DISCUSSION.

Mr. W. D. Cruickshank, in referring to the paper generally, said it would, he thought, be freely admitted that the author was entitled to their best thanks for the clear and lucid explanation he had given of his experience with double-ended screw steamers. The paper to a large extent was of a descriptive character; consequently, in a critical sense, there was very little to lay hold of, and this was specially so because there was no particular credit claimed over other vessels of a similar class. The author simply stated facts connected with their design, construction, and trials, from which we might draw our own conclusions. That this should be so was a natural consequence. Mr. Reeks could not help himself, because he had no reliable means or data, nor was there any such in this country, by which his ships, or, in fact, any ships, could be compared; while opinions expressed by him, or by us, as to superior efficiency or otherwise must of necessity be to a large extent assumptive, and could only be taken for what they were worth. It was the knowledge of this fact that induced him (the speaker) to propose the present discussion, as he considered the subject matter contained in Mr. Reeks' paper presented an exceptional opportunity of bringing before this Association certain points of considerable importance, and which were intimately connected with the economical development and efficiency of our steam marine—points which, had they been better understood and practically applied to every steamer we had built, would have been an undoubted advantage, not only to the shipwright and engineer, but also to the owners. Before doing so, however, it would be desirable to glance briefly at what had been done in Sydney with this method of propulsion.

The credit of introducing the principle of double-ended screws for the passenger traffic in this Colony was due to Captain Bremner, who, at the suggestion of Mr. John Wildridge, proposed that a vessel propelled in this fashion should be built for the North Shore Ferry, Captain Bremner being a Director of the Company at the time. His proposal was favourably received, resulting in the construction of the "Wallaby" in 1878. The hull lines, fittings, &c., were by Dunn, and the machinery designed by Mr. Norman Selfe and manufactured by Mort's Dock and Engineering Company. The engines were of the compound surface condensing type, having cylinders 13in. and 26in. diameter, 18in. stroke, working pressure 100lbs. Her dimensions were: Length, 108ft. 6in.; beam, 18ft. 4in.; and depth, 7ft. 6in. Her best speed on trial was a trifle over 10 knots, and for the purpose intended, after 16 years of constant work, she had proved to be an undoubted success. In September, 1887, some trials were carried out with this craft under peculiar conditions, but they were not conducted with sufficient accuracy to entitle them to be regarded as "standard data." The results obtained were, however, both curious and instructive, and were as follows:—Ran over the measured mile with bow screw disconnected and revolving freely, the whole of the power being put through the after screw in the ordinary way; then stern screw disconnected, revolving freely, and bow screw doing all the driving; then both screws connected, as in everyday work. Briefly expressed, it was found that with the stern screw alone the speed was 9·8 knots, and with the two connected 9·9 knots; so we might say that, under the conditions of trial, the "Wallaby" went as fast with one screw as with two.

The next double-ended screw was the "Alathea," built at Brisbane Water in 1881, having a pair of 11in. high-pressure cylinders and 12in. stroke, with 90lbs. steam. This vessel was of similar dimensions to the "Wallaby," being, length 109ft. 6in., beam 18ft. 3in., and depth 7ft. 6in., but turned out a rank failure, her greatest speed being $6\frac{1}{2}$ knots, and this after trying different screws of varied proportions. Strange to say, by disconnecting the bow and stern screws alternately, the same result was obtained as in the "Wallaby" trials; the stern screw alone (bow being disconnected and revolving freely) drove the vessel the same speed as when both screws were driving. This vessel was sold, and her owner finding her useless for his work, and acting under advice, determined to discard the bow screw altogether, taking care that the single screw aft was of standard proportions, so far as diameter, pitch, and surface was concerned. The result of this alteration was that the speed was increased from $6\frac{1}{2}$ to 9 knots.

The next vessel on this principle was the "Kangaroo," designed by Messrs. Wildridge and Sinclair, and built by Drake for the North Shore Ferry in 1891. She was 120ft. overall, 110ft. on keel, 21ft. 7in. beam, and 8ft. deep, her draught in running trim being 6ft. 5in. Her displacement on driving water line was 152·9 tons, while her co-efficient of fineness was ·512. The machinery (designed by the same firm) was of the triple expansion type, constructed by Muir and Houston, of Glasgow, having cylinders 12in., 20in., and 32in. diameter, and a stroke of 21in., and 160lbs. steam. Engines, &c., were a high-class job, well designed and exceptionally well finished, and were more than capable of developing sufficient power to drive a hull of the above dimensions, lines, and displacement at a speed of 12 knots, if fitted with a single screw; but, after various trials, the greatest speed attained was 10 knots. On the 30th May, 1891, a series of trials were made over the measured mile at different speeds, indicator diagrams taken, and the necessary calculations worked out. The bow and stern screws were also disconnected alternately, and the speeds taken as in "Wallaby" and "Alathea" trials. The following table gives the results:—

PROGRESSIVE and Full Speed Trials, with new cast-iron, three-bladed propellers, made by Atlas Eng. Coy., Ltd. Diameter, 6ft. Pitch, 10ft. Surface in one propeller, 9·75ft. Total surface, 19·5 square feet.

