## VII. *Deſcription of a new Dipping-needle. By Mr.* J. Lorimer, *of* Penſacola, *in a Letter to Sir* John Pringle, *Bart. P. R. S.*

TO SIR JOHN PRINGLE, BART. P. R. S.

SIR, Penſacola, Sept. 13, 1773.

Redde, Feb. 2, 1775. WHENEVER any one meets with a *terrella*, or ſpherical loadſtone, the firſt thing he does is to find out its poles; and having once diſcovered them, he knows immediately how any ſmall bit of needle will be affected, if it is placed upon any part of the ſurface of that *terrella*. The poles are moſt readily diſcovered by trying where the filings of iron, or a ſmall bit of needle, will ſtand erect upon the *terrella*; and this is generally found to be upon two points which are diametrically oppoſite to one another. But the magnetic poles of the earth ſeem to be ſituated obliquely to one another (ſee the Berlin Memoirs, 1757); but where they are actually ſituated is hitherto unknown; whether they are upon land or water; or in either caſe, whether we can come nigh to them. Yet be theſe things as they may, it appears evident to me, that accurate obſervations, made as near to theſe magnetic poles as poſſible, with a good dipping-

dipping-needle, are the ſureſt way to complete the magnetic theory of this globe, analogous to the method we purſue in examining the *terrella*. But as all the dipping-needles which I had ſeen, appeared to me to be very ill calculated, for the ſea ſervice at leaſt, I contrived one upon a different plan in 1764, and had it executed before I left England, by Mr. SISSON. I have called it an Univerſal Magnetic Needle, or Obſervation Compaſs; becauſe I can by it take the dip and amplitude, and even the azimuth, with only one aſſiſtant, to take the altitude for me. The needle is of the ſame ſhape and ſize nearly as thoſe uſed now for the compaſſes of the royal navy, and plays vertically upon its own axis, which has two conical points, ſlightly ſupported in two correſponding hemiſpherical (a) ſockets, which are inſerted into the oppoſite ſides of a ſmall upright braſs paralellogram, about one inch and a half broad and ſix inches high. Into this parallelogram is fixed, at right angles, a ſlender braſs circle, about ſix inches diameter, ſilvered and graduated to every half degree, upon which the needle ſhows the dip, by a *vernier* if you chooſe; and this, for the ſake of diſtinction, I ſhall call the circle of magnetic inclination. This braſs parallelogram, and conſequently the circle of inclination, alſo turns horizontally upon two other pivots, the one above and the other below, with correſponding ſockets in the paralellogram. Theſe pi-

(a) Mr. SISSON thinks, that theſe ſockets were conical as well as the ends of the axis, but more obtuſe than them; which ſeems moſt likely to be the caſe, as they ſeem much more likely to anſwer well than hemiſpherical ſockets.

vots are fixed in a vertical braſs circle, of the breadth and thickneſs of two-tenths of an inch, and of ſuch a diameter, as to allow the circle of inclination and the parallelogram to move freely round within it. This ſecond circle I ſhall call the general meridian. It is not graduated, but has a ſmall braſs weight fixed to the lower part of it, to keep it upright; and the circle itſelf is ſcrewed, at right angles, into another circle, of equal internal diameter, of the ſame thickneſs, and twice the breadth, which is ſilvered and graduated on the upper ſide to every half degree. It repreſents the horizon, as it ſwings freely upon gimbols, and is always nearly parallel to it. The whole is contained in a neat mahogany box, of an octagon figure, with a glaſs plate at top and one on each ſide, for about two-thirds down. That part of the frame which contains the glaſs lifts off occaſionally. The whole box turns round upon a ſtrong braſs center, fixed in a double plate of mahogany, glewed together croſs-ways, to prevent its warping or ſplitting; and this again is ſupported by three braſs feet, ſuch as are uſed for the caſes of table knives, froſted that they may not eaſily ſlip, if the veſſel ſhould have any conſiderable motion. It has another ſquare deal box to lock it up in, to preſerve the glaſs, &c. when it is not wanted for uſe.

