

This article was downloaded by: [Monash University Library]  
On: 01 February 2015, At: 23:57  
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 Construction, Mode of Application, And use of Hind-Wheels: Being a New Form of Paddle-Wheels Working Under the Counters

Major J. Scott Phillips

Published online: 11 Sep 2009.

To cite this article: Major J. Scott Phillips (1864) On the Construction, Mode of Application, And use of Hind-Wheels: Being a New Form of Paddle-Wheels Working Under the Counters, Royal United Services Institution. Journal, 8:32, 271-280, DOI: [10.1080/03071846409417777](https://doi.org/10.1080/03071846409417777)

To link to this article: <http://dx.doi.org/10.1080/03071846409417777>

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>

# Even Meeting

---

Monday, April 25th, 1864.

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

---

NAME of MEMBER who joined the Institution between the 18th and 25th April, 1864.

## ANNUAL.

Mayo, J. H., Lieutenant West Norfolk Militia. 17.

---

### ON THE CONSTRUCTION, MODE OF APPLICATION, AND USE OF HIND-WHEELS: BEING A NEW FORM OF PADDLE-WHEELS WORKING UNDER THE COUNTERS.

By Major J. SCOTT PHILLIPS, late H.M. Bengal Artillery.

LADIES AND GENTLEMEN,—It is with great deference to the opinions of the Members of the Royal United Service Institution, as well as to the opinions of the scientific friends who have honoured me by their presence, that I venture to address this meeting, and attempt to bring forward a naval propeller, for which I solicit your favourable attention, while I endeavour to set forth its construction, its mode of application, and its claims for further notice. And as you have so kindly granted to me this favourable opportunity, I will not further preclude that which I have to say concerning this propeller, save merely to observe, that I have been making studies and experiments on the subject of propulsion for upwards of two years past; and were I not conscious of having devoted much time and pains to the matter in hand, I should not have ventured to appear before you. Before proceeding with my subject, I will just show the action of the common paddle-wheel by means of the model in the trough of water, seven feet long by two wide, before you, in order that you may have a clear view of the quantity of water which it lifts, and thereby also form some estimate of the power lost on entry; and though Morgan's patent feathering-wheel lifts very much less water, it loses some power

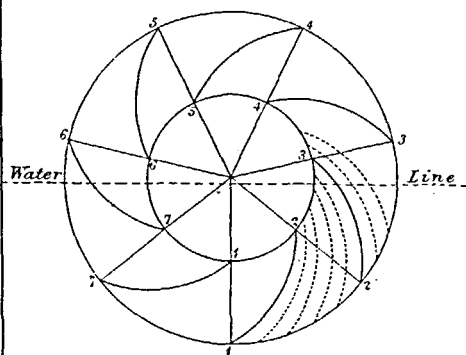
by the friction of its governing rods and their eccentric, while of course, like the common wheel, it cannot be carried out of the way of danger from shot and waves, or be applied with equal advantage to a sailing vessel. And I will mention that in the model fitted with *hind-wheels*, of similar diameter to the common midship-wheels before you, the hind-wheels (such being the most appropriate name for my wheels as will appear in the course of this paper) beat the common wheels by seven per cent. in speed, though I consider that as yet I have not been able to study ship-building so as to give to the hind-wheels their full advantages. After this necessary digression I return to the propellers fitted on the hind-wheels, which I wish to recommend, and which are made like the model which I hold in my hand, (Plate XIX, Fig. 4,) formed either by casting, or by fastening together two sheets of metal cut upon curves, to which I will presently allude, and folded as it were upon a certain angle, till the shape produced resembles that of a deer's or hind's foot.

In fact, the forward curved angle, if I may so express myself, of this propeller, is formed on a line which after marking the extreme circuit of the proposed wheel at seven equidistant points all round, and, as in Fig. 1, marking off the subdivisonal points of seven radii drawn to the said seven points, will connect the semi-radial with the circumferential points; and on such points by such a line or lines, seven like propellers being affixed, (for I have found by experiment that the proper number of floats is exactly seven, that number giving a clear beat into unbroken water for each successive float) a wheel is formed such as I now exhibit, which cannot lift water—a fact of which you can judge most assuredly, if you will but kindly attend while I move the sheet of zinc cut to represent the inner flange of a hoof-shaped float over the face of the diagram (Fig. 1), which, representing a wheel with its proper water-line or dip, enables me to show that the front curve of the hoof-shaped float is so framed as by the said sheet of zinc, that this curve, and in fact the whole propelling surface, comes out of the water at very nearly, if not absolutely a right angle to the water-line. Now there being no other angle but the front angle in my propelling floats, I trust I have decidedly cleared my great leading fact, namely, that this propeller having no opposition at entry, its entry being covered, as you see, by the front of the well in which it works (see Diagram, Fig. 3), has, above all, no lift or breakwater on coming out, and this I will exemplify before your eyes by causing the hind-wheels to revolve at speed.

