After this slow speed trial the boat was run at 140 revolutions, or fully eleven knots, and turning trials made in Rose Bay. With the helm hard aport, a complete turn to starboard was made in 2 minutes 25 secouds, the diameter of the turning circle being estimated at 200 yards; helm hard astarboard, she turned to port in 2 minutes, the circle being of somewhat less apparent diameter. Stopping trials were then made, the engines being put full astern, when thus going eleven knots, floats being thrown over on each bow by independent observers to assist in judging distance run before stopping. She was reckoned to stop in 26 seconds having gone less than 2 lengths, say 200ft., and the rudder being kept amidships, she went round 11 degrees to port.

The vessel was then run for over an hour at this speed of 11 knots, from the Sow and Pigs lightship up to Hunter's Hill and back to Kirribilli Point. for a coal consumption trial, coal having been weighed into bags, and a note kept as to its burning. The consumption for one hour was 1220lbs., or 27lbs. per square foot of grate. The I.H.P. at this speed being 427, this corresponds to a consumption of 2.85lbs. per I.H.P. including consumption for auxiliary, steering engine and fan. On a short trial like this, however, there is room for a large margin of error in coal consumption figures. The steadiness and absence of vibration at all speeds were remarked by all, although a somewhat heavy bow wave was set up, the wake was very little disturbed. The machinery, including the steering engines, worked very satisfactorily, and the committee congratulate the Sydney Ferries on their adding a boat like the "Kookooburra" to their fleet.

They desire to put on record their appreciation of the kindness and courtesy of the Sydney Ferries' Directors and thelr staff, in granting facilities for these trials, and for providing a profitable and pleasant feature in this Session's programme of the Engineering Association.

The results of the trials are given in the following table, and on Plate VIII.

TRIAL TRIP OF S.S. "KOOKOOBURRA."

Engines— $\frac{13\text{-}21\text{-}35}{21}$ Steam Pressure 180lbs. sq. in.—23/3/07.

Displacement at 7ft. 9in. draft 303 tons.

Boilers—Two 7ft. 6in. ext. dia. x 18ft. 0in. long (ext.) 936 sq. ft. H.S. (each) 22 sq. ft. Grate each.

Co-efficient of fineness ·467.

Propellers—One at each end—6ft. 6in. dia., 10ft. 0in. pitch. 15·2 sq. ft. surface each propeller.

Run.	A		B		C		D		E		
Course	Pinchgut to Bradley's.	Bradley's to Pinchgut.	Pinchgut to Bradley's.	Bradley's to Pinchgut.	Pinchgut to Bradley's.	Bradley's to Pinchgut.	Pinchgut to Bradley's.	Bradley's to Pinchgut.	Pinchgut to Bradley's.	Bradley's to Pinchgut.	Bradley's to Pinchgut.
Time on Mile	8m. 53s.	8m. 21s.	6m. 58s.	6m 54s.	6m. 0s.	5m. 52s.	5m. 21½s.	5m. 24½s.	5m. 1s.	4m. 53½s.	4m. 52½s.
Speed in knots	6·754	7·186	8·612	8·696	10·	10 227	11·195	11 094	11·96	12·267	1·2308
Mean Speed—Knots ...	6·97		8·654		10·113		11 144		12·178		
Boiler Pressure	180	179	180	180	180	180	180	177	169	175	177
Intermediate Pressure ...	4·5	7	9	11·5	16½	12	37	31	52	54	55
Low Pressure	14½in. vac.	16in. vac	11in. vac.	12½in. vac.	8in. vac.	9in. vac.	0·33lbs.	2in. vac.	4·5lbs.	5·7lbs.	5
Vacuum	22¾in.	23in.	24in.	24in.	25in.	25in.	26in.	26in.	26in.	26in.	25½in.
Revolutions	83	83	102	100	120	120	140	140	160	162	160
Mean Revolutions	83		101		120		140		160·7		
Slip %	14·9		13·2		14·6		19 4		23 2		

I.H.P. developed, being mean of 3 sets on each run.

