

and nothing the next. On reducing the water by 12 inches this variation of pressure was reduced to 1 or  $1\frac{1}{4}$  lbs. On making a further reduction of 12 inches + 24 inches = 3 feet, the register was reduced to  $\frac{1}{2}$ -lb., the movement of the pressure gauge agreeing with that of the indicators, the greatest movement of the water in the gauge glasses being 36 inches, or 18 inches above and as much below normal level.

Commenting on the subject, Professor Warren, of Sydney University, wrote:—

“From observations in the inside of the tank when partially filled with water on January 18th, 1911, in a moderately rough sea, the water was seen to rise and fall against the bulkhead as the ship pitched; the period of this rise and fall appeared to correspond with the waves of the sea producing the motion. There was no translation of the particles of water on the surface along the tank from the bulkhead to another, such as occurs when a wave breaks upon a rock or beach, and the water moves forward as a whole. In an unbroken wave, the particles of water, although oscillating according to known laws, do not move in the apparent direction of motion. What is frequently described as the ‘send of the water’ against the bulkhead, is merely the undulation of the water developed in the tank, and its reflection from the bulkhead at each end. This rise and fall produces no difference in the hydrostatic pressure, which remains constant, and is always equal to the main head of the water. A gauge fitted and a glass tube attached to the tank clearly demonstrated this action, although it is well known to those who have studied the question, being first pointed out by Professor Rankine in his ‘Selected Papers.’ No matter how rough the sea, the pressure gauge shows no alteration, notwithstanding the rise and fall of the water during pitching. Any statement in regard to enormous pressure due to the send of the water is based upon a misconception of what actually takes place.”

These studies led the Author to rig up a machine, so that a record of her action in a sea-way might be obtained, and these records we will now proceed to study, and also the effect upon the mind and comfort of the Voyager.

It was said of a late ship-mate that he had seen the seas so high that they had washed the face of the moon. Why should such exaggeration pass? Simply because the conditions are so contrary to ordinary experience that there is a difficulty in gauging the actual motion. A quotation from a review in "Engineering" reads thus:—

"The phrase 'mountains high' is an indication of impression rather than of measurement; being mounted on a deck, there is a feeling or impression that the horizon is at a distance, which it would have been on land with such an eye elevation. This would mean a mile or two from ridge to ridge, which is ten (10) times the actual distance, and the apparent height is consequently increased in the same ratio, making a wave of 40 feet look as high as a hill of 400 feet. The altitude of a wave during an ordinary storm is practically constant, and does not exceed 43 feet. At the same time, effects akin to interference may cause peaks to shoot up to 60 feet. Lord Kelvin has recorded such, but these experiences are rare."

But to proceed with our measurement of the storm of July 14th, 1912. (Fig. 8.) To give character to the blow, the "Daily Telegraph" of 15th July:—"The strongest blew at the rate of 51 miles per hour at 2.30, 7 and 11 a.m. from South and South-South-East."

The Newcastle telegram in the same paper was:—"A terrific storm swept over Newcastle last night and this morning. The wind blew at times with astounding violence, and reached a velocity of 70 miles per hour. On the harbour the shipping had a lively experience."



Leaving Sydney on the 12th, the weather was Westerly, fresh, smooth sea; the records showing the rolling of the ship with an amplitude of from 2 to 3 degrees only, with a perfectly straight line for pitching or zero; in short, "a lovely night." The following day being Saturday, there were no 8.0 p.m. Weather Reports, and there were no indications by the earlier reports.

We left Newcastle with a strong Southerly breeze, but no sea. This continued for the first hour, the records showing a maximum roll of from 5 to 8 degrees, with 1 or 2 degrees pitching. The weather increased until at 4.0 a.m. the rolls had increased in amplitude to 36 or 37 degrees, with pitches of from 10 to 13 degrees, the engines at times racing heavily. To moderate this effect, the water in the tank was reduced so as to produce an easier entrance for the vessel, and also to immerse the propellor; in all, 120 tons were discharged, and also a reduction of power, but not before a maximum roll of 49 degrees and a maximum pitch of 24 degrees had been recorded—the first caused everything on the table in the Chief's room to be thrown off, and the pitch was a startling experience.

