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Sir William Thomson's Sounding Machine: Its Advantages in Peace and War

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Wednesday, June 18, 1884.

ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B.,
Vice-President, in the Chair.

24 2 83

SIR WILLIAM THOMSON'S SOUNDING MACHINE: ITS ADVANTAGES IN PEACE AND WAR.

By Captain CLAUDE E. BUCKLE, R.N.

(Read by Captain S. LONG, R.N.)

The CHAIRMAN: Captain Buckle, who prepared this paper, has been appointed to a ship on foreign service, but Captain Long has been kind enough to undertake to read it for him. I believe Captain Buckle has had considerable experience in the actual use of this machine, and therefore his paper ought to be valuable as showing us the practical application of Sir William Thomson's invention.

I PROPOSE to divide the subject into two parts, viz., Peace and War; to demonstrate the advantage of having this sounding machine on board ship in both cases, and the very serious disadvantage of being without it.

The advantages of Sir William Thomson's sounding machine are:—

1st. Practically perfectly correct and reliable soundings in any weather, and in any sea.

2nd. Soundings at considerable depth can be obtained at a high speed.

3rd. That a ship need never be off her proper course for one minute for the purpose of obtaining soundings.

4th. That by running a line of soundings a ship's position can at all times be known with certainty, provided the charts are accurate.

5th. That by frequent use of this sounding machine in fogs, vessels can with much greater safety continue at a moderate speed, and greatly decrease the danger of collision in narrow waters.

I think I should waste time by entering into a very full description of either the original or later invention (for which I refer you to the Journal of this Institution, vol. xxv, No. CX),; but I will confine myself principally to consider the apparatus as now supplied by Sir William Thomson.

The original invention has been improved upon, and is that now in use. The later invention, though successful, had one important drawback—it was expensive. The sounding apparatus and indicator were combined, and if lost, you lost an article that cost 6l., and could sound no more, unless you had a spare apparatus.

The instrument as now made consists of a drum on which is wound fine steel piano wire, fitted into a frame. This must always be kept, when not in actual use, in a water-tight box containing lime and water. Attached to the end of the wire is an iron ring to which is

LATEST FORM OF SIR W. THOMSON'S SOUNDING MACHINE.

The wire is coiled on the drum or wheel *a, a, a*. This drum can rotate independently of the axle, or it can be clamped to the axle and made to rotate with it. The arm *c* is attached to a nut, which works in a screw on the axle. When the arm *c* is held in a fixed position by means of the bolt *d*, and the handle is turned in the direction for paying out the wire, the disc *b, b, b* is loosened from the drum, and the drum is free to turn round independently of the axle. When the handle is turned in the direction for winding in the wire, the disc is tightened up, and the drum is clamped to the axle.

As soon as everything is ready for a cast the handle is turned in the direction for paying out the wire. This releases the wire-drum, and allows the wire to run out. As soon as the sinker reaches the bottom the handle is turned in the direction for hauling-in. This clamps the wire-drum to the axle and prevents any more wire running out. The bolt *d* is then withdrawn, and the winding-in of the wire proceeded with.

secured a plaited rope. To this rope is seized in the centre a brass guard tube, and to the end of the rope is attached the sinker, having a hole at the bottom for the arming.

Into the guard tube is introduced a glass tube, hermetically sealed at the upper end, open at the lower, and coloured internally by chromate of silver.

When ready for use, the wire is taken over a fair-lead on the stern-rail, and the sinker lowered down over the stern. By lifting the brake the sinker descends rapidly, the water forces its way into the glass tube, gradually compressing the air in it, and decomposing the chromate of silver.

When the sinker is seen, or felt by the slackening of the wire, to have reached the bottom, the brake is put on, the wire is wound in, the tube taken out of the guard, arming examined, and placed in the scale (care being taken never to let the tube get out of the vertical position). The closed end of the tube is pressed against the brass plate on the top of the scale, and the depth of water is read off by the line in the tube, showing where decomposition of the chromate of silver has ceased.

Although I have never worked with the present improved machine, the principle is so much the same, that I do not think the difference in fittings need be considered.

Thanks to Sir William Mends, I got one fitted to H.M.S. "Assistance" in 1879, and had nearly three years' work with it. During that time, I think, we only lost one sinker, with a small quantity of wire; and this from no defect in the instrument.

On inquiry, I find that both the original machine, the improved, and the "improved original" are largely in use in the mercantile marine, while a small number are in use in the Royal Navy; but the present machine, "the improved original" as I term it, is that most in favour.

I can imagine nothing better or simpler than the glass tubes. With care they will keep without serious deterioration for two or three years. Certainly, I had some in H.M.S. "Assistance" for over two years, and I think only one or two lost their colour to any extent.

Before giving my own experience, I will mention that I have been in communication with a large number of the principal shipping firms, and only two of those communicated with do not use the machine.

H.M.S. "Assistance" is employed to carry troops from port to port in England, Ireland, Scotland, and the Channel Islands; the greater part of the work being done during the winter months. Much bad weather, gales, and fogs were experienced, and the lead was in frequent use. When, to my great satisfaction, Sir William Thomson's sounding machine was first fitted, an Officer of great experience shook his head over it, advised me not to trust it, and enumerated various defects. This somewhat damped the feelings of the Navigating Lieutenant and myself, but, being both believers in the machine, we determined to give it every trial. We soon found that, at any rate, we got very good soundings by it; but it was not till we found

ourselves in a dense fog off Alderney, standing off and on, that we realized what we owed to Sir William Thomson. Shortly before 8 o'clock the Navigating Lieutenant ran below to wind up the chronometers, and I went aft to sound, prior to reversing our course. My first soundings gave 70 fathoms, which surprised me. Immediately replacing the same tube I sounded again, getting 90 fathoms. I changed the tube, and got a decrease. I at once went to the bridge, looked at the chart, and saw we were undoubtedly crossing "Hurd's Deep," a long narrow deep off the Casquets. As I put the helm over to stand out, the Navigating Lieutenant coming on deck just caught sight of the Casquet Rocks under the fog, for we had been set to the westward more than we had expected. After this we never doubted Sir William Thomson's sounding machine, but felt it was a guide, counsellor, and friend.

On another occasion, when off the Land's End on a winter's night, we were caught in the most severe gale I ever experienced in the "Assistance." The wind was from S.E., backing, and weather very thick. We were bound for Kingstown, and having the ship very full with troops, women, and children, I decided to shape my course for Holyhead. We therefore steered for the Tuskar, sounding every hour or half-hour. We saw nothing of the Smalls Lighthouse or Tuskar, the weather being too thick, so we steered for Bardsey Island, so as to keep a weather shore; but before making Bardsey, the wind flew round from N.E. to N.W., and I then decided to steer for the Codling Lightship. So satisfied were we of our position by soundings only, that we calculated the exact time, as the weather was clearing, that we should see the light, and we did actually see it within 10 minutes of the time expected.

I think this case proves that our soundings were correct and reliable; they were obtained without stopping the ship once, and the depth varied from 40 to 60 fathoms. By keeping a line of soundings we always knew our position, and thus were able to avoid "lying to," and the consequent risk of being run into.

