

Communication from the President and Council of the Royal Society to the Board of Trade on the subject of the Magnetism of Ships*.

"To the Right Hon. Thomas Milner Gibson, President of the Board of Trade.

"The Royal Society, May 18, 1865.

"SIR,—The attention of the Fellows of the Royal Society has been recently directed to the very great increase which has taken place in the employment of iron in the construction and equipment of ships, and the consequent augmentation of the embarrassment occasioned in their navigation by the action of the ship's magnetism on their compasses.

"The inconveniences which have already made themselves felt in the ships of the mercantile marine, and which threaten to be productive of very serious loss of life and property, unless remedial measures be adopted similar to those which have proved so advantageous to the ships of Her Majesty's Navy, have induced the President and Council of the Royal Society, after much consideration, to venture on the step of calling your attention, as presiding over the Department of Trade, to a subject which they believe to be of pressing importance.

"In this view the accompanying Memorandum has been prepared, stating, as briefly as may be, the particulars which they are desirous of bringing under your consideration; in the belief that the time has fully arrived when measures of a more stringent and effectual character are required, in the direction which has been already taken by Her Majesty's Government in such legislative enactments as those contained in the Merchant Shipping Act (1854), adverted to in the accompanying Memorandum.

"I have only to add that it would afford the President and Council great satisfaction if they could be of any further assistance in a matter which they believe to be of so much importance.

"I have the honour to be,

"Your obedient Servant,

"EDWARD SABINE,

"President of the Royal Society."

"Memorandum.

"It is believed that the time has come when it is expedient that the Executive Government should exercise a more direct and systematic supervision over the adjustment of the compasses of ships of the mercantile marine than it has hitherto done. The opinion that it might do so with advantage is not new, as may be seen from passages in the 2nd and 3rd Reports of the Liverpool Compass Committee (2nd Report, p. 30; 3rd Report, p. 38), but it has of late been gaining strength from the following among other circumstances:—

* Published in the Proceedings, by order of the Council.

“(1) The great increase in the number of iron ships, as well as in the amount of iron used in the construction of such ships.

“(2) The losses of iron ships.

“(3) The advances which have been made in, and the present state of, the science of the deviation of the compass.

“We may consider these separately.

“1. It is believed that for some years the number of iron ships constructed has greatly exceeded that of wood-built ships, and this is particularly the case as regards passenger steamers. In such vessels iron is now used not only in the construction of the hull but in decks, deck-houses, masts, rigging, and many other parts of the ship for which wood was till recently used. The consequence has been a great increase in the amount of the deviation of the compass, increased difficulty in finding a proper place for the compass, and increased necessity for, and difficulty in, applying to the deviation either mechanical or tabular corrections.

“2. Many recent losses of iron steamers have taken place, in which it is probable that compass-error has occasioned the loss. In most of these, however, from the want of any record of the magnetic state of the ship, of the amount of original deviation, and of the mode of correction, and from the investigations into the causes of the loss being conducted by persons not instructed in the science, and who are necessarily incompetent either to elicit the facts from which a judgment can be formed, or to form a judgment on those facts which are elicited, no certain conclusion as to the cause of loss can be arrived at. The investigations are, however, sufficient to show the want of a better and more uniform system of compass-correction in the mercantile marine, and of more knowledge of the subject among masters and mates.

“3. Since the first introduction of iron ships it has been a recognized fact that they cannot be safely navigated without the compass being as it is termed ‘adjusted,’ *i. e.* without the deviations being corrected either mechanically by magnets or by a table of errors; but at first the correction of each ship was a separate and independent problem. Now the case is different. The theory of the deviation, its causes, and its laws, are now thoroughly understood and reduced to simple formulæ, leaving the numerical magnitude of a certain small number of quantities to be determined by observation for each ship separately; and further, by recording, reducing, and discussing the deviations which have been observed in the ships of the Royal Navy of different classes, numerical results, as to the values of these quantities in ships of each class, have been determined which promise to be of the greatest use in facilitating the complete determination of the deviation and its correction, and in suggesting modes for constructing iron ships, and in the selection of the position of the standard compass. The science of magnetism, in its relation to navigation, is, in fact, in a position in some degree analogous to that in which the science of astronomy at one time was. The principles of the science have been

established, the formulæ have been obtained; but numerical values are wanted, which can only be derived from a large number of observations systematically made and discussed. At present these numerical results have only been obtained from, and are only applicable to, the ships of the Royal Navy. Without some systematic direction, the mercantile marine can neither derive the full benefit of, or contribute its due share to, the advance of the science.