	A		B		C		D		E		
M.E.P.—H.P. Cylinder ..	29 67	29 67	41·73	37·67	60·38	61·12	77·17	77 33	77·5	77·83	78·67
,, I.P. ,, ...	9·717	9 5	13·87	12·64	20·62	20·38	35·13	29·85	44·5	46 72	45·03
,, L.P. ,, ...	2·167	1·91	3·533	3·173	4 567	4·667	8·617	6·533	12·12	12·45	12·03
,, Reduced to L.P. Cyllnder	9·767	9·43	14 273	12 923	20 317	20 427	31·917	27·983	38·82	39·97	39·08
I.H.P.—H.P. Cylinder ...	34·65	34·65	59·8	53·0	101·8	103·8	152·0	152·1	174·2	177·1	177·
,, I.P. ,, ...	29·6	28·95	51·9	46·4	91 0	89·75	180·7	153·5	260 7	278·0	265·
,, L.P. ,, ...	18·35	16·16	36·7	32·35	56 0	57·2	123·0	93 5	197 5	206·0	196·5
,, Total	82·6	79·76	148 4	131·75	248 8	250·75	455 7	399 1	632·4	661·1	638 5
,, ,, Mean	81·18		140·07		249 77		427 4		644·		
Co-eff. of Performance $\left\{ \frac{\text{Disp}^{\frac{2}{3}} \times \text{Speed}^3}{\text{I.H.P.}} \right.$	188 2		208·7		186·6		145·9		126·6		

Coal Consumption ... 1460 lbs. in 72 min. @ 140 revs =427·4 I H P. 11·144 knots.

Coal—Burwood and Heddon mixed.

$\frac{1460 \times 60}{72}$ = 1220 lbs per hour, $\frac{1220}{44 \text{ sq. ft. grate}}$ = 27·75 lbs. sq. ft. grate. $\frac{1220}{427{\cdot}4}$ = 2 84 lbs p. I.H.P. hour.

MR. HECTOR KIDD'S REPORT ON THE INDUCED DRAFT TRIALS:—

Figures giving the results of observations taken on the working of the induced fan draft installation and the draft intensities produced during the progressive speed trials with the double-ended ferry steamer "Kookooburra," on March 23rd, 1907.

INDUCED FAN DRAFT OBSERVATIONS, MARCH 23RD, 1907.

Date.	Time.	Top of Fire.	Smoke Box.	Revolut'ns of Fan.	Steam Pressure on Boilers.	Revolut'ns of Main Engines.	Pressure on Oil Pump.
1	a.m. 2	3	4	5	6	7	8
23/3/7	10.40	0.025	0.125	140	180	100	6lbs.
2 23/3/7	10.52	0.05in.	0.125	140	...	...	...
3 23/3/7	11.5	0.05in.	0.125	130	...	102	...
4 23/3/7	11.20	0.06in.	0.125	130	...	120	8lbs.
5 23/3/7	11.30	0.05in,	0.125	300	...	140	9lbs
6 23/3/7	11.45	0.125in.	0.19	500	...	140	11lbs.
7 23/3/7	11.5'	0.310in.	0.50	525	...	...	12lbs.
8 23/3/7	p.m. 12.00	0.250in.	0.56	575	175	162	11½lbs.
9 23/3/7	12.10	0.250in.	0·56	570	170	160	12lbs.
10 23/3/7	2.30	0.320	0 625	600	179	160	13lbs.

Tests were made to determine the intensity of the natural draft due to height of funnel (23ft.). The average of three tests gave a water-gauge reading of 0.125. The results are shown in diagram form on Plate IX.

Referring to the table it will be noted that during trials Nos. 1 to 4 inclusive, when the main engines were running at moderate speeds, the fan engine was being driven at a speed to keep the steam just on the blowing-off point. When the main engines were speeded to 140 revolutions per minute the fan was run at 500 revolutions per minute to maintain a full head of steam.

Trials 8 and 9.—The main engines were run at full speed, and although the fan was speeded up to 575 revolutions per minute the steam pressure gradually fell back to 170lb. per square inch. An examination of the fires disclosed the fact that they had been allowed to burn down rather low, with the result above noted. It was, therefore, deemed advisable to make another run at full speed, with the fires in good working condition and properly stoked. To get ready for tenth run the main engines were slowed down to allow of the fires being worked up to about 12in. to 13in. in depth, and to raise the steam to 180lb. per square inch. Under these conditions the vessel was run over the measured course again at full speed, with the result that a full head of steam was maintained on the boilers.

