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DOUBLE-ENDED SINGLE-SCREW STEAMERS.

(By WALTER REEKS.)

The author has experienced the greatest difficulty in opening this paper, because now that the system of running steamers either way with only one screw has become an established fact, it seems such a ridiculously simple thing that one wonders what there is to say about it, and wonders still more that we ever did anything else. All that remains to him, therefore, is to give you, gentlemen, the experiences of himself and those associated with him, the results of trials, and leave you to judge how far the system goes in the direction of success.

The history of double-ended, double-screw boats is so well known to all, or nearly all of you, that there is no need here to do more than give the merest sketch.

About 1879, or nearly thirty years ago, a successful double-ended double twin-screw boat, called the Oxton was built for the Municipal Corporation of Birkenhead, England, and ran as a traffic ferry from that place to Liverpool for years. About the same time one or more boats were built for towing and general service on the Clyde, but the system did not gain much favor, as shown by the fact that only a very limited number were built.

About that time, or shortly after, Captain Bremner, of Sydney, being on the Clyde, was impressed with the idea, and returning to Sydney caused to be built a double-ended double-screw steamer for the North Shore Ferry Co., which old craft, the Wallaby, is running yet, and is, the author understands, good for some years to come.

So far as the author can find records, no other boats of the class were built in any part of the world for some years, the Clyde went back to paddles, so did Liverpool. Sydney also returned to her old love, and other ports just continued building paddle steamers, never having, so to speak, strayed from the strict path of virtue.

The year 1887 saw the next successful boat of this type in an entirely new quarter of the globe, viz., Hoboken, across the Hudson to New York. She was quickly followed by others, and may be said to mark the period from which double-ended screw ferry steamers became recognised by those who take heed of the world's progress, as distinguished from those who know only what they actually see.

Coming close home, the Wallaby having proved her ability to cross Sydney Harbour with reasonable safety, and reassured some of the people who previously had positively refused to go in her, and would on no account let their families do so, and who looked upon the Bunya Bunya, Cameray, Memell, and Lincoln, as ideal craft to travel in, some of our more enlightened friends began again to think of double-ended screw boats, and in 1890 the Kangaroo was placed on the North Shore service, and quickly following her, but under other ownership, the Lady Mary and Lady Napier.

These three easily distanced the old paddle-boats, gave more room on deck, were better in bad weather, and had the effect of establishing the type in local waters.

Since then no paddle-boats have been built in Sydney for ferry service, but instead, a long list of double-ended double-screw boats, too many to enumerate.

So much for the history of the parent. We can now see when and how the second generation, or double-ended single-screw boats came about.

It will be remembered that for some time after the advent of the Balmain New Ferry Company, in 1891, a pretty lively competition was carried on between their boats and the Balmain Ferry Company, generally known as the old Company, and the screw boat Birkenhead was requisitioned as the only one equal in point of speed to the Lady Mary, the paddle-boats being hopelessly out of the hunt. At that time the New Company only had two boats on the run, if we except the old Millie, which, for the purposes of this paper, doesn't count, and apart from ordinary overhauls from time to time they had to be docked to repair damage from collision and otherwise.