And now I would ask your patience while I endeavour to run through the preparatory subject of the water lines beneath and around the stern of a swiftly-progressing vessel.

Not to dwell upon the mode of that dispersion of the waters which is necessary to make way for a vessel at speed, I consider those waters as pushed aside and virtually dispersed to such a degree that they cannot furnish the necessary supply to fill the space beneath the stern; and therefore that space must mainly be supplied by waters rising up from underneath, of which we have what I venture to think is a very strong proof in the fact of chips and straws following a round-sterned

Fig. 1.  
Principles of Construction.



Curves for front edges of hoof propellers (or Floats) struck from inner Circle at the 7 Points of inter-section as by Points 1, 2, 3, 4, 5, 6, 7 &c.

The Dotted Curves show the extreme angle at which the Floats quit the Water, demonstrating the impossibility of their having any lift.

Fig. 2.  
Sketch of Backwater as seen rising under the Stern of a Section of the Connector Steamer at Anchor in a four knot Tide.

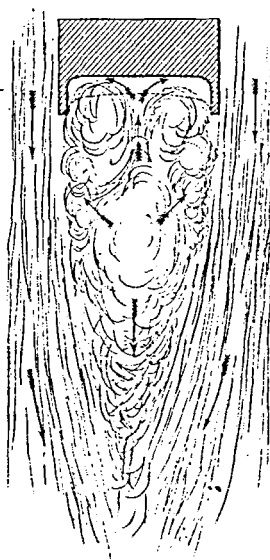


Fig. 3.

Rough Sketch; shewing by actual Experiments the general form of the intrush from both sides and the uprise from beneath in a Well prepared for a hind Wheel when a Vessel is rapidly drawn through the Water.

This Diagram will aid the conception of how it is that fluid Wheels however fast they may be driven will always obtain a full supply of Water, which is not the case with all other Wheels as hitherto used.

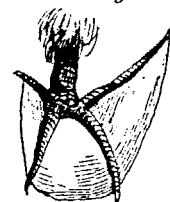


Foot of Cormorant Standing

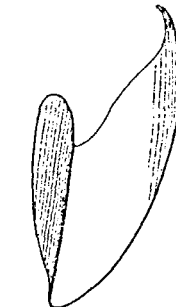


Fig. 4.

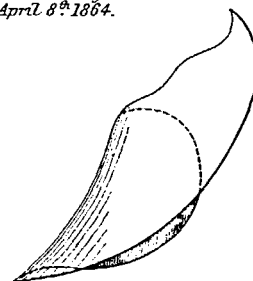
Foot of Cormorant Swimming.



The form and Action of the Cormorants foot in Swimming was noted at the Zoological Gardens. April 8<sup>th</sup> 1864.

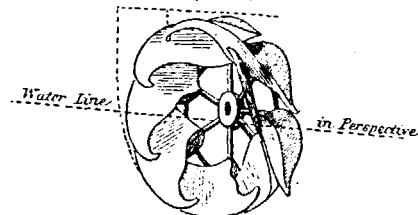


Hoof Float Propeller

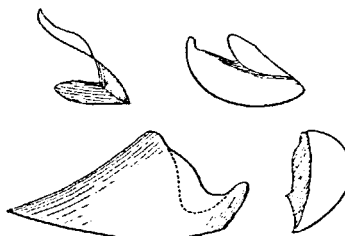


Hoof Float (Side View.)

Fig. 5.  
Side View of Wheel in Perspective.  
Dotted Line, Front of Well



Hoof Floats or Propellers.