The speed of the fan engine was 600 revolutions per minute, producing a W.G. in smoke box of $\frac{5}{8}$, or equal to five times the natural draft due to the chimney.

Mr. Hector Kidd said, referring to the figures in the report, giving the results of working the induced draft fan at different speeds, attention may be here directed to the great advantage obtained by mechanical draft in small steamers where the height of the funnel is limited on account of having to pass under bridges or for other sufficient reasons.

The height of the funnel of the "Kookaburra" is given as 23ft. from level of firebars to top. The natural draft corresponding to this height of funnel and working conditions was found to be 0.125ins W.G. Then $\frac{0.625}{0.125} = 5$ that is to say the draft produced by the fan was five times the natural draught, and was therefore equal to that of a funnel $23 \times 5 = 115$ft. high. As the rate of combustion is approximately as the square foot of the effective draft of water gauge the application of induced draft in this instance has enabled 2·24 times the quantity of coal to be burned per square foot F.G. that could be burned by natural draft with a chimney 23ft. high. The fan is 30ins. diameter over the tips of im peller × 18in wide, of the well known Sirrocco type driven by a high speed engine 4in. diameter × 4in. stroke of the enclosed forced lubrication type. The engine and fan ran smoothly and without undue vibration during the trials.

The application of induced fan draft to vessels of large tonnage and for land purposes dates back many years, but the installation in the "Kookaburra" was, he believed, the first for small ferry steamers in this State. It seemed to him a most effective system, and might be compared in efficiency to the action of the blast in a locomotive, for when standing at a station there was just sufficient draft with the short chimney to keep the smoke from coming out of the furnace door, and little or no steam was being generated, but directly the driver moved the regulator and the engine began to draw steam from the boiler, the exhaust steam passing through the blast nozzle preduced a powerful suction draft and accelerated the rate of combustion in the furnace to generate steam just as fast as the engine consumed it.

In the "Kookaburra" the funnel was just long enough to produce draft to supply a moderate quantity of steam so that when coming to a wharf or lying at one for some time it should not be necessary to have the steam blowing off, but when leaving the wharf for a run all that was necessary was for the engineer to speed up the fan engine to keep a full head of steam, provided, of course, the fires are kept fairly heavy and stoked properly.

The writer had the privilege of discussing with the President the details of the fan installation before it was fitted into the vessel, and with his permission the following figures were given to indicate the working conditions:—

Heating surface, two boilers, 1872 square feet.

Grate, 44 square feet.

Ratio of heating surface to grate bar surface, 42·5 to 1.

Coal to be burned per hour, 1300lbs.

Coal to be burned per square foot grate bar surface, 29·6lbs.

Cubic feet cold air entering furnace, 6820 per minute.

Indicated horse power, 650.

Speed of fan, 500 revolutions per minute.

$$\text{Coal per I.H.P.} = \frac{1300}{650} — 2\text{lbs.}$$

Assuming 8lbs. of water evaporated per lb. of coal of fair quality, $8 \times 2 = 16$lbs. of steam per I.H.P.

Then $16 \times 650 = 10{,}400$lbs. of water evaporated per hour,

and $\frac{10{,}400}{1872}$ square feet $= 55{\cdot}5$lbs. of water evaporated per square foot of heating surface.

At this rate the evaporation per square foot of heating surface and efficient combustion in furnaces, the smoke tubes being fitted with retarders, the exit temperature of waste gasses should range from 625 to 650 degrees. Fahrenheit. The estimated volume of cold air to be handled per minute provided for 23lb. of air per lb. of coal. This seemed a generous allowance when mechanical draft was in use. The volume of gasses per lb. of coal equalled $23 + 1 = 24$lb. The temperature of the air in stokehold may be taken at 80 degrees Fahrenheit, and the volume at 13 6 cubic feet per lb.—$24 \times 13{\cdot}6 = 326$ cubic feet per lb. of coal. Volume of hot gasses to be handled by fan $= \frac{635+461}{80+461} \times 326 = 660$ cubic feet hot gasses per lb. of coal.

$$\text{Coal used per minute, } \frac{1300}{60} = 21{\cdot}68\text{lb.}$$

Then $660 \times 21{\cdot}68 = 14{,}309$ cubic feet per minute.