“That the subject is one coming properly within the cognizance of the Board of Trade may be inferred from the Legislature having already in the Merchant Shipping Act, 1854, sect. 301, art. (2), provided that ‘every sea-going steamship employed to carry passengers shall have her compasses properly *adjusted* from time to time, such adjustment to be made to the satisfaction of the Shipwright Surveyor, and according to such regulations as may be issued by the Board of Trade.’ The Shipwright Surveyor is then (sect. 309) to make a ‘declaration’ that the ‘compasses are such and in such condition as required by the Act,’ and on such ‘declaration’ the ‘certificate’ of the Board of Trade is issued.

“It does not appear how these enactments are construed or carried into effect. It is not, however, understood that the Shipwright Surveyor is expected or is necessarily competent to do more than see that the ship is furnished with proper compasses, but the goodness of the compass has nothing to do with the deviation; the best compasses are affected by the deviation precisely in the same way and to the same extent as the worst*. It is not understood that he exercises any judgment or control as to the position of the compass, the amount of deviation, or the mode of adjustment, or any of the various points which are involved in the compass being ‘properly adjusted.’

“As regards the important subject of ‘deviation,’ all that has been done by the Board of Trade consists, it is believed, in the publication of the ‘Circular on Deviation’ compiled by Admiral FitzRoy, the publication of the Reports of the Liverpool Compass Committee, and the publication of ‘Practical Information for Masters and Mates,’ by Mr. Towson.

“As regards the particular points to which the attention of the Board of Trade may be invited, they may be considered under the following heads:—

- “(1) The correction of the compass in particular ships.
- “(2) The advancement of the science of deviation of the compass.
- “(3) The education of Masters and Mates.

“1. As before observed, it is now recognized that every iron ship must have its compasses ‘adjusted.’ Hitherto two totally different modes of

* This is subject to the qualification that, from the diminution of directive force in ships having large deviations, compasses of superior power and delicacy are required; and if the compasses are corrected by magnets, a particular arrangement of needles is requisite.

adjustment have been practised, each of which has its advantages and disadvantages.

“1. The system recommended by a Committee of Men of Science and Naval Officers appointed by the Admiralty in 1837, and which has been uniformly followed in the Royal Navy from that time. In this system each ship has a ‘Standard Compass,’ distinct from the Steering-Compass, fixed in a position selected, not for the convenience of the steersman, but for the moderate and uniform amount of the deviation at and around it. The ship is navigated solely by that compass. The deviation of that compass on each course is ascertained by the process of ‘swinging’ the ship; a table of deviation is formed, and the deviations given by the tables are applied as corrections to the courses steered.

“2. The system proposed by the Astronomer Royal in 1839, and which is understood to be generally followed in the mercantile marine. In this system the deviations of the compass are compensated by magnets (and occasionally soft iron). The ship is navigated by the compass so corrected—generally the steering-compass, and generally without any tabular correction.

“It would not be right, considering the weight of authority on each side, to pronounce any decided opinion against either of those modes of correction when properly used. The first system has proved in the Royal Navy to be one which can be used without danger. The same cannot be said of the second method as regards the mercantile marine; but the principal danger of the method arises from what is in truth an abuse of the method: it is that, in reliance on the power of correcting any amount of original deviation, however great, the navigating-compass is placed in a position in which the original deviations are excessive and vary rapidly, and in which no navigating-compass should be placed.

“In merchant ships the most convenient place for the steering-compass is generally near the upper part of the stern-post, the rudder-head, the tiller, and the iron spindle of the steering-wheel—all, from their shape and position, powerfully magnetic. The constructor and owner, for the sake of economy, desire that the steering-compass should be the navigating-compass. The compass-adjuster fears that any objection on his part would be considered a confession of incompetence, and that some less scrupulous adjuster would not hesitate to undertake the correction. The correction can only be made by powerful magnets. The compass is then held, as it were, in equilibrium by powerful antagonistic force; and when the changes take place, which it is known do take place in all new iron ships, or when any changes take place in the magnets, large errors are introduced, which are the more fatal because the shipmaster is taught to believe that his compass is correct.

“This abuse of the method is one the temptation to which is unfortunately so strong, that it is believed it can only be effectually prevented by prohibiting the use of the steering-compass as the navigating-compass, or

rather by requiring that the ship shall have a navigating-compass distinct from, and in addition to, the steering-compass.