I could name an ironclad that some time after this was making for the Irish Channel, and got into bad weather between the Land's End and Tuskar. Not liking to try for the Tuskar she had to lie to and wait till the weather cleared.

I need scarcely say she had no "Thomson" on board, and I should think, between coal and knocking about, she cost the country quite one-half the first cost of Sir William Thomson's sounding machine. You will of course suppose she is possession of one now.

Another time, bound for the Irish Channel, we were caught in a dense fog when steering for the Lizard from the Start. We decided to run a line of soundings to a certain depth off the Lizard, and then to alter course to clear the outlying rocks off that point. So accurately did we carry this out, that we got our exact soundings, altered course, heard the siren, and actually saw the sea breaking on the rocks, by looking under the fog, our heads being level with the rail.

Later on, in the commission I mentioned this case to a Navigating

Officer who had just joined, and found that he had heard of it, and also that we had found ourselves closer to the rocks than we had intended. I soon proved to this Officer that we had worked on a principle, and had never run the slightest risk.

I think in this case you will see the enormous advantage of the "Thomson" in a fog at such points as the Lizard or the Longships, Tuskar, or any turning points in navigation. Instead of having to stop and poke about to get hold of something—a lighthouse, fog-horn, siren, or lightship, a vessel may proceed steadily on her course. If all vessels could do this when moving up and down the Channel (Channel groping, as it is well called), how many disasters would be avoided—how much fewer would be the number of collisions in fogs—how much less property lost—and what a decrease we should have in the loss of life, and the consequent misery and suffering to widows and children.

Whilst so many strides have been made in guns, arms, torpedoes, and in the art of killing, I know of no invention more calculated to save life and property afloat than Sir William Thomson's sounding machine; and, considering the enormous cost of building ships, surely it is worth while to expend 25*l.* on an instrument which would so greatly contribute to their safety.

I must apologize for giving you so much of my own experience, but I think facts are better than hearsay evidence, and I hope I have pretty well proved, by my personal experience alone, the advantages of Sir William Thomson's machine in time of peace. But, before I turn to the second consideration, viz., the advantage in time of war, I would mention that the great number of large shipping firms with whom I have been in communication on this subject almost unanimously speak in the highest praise of this invention. A Captain in one line of Atlantic steamers says, "I would not take command of a ship in that trade without a 'Thomson';" and an Officer in command of a P. and O. steamer goes so far as to say, "he would sooner go to sea without his chronometers than without his 'Thomson.'"

I have heard objections raised to this most valuable instrument on account of alleged defects, such as kinking and breaking of the wire, discoloration of tubes, and the failure of the brake. If the instructions sent with the sounding machine are followed, none of these defects will arise. When they do, it is entirely due to the want of knowledge on the part of those working the machine.

Men must be instructed in the use of this, just as well as in other machines. But the instructions sent with it are ample, and a very short course of instruction suffices. It can be given with the ship at anchor in a moderate depth of water.

In the "Assistance" by day, the work was generally done by the boatswain's mate of the watch, one seaman, and the soldier on the life-buoy, or a soldier reeler (if not too sick). By night a seaman took the place of the soldier. As a fact, I very often took the soundings myself, but solely as a matter of interest, not from any necessity.

It is of course well known that vessels do, as a fact, frequently run in fogs at a very high rate of speed, and I have heard it objected

that this invaluable sounding machine will still further tempt Officers to run at a dangerous speed. I do not see the strength of the argument, but if you cannot check the high speed, surely it is better to provide every possible safeguard—and a safeguard is certainly found in providing a machine that will enable Officers to run a line of soundings, and know where they are going, rather than let them run blindly on, risking everything, to avoid losing the time taken in sounding by the old system!

To us in the Royal Navy, "Watch, pass the line along!" was never a welcome sound; but consider what it means in short-handed steamers, rolling about in the trough of a sea, with floods of water rushing to and fro on the decks! Think of sailing vessels making for the Channel, or working down Channel with the crews they now have; consider what sounding means to *them*: shortening sail, and rounding to for one sounding, and then making sail again—all hands perhaps wet through in doing it. Can it be supposed that an Officer in command of one of those splendid four-masted sailing ships, homeward bound from Australia, India, or the Pacific, making for the Channel with a fair gale and thick weather, will feel much inclined to heave-to repeatedly to sound, when once he has passed the 100-fathoms line? Does he not try and shove on, though possibly doubtful as to his exact position, and the country is startled by the news of a terrible disaster at sea, and many homes are made desolate by the loss of lives unnecessarily sacrificed.

If owners would but see it, there is available for their ships a substitute within the 100-fathoms line, for lighthouses, buoys, and beacons, and their ships would be steered in safety until a pilot was secured! What Officer who has served in Her Majesty's sailing ships, or has handled the long ships of the present day under sail, fails to remember the amount of labour entailed, the number of men wet to the skin, and often damage to the ship, caused by rounding-to in a gale of wind or strong breeze, to get soundings, to say nothing of the loss of time and position incurred in the process?

Some of us, I daresay, have heard of vessels finding themselves off Lundy Island instead of off the Start, but with a "Thomson" on board I do not think such a mishap would be possible, provided always a line of soundings were carried out, beginning, say, at every two hours, and decreasing the intervals as water got less and the land was neared.

It is useless to put off sounding until near danger. The method of a line of soundings should be the rule, and only by that means can perfect confidence be gained.

I know of one instance where a flag ship on a foreign station, fitted with a "Thomson" of the condemned pattern, lost the sounder, and not having a spare one on board, the Admiral had to depend for soundings upon an Officer in command of another ship, who had purchased one at his own expense.¹

¹ This instance also showed the great advantage of being able to sound when sailing or steaming at a high speed in line ahead, which can be done without checking the speed of a squadron.

Certainly, all ironclads are having them fitted as they recommission. Many ships, however, recommission abroad, and so do not get them; but I would have every ship in Her Majesty's Service fitted with one, and I am sure that it would be equally desirable that all vessels employed in the transport service should be supplied with it.

An Officer who used the apparatus for six years when in command of a steamer running between England and the United States, says: "Carrying mails and passengers as we did, it was important to make a quick passage and at the same time incur no risk; I had therefore to run sometimes nearly 1,000 miles by the lead alone; and as with Sir William Thomson's machine there was no need to stop for a cast, I took one every two hours, noting log." A most useful instrument in connection with Sir William Thomson's machine is the taffrail log. The same Officer states that he found the soundings of the United States survey beautifully accurate, but those to the eastward were in some instances incorrect, and the banks badly defined. By the aid of a "Thomson," this Officer brought from Belfast to Liverpool a new steamer, 430 feet long, when the fog was so dense that no fewer than six coasting steamers ran ashore; and several times a conversation was held between those on board the steamer and those on board other vessels that could not be seen! Notwithstanding the denseness of the fog, the bar lightship was made, and the vessel successfully taken up the Mersey.