During the height of the competition the Lady Mary doubled up one of her propellers, ran as best she could till the last trip at night, and went straight to dock. The propeller was unshipped, the tail shaft end protected, the boat refloated, and took up her running next morning (first trip), with only the one propeller, even at the risk of having to turn at the wharves, as had her rival Birkenhead; but it was found she steered and handled perfectly well with the propeller ahead, but, of course, as would be expected, the engines ran away too fast. A larger and ready-made propeller was obtained at short notice and put on at night, which went a bit the other way, slowing the engines and rendering the boat somewhat unhandy at wharves. It was, however, only a make-shift while a new one was being cast to replace the one previously damaged. She ran about a fortnight with the single propeller, and was then restored to the original condition, viz., a double-ended screw boat. It may be urged that had the single screw been a success, wise men would have kept it so; but against that it must be remembered that the minds of men move slowly, and it is not every day that a Board of Directors is unanimous on a point involving an innovation on preconceived ideas; so the prudent thing was done, and no risks taken. But the memory of that fortnight remained with the Directors, particularly those of the more practical way of thinking, and when some months after they considered a new boat, the advisability or otherwise of making her a single-screw double-ended boat gave them some concern. Again, however, prudence prevailed, the strong argument being advanced that it were best to provide her with two screws, and that at the first opportunity the experiment of running with one only should be again tried, which was done in 1894, but this time a propeller properly proportioned to absorb the full power of the engines was provided before hand. The result was completely satisfactory; in fact, the Lady Manning (Plate XI., Fig. 1) has run in this wise ever since, her speed being just under 12 knots as a double-screw boat, that is, her mean time on the measured mile was 5 minutes 2 seconds, while as a single-screw boat it was just over 12 with the propeller aft, and just under with it pulling, the times being 4 minutes 57 seconds, and 5 minutes 4 seconds respectively, which brings her speed practically the same under both sets of conditions.

In the two boats that followed, the same argument predominated, and both were provided with two screws; meantime, in both cases one has been removed, and the boats run with one only. The results seemed to remove all doubt from the minds of the majority of the Directors, and the Lady Northcote (Plate XI., Fig. 2) was built with provision for only one propeller, as likewise was the Vaucluse (Plate XI., Fig. 3), built about the same time (last year) for the Watson's Bay Ferry Company; and a new boat about to be built for the Balmain New Ferry Company will have one propeller only, and will have straight keel from end to end, like in point of contour to the double propeller boat Derwent (Plate XI., Fig. 4) shown in the last diagram, and demonstrating that to the minds of those gentlemen who have had most experience of them, the single-screw double-ended ferry boat, pushing one way and pulling the other, is a practical success.

The diagrams before you show different types; it should be explained that the first two were not originally designed for single screws, but were converted, and showed some shortcomings, the most important being that sometimes difficulty was experienced in making wharves, due to wiping off under the influence of the propeller when ahead, and this came very nearly putting an end to the trials of obtaining a successful single-screw double-ended boat, it being argued, and very properly, that a ferry boat, of all boats, should be under absolute control at all times and seasons. The trouble however, was not with the principle, but due to the unsuitability of the boat for the purpose. You will observe the Lady Manning is the most extreme type of rocker keel, and the author says right here, and without hesitation, that a double-ended single-screw ferry boat should not be rocker keel. The next, the Lady Rawson (Plate XI., Fig. 5), which, though rockered, was filled in in the deadwoods, and wiped off much less; while the Lady Mary, with her straight keel, but having no deadwoods to speak of, showed this defect the least. In the Northcote the keel is straight, but stopped off at the tube end, and has very large rudders. The result is eminently satisfactory, for in point of fact, she steers better with the propeller ahead than when it is astern. The Vaucluse is, in point of principle, exactly like the Northcote, but longer, finer, and faster, she having repeatedly broken 14 knots in ordinary service trips.

It having now been proved, at least, to the satisfaction of those most interested, viz., the custodians of the cheque book, let us look briefly at the advantages and disadvantages of the two types.

Broadly, it may be conceded that other things being equal, a steel hull will be a stiffer structure than is possible in wood—but for our local requirements, and for ferry boats in particular, wood will be used as a constructive material for some time to come.

Take an average length of ferry boat at 125 feet, giving approximately a length between centres of propellers at 110 feet. In order to have a boat running satisfactorily that 110 feet of shaft has to be kept in line, which, it will be admitted at once, is not an easy matter. The reasons are too well known to require enlargement here, and the cure for the trouble is one of the big problems of the day throughout the shipbuilding world. Heavy scantling has been tried and failed; girders have been built inside and outside, in some instances to the extent of enormous trusses reaching 4/5ths the vessel's length, and 30 feet high, and only with partial success. A vessel changes shape more or less in spite of you, hence vibration and humping to the detriment of the structure and inconvenience to passengers; constant attention to the propeller shaft and frequent lining up.