An Average Shaped Hinds or Deers Foot.

vessel when at speed, pressed close against the stern by reason of that sudden welling up of waters from below, of which I have just spoken. Indeed, we may consider that of necessity the space astern between the side currents of displacement, will certainly in the largest measure be filled up by waters from underneath; because the beam in a vessel built for skimming rather than ploughing the deep, being equal to more than three times the draught, the side currents cannot close in as fast as the lower waters must rise; those waters also rising the faster, because of the pressure of the ocean increasing in proportion to the depth of the space requiring to be filled.

In speaking thus, I would not be understood as attempting to do more than merely indicate a general view, which will admit of great modifications, as by the stern build of vessels and the point and depth of outbreak of the wheels. But when we may be so happy as to see an experiment made with a vessel of 80 or 100 tons, a canal tug (such as could be built and fitted complete for £1,200) or an Indian river cargo boat, we shall be enabled to look between the spokes of a revolving wheel to "discover the channels of waters," to see distinctly how the inner or breakwater rises, the form which it assumes at different rates of speed, and so obtain more decided ideas upon absolute demonstration.

I have, however, been able to experimentalize in some degree, by placing a tin box without a lid and left open, on one of the smaller sides, in a strong current of water. For on sinking the box one-fourth of its depth, it became emptied of water, while the forms of the rising under-current, and the two side currents became clearly visible. And I would also draw attention to the drawing which I exhibit (Fig. 2), showing the rise and the side currents astern of a section of Mr. MacSweeney's ingenious connector steam-ship, when anchored in a four-knot tide. There you will perceive (though the illustration is an extreme one) the side currents only joining one another about 40 feet astern; while between them arises a tumultuous welling up of waters with eccentric curves; half of which rush towards the vessel, and dividing against it form two side eddies, which presently retire in a series of eddies to the general wake. These illustrations it may be of some use to consider, and it will then, if this theory be acceptable, be evident that there will always be under the quarter of any vessel in motion, and influenced by the vessel's build, a certain general line which may be termed the line of contact between the rising waters and those which are closing in; outside of which line the current is passing in swift curves to form the wake, and inside of which the waters from beneath are tumultuously welling up and rushing in a continued series of eccentric curves, part more or less against the vessel's stern, part to meet the side currents, and part astern into the general wake.

And here my propeller, may I say it, naturally drops in. Feathering as it were smoothly down, the outer flange of my hoof-shaped float gathers water from the outer current, and then embraces with full scope the waters of the inner rise, a point to which I earnestly beg your attention, especially in connection with the peculiar form of the

wells in which the wheels work as shown in diagram (Fig. 3); and as the propellers in swift succession meet with their curves the swelling waters of that inner rise, so they obtain in some degree the fulcrum of opposing waters, instead of driving, as does the screw amid waters, passing through it; or, as the midship paddle-wheels, through waters in some measure slipping past them. And now, if you will kindly observe, the propellers are so arranged, and the wheels carrying them are so placed, as to be thoroughly shielded on entry, and then so as to break out from the wells in which they act, feathering smoothly in to their work, at the precise point of advantage to make the most of the rising back and side water; while, as the propellers aid each other, they so keep back the waters that they have not only their inside gathering of waters to aid their fulcrum, but also the pressure of the waters heaped up from below. Nevertheless, the heaping or driving back does not affect the clear exit of the propellers (or floats), since owing to the mode in which each propeller is lifted out of the water, they do not lift water, leastwise (for these are not of perfect manufacture) but a very little; while, I believe, that by giving a slight twist inwards, as by the shape of a natural hind hoof (Fig. 5.); even this small amount may be obviated, and the propellers come out emptied to the smallest drop.

These propellers, however, have also, as I conceive, an additional recommendation when driven at high speed, which I may best exhibit after suggesting the query as to why it is that, while we can travel 60 miles by land in an hour, we cannot get a speed of more than 20 by water? seeing that we have an incompressible fluid to deal with, though contrasted with solid metal?

Now, the theory has been suggested to my mind, that as the incompressible waters must require some average time to allow of the particles acting against each other, and so of the masses being moved; it is but a question of time versus matter or driving speed, to convert the moveable yet incompressible fluid into practical solid; and, therefore, if we can construct propellers so strong, and so perfect, as to contain merely the elements of propulsion at a certain angle, with a perfect entry and no lift; and if such propellers can be formed to grip—I say to grip—the fluid for so long a time, and no more than is precisely needed; then, if we drive these propellers at a speed exceeding the measure of time which is required to set the particles composing water in motion, we shall drive as against a solid, and obtain transcendent results with corresponding benefits.