As the degree is equal on the beam of the ship to  $8\frac{1}{2}$  inches, this would give an angle on the deck of 17 feet 6 inches higher on one side than on the other, or one in 2.4 feet. The pitch of the vessel at 4 feet 6 inches per degree would give an angle on deck of one in 4 feet 9 inches. Working this out would give a lift at the stem of 36 feet above and as much below the normal level, while the stern would be moving in an opposite direction of 18 feet, the neutral point of the ship being  $\frac{2}{3}$  of her length from the stem head; but taking an average roll as 30 degrees amplitude, or 15 degrees each way, would give a movement of one side above the other of 10 feet 6 inches, or an angle of 1 in 4, and, taking 12 degrees as the average maximum pitch, would give a movement of 18 feet above and below, or a total of 36 feet for the stem head and aft, 9 feet above and below, or 18 feet.

S. S. HUNTER

12th June, 1914.

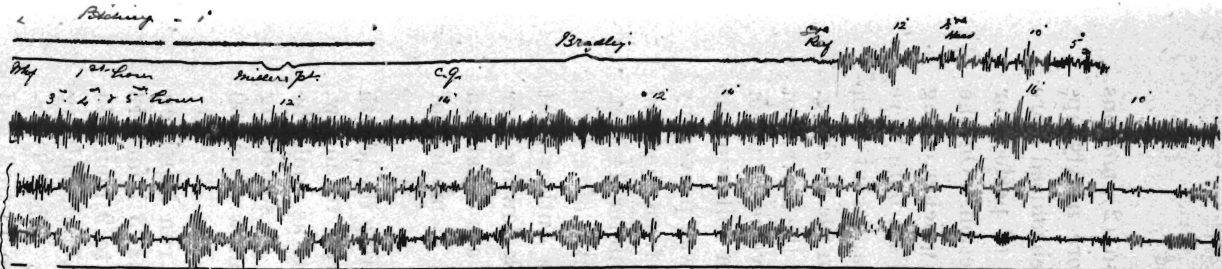
W. Fresh. Sea Mod.

5 a.m. to 9—Thick Fog.  
Engines as required.

Dense Fog { 5 a.m. to  
6 a.m.

Miles Eng 71 { 6 to 7 a.m.

„ Log 53 { 7 to 8 a.m.



29th June, 1914. South

S.W. Light. Sea Smooth

7.5. 11.10.

Eng. 63. Log 56½

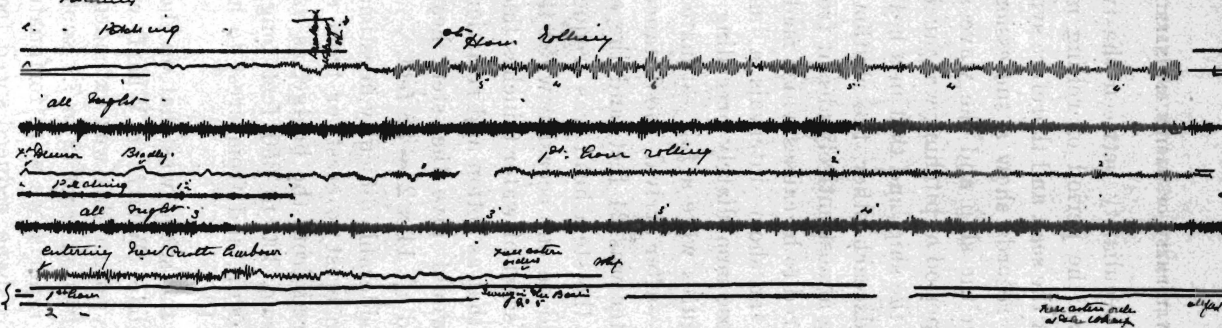
North 30/6/14.