When you consider the work done by Her Majesty's ships in all parts of the world, I think much useful information might be gained if Officers made use of the "Thomson," and reported the result. I find that some of the Commanders of the Atlantic steamers keep a regular record of their soundings in crossing, and some keep specimens of the bottom when they can be detached from the arming.

For myself, I cannot but think that this invaluable invention should be seriously considered by the Board of Trade and all insurance offices; vessels over a certain tonnage should be made to carry and use it. I believe that much might be done to reduce the number of collisions in the English Channel and round the coasts of Great Britain if vessels steering to the westward were made to keep in one line of soundings, and vessels bound east in another line.

All the advantages that I have adduced in favour of Sir William Thomson's sounding machine in time of peace are doubled, nay, trebled, in time of war. A squadron or a vessel on approaching an enemy's coast might find lights extinguished and buoys and beacons removed. The whole success of an expedition might turn upon the arrival at a certain point at a given time of a fleet of ships of war and transports laden with troops. Time is precious, troops are urgently wanted, and thick weather comes on. Now, unless every vessel is able independently to keep her position by soundings, delay is inevitable. Each vessel is compelled to depend on her own resources, and what, I may ask, in such a case could be of more infinite value than a "Thomson's" sounding machine? Should there be a limited number only of these machines in the fleet, the endeavours to make known

the soundings by siren would inevitably lead to confusion and discovery to the enemy. Consider the case of a ship-of-war in chase of a vessel, the weather thick, lights and buoys removed. Can there be any doubt as to the result of a chase in shallow waters and dangerous ground, provided one vessel carries a "Thomson" and the other does not? Give it to the vessel chased; she will carry her line of soundings, know her position, lead her enemy into danger, and probably wreck her, while she will be safe herself, unless indeed the Commander of the chaser is prepared to go blindly on, for of course when once he stops to sound by the old system the chase may be said to be over.

Take again the case of a vessel conveying important information to an Admiral or the Admiralty, and making up or across the Channel in a fog. She certainly will not decrease speed if she can avoid it, and the necessity of sounding need in war be the only check on speed in any emergency. With Sir William Thomson's machine a vessel would carry a line of soundings for the nearest telegraph station, and run without stopping. Without a machine a vessel can only run up to a certain time, when she must sound; her position even then is uncertain, and time, of all things valuable in war, will be lost.

How often in war time it becomes necessary to get a line of soundings off some fort or well-guarded position. To do this with the old hand lead would be fatal, whilst a "Thomson" might be fitted to a boat and soundings taken either by day or by night in a very short time.

Captain Singleton, of H.M.S. "Jumna," told me that he found Thomson's apparatus invaluable amongst the shoals and reefs in the Red Sea, in the vicinity of Suakim and Trinkatat. Also Staff-Commander Cole gave me a most interesting description of the navigation of the "Northampton," flying the flag of Sir Leopold McClintock, when in dense fogs on the North American Station. It is well known that at certain times of the year the Baltic is subject to dense fogs; and I need scarcely say that the Russians, with their usual appreciation of advance (whether scientific or otherwise), have provided all their ships with a Thomson's sounding machine. The French have not been behindhand in securing this important invention for the benefit of their Navy; and I have heard of a French squadron making remarkable use of it, each ship working her own machine.

If foreign Powers so thoroughly appreciate this valuable invention, should not we, who have the honour of claiming the distinguished inventor as our countryman, accept with pride and gratitude the priceless boon offered us, as a sure and certain guide for the sailor in the most difficult and dangerous portion of his voyage?

I must plead your kind indulgence for the many defects in this paper, but a sudden call to active service has prevented my bestowing all the time and labour I could have wished on a subject I take so deep an interest in, and which so vitally concerns the shipping interest of this great country.

I maintain, in conclusion, that of late years no man has done more

for the safety of the mariner than Sir William Thomson by this invention, and to him are due the grateful thanks of all "that go down to the sea in ships, and occupy their business in great waters."

APPENDIX.

CORRESPONDENCE.

Letters addressed to Captain Claude Buckle, R.N., on Sir William Thomson's Sounding Machine.

No. 1.

The University, Glasgow,
March 18th, 1884.

Dear Capt. Buckle,

I have received your letter of the 14th, and thank you very much for the kind interest you take in my Sounding Machine. I cannot but agree with you that it is not sufficiently used even in ships provided with it, and that those who have it, have not been sufficiently instructed to allow them to use it with intelligence. A few days ago I heard from an Officer (only a soldier however) who has seen it used in the * * * that they could not use it at night, because they had not light to read the scale! "Kinks in the wire" never occur when the brake cord, &c., are used according to the printed instructions.

My nephew (W. Bottomley) will send you some printed papers and references regarding the Sounding Machine. If there is anything else in the way of information or otherwise we can do in respect to your paper at the United Service Institution, we shall be most happy to do it. If you would like to have a Sounding Machine to show, we shall have one sent, with specimens of gauge tubes as actually marked for different depths.

Believe me,
Yours very truly,
WILLIAM THOMSON.

No. 2.

The University, Glasgow,
March 24th, 1884.

Dear Sir,

In reply to your letter of the 20th, the price of the Sounding Machine which we now make is 25*l*. This machine is used with either the glass tubes or the depth gauge, but very few of the depth gauges are used now, and almost all the machines have glass tubes supplied with them.

The glass tubes answer very well, and we find that sailors do not like to trust the depth gauge to the wire for fear of the line carrying away. They prefer to have a supply of the glass tubes on board. If the line breaks and they lose a glass tube and sinker, it is not a serious matter as regards expense. We always recommend the glass tubes now, as we think it most important that sailors should not have any hesitation in taking a sounding at any time. The depth gauge is an expensive instrument, costing 6*l*., and if sailors know there is a chance of losing 6*l*. in taking a cast of the lead, they would be inclined to put off sounding as long as possible.

If you are in London you can see the present form of Sounding Machine at Messrs. Lilley and Son's, 9, London-street, Fenchurch-street, London, E.C. It is probably different from the one you had on board the "Assistance."

I think your paper for the United Service Institution might be made very interesting if you were to give your experience on board the "Assistance," and urge on the Institution the importance of frequent soundings before there is any chance of the ship being in danger.

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I think your paper for the United Service Institution might be made very interesting if you were to give your experience on board the "Assistance," and urge on the Institution the importance of frequent soundings before there is any chance of the ship being in danger.

Many sailors would be saved a great deal of trouble and anxiety if they made a rule of always taking soundings periodically when they are in water of 100 fathoms or less, whether the weather is clear or thick.

Yours truly,
W. BOTTOMLEY, Jun.

No. 3.

The University, Glasgow,
March 23th, 1884.

Dear Sir,

I have received your letter of the 26th, and am much obliged to you for telling me what the Captain of the "Yucatan" says.

I believe he is right in saying that damp does injure the chromate of silver, but if the tubes are properly looked after and kept in a dry place, they keep good for a long time. The salts of silver are rather easily decomposed if exposed to light, and if we could get another more stable chemical as suitable for the work as chromate of silver, we would use it.