The uſe of this inſtrument is very plain, as the inclination or dip is at any time apparent from inſpection only, and alſo the variation, if the frame is turned round till the great vertical circle lies exactly in the plane of

the true meridian: for the circle of inclination, being always in the needle's vertical plane, the edge of it will evidently point out upon the horizon, the variation E. or W. But at ſea, when there is not too much motion, you turn the frame round, till the vertical circle is in the plane of the Sun's rays; that is, till the ſhadow of the one ſide of it juſt covers the other, and the edge of the circle of inclination will then give the magnetic amplitude, if the Sun is riſing or ſetting; but the azimuth at all other times of the day, and the true amplitude or azimuth being found in the uſual way, the difference is the variation. If the motion is conſiderable, obſerve the extremes of the vibration, and take the mean for your magnetic amplitude or azimuth. When the Sun does not ſhine ſo bright as to give a ſhadow, you can ſet the braſs circle in a line with his body, if he is at all viſible by your eye. The principal advantage at firſt aimed at in this compaſs, was to contrive a dipping-needle, which ſhould be ſufficient for making obſervations at ſea. As thoſe needles, to be of uſe, muſt be placed, by ſome means or other, in ſuch a manner as that all their vibrations ſhall be made in the true magnetic meridian, North and South, otherwiſe they are good for nothing. For if one of them is placed at right angles, acroſs the magnetic line, it will ſtand perpendicularly up and down in any part of the world; the leaſt dip, therefore, is always in this magnetic line. But the only method of ſetting a dipping-needle at ſea, was to place it in a line with the common compaſs needle; and this muſt be very

very inaccurate, if they are at any conſiderable diſtance one from the other; or if they were near, the two needles would influence one another, and neither of them could be true: nay, ſuppoſing them for once to be properly placed in this line, the leaſt motion of the ſhip throws them out again. But this inſtrument has a conſtant power in itſelf, not only of ſetting itſelf in the proper poſition, but alſo of keeping itſelf ſo; or of reſtoring itſelf to the ſame ſituation, if at any time it has loſt it; and it is curious to ſee how, by its double motion, it counteracts, as it were, the rolling motion of the veſſel. I have only one thing farther to obſerve, that as it is impoſſible for human hands to make any inſtrument mathematically true, ſo when we have two graduations to look to, as in the preſent caſe, one on the North, and the other on the South of the needle, we ought to attend to both, and take the medium for the true dip or variation pretty nearly. But in this compaſs there is another method of examining the obſervations. Take a good artificial magnet, and on the outſide of the compaſs-box, point one end of it towards the needle, and by moving your magnet you may thus guide the north-end of the needle round to the ſouth; or, *vice verſâ*, without opening your compaſs-box. The magnet being then laid aſide, the needle will come to its true poſition, after a few vibrations: but as both the needle and the circle of inclination are now reverſed (*b*), it will not point exactly to the

(*b*) Mr. LORIMER means, that the magnet ſhould be applied in ſuch manner as to turn the parallelogram and circle of inclination half way round horizontally, ſo that that end of the axis of the needle which before pointed to the weſt, ſhall now point to the eaſt.

ſame diviſion as before; yet a mean of the two will be the truth, as nearly, I believe, as it is poſſible for any inſtrument to give it.

Quere 1ſt. May not a part of this ſmall difference be attributed to the direction of the magnetic influence (whatever that be) in the ſteel bar? and if ſuch an experiment could be tried upon the preſent azimuth compaſſes, is it not probable, that the variation in them would be at leaſt as ſenſible? Quere 2d. May not this be the cauſe that two of the beſt of them will differ a ſmall matter from one another? Quere 3d. Would the ends of the needle being made thus ⊏⊐, inſtead of the ſquare form be, in ſome meaſure, a remedy for this ſmall variation?

I am, moſt reſpectfully, SIR,

Your moſt obedient humble ſervant,

J. LORIMER.