

ART. LIV.—*On the Comparative Performances of certain RIVER STEAMERS, on the Waikato.* By JAMES STEWART, C.E., Inspector of Steamers, etc.

[Read before the Auckland Institute, September 20, 1869.]

DURING an official visit to the Waikato, a few months ago, I was enabled to collect pretty definite particulars of the comparative performances of side paddles and stern wheel, as applied to the steamers "Blue Nose" and "Rangiriri." Two vessels differing widely in construction, and, as the investigation proves, just as much in effective results of the applied steam power. I have worked the comparison in various points, and now take this opportunity of laying the same before the Institute, feeling assured that it will prove of interest to many.

The construction of these vessels is known to all who have been interested in the Waikato during the last five years. The "Blue Nose" is a wooden vessel, propelled by side paddles of the common sort. The "Rangiriri" is an iron vessel, with a single feathering paddle wheel at the stern. The "Blue Nose" is moderately fine in shape, while the other is hideously bluff at the bows, straight in the sides, and square in the stern. Both vessels have direct-acting, high-pressure machinery, and nearly the same draft of water, but with these similarities their points in common cease, and a wide divergence on all others takes place, the particulars of which are the subject of this paper.

In comparing the vessels, it will place the matter more clearly, if the various points are tabulated as under.

POINT OF COMPARISON.	"BLUE NOSE."	"RANGIRIRI."
Ratio of beam to length .	1 : 6·3	1 : 4
Immersed midship section	40 sq. ft.	55 sq. ft.
Cylinders	13½ in. × 2 ft. 4 in.	11½ in. × 2 ft. 3 in.
Steam pressure during trial	56 lbs. per sq. in.	51 lbs.
Revolutions per minute .	28	25
Computed indicated h. p.	53	31·5
Speed per hour	6·5 knots	6 knots
Paddles	Common	Feathering
Effective diameter of wheel	10·7 ft.	9·2 ft.
Slip of wheels	30 per cent.	17 per cent.
Ratio of immersed floats to immersed midship section	1 : 1·9	1 : 2·4

It will thus be seen that, notwithstanding the very great advantages in point of build, power, etc., the "Blue Nose" only attained a very small increase of speed over the "Rangiriri." To put the comparison more clearly on this point, let the usual Admiralty formula be taken to fix the value of the constant of efficiency, premising that for vessels of similar build, the larger the constant, the greater is the useful effect of the power applied. This

rule is $C = \frac{V^3 S}{HP}$ in which C is the constant, and V the speed in knots per hour ;

S the area of immersed midship section, and HP the indicated horse power. Reducing from the above values of those signs, we find for the "Blue Nose" $C = 207$, and for the "Rangiriri" $C = 377$. The result is sufficiently startling, and in great part must be accounted for by the faults of the "Blue Nose," although I have been aware, ever since the "Rangiriri" was placed on the river, that the stern wheel developed more useful effect than the side wheels. But I never had an opportunity, until lately, of fully comparing them.

Before attempting to give a reason for the above result, I will mention

another circumstance which has long been remarked on the Waikato. When a stern wheel boat enters shallow water, the engines move slowly and appear to drag with difficulty ; while if a side paddle vessel of like draft of water enters the same part of the river, the engines get away very much *faster*. The speed of the *vessel* being in both cases somewhat lessened, in proportion to the shallowness of the water. The explanation of this, no doubt, lies in the same path as that of the comparative useful effect of the stern wheel above noted, and also with that of the phenomenon of negative slip of screw propellers.

In the case of screw steamers, the paradoxical result of the vessel being propelled through the water faster than the advance of the propeller, has often claimed serious thought ; and in all single-screw steamers the positive slip is very small, as compared with paddles. Many ingenious theories have been propounded in explanation, but the one now generally held to be the true one, applies, I believe, equally to the explanation of the case in point. When a vessel moves at some speed through the water, skin friction must necessarily impart motion to a sheet of water under and around the hull. The water in contact with the hull having nearly the same velocity, and lessening in proportion to its distance from it. There must then be a sheet of water having a mean thickness, and an average velocity, which cannot be at once brought to rest, but must follow up the vessel, and gather in a column of moving water having some ratio of speed to that of the vessel. In this column of moving water, the screw works, and as the velocity of this may in some instances be greater than the positive slip of the screw, the result is apparent negative slip. In the case of a flat vessel like the "Rangiriri," the stern wheel moves in a moving sheet of water, which has the same result of giving back part of the power expended in putting it in motion ; which power is entirely lost to side paddle vessels, and also, in a great extent, to twin screws, hence the great observed slip of those, as compared with a single screw. The effect of shallow water above referred to, is, no doubt, traceable in great part to the same source.

I have thus endeavoured to make clear the observed results of the two systems of applying power in paddle vessels, but in doing so, I must not be understood as advocating for river steamers, stern wheels as preferable to the ordinary method, unless in very exceptional circumstances. There are constructional disadvantages attending the design of such vessels, which are serious, while the uncertainty of steering in shallow water, the impossibility of using disconnected paddles, and thus steering without way on the vessel in shallow water, make, even for a tortuous narrow river, a stern wheel vessel, inadvisable. Neither must the effective results of the "Blue Nose" be taken as an instance of those of side paddles, as with her general form, and small immersed sectional area, the constant of efficiency ought to be nearly equal to that of the "Rangiriri," which would then, with everything considered, still leave a balance in favour of the latter.