The mark is made by the action of the salt of the sea water on the chromate of silver, so that brackish or fresh water will not act on the tubes. If it were necessary, we could prepare special tubes for fresh water. We would then coat the tubes with prussiate of potash, and put some solution of sulphate of iron into the guard tube. The sulphate of iron would rise in the glass tube with increase of pressure, and acting on the prussiate of potash would coat the tube blue. This was the original way of coating the tubes, and it answered very well, but there was the trouble of always putting some solution of sulphate of iron into the guard tube. The chromate of silver tubes could be used in fresh water by plugging up the hole in the guard tube and putting some salt water in it before taking the sounding. Many sailors object to the rope brake, but I don't think they have any good reason for their objection, except that it is a new thing for them. From our experience of it, we think it works very well indeed.

We are just now experimenting with a new brake which, if successful, the sailors may like better, as it has not the rope.

The wire bears about 8 or 9 times the greatest strain that is put on it, even with a sudden check, and I don't think it would ever break with a fair pull in practice, unless it has a kink or has been allowed to rust through carelessness.

In many cases where it has been properly kept, it has lasted for two or three years.

Yours truly,
W. BOTTOMLEY, Jun.

No. 4.

Continuous Use of Sir William Thomson's Sounding Machine for Rapid Soundings, when near shore or within 100 fathoms in Thick Weather.

Keep the machine going incessantly; two men working it and one to relieve.

As soon as the sinker comes up, let it go again without using a glass gauge tube every time. Judge the depth as well as you can from the length of the wire out, as shown by the counter.

Use a glass gauge tube every third or fourth cast, or not so often, or oftener, according to judgment.

No. 5.

Peninsular and Oriental Steam Navigation Company,
Offices, 122, Leadenhall Street,
London, E.C., 18th March, 1884.

Dear Sir,

In reply, we beg to say that Sir William Thomson's Sounding Machine with tubes, which has quite taken the place of the old deep sea lead, is in constant use on board all the steamers of our fleet, and gives the utmost satisfaction. The reports

received from the Commanders and Officers bear undeviating testimony to its practical value.

Yours faithfully,
F. R. KENDALL,
For the Managing Directors.

Peninsular and Oriental Steam Navigation Company,
Offices, 122, Leadenhall Street,
London, E.C., April 14th, 1884.

Dear Sir,

In reply to yours to the Secretary of yesterday's date, *re* sounding with Sir Wm. Thomson's Sounding Machine, I beg to say that although it is used throughout our fleet, and is well spoken of and highly valued, at the same time we discourage our Officers from relying implicitly on soundings taken at a high rate of speed, with a great depth of water, and require them to be cautious in this respect, when necessary.

My own opinion and experience is, that the instrument may be used at a speed of 10 to 12 knots. With soundings of from 40 to 50 fathoms with increasing depth, the speed must be proportionately reduced. This rule is generally followed by my brother commanders.

It is a most valuable instrument, but must be used with intelligent seamanlike judgment.

I am, dear Sir,
Faithfully yours,
JOHN C. ALMOND,
P. and O. S. N. Company.

No. 7.

Union Line.

Cape of Good Hope, Natal, and East African Royal Mail Service.

Union Steam Ship Company, Limited.

Southampton, 18th March, 1884.

Dear Sir,

In reply to your separate letter on this subject, *all* our ships are fitted with Sir W. Thomson's Sounding Machine, and I have heard no opinion expressed adverse to their use. I do not know *which* machine is supplied, but I understand it is the one described in enclosed pamphlet. I return Captain Buckle's letter.

Yours truly,
W. R. DIXON,
Superintendent.

No. 8.

Mississippi and Dominion Steam Ship Company, Limited,

Harvey Buildings, 24, James Street,

Liverpool, 28th March, 1884.

Dear Sir,

Your favour of yesterday to hand, and in answer beg to say that we showed your letter to Captain F. B. Bouchette of our steamer "Montreal," and Captain O. J. Lindall, s.s. "Sarnia," and they both speak very favourably of Sir William Thomson's Sounding Machine. Each of these Commanders is in the Montreal trade, during the season, and say they have never experienced any difficulty in obtaining soundings in any portion of the St. Lawrence.

None of our New Orleans Commanders are in port at present.

Yours truly,
FLINN, MAIN, & MONTGOMERY.

No. 9.

White Star Line.

34, Leadenhall Street, London, E.C.; 37, Broadway, New York.

Dear Sir, 10, Water Street, Liverpool, 18th March, 1884.

In reply to your inquiry addressed to our London Office, we beg to state that

Sir William Thomson's Sounding Machine has been in use for deep-sea soundings on board of the White Star ships for a very considerable time, and has been found to give very satisfactory results.

In approaching the land, however, in thick weather, the Commanders are required to take frequent soundings with the lead quite regardless of the delay which may be thereby occasioned, using the patent as an auxiliary check only.

Yours faithfully,

ISMAEL, IMRIE, & Co.

No. 10.

Allan Line, Canada and United States Royal Mail Steamers.

City Line of Steamers to Calcutta and Bombay.

19, James Street, Liverpool, 18th March, 1884.

Dear Sir,

In reply to your favour of 14th instant, Sir William Thomson's Sounding Machine is in use in all our mail steamers, and is very highly spoken of. We have the first machines in use, but we are aware the more recent ones have been considerably improved.

Yours truly,

R. THORN.

No. 11.

Allan Line, Canada and United States Royal Mail Steamers.

City Line of Steamers to Calcutta and Bombay.

19, James Street, Liverpool, 29th March, 1884.

Dear Sir,

Our Superintendent informs us that he has frequently used the machine in the St. Lawrence, and found no difficulty getting soundings, relying more on the pressure than on nature of the water.

Yours truly,

R. THORN.

No. 12.

Pacific Steam Navigation Company,

31, James Street, Liverpool, 21st March, 1884.

Dear Sir,

I have now to say that Sir William Thomson's Sounding Machine is in use on our ships, both the old and later type, and has given very great satisfaction, the Commanders reporting highly of the latter, and also of the older type of machine.

Yours faithfully,

J. W. WILLIAMS.

No. 13.

James Moss and Co., 31, James Street,

Liverpool, 17th March, 1884.

Dear Sir,

We have had only one of Sir W. Thomson's Sounding Machines in use on board our steamers. It was supplied to the "Canopus," then running between here and Boston, and was reported on very favourably as registering correct soundings while the ship was going at full speed.

Yours truly,

JAMES MOSS & Co.,

Per G. S. Cook.

No. 14.

Dear Sir,

Formby, Lancashire, 20th March, 1884.

