any other type of form, as by it the number and extent of their oscillations would be considerably reduced.

The sailing of the latter class would be impaired if nothing more were done; but the addition of six inches of false keel would correct this. But, as many may be at a loss to understand how keel could produce this result, I will endeavour to explain.

One effect of keel is to reduce the arcs of oscillation; but, as a ship rolls *not* round the centre of gravity, as is generally supposed, but round points alternately on one side and the other of that centre,

and the more distant the more deep or extensively she rolls, so she presents a more irregular and more changed form of transverse section, and consequently in that degree offers more resistance to motion in the direction of her keel.

Thus a cylinder, if revolving on its axis, and moving in the direction of that axis, would always and only offer the same-shaped area of resistance; but if the axis were on either side of the centre, increased resistance would result, because this same area, revolving round its new axis, would, so to speak, make a larger hole and offer more resistance. Now keel, by reducing these arcs, reduces the resistance, and to that extent contributes to fast sailing, while if the ship be sailing by the wind, or, in any degree a side-wind, by preventing her drift to leeward, in that degree also contributes to fast sailing.

Till we possess the result of many more observations and experiments worthy of the name, naval architecture, to a great extent, must remain sheer empiricism, and the extent to which it is so now, and the great loss which the country sustains in consequence, none can know but those very very few who have really studied the subject—losses which are all the more to be regretted, since they are so unnecessary, but are the result of every sailor, and everyone that pretends to be one, taking for granted that they know all about naval architecture, while it is marvellous the extent to which, and the oracular air with which, fallacies are propounded.

The Government ought to have taken up the subject long since as one certainly not less important than meteorology, in reference to which they are gathering statistics; failing their doing so, private individuals will have to establish a society for promoting naval architecture.

The great American clipper-builder admits that his information was drawn first from lectures which were delivered in your Institution, and thus a new era in naval architecture may be said to have been inaugurated there. It may be that these few thoughts may elicit something further, and help on the formation of a society such as I have alluded to; greater things have had much smaller beginnings. It is time that this great maritime country should lead in questions of maritime science.