The single screw shows distinct advantages in this connection, for the length of shaft is reduced to about 40 feet from 110, which can much more easily be kept lineable, and should it come to lining the engine up to the shaft it is a case of lifting instead of lowering, a very much simpler process. The first cost of about 70 feet of shaft, one stern tube, one propeller, several pedestals, and one stuffing box, together with the cost of fitting is saved, which on an average boat, such as the one we have selected, will be about £250. The exact saving in up-keep is not known, but can be put as a low valuation at £100 per annum.

Taking the greater truth of the shaft line and the higher efficiency of the single screw over two driven by the same engines, there is a considerable reduction in the coal bill, but in the absence of actual figures, the author is not prepared to state it exactly.

We have seen that in the two boats specially designed to suit single screws, the steering and handling is quite as good as with a screw at each end, and at the same running cost the results in speed are approximately equal, so we have in favour of the single screw:—

1st. Reduced first cost.
2nd. Reduced up-keep.
3rd. Reduced consumption of coal.
4th. At least equal handling power.
5th. Equal average speed, with the advantage of a little better speed one way of going.
6th. All round a more profitable ship.

Before concluding, possibly some particulars of the boats mentioned in the foregoing may be of interest, and we will select the three most typical of their respective classes.

The Lady Manning, built in 1893, may be taken as a fair specimen of light construction and small displacement.

The Vaucluse, 1905, is a medium weight boat, though of small displacement, due to her water-tube boiler and open-faced type engines, and less upperworks.

The Lady Northcote, also 1905, is an extremely strongly built vessel, with scantling in excess of requirements for her service, straight through boiler, and heavy machinery, consequently of large displacement and draught, being, in point of fact, though of approximately the same dimensions, nearly double the displacement of the Lady Manning.

The leading particulars of the three boats under consideration are as follows:—

	Lady Manning.	Vaucluse.	Lady Northcote.
Length over all	116ft. 0in.	140ft. 0in.	116ft. 0in.
Beam of Hull	23ft. 6in.	23ft. 0in.	24ft. 0in.
Beam over all	26ft. 6in.	25ft. 2in.	26ft. 2in.
Depth moulded	8ft. 5in.	9ft. 0in.	9ft. 8in.
Draft of Water	7ft. 3in.	7ft. 3in.	8ft. 6in.
Displacement in tons ...	114	178	202
Coefficient of fineness ...	·285	·296	·334
Type of Boiler	Marine Return Tube	Water Tube Babcock & Wilcox	Gunboat
Length	9ft. 0in.	13ft. 0in.	18ft. 0in.
Diameter	9ft. 2in.	Width 9′ 6″	8ft. 0in.
Pressure in lbs. per sq. in.	120	200	130
Engines, Type of	C. S. C.	Triple	C. S. C.
Size of Cylinders	13 & 26in	12 19. 32	13in. 27½in.
Length of Stroke	18in.	18in.	18in.
Revolutions per minute ...	165	184	182
1 H.P.	215	480	330
Number of Propellers ...	One	One	One
Diameter	6ft. 0in.	6ft. 6in.	6ft. 6in.
Pitch	10ft. 0in.	10ft. 0in.	9ft. 6in.
Surface in square feet ...	12	18	14
Speed of Boat in knots ...	12	14	12¼

The Lady Manning, as has been said, had originally two propellers, each of 5ft. 10in. diameter, 9ft 3in. pitch, and 9½ square feet surface, which gave so nearly the same results in point of speed as that now obtaining with the single screw of 6ft. diameter, 10ft. pitch, and 12 square feet surface as not to matter in practice.

While on the subject of propellers, it may be mentioned that to obtain approximately equal results, both pushing and pulling, a modification of the ordinary propeller has, of course, to be made. Ordinarily the driving face is made flat, and the metal necessary to obtain the requisite strength put in in the form of a round back, it is obvious that the round back would make but a poor driving face, probably less than half the area would be acting on the water, the following edges useless, and the engines run away at a dangerous speed, so as to meet the case a propeller to run equally well both ways must have both faces alike. Sometimes, particularly in the earlier boats, both faces were made slightly round, but lately they have been made quite flat with chamfer edges and have been found to answer well.