The effective area of fan discharge, assuming a co-efficient of $\cdot8 = 2\text{ft.} \times 2\text{ft.} \times \cdot8 = 3{\cdot}2$ square feet, then $14{,}309 \div 3{\cdot}2 = 4471$ft. per miunte as the speed of gasses through discharge opening. The fan has ample capacity to handle 14,309 cubic feet of gasses per minute when driven at 500 revolutions per minute, but as a higher W.G. had to be obtained than that speed provided for it was found necessary to speed the fan up to 600 revolutions per minute. I need not trouble the members with the figures, but would remark that to fulfil the conditions of maximum rate of combustion when the main engines are developing full power the fan should run at from 600 to 650 revolutions per minute.

Referring to the special run of 72 minutes to determine the coal consumption per I.H.P., the figures seem to be rather high, As one of the observers I would venture to remark that if the test be repeated—the run being longer—that the figure would be nearer 2·5lb. per I.H.P. instead of 2·84.

It should be further noted that when working at full speed 20lb. of hot gasses per lb. of coal would be about the quantity to be handled by the fan. Then $\frac{650 \times 2{\cdot}5}{60} = 27{\cdot}1$lb. of coal per minute.

$20 \times 13{\cdot}6 = 272$ cubic feet cold air.

$$\frac{635^\circ \times 461^\circ}{80^\circ \times 461^\circ} \times 272 = 549 \text{ cubic feet of hot gasses.}$$

Then $549 \times 27{\cdot}1 = 14{,}878$ cubic feet of hot gasses to be handled per minute by the fan when the engine is developing 650 I.H.P. and burning 2·5lb. of coal per I.H.P. per hour, so that the fan has about the right capacity to handle the volume of hot gasses produced when the engines are developing their estimated full power.

I take this opportunity to express my thanks to the President, and also to the directors of the Sydney Ferries Company, for the opportunity of being present at the trials, and to congratulate them on the successful results obtained.

The question of mechanical draft for boilers is one that is receiving much attention from engineers, and the time does not seem far off when tall chimneys will be displaced by the more efficient system of mechanical draft. The writer has had experience with the successful working of four large induced draft plants, where their installation had resulted in a considerable saving in fuel, and also a perfect control of the steam supply. It might interest the members to know that the Colonial Sugar Refining Company were making and installing three plants this year, the largest of which was 12ft. diameter × 5ft. 6in. in width; engine for driving fan, 16in. diameter × 12in. stroke, high speed, of the enclosed forced lubrication type. The capacity of this fan was 130,000 cubic feet of hot gasses per minute, and was intended to handle the gasses from twenty large locomotive boilers in a sugar refinery in Fiji.

Mr. James Shirra, in opening the discussion, said that our ferry steamers had been more than once discussed at the Association's meetings, and a study of the paper by Mr. Reeks, given in 1894, on double-ended ferry steamers, and the discussion thereon, will be profitable; while Mr. Harry Selfe, in 1886 and 1888, read papers that did much to awaken interest and induce progress in the design of these boats. The contrast between the boats of a quarter of a century ago and those now on our harber was marked. We had gone on increasing the beam and fining the ends until the hull of a ferry steamer resembled that of a miniature battleship. The "Kookooburra" showed this proportionate increase of beam more than some of our recent boats, her length being under five times her breadth, while her co-efficient of displacement was fairly high. Still she steered well for so short and broad a boat, a result due not only to her shape, but to the bow propeller neutralising to some extent the erratic tendency of the after one. At the same time the requirement of a bow propeller being fitted complicated the problem of attaining a high speed. The speeds attained in our modern battleships could not be reached if fitted with screws at both ends; however, their manœuvring qualities would be affected. This point, the mechanical disadvantage of a bow screw, as regarded speed producing, was, he thought, clearly demonstrated at the discussion on the paper of 13 years