Engines, Triple Expansion.

Cylinders, $\frac{12\text{in.}\quad 20\text{in.}\quad 32\text{in.}}{21\text{in.}}$ Pressure, 160lbs. square inch.

No. of Trial.	Steam.	Vacuum.	Revolutions.	Time on Mile.	Speed per hour.	Slip per cent.	I.H.P.
	lbs.	in.		min. sec.	Knots.		
No. 1 ...	154	28	100	8 17½	7·24	25·5	101
„ 2 ...	152	28	120	6 57	8·63	27·1	162
„ 3 ...	150	27¾	144	6 9½	9·75	31·8	284
„ 4 ...	152	27½	144	6 2	9·94	30·4	284
„ 5 ...	150	27	152	5 55	10·14	32·4	350
„ 6 ...	150	27	156	6 5	9·86	35·5	267
„ 7 ...	150	27½	160	7 5	8·47	46·3	268

Numbers 1, 2, 3, 4, and 5, both screws driving; No 6, bow screw disconnected and revolving freely; No. 7, stern screw disconnected and revolving freely.

The results, so far as they went, were exceedingly interesting and instructive. If we referred to No. 4 trial we found that with 152lbs. steam and 144 revolutions, the speed was 9·94 knots, and that it took 284 i.h.p. to get it, with both screws working. Compare this with No. 5 trial (both screws working), where the revolutions were 152, the i.h.p. 350, and the speed 10·14 knots, there was a difference of only 2-10ths of a knot; in fact, the diagrams showed clearly that 10 knots was practically the maximum speed that could be obtained; also that no matter how much more power was developed by the engines, there would be no increase of speed. Another curious thing, which agreed with results obtained in "Wallaby" and "Alathea" trials, was that if we took No. 6 trial, where the bow screw was disconnected and the vessel driven entirely by the stern screw, we approximately got the same speed, 9·86 knots, with 267 i.h.p. instead of 350, the difference being 113 h.p. less, so that in this particular case we put 113 h.p. through the engines for nothing, this power being almost entirely wasted. No. 7 trial was both interesting and suggestive. In it the bow screw did all the work, the speed being 8·4 knots with 268 i.h.p. This proved conclusively that in the "Kangaroo" the stern screw alone drove the vessel $1\frac{1}{2}$ knots faster than with the bow screw alone, thus demonstrating the superior efficiency of the stern screw, and also furnishing strong evidence that in all such cases there was a material loss of power due to the action of the bow screw.

It was neither desirable nor necessary that he should offer any opinion in reference to the results just mentioned beyond stating that for vessels of ordinary form propelled as described, our experience proved that the limit of anything like economical speed was soon reached, and that after passing or attempting to pass 10 knots the increase of resistance was phenomenal; also that any attempted increase meant a large and comparatively useless waste of power.

The "Kangaroo" was followed by the Balmain Ferry Company steamers "Lady Mary," "Lady Napier," and "Lady Manning," the first and last named forming the subject of Mr. Reek's paper. Their practical working had been very satisfactory, and they have been found to be admirably suited for the purpose for which they were designed.

When the vessels were tried they (like all others) simply ran over the measured mile at their highest speed, and there the trials ended. It would, however, have been interesting if, being of a different form, they had been tested under similar conditions to the others, viz., with the bow and stern screws disconnected alternately, to determine whether this alteration, consisting in cutting away dead wood, diminishing skin friction, reducing the bow and stern waves, &c., had increased the efficiency; or, to put it another way, to find out how much the resistance has decreased or otherwise.

The author's paper, briefly expressed, was simply a concentrated effort to design vessels in such a manner as would ensure his getting for the same power a greater percentage of efficiency than anybody else; and personally he (the speaker) was of the opinion that he had succeeded, although to what extent could never be known until we inaugurated a much better system of testing all our steamers. What that system should be would be referred to and explained later.

The latest addition to our fleet of double-ended screws was the "Waringa," recently built by Dunn for the North Shore Company. The designs and specifications were furnished by the officers of the Company. Her dimensions were: Length, 118ft. 6in. overall, 108ft. 6in. on keel, 21ft. 9in. beam, and 6ft. 6in. depth. She was of the ordinary form, and on her trial steamed 11 knots. Her machinery was of the ordinary compound surface condensing type, having cylinders 13in. and 26in. diameter, with a stroke of 18in., 120lbs. steam, constructed by Muir and Houston of Glasgow; and certainly they had no occasion to be ashamed of their work. This craft had been running successfully, and in the many qualities required for this special service she was quite up to expectations.