N.W. Light. Sea Smooth

8.4. 11.11.

Eng. 68.6. Log 59.

Coaling—  
100 tons  
taken.



Aug. 19th, 1914,

South.

h. m.

8.29. 8.2. 12.6.

S. E. Fresh. Sea Rough

Showing the effect of the  
slackened tank.

A reduction in motion of  
25 per cent.

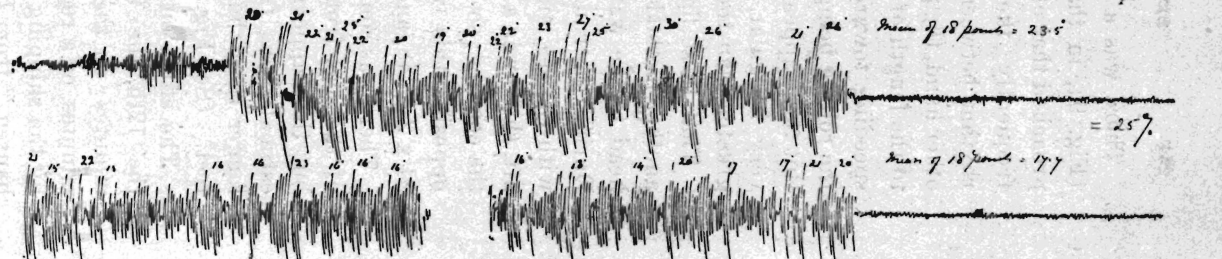


Fig. 9

There was a peculiarity between the two (2) motions (Fig. 9), in that the period of rolling more nearly approached that of the seas, and therefore synchronised more frequently; the records show a succession of periods or rhythm between the ship and the wave action. On the other hand, the period of pitching was much quicker owing to the length of the ship, and that in a head sea both were speeding towards each other, the rhythm apparent with the rolling being almost entirely absent from the pitching. But there appeared to be causes which made the movement very irregular, at short intervals a movement much greater than those immediately preceding or following it.

That these figures were a fair estimate was proved by another method—after arrival, the distance from the stem head to the water was 24 feet, and the counter 14 feet. During the run the stem head was frequently on a level with the sea, and on one occasion when the Author went aft, there was a sheet of water 6 inches thick flowing over the counter; so that as action and re-action are equal and opposite, this would give the stem head a motion of  $24 \times 2 = 48$ , and aft  $14 \times 2 = 28$  feet.

There was considerable difficulty in estimating the length of the seas from crest to crest, or from crest to hollow, but they appeared from the bridge, as near as could be estimated, as from 300 to 350 feet long, or something longer than the ship, and from crest to hollow about 30 feet. (See Fig. 10.)

The effect on the speed was that on the run North on the 12th, the time, Wharf to Wharf, was 5 hours 42 minutes; on the return this was extended to 9 hours 39 minutes, or a reduction from 12 to 7.1 knots, and, judging by the shipping reports, we were fortunate. The "Oberhausen," from Brisbane, reduced speed from 13 to 3, and had discharged her forward water ballast. While one of the Interstate Colliers was reported as having drifted backwards 222 miles, others were weathering the storm at sea.

Daily Telegraph 15<sup>th</sup> July 1912

"The strongest blow with rate of 57 miles per hour at 2.30  
7 and 11 am (12) from South and South-Side-East"

"North-east Sunday - A terrific storm swept  
over New Zealand last night and this morning. The  
strongest blow at times with accompanying gales,  
and reached a velocity of 70 miles per hour. It  
did the heaviest shipping and a heavy loss of life."