Now if both faces of the propeller are alike, and at the same revolutions, they should give the same speed of ship, and probably if it were not for practical considerations of having to keep the propellers well under the boat to leave room for an efficient rudder and for protection against wharves through the guards, the same results both ways might be obtained, but as these two points are vital, we must of necessity, when pulling, throw a lot of water back on to the vessel's bow at a speed greater than her passage through the water elsewhere, viz., at the ship's speed plus slip, or, in other words, at the speed of the screw, and it follows that that resistance will vary with the excellence or otherwise of the boat's bow.

A form of end is conceivable that would practically not be affected by this stream of fast running water, but it is questionable if one so designed would be a successful practical working boat, therefore we are left to wrestle with the conflicting conditions, and design, to a compromise between the practical and the ideal, and that compromise must ever remain like Sam Weller's name, depending largely on the taste and fancy of the speller.

One designer acting, of course, in what he conceives to be the best interests of the Company he is acting for, will place his propeller, or propellers, as the case may be, far under the boat, and consequently remote from danger from piles or wharf, and so cost something considerable in speed; another, as the author did on one occasion, placed them far out, with a view to reducing the effect of the stream of water before referred to, with the result that one of the propellers was damaged, and the guards had to be increased, it was only justice to him, however, to say that those wide guards were shown on the original design, and cut out of the specification to curtail expense.

The happy mean seems to be to decide on the requisite space for the rudder and the propeller, or propellers, immediately next them, leaving only sufficient room to unship the screw when necessary. This permits of normal flange of end sections, and guard and provides adequate protection from wharves.

In both double-ended two-screw boats and double-ended single-screw boats, perhaps more particularly in the latter, this stream of fast running water delivered by the propeller when ahead and pinging on the bow is an element that has to be carefully taken into account in designing craft of this type, whether the ultimate object be speed or not. If speed, it is essential, for if fault there be it will only be accentuated by putting through a lot of power and thus increasing the volume and velocity of that stream, and if speed be not the first consideration it must still remain folly to be putting through power in the vain attempt to correct a fundamental error.

The author once heard an old ship's captain say, "My idea of a ship is that an inch should do an inch's work and no more," and on another occasion, when, on looking over a boat of his own design with a friend, the friend said, "I have seen fine lined boats, but this one is double fine." And there we have the whole philosophy of the situation, not in very scientific language, perhaps, but the true inwardness of it all the same, for supposing the vessel's speed to be 12 knots and the column of water off the propeller 15 knots, then it follows that the boat wants designing for 15 and not for 12.

The question may be asked, "Is there any object in making the end next the propeller in the case of a double-ended single-screw boat different from the other, the author thinks not in a ferry boat, but in the case of a cargo boat, where one is looking for every available cubic foot of displacement, a considerable filling of the end remote from the propeller could, he thinks, be made without detriment to the vessel's speed.

Now, gentlemen, you may say this paper has taken too much the popular form, and not enough of the technical; you might have liked tables of results and comparisons of efficiency, evaporative power, consumption, etc., but the author ventures to believe that those subjects could be better treated under another heading, "Progressive Trials," "Types of Propellers," "Steamers, Their Design and Construction," or some other. The author quite admits a great deal could be said on these points, but his object has been more to introduce the subject in the hope that much more light will be thrown on it during the discussion than is omitted hereby.

The author desires particularly to thank the Directors of the Balmain New Ferry Company and their Manager for the opportunities given him, and for the invitation they extend through him to this Association, that at a date to be fixed any one of their double-ended single-screw steamers will be at the disposal of this Association in which to make any tests or trials that may enhance our knowledge on this, he ventures to say, interesting subject.

Thanks are also due to the Directors and Managers of the Watson's Bay Company for information obtained from their steamer Vaucluse. While for our knowledge of double-ended double-screw steamers we are indebted to the Government of New South Wales, the Port Jackson Co-operative Steamship Company, and the Sydney Ferries Limited, the benefits of which knowledge we have been privileged to pass on to our friends in Tasmania, Western Australia, and New Zealand.