In reply to yours of the 17th inst., I have to state that I commanded a trading steamer in the Liverpool and Boston trade for above two years, during which time I constantly used Thomson's Sounding Machine, and outwards and homewards I took the Northern passage, *via* Cape Race, which I dare not have done without this valuable patent. I regret having parted with my soundings, or I would have sent

them to you, and I had an interesting collection of some hundreds of samples of the bottom taken up to 120 fathoms, and by using an arming of white lead, I have been able to bring up a small stone at the above great depth, and after comparing samples of one voyage with a following one, I could make a certainty of the position; for example, off Sable Island, you have between 70 and 20 fathoms three different kinds of sand, the very fine being on the shoal water. I seldom lost a sinker with any old hand at the work, and with a careful watch to stop the running, and directly the bottom was touched, there was no fear of the wire giving way, and should the bottom prove to be rock, on placing the white lead arming under a strong glass, there was the indent marked to assure me of correct soundings. I never made but one mistake whilst using this machine, and that was under the following circumstances; whilst running out of the North Channel during a thick fog at full speed, say 12 knots per hour, and with hardly two men in the watch for this kind of work—say chief officer on the bridge, myself on the saloon deck (deck under the bridge), another man to listen from the lower deck, the usual two lookouts forward, with third officer at the cord, to see that course was made good. I was approaching the Narrows when I relieved the third mate with the boatswain, and sent that officer to get a cast of the lead. He came back and reported that he was not sure, but he thought he had soundings. I took the arming into the chart room, put it under the magnifying glass, and could see no trace of bottom, and thinking the young man was strange to the machine, I ordered another cast at once, and for fear of any mistake, I gave the order to stop the engines to give time to verify soundings. Unfortunately just then a steamer's gong was reported from forward on starboard bow, and for fear of stopping athwart hawse of another vessel, I gave the order to keep going till we passed, and the consequence was running on shore on Cantyre, the signal there, Sanda, though advertised as per Admiralty List as a siren, proving to be nothing but a steamer's gong, and though the Board of Trade brought the maker and the man who worked the machine, they only gave evidence in my favour, and the President of Court of Inquiry said I had evidently been trapped, as the maker and keeper declared the gong was not to be known from an "Anchor" steamer's whistle, and they agreed it was not regularly sounded. I was clear of blame. Here you have a case of what some people would call reckless navigation and full speed in a fog, and neglect of lead would most likely have gone against me, but for producing my samples of soundings, and here was evidence for the Court of an experience of use of the lead that they had never seen before. But to come back to cause of no sign of bottom: it appeared that there was a vegetable growth of some 8 feet that prevented in this, the only case I ever met with, the sinker showing it had been down, and here was no fault in the machine, and any old hand could have at once said certainly bottom. The great advantage is of course in being able to get the soundings at full speed, and there was no necessity to ease down even at 100 fathoms. My own experience is that I would not have taken command of a vessel in that trade without Thomson's Sounding Machine, and it would be dangerous work to attempt the Northern passage without such a simple, easy way of getting soundings. Of course I had the old machine, and I considered that perfect, and as regards comparison of soundings got with those of chart, they were nearly identical in from 75 fathoms, to less, but in the gully between Cape Race and the Great Bank, I found more water than as per chart, and more variation, say from 90 and above 100 fathoms, but I am not at all sure but that my variable soundings were not the more correct of the two, and there was at anything over 90 fathoms a certainty of being in the track. I have written you fully, but if I can collect you further information from the masters of the mail steamers, who all use this machine, I shall be glad to do so on again hearing from you. Meanwhile I am

Yours truly,
ALFRED HORSFALL.

No. 15.

Anchor Line of Steam Ships,
Henderson Brothers, 45 and 47, Union Street,
Glasgow, 19th March, 1881

Your note of 14th inst. has been forwarded to us by our Liverpool firm.

Sir W. Thomson's Sounding Machines are used on board all our Atlantic steamers, and we have found them of very great service. The old machines required to have the tubes refilled every time they were used, but the improved one which we have now adopted does not require this, and is the best sounding machine we know of.

HENDERSON BROS.

No. 16.

The Castle Mail Packets Company, Limited. The Castle Shipping Company. The
Liverpool and Hamburgh Steam Ship Company.

3 and 4, Fenchurch Street, London, E.C.,

Dear Sir,

27th March, 1884.

In reply to your note of the 26th instant, we beg to inform you that Sir William Thomson's Sounding Machine is used by our line, and that we use the glass tubes in preference to the apparatus with tubes and sinker combined, the former being more favourably spoken of by our Officers. We understand that Sir Wm. Thomson personally also prefers the former apparatus.

We are, dear Sir,

Yours truly,

DONALD CURRIE & Co.

No. 17.

Messrs. Gray, Dawes, and Co.,
Agents, B. I. S. N. Co., Limited.

13, Austin Friars, London, E.C.,

22nd April, 1884.

Dear Sirs,

In reference to the enclosed letter from Captain Buckle, R.N., my experience of Sir W. Thomson's Sounding Machine, which I invariably use, is that 80 fathoms can be attained at 10 to 11 knots speed. I have never had occasion to take a deeper cast at such a high rate of speed.

I can always rely on the soundings. A defective tube fills with water, and is easily detected, all the colouring matter being washed out. I have always found a small percentage of the tubes fail to keep their colour, but so small as to be practically of no account.

I have never found the climate to affect them, at least during the time when we have them in stock, say 12 months.

I remain, dear Sirs,

Yours faithfully,

(Sd.) J. C. SHARP,

Commander S.S. "Goorkah."

No. 18.

The National Steam Ship Company, Limited, Drury Buildings,
Sir, 21, Water Street, Liverpool, 18th March, 1884.

In reply to your note we use Sir Wm. Thomson's first Sounding Machine (reel-wire and glass tubes), and same is well spoken of by our Captains.

Yours truly,

J. G. LANGLANDS,

General Manager.

No. 19.

The Orient Steam Navigation Company, Limited,
13, Fenchurch Avenue, London, E.C.,

17th March, 1884.

Dear Sir,

In reply to your letter of the 15th inst., we have Sir William Thomson's Sounding Machine in our two newest steamers, the "Austral" and "Orient," and it is very well reported on; the only drawback to its use is the uncertainty of getting the soundings, owing to the wire breaking; it is not therefore thoroughly to be

depended upon. The old lead and line should always be on board and ready for use.

Our machine is the original Sinker; the improved one is considered too expensive.

Yours faithfully,
S. WAYMOUTH,
Secretary.

Extract from Letter of a Captain, R.N.

"Take the case of a long steamer running at speed, how much ground she would have to pass over to get a reliable cast under the old system, necessitating deadening of her way, whereas the 'Don,' West India Mail steamer, going 15 knots, got soundings in 70 fathoms with Sir William Thomson's Sounding Machine, with two men only."

No. 21.

Extract from a Letter of a Staff Commander, R.N.

"I am glad to say that I can give you any information you may require about Sir William Thomson's Sounding Machine.

"We had two fitted on board H.M.S. * * * during the whole commission, and as the fogs in North America are very dense and frequent, you will readily understand that our experience in the use of these machines was by no means small. I consider it to be one of the most useful instruments ever supplied to a ship. It is invaluable—in fact, when a man knows and experiences how extremely simple it is in its working, and accurate in its results, he shudders to think of the amount of labour that was required to get a line of soundings with the old deep sea lead and line.

"Of the two kinds, I very much prefer that with the chemically prepared tubes; we had them in the * * * ; the only objection is that the chemical preparation deteriorates with age. We left England with a large supply of glass tubes, which lasted during the whole commission. During the last year, however, the red colour in the tubes became rather indistinct; but only in a few cases was it necessary to change the tube and take a second cast.