In support of this view, allow me to quote the able Editor of *The Engineer*, who writes concerning the benefit of quick driving under date February 12, 1864, as follows: “It may yet be found that “light quick working engines are superior in all respects to the vast “masses of machinery now placed in our vessels of war. It is perfectly well known that small engines, working at high pressure and “at quick speed, have far the most power for their weight. They “are too by far the best adapted for economical expansive working, a “fact proved by locomotive practice. With improved engines of “greatly diminished weight, and driven, say at 600 feet of piston

"per minute, and with twin screws (for which I would say, read "wheels), a great increase of effective power might be introduced into our ships of war, and that, with a decreased weight of machinery and decreased consumption of coal."

And so, I venture to think that, quick driving—if you only have but a proper machine—is the thing to be aimed at; and I suggest the theory that, with quick driving, and with my hoof-shaped floats, a positive grip may be obtained, which will avoid slip, and enable us over the waters to emulate the railway engines on the land.

An ordinary paddle float cannot grip the water, cannot be driven beyond a certain speed, but it forthwith lifts an enormous load of water, or scoops off the surface water, and is endangered by its own action, or actually loses power.\*

The best screw likewise has no grip, the waters are passing off its surfaces continuously, while in both screw and paddle the driving surface power increases only as the square, while the hoof power increases in a measure as the cube.

For the propeller or float, which I have been permitted to bring before you (Figs. 4 and 5), containing, I repeat, the pure and simple elements of propulsion, without drawback, has, owing to the gradual contraction of the hoof shape (a most material point) a grip; at high speed will have a powerful grip, aided by strong internal friction, when, at a certain, and that a beneficial angle, slightly downwards, and I do hope that I may carry the consent of some present with me, when I beg to affirm, that were this but the merest theory, such theory would be worthy of a trial on a large scale; in the hope, if but in the hope, to grasp such transcendent advantages as a realization would secure.

To the gentlemen present I need not dwell upon the combined strength and lightness of the wheels before you, or point out that the whole working strain is thrown upon the inner-angle of each propeller in lines perpendicular to the radii of the wheels. And I will only, ere passing on to a brief summary of the advantages to be gained by their use, pause to note that these propellers have besides other analogies, a strict analogy with the propeller of the most powerful swimmer and diver of the web-footed tribes. I mean the cormorant, which, with his triple-webbed foot, overtakes the fishes with their finny tails.

In these feet I have found, by actual inspection, at the Zoological Gardens, on the 8th of this month, and in clear water, that when the

\* Three days after the reading of this paper, having obtained a spring of greatly increased power, it was found that, on trial, the common wheels were whirled round so rapidly that, having scooped out a hollow, they merely produced a scattering of water ast, the vessel making no progress in the water, because the wheel-floats being parallel to one another and set on at right angles to the line of progress, could not get the needful supply of water to enable them to propel the vessel; while the hoof-shaped floats, entering without loss of power, being put on at consecutive oblique angles to the line of progress, supplied with water from within, and from without, and from underneath, and gripping the water, drove exceedingly well, the wheels revolving at a proper speed, and lifting no water as they revolved. Hence it is concluded that the discovery, as set forth, is now established and complete.—J. S. P.



bird is striking out, the inner web, as shewn in the Plate, of a triple-webbed foot, is thrown back, and the outer-webs are also thrown back, until the foot obtains the form of my propeller; and then the cormorant, with instantaneous strokes, amid the waters, drives as against a solid, and cleaves the waters like a flash of lightning.\*

And, now, allow me to narrate the advantages looked for from the use of hind-wheels, throwing in such remarks as each may call for:

1stly. Being of strong construction, the force of stroke falling on the inner angle of each propeller, and being sheltered from shot and waves, they will scarcely ever need repairs, cannot get fouled, and will work with perfect smoothness. Dipping deeper than the common wheels, they are not so liable to be alternately rolled out and unduly immersed.