“It is therefore recommended that every iron passenger-ship should be required to have a standard compass distinct from the steering-compass in a selected situation at a certain distance from all masses of iron; that, whether corrected or not, the original deviations of the standard compass should not in ordinary cases exceed a certain limited amount; and that on each occasion of the compass being adjusted, a table of the deviations should be furnished to the Master and returned to the Board of Trade; and that if corrected by magnets, a return should be made of the position of the magnets and of every subsequent alteration of their position. Provision may be made for exceptional cases, in which it may be found impracticable to place the standard compass in a position where the original deviation is within the limit, by requiring in such cases a special certificate from the central authority.

“It may be here observed, as regards many practical matters connected with the adjustment of the compass in particular ships, in which at present great diversity of practice prevails, that an organized department under a skilful superintendent in constant communication with the ports, would probably be of the greatest service, not merely in laying down rules, but in giving advice and suggestions to naval constructors, compass-makers and adjusters, and producing a uniform system of adjustment at the different ports, which would be generally understood by shipmasters. Advice from the same source would be not less useful to the authorities in the different ports in suggesting means of facilitating the adjustment by meridian-marks on shore, laying down moorings, &c. It would probably be one of the first duties of the superintendent of such a department to acquaint himself thoroughly with the methods practised at the different ports, and to give such suggestions, either in the form of reports to the Board of Trade, or in private communications, or both, as might appear to him advisable. Such a superintendent would also be available as an assessor in investigations into the loss of iron vessels, in cases in which there is any possibility of the loss having been occasioned by compass-error.

“2. The advancement of the science of the Deviation of the Compass.

“Whatever difference of opinion exists as to the advantage or necessity of a Standard Compass as regards the safety of particular ships, there is none as to its being indispensable for any scientific inquiry into the amount of the deviation and of its constituent parts and its changes. It is from the Tables of the deviation of such compasses, and such compasses alone, observed at different times and places, and systematically reduced and discussed, that those numerical results can be obtained which promise to be so useful in securing in iron ships a place for the Standard Compass where the deviation is of a safe and manageable amount, and in guarding against the dangers which arise from changes in the magnetism of recently built ships. It is from the recorded deviations of such compasses that on the loss of a

ship a judgment may be formed of the effect of the deviation in causing any error in the course of the ship.

“3. The education of Masters and Mates.

“At present it may be said that entire ignorance of the subject is the rule.

“The subject has not hitherto been a recognized branch of the education of the seaman ; and the most skilful seamen frequently either ignore it altogether, or look upon it as a mystery not capable of comprehension. Now, however, that the principles of the science have been established, it is found that the subject is not one of any serious difficulty ; and although it might not be considered just to require Masters and Mates already certificated to pass an examination in a new subject, yet an opportunity might be given them of passing a voluntary examination ; and as regards future Candidates for a Certificate of competence, notice might be given that after a certain period, say two or three years, a certain amount of knowledge of the subject will be required from Candidates (and in the mean time a text-book containing the necessary amount of information might be prepared and published), and the Examiners of the Local Marine Boards will themselves receive instruction, and, if necessary, undergo an examination on the subject.

“For the purposes indicated, it seems desirable to establish a department of the Board of Trade under a competent Superintendent, the whole, or greatest part of whose time should be devoted to this subject. Almost all the advances which have hitherto been made in the science, and which have placed England at the head of the science, are due to there having been for the last twenty-five years one Officer charged by the Admiralty with this duty almost exclusively. Such an Officer becomes the depository of all that is known on the subject, and has no difficulty in obtaining the best scientific assistance. It seems desirable that for some years at least the Board of Trade should take advantage of the ability and experience of the present Superintendent of the Compass Department of the Navy. It is understood that there would be no practical difficulty, and there would be many advantages in the present state of the science in having the superintendence of the compasses of the Royal and Mercantile Marine united in one head, with competent assistants in the two branches of the service. The subject, as has been observed, is not one of difficulty. Any intelligent man could speedily be instructed in all that would be necessary to enable him to discharge the duties of Assistant for the Mercantile Marine ; and in the selection of such an Assistant, probably it would be more important to look to general ability, intelligence, docility, and the habit of, and aptitude for, dealing with men, and particularly with Masters of merchant vessels, than to any previous knowledge of the subject.”