"The great advantage of the glass tube is that each one may be considered a separate sounding apparatus; for instance, if the line carries away, and the sinker and tube are lost, it is simply necessary to bend on another of each, and you are again complete; but with the new apparatus, if the line carries away the whole thing is gone, and you have nothing to fall back on but the old-fashioned, untrustworthy 'patent lead.'

"I pointed this out to Sir William Thomson last summer, and I understood him to say that he quite recognized it, and that the glass tubes would be again issued in preference to the new machine.

"I am strongly of opinion that Sir Wm. Thomson's Sounding Machine should be supplied to all ships. In fact, when the great advantages of simplicity, quickness in obtaining soundings, accuracy, and economy of labour, are taken into consideration, it is difficult to understand why this useful instrument has not been added to the establishment of every ship in the Service.

"If you have not been shipmates with it, I may mention that all the manual labour required to work it is two men besides the quartermaster, although the ship may be going at any speed."

Admiral Sir ERASMUS OMMANNEY, F.R.S.: The merits of Sir William Thomson's sounding machine are too well established to require any testimony either from me or anyone else, but still, having seen the utility of it, I may perhaps say one word. On one occasion when coming along in the "Sorata," one of the Orient line, at 15 knots'

speed, on entering the Channel off Ushant we fell in with a strong north-east gale of wind with very thick weather; we could hardly see a mile distance. They continued, however, to drive the ship 9 knots an hour against a tremendous gale and preserved her course, taking soundings without checking the engines in the slightest degree or making any deviation. We obtained accurate soundings every hour, and were able to make Plymouth Sound before sunset, thus saving the night, which was of very great importance. I am quite sure that had we not been provided with this machine we should have lost the night altogether. So accurate were the soundings, that the master had the greatest confidence in the navigation of the ship, and we made Eddystone Lighthouse with the greatest precision. I was greatly struck upon that occasion with the extreme value of this sounding machine to navigation; and I think no ship navigating along our coasts should be without it.

Captain CURTIS: We appear to be coming back to the old system of lead, latitude, and a good look out. We have constant fogs in the North Sea and in the Atlantic, and as the mail steamers cannot stop, I think the use of the lead and the registration of soundings is invaluable when obtainable. A steam vessel bound from Bilbao to the Bristol Channel had to make Lundy Island. In that case the caulker after caulking the decks at Bilbao was good enough to reverse the magnets, and the master of this vessel found himself off Ushant instead of off Lundy. If he had had one of these sounding machines he would have sounded and have detected his position sooner. On one occasion I was put in a gunboat in the Mediterranean, and had 24 hours' notice to go to Tripoli and Bengazi. The vessel had a set of men put on board of whom I knew nothing. I had to stow coal and provision her. I said I should like the compasses to be adjusted, but the master attendant told me gunboats' compasses never required any adjustment. I took him at his word, and started for Tripoli. It came on very thick when I should be off Tripoli, and I took soundings, standing off to 50 fathoms and in to 10 fathoms. I had to stand off and on a couple of days. I made out a marabout tower, but marabout towers are so much alike that that did not give me much information. We got there at last, and there I had to adjust the compasses. In coming back you do not get soundings at 100 fathoms between the mainland and Malta in mid-channel. There is a volcanic reef between Sicily and Malta, and this sounding machine, in making that channel, would be very useful indeed. As to the number of these tubes carried in surveying vessels, they should have a good supply. If a Quartermaster brought one of them up the companion ladder and someone came rushing down, in all probability, unless they were in a guard, they would be broken. I think, therefore, the tubes should be kept in racks or some kind of guard. I understand that the North Sea fishermen find their way about their fishing grounds entirely by the lead. They go in fleets from Grimsby and Hull, and I think if the Admiral's ship were provided with one of these instruments it would be a very good thing, and would relieve other skippers of a great deal of anxiety and trouble. When Sir William Thomson was explaining this instrument here, he said he could not get the ordinary deep sea lead down over the quarter of the "Livadia;" that the screw knocked it first to one side and the reflux to the other, it danced about in the rush of waters so madly that he had to provide a lead in the form of a steel yard weight before he could get it down. Mr. Bottomley, however, said that in an ordinary ship that lead answered every purpose. On the question of speed I cannot altogether agree with Captain Buckle, and although you have a sounding machine, I think certainly coming up the Channel in a fog you should not exceed 7 or 8 knots. You must keep a certain amount of way on a large vessel in order to have it in command. I have heard it said in this Institution that you should slow a vessel for ramming, but I should say give her as much speed as you possibly can.

Admiral BOYS: May I ask if Sir William Thomson's instrument is not on the establishment of stores of all ships?

Admiral CHARLES M. BUCKLE: I am well acquainted with this instrument, but I have not had much use of it. I should like for a moment to refer to a circumstance that occurred to me many years ago. I had to take a sloop I commanded at that time up the Talawan Passage from Labuan to Manila. The weather was exceedingly bad; it was not only very thick, but it rained for 24 hours to such an extent as to be exactly the same as a fog. I went straight and went clear, but I had very great

anxiety, because during the whole time there was a strong head wind, and coral shoals were on either side, particularly on the off shore side, and if I had gone on one of those I should probably not have got off again. Sounding was continuous, and I remember on that occasion losing more than one lead and line in the dark by its happening to catch under a clutch outside the ship for the purpose of hanging a plug for the discharge pipe upon, and altogether I went through about as much anxiety in those 24 hours as could well fall to the lot of any Officer in command under similar circumstances. I did not stop the ship to sound, because her speed was very slow, and therefore there was no necessity for stopping. If I had had Thomson's sounding machine on board I should have been quite at ease, but as it was, I had a very anxious time of it.

Commander HULL: I think the thanks of the Service should be given to Captain Buckle for calling attention to this valuable instrument, as perhaps it may be the means of getting it more largely used in the Royal Navy. Since 1880 I have been in constant connection with the Mercantile Marine for the purpose of correcting their charts, and I find that hardly any well found steamship goes to sea without Sir William Thomson's sounding machine. All Captains in the Mercantile Marine who have used the machine, without any exception, speak of it in the same high terms as Captain Buckle has done. The attention of the modern naval Officer might perhaps be more alive to the important business of sounding and piloting. I think we have shown more energy on our guns and ships than on this affair of sounding. Guns on board ship, no matter how effective, are of little service unless the Captain is pilot enough to put his ship into a position to use those guns. The facility which this excellent machine of Sir William Thomson's gives to every sailor of obtaining that most important item in navigation—the depth of water he is in—and to use that knowledge and feel his way, as a beetle would use his antennæ, would not only prevent many accidents and much expenditure of coal, but would be of invaluable service in case of war. The remarks contained in the paper are so terse and so good that I can make but little addition to them. I am very pleased to see at the end of the paper the numerous testimonials from gentlemen of the Mercantile Marine and those connected with it, showing how thoroughly Sir William Thomson's machine is appreciated in our merchant navy, and I have no doubt when the paper gets into the hands of our new Hydrographer, something will be done towards the general supply of this much wanted instrument to the Royal Navy.