2ndly. If found needful, though I doubt the necessity, larger wheels can be carried than is usual, because these wheels dip so much deeper than the midship wheels now used, and can be made to sweep the full draught of a ship. Indeed, I have found by experiments with the model and wheels before you, that I could drive the same seven per cent. faster with the hind-wheels, than with the common wheels; the machinery giving out its power in one-third less time, while I am entitled if I choose to use wheels one-sixth larger than the common wheels, if it is not found that small wheels rapidly driven give the best results. I shall thus bring my driving surface fully up to that of the largest midship-wheels (the large seven-inch wheels before you making equal revolutions with the six-inch paddle-wheels), while yet I retain the great superiority of easy driving at the highest speed, or any speed whatever, because, as afore-shown, my hoof-shaped floats contain the pure and simple elements of propulsion, without resistance on entry or lift on exit. The common wheels lift more and more water the faster they revolve; my hind-wheels have no lift, and therefore they excel.†

3rdly. Hind-wheels give, of necessity, a very powerful steering, because they send aft two columns of water, one upon each side of the rudder, which also meeting aft, destroy each others ripple, thus making tugs so fitted, peculiarly suitable for canal work. Worked with a pair of horizontal engines, each distinct from the other, but with a power of coupling them in long distances, no rudder will be absolutely needed, and hind-wheels will turn a vessel on its centre even better than do the twin-screws; while these last require a greater depth of water than do the hind-wheels.

4thly. They will enable us to use vessels of very light draught, instead of 20, 26, 22, 18 feet, they will enable the heaviest guns to be carried at 16, 12 feet, with buoyant, steady swiftness. In fact, all vessels will now be constructed to skim the waters rather than to plough

\* At this stage of the lecture the action of the hind wheels, with wheels of 7 inch diameter, were shown in water.—J. S. P.

† H.M.S. ship "Salamis," October, 1863, could not use full boiler power to advantage with Morgan's feathering wheels, the vessel being found to go fastest with but half-power.—J. S. P.

deep; a great gain, indeed, for with increased beam, and a long fore-foot, and great swiftness, increased seaworthiness will be obtained, and that in many points, such as wear and tear, pitching, straining, tossing, and rolling, &c., on which it is not needful for me now to dwell.

5thly. The backing power for suddenly bringing up at speed will, I think, be found to be very good, and amply sufficient to back a ram off if required, which I doubt, after the delivery of an overwhelming stroke.

6thly. They give power to run upon an even keel to the diminishing of loss by friction, requiring even less draught of water than do the present highly approved twin-screws.

7th and lastly. They can be screened in a very considerable measure below the water line from side shots, by shields of double strength, for the breadth of the vessel between the wheels will give ample buoyancy to her stern, and while claiming a great superiority of speed and steerage, they can always drive a ship direct upon an enemy, so as only to expose the bows to glancing shots, a matter of imperative necessity, as the guns continue to triumph over armour-plates. Our present deep rams, driving between close jamming walls of water, will be able to inflict little or no damage upon a flying steamer, their speed being so little superior if at all, while to our grief, as Britons, we have to lament that rams will be formidable to sailing merchantmen, unless we can secure by means of hind-wheels, a vast superiority of speed for all our vessels. With rams of light draught and great speed, gunnery may be defied. The ship magnificently propelled will be its own self-contained projectile, the be-all and the end-all for itself and others. We shall "pursue our enemies and overtake them, and turn not again till we have consumed them."

Of the twin-screw system I will only further notice, what all will probably have observed, namely, the larger continuous driving surface of the hind-wheels, and their direct action as opposed to indirect.

In conclusion, I have to perform a certain duty, and to ask for your kind, your friendly consideration, if I may so speak, while I endeavour to discharge it. We all know that it is considered a mean thing for a man to borrow his ideas from other men's books, and after working them to his own purposes, bring them forth as if original, as if his own. Therefore, I have to render honour where alone it is due; and am as truly constrained by common honesty as I am by other feelings, to tell you that I obtained the propellers before you from the Bible, as if I had obtained them by reading in the book or books of man.

It were too long to narrate how I first got the idea of the shape of a calve's foot as a naval propeller; though strange possibly for me to say, and you to hear, I got it from the Bible. And with wheels like those before you, modelled from a calve's foot, I drove a boat (in the presence of three witnesses) 22 x 5 feet beam, with two pairs of wheels, the other pair being common wheels, and both pairs of 4 feet diameter—I say I drove this boat 300 feet in 41 seconds (5 miles an hour) with two young men working, as against

the performance by the common wheel of the same distances in 57·4 seconds—41" to 57·4"—in one-third less time.

