Art. XIII.—On the Influence of Change of Latitude on Ships' Compasses.

by Captain Edwin.

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In all calculations concerning the magnetic character of ships, several co-efficients are used; of these, five, namely, from A to E, are used to ascertain the approximate value, and the corresponding letters of the German alphabet are used to obtain the exact values: these co-efficients enable us to compute the alterations that take place on change of magnetic latitude, and enable us to compute and correct excessive deviations, and also the heeling error or the new magnetic character which becomes developed as the ship leans over. This error is due to vertical induction in soft iron, and though well known to exist is, except in vessels of war, taken but little notice of. It is most important, as the change in deviation due to its influence is very great, it having been found that, even in most carefully placed compasses, a vessel may have when upright an easterly deviation, but an inclination of a few degrees may change it to westerly; this shows at once that, unless this peculiarity is allowed for, it will seriously affect the position of the ship.

Suppose an iron ship is coming to Wellington from Lyttelton, and that soon after leaving port a fair wind comes off the land, and being of good strength it leans the ship over, it is evident that iron which was before horizontal now becomes inclined and thus becomes magnetized by induction, the upper ends becoming north poles; these poles now attract the south end of the compass needle, and consequently it approaches the higher side of the vessel, and the north point drops towards the lower side. The helmsman, who we will suppose has been told to steer north, finding that the vessel's head is not in the given direction, brings the north point ahead again, and the result is that instead of making the desired course the vessel is steered to that side of it toward which the north point has dropped, and the captain finds that the vessel is not in the position he intended, but not being aware that this is the effect of heeling error he probably considers it to be the result of inattention on the part of the helmsman. One of the greatest difficulties which the navigator of the present day has to contend against arises from the magnetic changes which take place in iron-built ships on every change of latitude, especially in places where the dip of the needle or magnetic latitude varies rapidly. These changes affect the compass in a proportionate amount, and in cases where no special care has been observed in the selection of a place for the compass by which the ship is navigated the changes in the deviation become a source of great anxiety to the mariner. It appears to me that considerable advantages in this respect would arise from the increased employment of steel-built ships. During the process of building the common iron-built ship becomes highly magnetised by induction, but does not become a really permanent magnet—it has more the properties of what is termed sub-permanent magnetism. A vessel built of steel must, however, become a permanent magnet during the process of building, and I think there would be much less change in the magnetic character of this vessel than in the one built of iron, because the changes would be due to hard iron only, while in the iron ship it arises from both hard and soft iron. In the case of the steel ship the change takes place in the inverse ratio of the horizontal force, while in the vessel built of iron the change arises from this, and is also

for soft iron in the ratio of the dip. In this colony there is a difference of about ten degrees of magnetic latitude between Auckland and the Bluff, and as the soft iron is the part most affected by change of latitude it is evident that if it is of considerable amount its effect upon the compass will be marked. I will now suppose that the co-efficients have been found for a vessel at the Bluff, and that A = — 1°, B = + 15°, C = — 6°, D = + 3° 30°, E = — 0° 30°, and that it has been ascertained that there are + 3° to be allowed for vertical induction in soft iron, then at Auckland B will have decreased to + 5° 42° and C to — 4° 30°, and the deviations of the compass from which the co-efficients were obtained will have decreased at North 1° 46°, at N.E., 5° 28°, or half a point, and at East, 9° 18°, or very nearly seven-eighths of a point; and if the vessel was steered to make an east course near Auckland, using the same deviation as at Bluff, the result would be that the vessel would be directed nearly one point too much to the southward, which would, in so short a distance as five miles, cause an error in the assumed position of one mile, or twenty per cent in the estimated distance. I have omitted all notice of heeling error in this instance, which, as already shown, may be such as to very seriously interfere with the navigation of the ship if guided by an uncompensated compass. The Government steam vessel “Luna” being built of steel enables me to bring forward a case in point. The co-efficients of this vessel have been ascertained from observations made in Auckland by Mr. Stewart, C.E., whose ever careful work I am glad of an opportunity of acknowledging. In this vessel the co-efficients are very small, A = -1° 17°, B = -0° 31°, C = + 3° 31°, D = + 6° 50°, E = + 0° 25°, and, assuming that any change is due only to the influence of hard iron, I find that the greatest difference in deviation due to change of magnetic latitude between Auckland and the Bluff amounts to only 2° 32°, or a fourth of a point nearly; this occurs on the N.W. point, and in a run of five miles would place the vessel about one-fifth of a mile to westward of its true position. It must, however, be thoroughly understood that no soft iron should be so placed as to influence the compass of the steel vessel. The changes due to difference of magnetic latitude, and also to heeling error, have brought a great feeling of distrust as to the compensation of compass errors by magnets into the merchant navy. This arises partly from no warning as to the existence of such changes being certain to take place having been given to shipmasters, and partly from their not having been cautioned that compensation by magnets is not intended to eliminate all compass errors, but only to bring them within such limits as may render navigation more easy. Something may also be due to erroneous compensation, and thus it has happened that after a vessel had got some distance upon her voyage the courses steered did not produce the desired effect, and the magnets have been considered the prime cause of the ship not being in the place to which the courses steered should have carried her. Compasses are, in the merchant navy, frequently placed with the most utter indifference as to the position and amount of the adjacent iron, and this will be found to be the case in both wood and iron-built ships; compensation in such cases is useless, as from the influence of soft iron the deviations are continually changing in value. It is with a view to the correction of this indifference that the Board of Trade now require every candidate for examination as Master to answer certain questions as to the effect of iron on the compass-needle, with the hope that the result will be in time that masters of vessels will attend to the placing of the compasses in

more effective positions, and I hope that in a few years the important effects due to deviation, heeling error, and change of magnetic latitude, will be so well understood that it will be a matter of some difficulty to obtain a captain for any vessel which has not at least one compass placed with due regard to the magnetic character of the ship. In small vessels it is a matter of great difficulty to place the compasses properly, but there can be very little in placing them so that they may be much more reliable than is often the case at present.