Sir ERASMUS OMMANNEY: I may mention one great advantage with regard to these tubes, viz., the valuable evidence which is obtained and which can be retained. If anybody is to be tried by court-martial, this tube can be produced, and that will give you the precise depth of water.

Captain C. JOHNSTONE, R.N.: I think the advantage of Sir William Thomson's machine is unquestionably recognized by every seafaring man: there cannot be two opinions with regard to that, and perhaps the small attendance here to-day may be accounted for by the fact that the value of it is so thoroughly understood that people may imagine that there is not much to be said on the subject. It far surpasses any other machine, and I certainly cannot imagine how any Captain can go to sea without one. It has been added by the Admiralty to the establishment of all ironclad ships, that is to say, the Captain can have whichever he pleases, Sir William Thomson's machine or the Massey. The chief advantage of this machine unquestionably is in deep water; in shallow water I suppose it would not be so convenient. It is in deep water that it shows a great advantage over the Massey, because the Massey cannot be depended upon at a great depth. I think this question of soundings has been somewhat neglected in the Navy; I do not mean to say that Naval Officers underrate the question of soundings, but all the details in connection with it have unquestionably been neglected. In 20 or 30 fathoms you can keep on sounding with Massey's lead with the greatest ease, but I think this is rather overlooked in the Service. I had the good fortune to serve a short time in a surveying ship, and my attention was drawn to the method of soundings adopted. There is the greatest possible difference between the method of sounding in a surveying ship and in any other. The leadsmen sounds in a different way; the soundings with the Massey machine are carried on in a different way; and I think it is a very great pity that some improved system is not introduced into the Service.

Our present Hydrographer (Captain Wharton) wrote a book on surveying some time ago, in which he points out several defects in our present system, and I think it would be a very good thing if the attention of the Service were drawn to that. One especial point he there mentioned was that when the ship gets into shallow water and the leadsmen are unable to get his soundings, that is to say, he has got so much line out that he cannot tell what his soundings are, he should invariably call out immediately "Shallow water!" He cannot read off his line, because there is so much slack, and he shouts out "Shallow water!" at once. That is the system generally carried out in surveying ships, but it is unknown in any man-of-war. I have had a little experience in this matter, for in making the Channel in a gale of wind when I commanded the "Liberty," we were a whole night trying to get soundings with Massey's machine, and at last, in the morning, we gave it up as a bad job, and made the best we could of it. We tried all we knew, but we could not get them: we ought to have had about 80 fathoms; but with Sir William Thomson's machine we could have got them immediately. There is one other point with regard to soundings in the Navy which I think is a mistake. I was told the other day by the Captain of a troop-ship which was bringing home men from service on the Mediterranean station, that a number of young able seamen who had been rated not a very great time before were put into the chains, but could not take soundings. Some were tried first and then changed, and others put in their place, but they also could not get proper soundings. He then sent for the petty officers, and said, "What is the reason that these men cannot get soundings?" They replied, "In the ship we come from they had selected leadsmen, and when the ship went in or out of harbour these selected leadsmen were put in the chains, and the rest of the able seamen never had a chance of getting soundings." It was only the selected seamen that were well up to the thing, and the able seamen did not understand it; so that these men were passing through the Service as qualified able seamen when, as far as soundings were concerned, they really were not, which is a great mistake.

Admiral SELWYN: We have recently had a Bill of great importance brought forward for the better regulation of the Mercantile Marine. It is extremely doubtful whether that Bill, in consequence of the opposition to it, will pass; but I am quite sure that if this machine is made a requisite fitting of every ship by the Board of Trade, more good will be done and more lives will be saved by Sir William Thomson's sounding machine, and the constant use of it, than could ever be saved by all the Bills that may be brought forward and passed. I should like to see a strong sense of responsibility abroad, and should like to ask whether if an ironclad is worth putting a Thomson sounding machine on board, every ship in the service is not worth it? Is 25*l*. more than a ha'porth of pitch compared to even a gun-boat? Knowing what we do about this machine for the last three years, it ought to be as requisite for a man to take this to sea as his compass or his chronometer. A ship ought as little to be left to go to sea without it as without a compass or chronometer. I cannot agree with many of my brother Officers about slowing up. I say distinctly the more ships slow up in a fog, the more ships there are to be in collision. A wise man always goes through a fog at speed, of course taking every precaution, but you will not find a single Officer of the great steamships running across the Atlantic who does not say, "I am far safer going 15 or 16 knots than I should be if I went 7 or 8 and stayed in the fog." If you consider what a fog is, and what delay would occur in consequence of slowing down to 7 or 8 knots, you might easily see that it is simply recommending a precaution to increase the number of collisions. There is no other view that is rational. The old system of slowing down might apply where we were all going at very slow speed, and where it did not matter whether we went 7 or 8, or 6 or 7 knots, or 5 or 6; but now it is a very different thing. A great improvement might be made no doubt in that respect by settling once for all, in narrow waters particularly, as has been once or twice proposed in the Channel, an up and down path; that is to say, steamers going down Channel should keep on one side, and steamers coming up the other side, generally speaking; but as for slowing down it is an error and a fallacy. With regard to this sounding machine, I should like to say one word about another machine brought before us by Sir William Siemens, because the two machines do not clash with each other in any

way, but on the contrary the one is not perfect without the other. Sir William Siemens's sounding machine takes the shape of a barometer, a weight measure. It can be kept in the cabin, and it gives us the depth of water underneath the ship's bottom at any moment by mere inspection without any soundings at all, to I think one-tenth of whatever the depth may be. I had this from Sir William Siemens himself, because I went into the matter, when he first brought it out, very closely with him. It is on an entirely different principle. One is an adaptation of the principle of the highest physics, that is to say, the consideration of what is the difference between the specific gravity in consequence of the attraction of the mass of earth or the mass of water, and the other is a machine beautifully adapted for its purpose, but which is not fitted to perform the function of telling you that you are nearing a coast or rocks. It has this other advantage that it is capable, by a very small modification, of being made automatic—by the attachment of a small constant electric battery, you can make it ring a bell whenever you are in soundings. It is no answer to say it only tells you within one-tenth of the actual depth, for this reason. Supposing I am carrying a line of soundings across the Atlantic, or any other sea, for the purpose of a cable, I do not want to know the depth very accurately, and one-tenth of the actual depth is of no importance. Take the other case, that in which I am coming in from the sea, and believing the ship in deep water I suddenly get into soundings without knowing it. It is of little importance to find that instead of being in 30 fathom soundings you are in 27; that difference is not of importance; the main fact is you have got out of what you believe to be an unfathomable ocean suddenly into soundings. I say the two things ought to be in the interest of the Naval Service and of the Commercial Marine requisites of the Board of Trade. No ship ought to be allowed to proceed to sea without these requisites, any more than without chart, compass, or chronometer.