Having achieved thus much, I thought that it would gladly be taken up, and lost a whole year in trying to have it so done. But failing, I took up the idea of prolonging the calve's foot, to suit after or hind-wheels.

While protracting the same on paper, my attention was drawn to several passages in Scripture; one in the Second Book of Samuel, one in Micah, one in Habakkuk; but especially to the 33rd verse of the 18th Psalm, where, describing the making of war, it is written, "it is God that girdeth me with strength, and maketh my way perfect. He maketh my feet like hinds, and setteth me upon mine high places." While the passage in Micah reads, "Arise, and thresh, O daughter of Zion (by which I think Great Britain is meant) for I will make thy horn iron, and I will make thy hoofs brass, and thou shalt beat in pieces many people."

Accordingly, having made my drawing, I took it to the British Museum, and found that I had actually, without knowing it, drawn the shape of a hind's foot. And applying that shape as a propeller, I have found that the more correctly I worked out the hind's-foot shape, the better my wheel became.

The greater the speed at which they are driven, the more decidedly their power and action are developed, in contradistinction to all other paddle wheels; and the direct action and driving surface of these hind-wheels, place them at once beyond all competition by any screw or screws.

So then I have, in conclusion, three analogies in order; namely, mechanical aptitude, for as an engineer said to me, "by all the rules "of mechanics, your wheels ought to be a great success." Next, I have the analogy of the cormorant's foot, according to natural history. And, thirdly, I have that literalism of the word of "The Lord of Hosts," alas! too much neglected, or even derided in these days, but to myself, I must confess, a source of practical comfort, of instruction, and, I hope, unbounded confidence. And I do look forward, I confidently avow, to the time when every steamer that leaves our River Thames, that river of strength, will go smoothly flashing through its waters driven by hind-wheels, fitted with hind's feet, and "Walk the waters like a thing of life."

While for the present, conscious that my wheels, or at least my mode of placing and adapting them to the lines of a vessel, may admit of great improvement, I do rather hope to obtain some assistance towards that end from any comments which my statements may evoke.

Gentlemen, I have to thank you for the kindness with which you have listened to so humble an amateur as myself, and I beg to offer my best thanks to the President and to the Vice-President in particular of this evening, and to the members of this Royal Institution, for affording to me the opportunity of bringing this new form of paddle-wheels working under the counters before a discerning audience.

Dr. CROFT: If it may be permitted to make a remark as the inventor of what I call screw-paddles, I should like to know how Major Phillips overcomes the back lift? \*If he is enabled to do that, I should be inclined to look upon his as a very valuable invention.

The CHAIRMAN: This would exhibit (pointing to the model in the water) whether there is any lift. Perhaps you will explain what you mean by your screw-paddles?

Dr. CROFT: I don't know whether I should be in order: if you will allow me to offer an explanation, I should be very happy to do so (producing a model).

Major PHILLIPS: I have put this pair of wheels, having straight-lined hoofs on for convenience sake. I shall be very happy indeed, if there is time to put this pair on (showing, as I consider it is a better pair); because, though the wheels are smaller, the hoofs have their angle lines curved.

The CHAIRMAN: I suppose, substantially, they are pretty much the same.

Major PHILLIPS: No, they are not quite, because of the difference in the angle lines; then again, the larger you make these wheels in reference to the dip, the less and less water they raise, and the better angle they go out at.

Dr. CROFT: I should like to see it on a larger scale, because we could then compare the results better.

Mr. BARRASS: This seems to be a very good thing; there is one point I should like to mention, the author seems to make a point in dividing the paddle into seven equal divisions, with a view of securing one float to enter the water at the same time as the float on the other side is rising.