One or two points in the paper might be referred to. He cordially agreed with the statement that for our harbour service and short runs, especially in narrow waters, the double-ended screw, everything considered, was the most suitable, and would be the ferry-boat of the future; but he could scarcely endorse the remark that "screws at each end, keyed on to the same shaft and driven direct, is an economical method of propulsion;" and he believed there must be some misunderstanding, because a little further on the author stated, when pointing out the difficulties he had to contend with in the items of speed, draught, and carrying capacity, that "these would have been little or no trouble with a single-ended boat, applying the whole power, that is, 13in. and 26in. cylinders with a 16in. stroke and 100lbs. steam to one screw and no limit to drag aft, but it was quite a different matter in this case," &c., &c.

The two statements did not harmonise, because if the economy of this principle was, as the author says, demonstrated in 1879, why should it increase the difficulty of its application in 1894?

The results of the trials previously described, apart from other considerations, proved conclusively that double-ended screws were not and never could be in a mechanical sense, economical. This method of propulsion like many others had its good and bad points, but for our harbour traffic, economic speed was only a fractional part of the problem, other qualities of even greater importance had to be considered and provided for, but we had had sufficient experience in actual working to justify the statement, that for this special service, the double-ended screw was, all things considered, the most suitable where the runs were short, the speed moderate, and the stoppages many.

Another special feature in the author's design of the "Lady Manning" was the overhung propeller and rudder posts, thereby doing away with a certain percentage of obstruction and skin friction, besides allowing a free flow of comparatively solid water to both propellers, which must to some extent increase their efficiency. The objection taken to the overhung posts was: that having no connection at the heel, there would be side movement and vibration, and that the shaft would not and could not run true, also that the whole fabric, including overhung rudder, would scarcely stand the severe strains of actual working. So far as the screws and shafts were concerned, the objection could be met by stating that in smooth water, so long as the propellers were wholly immersed, there was practically no tendency to vibrate or get out of truth, because when a four-bladed screw revolved in solid water there could be no tendency to vibrate one way more than another, except the variation in water pressure due to depth, which in this case was so small that it might be disregarded. The strain on the rudder, and which of course was developed on the overhung post, presented no difficulty, as it was simply a question of constructive strength and rigidity.

Two other points in the "Lady Manning" might be mentioned, viz.:—the difficulty in docking, which from her shape must be carefully manipulated, and the effect of a heavy beam wind when taking the Sydney wharf, there being so much of her above and so little below the water she would go to leeward much faster than a boat of the ordinary form, and would therefore not be so manageable, especially when the wind was at right angles to the ship's course,—that is, when the vessel was stopped.

Referring to the Steam Ferry Service of Port Jackson, its development had been so great, and it had assumed such proportions within the last few years in the number, size and speed of its vessels, that it would be difficult to match it in any other port of the world; and recognising the great natural facilities for settlement about and around the waters of Port Jackson, it did not require a large amount of perception to confidently predict the future certain and extensive expansion of this traffic.

Including Government vessels, we had at present over 260 harbour steamers alone, a large per-centage of which were of local construction; and everything considered, the builders were certainly entitled to a great amount of credit. With a few exceptions, all these steamers were built instinctively—that was, by a happy combination of intuition and practical experience our ship-builders generally managed to produce an article which as a rule was suitable for the purpose intended. The same applied to the machinery; experience and the practical results of other and similar craft constituted our stock in trade, and which was usually successful, but sometimes otherwise.

Now what he wished to demonstrate was that this instinctive system, although very good in its way, was not good enough; also, that in our method of testing vessels we were a long way behind modern standard practice; that in this connection for many years we had been actually standing still, and that it was high time we made a move.

The usual Colonial trial trip had little to commend it, consisting as it did in merely running over the measured knot at full speed three or four times, taking a few diagrams, calculating their power, &c. If the ship went the required speed, well and good; if not, we perhaps changed the propeller and altered the trim, but here the trials ended, and it was by no means creditable to us as shipbuilders and engineers that, taking into consideration the whole of the sea-going and harbour steamers built in this or any of the other Colonies, we had actually no information or data by which we could compare the efficiency of one steamer with another.

The propulsion and resistance of ships was a large and complex subject, and few branches of engineering were richer in mathematics and abstruse formulæ; but many of those scientific calculations had been modified, and now harmonized with the result of actual experiment, so that we had for our guidance certain standard rules, which were duly recognised as being approximately correct, and near enough to work by; but they embraced such a large field of inquiry that precluded any detailed explanation, and could only be referred to briefly and in general terms.

Perhaps the best way of putting this matter would be by an illustration. Assume a number of shipbuilders and engineers, from the old country, and who were well up in modern practice, visiting Sydney. They would naturally take a deep interest in our harbour service. Imagine them taking a trip in the "Lady Manning" or "Waringa," and afterwards pulling out their note-books and plying us with something like the following questions:—

1st. Yes, your boats are very nice indeed, and they appear to be very suitable; but tell us, how is the slip curve affected by the application of this principle of propulsion? and is there any abnormal increase due to the action of the bow screw? &c.

2nd. In applying the displacement formula, what sort of a co-efficient do you get? Does it differ materially from what would be expected from a similar vessel driven in the usual way?