Vice-Admiral SHORTLAND: We ought to be very much obliged to Captain Buckle for his very excellent paper. I should have been delighted if, at the time I had to do sounding work, such a machine had been put into my hands, when I should probably have done the work a great deal better. It is without doubt an excellent machine; it would be advantageous if we knew what are the limits of accuracy within which it will give the depth of water. We know that Massey's machines cannot be depended on very well, a blow on the fan blades will alter the rate of travel and change the reading of the index for a given depth, so that when using this machine I always tried it before and after using it; and at every time whilst sounding when an up and down sounding with the line could be obtained, the line was marked and measured, and the depth thus found compared with the reading of the index. I frequently found the soundings given by the machine a long way from the truth. Thomson's machine will also be liable to error, which will require to be determined, and this is what I should have been very glad to have heard something about. We now come to the point how hand soundings are taken in vessels of war and surveying ships. A man is no use in the chains if he gets too much slack line ahead of him; this shows he has not sufficient experience; the leadsmen must have the line tight in his hand from the lead when it is up and down, by the lead coming vertically under him; if this is not the case he is of no use whatever. Unless the leadsmen is well trained and attended to, the soundings cannot be worth much, especially when the ship is going fast. Then as to speed, we know that every ship has a particular speed at which she turns better than any other: no two ships agree exactly in this respect. If you determine the velocity with which a vessel will turn at different speeds, you can then calculate the velocity at which she will clear an object at the shortest possible distance, this can easily be determined (see note), and therefore when you say you will slow down the engines or go at a great speed, all depends on the ship herself, and every Officer when he commands a ship ought for himself on the very first opportunity to try her rate of turning at different speeds, and to know all about her movements; by which means he will find out what her safest speed in a fog will be. This is a maximum and minimum question which any one can calculate with the proper data.¹

¹ To determine practically the speed at which a vessel ought to go in a fog, which is also her best speed for manœuvring, proceed as follows:—

Captain CURTIS: May I add that in carrying a sounding across a bay I think the machine is invaluable, because there is always an indraught of the current, and many vessels are lost thereby, not allowing for the indraught.²

The CHAIRMAN: I did not interrupt my friend Admiral Selwyn when he alluded to Sir William Siemens's machine for ascertaining the depth of the sea, because it

Moor a boat securely in a convenient position, step her mast, and on it fix two distinct well defined marks, one at the mast-head, and the other near her gunwale, so that the vertical distance between them may be 31 feet 5 inches, when the angle between these two marks is 3° ; the observer will be one cable's length from the boat's mast, or nearly so. Suppose the vessel running straight for the boat at one cable's length distance from her has the helm placed hard over, and will be certain to run well clear of the boat, in such a case 3° may be adopted as the starting angle, otherwise a smaller angle must be used.

The observer, sextant in hand, should stand on the starboard side of the bridge when starboard helm is to be used, and on the port side of the bridge when the vessel is to be turned under port helm; a cable's length being the adopted distance he sets the index of the sextant to 3° ; let the number of revolutions of the engines selected for the first trial be n_1 , that for the second n_2 , and that for the third n_3 , where $n_1 - n_2 = n_2 - n_3$. The vessel must be taken a sufficient distance from the boat to acquire her normal speed for n revolutions before arriving at a cable's length distance from her, and steered straight for the boat. When the reflected image of the upper mark touches the lower mark seen directly, the observer orders the helm "hard a starboard," or "hard a port," as the case may be; when the boat is exactly a-beam of the vessel, the observer measures the angle between the two marks, and notes the reading of his sextant. Similar observations must be made with the engines going n_2 and n_3 revolutions respectively. Let A_1, A_2 and A_3 be the three readings of the sextant corresponding to the respective beam angles; let $A_1 - A_2 = a$,

and $A_3 - A_2 = b$, where a and b are expressed in degrees. With a ruling pencil, a 6-inch protractor, and a pair of dividers, draw the straight line $n_1 n_2 n_3$ (Figs. 1 and 2) make $n_1 n_2 = 1$ inch, and $n_1 n_3 = 2$ inches; from the points n_1 and n_3 draw the straight lines $n_1 P_1$ and $n_1 P_3$ perpendicular to $n_1 n_2 n_3$, and taking an inch to a degree, make $n_1 P_1 = a$, and $n_1 P_3 = b$ (in Fig. 1, a and b have the same, and in Fig. 2 unlike signs). Through the three points P_1, P_2 and P_3 describe a circle, of which O the centre has been found in the usual way, cutting the straight line $n_1 n_2 n_3$ (produced if necessary as in Fig. 2) in the point n ; then if n be the number of revolutions of the engine corresponding to the point n , the number of revolutions they should be made to go in a fog, &c., will be given by $\frac{n_3 + n}{2}$. In the cases represented

in Fig. 2, it will be better to make another trial with the engines going n_4 revolutions per minute where $n_1 = n_2 - n_3$, and proceed in a similar manner with the three observations corresponding to n_2, n_3 and n_4 revolutions.

² The binnacle compass in the gunboat was placed with lubber's point one half a point out from the fore and aft line.

was incidental to this discussion, and likewise because it is really one of the most remarkable instruments that I think was ever invented. Sir William Siemens was good enough to send me his pamphlet, and I remember asking him as to the limits within which he could ascertain the depth of the sea by it, and my recollection of his answer is that he did not arrive at the nice accuracy mentioned by Admiral Selwyn, namely, one-tenth of the depth of water. In 30 fathoms, for instance, the limit of error would only be 3 fathoms. I cannot help thinking—perhaps it was in the earlier stages of his trials of the instrument—that his limits of error were much wider than that. However, we are not here to discuss its merits; as a philosophical instrument it was a very remarkable one. I think we have only now to give our thanks both to Captain Long, for reading the paper, and especially to Captain Buckle for this information. It is most valuable to find a man who has really tried an instrument of this kind, and who can lay before us and before our members and the public generally the real facts of what has happened when the instrument itself has been actually tried, which is of course much more valuable than any discussion even in this theatre.

Captain LONG: I am sorry Captain Buckle is not here to answer for himself, as I know he would have been able, as to the tests he has applied to this machine. He told me once in conversation that he had tried it when he knew what the depth was, and had always found it to be correct. I myself had the other instrument, the depth gauge. I tried that on a great many occasions. Whenever we knew the position at noon when we were in soundings, I used to have a cast taken just on the stroke of the bell so as to be able to see what it gave, and I always found it correct, and had the greatest confidence in it. I think one of the most important things to remark about is that if anybody wants to use it in thick weather they must use it when they know where they are, so as to get confidence in it. I feel full confidence in it myself. I lost mine from using it with the patent log over. That is a thing that ought to be registered for anybody's information, because sometimes navigating Officers do not like to haul in the patent log; and if you put this over when the log is also over, and the vessel is going fast, it is very apt to get wound up, and then the wire breaks.¹

[Mr. Ludwig Benjamin then exhibited his apparatus for indicating the centre of gravity of loaded vessels.²]

¹ I have since ascertained, in reply to Admiral Boys, that ninety machines have been supplied to H.M.'s Navy to 24th June.—S. L.

² See Journal, No. CXXVI.