Major PHILLIPS: I am thankful to Mr. Barrass, for putting this forward, because it will enable me to clear up the difficulty. When I said that under this system there was always one float just entering, one working and one just leaving, I see from what you say, that this needs explanation. It is not so; that is to say, it is not so when the vessel is perfectly at rest, and before the well is cleared out; and, therefore, it is not until the well is cleared out, that the hoofs get into their full action. But of course, with any power on, the well is immediately cleared out; and then the action goes on with one hoof just entering, one full in and one just leaving. When the well is cleared down to that point (showing the lowest point of the well) you have one coming in in vacuo all the way. This one (pointing to the second hoof below the water line) is in full work—has full grip upon the condensed water, which is coming up from underneath instead of working in water rushing through it, as the screw does; and the third hoof is just coming out. In the trial of the twin-screws, mentioned to-day in the *Times*, they made 300 revolutions and only ran six miles an hour. Seeing that the experiment was deemed a great success, I was perfectly astonished to find only that result of speed; but I am not at all astonished when I consider that screws have to wabble amid waters which are rushing through them.

Mr. BARRASS: With respect to the double screw, do you propose to make your propellers as efficient as the double screw for manœuvring purposes? Do you have one shaft?

Major PHILLIPS: No; I use them with separate shafts, but I give them an arrangement by which you make the two shafts into one for purposes of long voyages. I arrange them so that they can work just as the twin-screws do with independent engines.

Mr. BARRASS: I simply asked the question, because you did not name it in the paper.

Major PHILLIPS: I have a sketch here which shows that. It is a drawing for an Indian river boat, of a hundred tons, in which I have drawn in two separate engines.

The CHAIRMAN: I am sure we are very much indebted to Major Scott Phillips for the introduction of this subject to the meeting. I think that without doubt, it is a decided improvement. I have long thought myself of adapting some form of float that would enter the water without violence, and without a shock, and would not raise the water; that would be a very desirable thing. Of course we have seen that

\* Dr Croft did not enter the lecture-room till after Major Phillips had shown that there could be no lift of backwater, as by Diagram Fig. I.

in screws there is a very considerable loss of power: you drive them at a great rate, and there is a great consumption of coal. You get a greater speed no doubt, and under certain circumstances a considerable advantage; but, taking it on the whole, there is a very great disadvantage arising out of the consumption of coal which is necessary, and when you come to head-winds, there is always a great consumption of coal without any corresponding result. I don't think that will occur here while under similar circumstances in smooth water. I think there would be a greater result. This plan has decided advantages over the side paddle-wheel, and it approximates more to the twin-screw. It is of course a question only to be determined by experiment, as to whether it will give greater results than the twin-screw. No doubt you can get a greater surface here, but all paddles have this one disadvantage, this, perhaps, less than any other, that they are immediately affected by the alterations of draught; that is to say, as you consume your coal, you lighten your vessel, and as you lighten the vessel you lessen the dip of your wheels, and the consequence is your engines run away with your wheels, and there is a loss of power. On the other hand, if you so adjust your paddle-wheels that they give the best results when they are very deep, they lose power accordingly as they get lighter, or *vice versa*. If you arrange them so as to have the best effect when the vessel is light, you have to contend with the disadvantage of heavy draught. I think alterations in draught will not make very much difference with this plan. I think they will be nearly as effective with a deep draught as with light draught, which is just what occurs in the screw. It seems in the screw, that the deeper the vessel is, notwithstanding the greater weight, the greater is the effect, because you get it into more solid water,—so you will have here. I quite agree with what Major Phillips says with respect to the water coming up from below. Again I think that experiments with larger vessels will give greater results than those mentioned arising out of this fact, that the larger the vessel is, the greater is the column of water to press the water under the paddles. The more solid the water is, and the deeper the immersion of the wheels arising from the greater column of water, so the effect will be increased.

As we have another paper to read, I will not occupy any more time. Will you allow me to offer your thanks to Major Phillips for his very interesting paper? He has gone into quite a new field, and it does him more credit inasmuch as it is not his profession, and he has not had the advantage which many of us have had.

Major PHILLIPS: I beg to return my best thanks for your kind reception of my paper, and that, not only by all present, but by the members of the naval profession in particular.

---

## MONT STORM'S SYSTEM OF BREECH-LOADING.

Contributed by Mr. F. A. BRAENDLIN, and read by CHARLES PHELPS, Esq.

GENTLEMEN,—At the request of several gentlemen much interested in the recent improvements of small arms, I am induced to come forward on the present occasion to state my views on the subject, which were acquired by theoretical and practical experiments.

All the recent improvements, particularly in breech-loading principles, depend in a great measure on mechanical laws; and I know of one breech-loader, devised and made by a mechanical engineer, which is in my opinion the best, and which will maintain its superiority over all other fire-arms.