Ships Log 13<sup>th</sup> July 1912

"Strong southerly gale  
Very heavy sea  
Steamer labouring heavily"

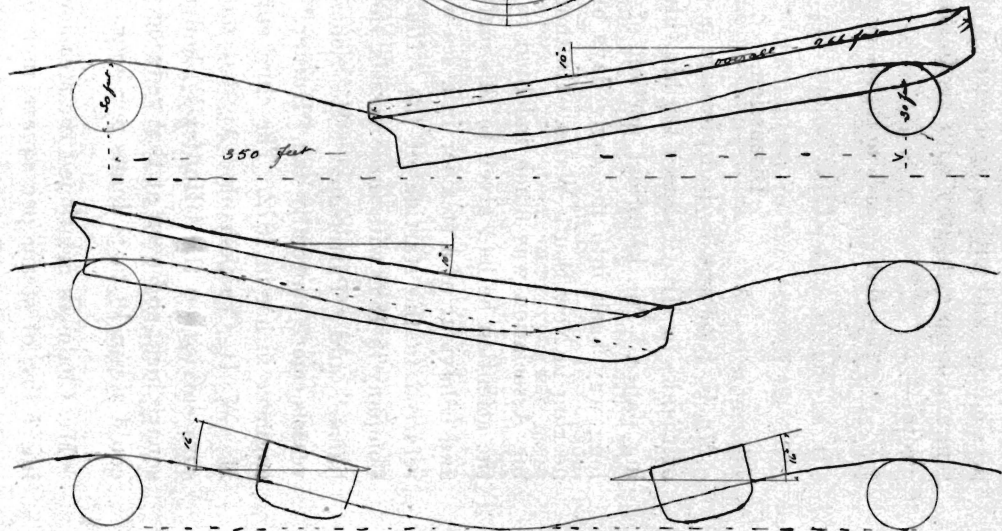
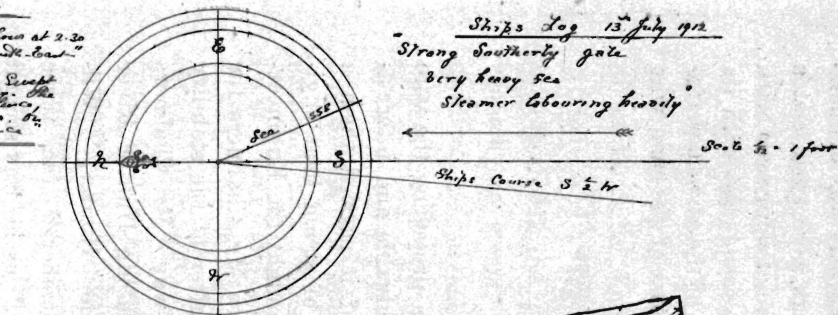


Fig. 10.

Whilst the pursuit of these investigations was in themselves a pleasure, yet the surroundings were such that a man must be callous, indeed, who was not impressed with the awful grandeur and power of the scene, and with its possibilities, and with an appreciation of the vivid description and keen sympathy with his fellows of the man who wrote:—

“They that go down to the sea in ships, &c.”

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### Discussion.

Mr. H. KIDD said he had pleasure in proposing the vote of thanks to Mr. Chalmers for his valuable and interesting paper. The historical portion of it carried them a long way back into the early days of steam boat engineering in New South Wales. He thought the Engineering Association was much indebted to Mr. Chalmers for the attention he had given to this matter of the stability and behaviour of a steamer in a sea-way. Mr. Chalmers referred to the starting of the “Illalong Hunter River Company in 1885 with three vessels, the “Hunter,” “Williams,” and “Patterson.” He remembered the three vessels, more especially the “Hunter,” as he was second engineer in her in 1872. The chief engineer was the late Mr. W. D. Cruickshank. At that date the steam pressure carried on the “Hunter’s” boilers was 10 lbs. per square inch, and even at that reduced pressure the vessel could steam 10 to 11 knots per hour.

Mr. Chalmers mentioned the steamer “Rose” as carrying 7 lbs. of steam per square inch on her boilers. To some of our young engineers this would seem a very low steam-pressure indeed; but he remembered, as an apprentice, working on two Parramatta River steamers, the “Emu” and the “Pelican,” which only carried 3 lbs.