

IV. *Concerning the Magnetism of Drills; by Mr. Ballard. Communicated by Dr. William Musgrave, Fellow of the Colledge of Physicians and R. S.*

1. **A**S to the first Proposition, *viz.* that a Drill in boring of Iron will acquire a vigorous Polarity. I suppose it does not fully appear from hence, That all the common Drills in a Smith's Shop, which probably have been used mostly, if not only, in Iron, and never been within the Virtue or under the Touch of any Loadstone, do, with their Bitts, constantly draw the South End of the Needle; and consequently are themselves a fixt N. Pole: For I caus'd Six or Seven several Drills to be made before my Face, and the Bitt or Point of every one became a N. Pole, only by hardening, before they ever came to be workt, either in Iron or any other matter; so that I cannot suppose those found in a Shop to have gotten their Polarity so much from their after use, as from their first make.

2. That pieces of plain Iron, in Shape like Drills, (that is something long and small) do always change their Poles as they are inverted, the end downwards being ever the N. Pole; I find not always true: For though it hold generally in such small pieces, and always (as far as I can yet find) in pieces of any Bulk, as large Hammers, Anvils, Andirons, Bars of Windows, &c. yet I found several small pieces of Steel, such as the Drills are made of, to have fixed Poles, one end North, the other South, in whatever Postures I held them. Some of these very vigorous in such their Polarity; others shewing plainly a Tendency to such a Pole, rather than

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the other ; yet so faintly, that it applied contrary to their Inclination ; (that is, at the upper end, if it affected to draw the South ; or the lower end, if the North.) They caused the Needle to stand in *æquilibrio*, East and West ; the particular Inclination of either one end seeming in some pieces, quite to conquer ; in others, quite to hinder that more general Polarity they both acquire, by being either upward or downward. Yet this seems only to be found in small Stems of Iron ; the being either upward or downward always prevailing in pieces of greater Bulk.

3. As to the Opinion of the Magnetick Philosophers, that nothing gives or receives a Magnetism, but what is in it self truly Magnetick, as is only Iron ; as to the last part, that is, only Iron receiving a Magnetism, I have nothing certain to say, but for giving the same ; I suppose it very questionable, whether only Iron (or what is of near kin to it, as we suppose the Loadstone it self to be) can bestow or impart such Virtue, since not only, as I have said before, the quenching in Water will do it, but the heating also of an Iron by violent Motion, will do the same ; as by quick and hard filing, which is the very same thing as brisk drilling in the Iron ; and therefore may be said to proceed from the File which is Steel or Iron. But to shew it comes from the meer Motion (or heat, which is nothing else but the Motion continued). This Experiment may suffice, if it succeed to others as it seem'd to do to me. I took my Knife, which had been formerly toucht (a quarter of a Year or more before,) and profering it to the Needle, it drew the North Pole ; which happened right for my purpose. I whetted it briskly on a dry dirty Threshhold, and being thin, it became very hot towards the Point, the Edge being whet away to a Wire, as they term it, I struck the very top, and back towards the top, against the Ground, as I had done

done the sides, to destroy and rub off, if I cou'd, all its former Polarity which was Southward; then offering it again to the Needle, it drew the South end, and was quite changed. To confirm the thing, I toucht the same Knife again with the North Pole of my Loadstone, and it drew vigorously the North End of the Needle. I whet it again strongly in the same manner, and it changed again. This I repeated five or six times, and it still changed by whetting, especially on the sides towards the top of the Knife, the very top and back, which cou'd not be whet to so great an Heat, retaining still some affection for that Pole the Loadstone had enclin'd them to. This I try'd with a Knife of a thicker Blade; but I could not with my Hand whet it to that Heat as to have the same Effect wrought upon, as on my own; though I used such force as at last to break it in two. I borrowed then another thinner; but presently had the same Misfortune. I intend therefore to try it at a Cutler's Wheel, laid with Emery and Oyl; and likewise on a Grindstone, both wet and dry; and I rather choose the Grindstone, because the other Wheel may be supposed to have much Iron worn into it from the many Knives that have been ground on it, and so the Effect if produced will prove no more than that of filing with, or drilling in Iron. And the wet Grindstone, though it want Heat to give a new Polarity, yet probably it may wear off those parts of the Iron in which the old did inhere, and so render it simple again.

As to the 4th, Whether Brass or Copper will, as well as Iron, give a N. Polarity to a Drill; this cannot well be try'd; since the very making, if it be well hardened, will certainly give it. Wherefore

5. The Drill Mr. *Hunt* made could not, if well hardened, according to what I can find, be indifferent to either Pole.

6. I suppose the Drill having a S. Pole given it by the Magnet, could not be heat so far upward toward the Box by drilling, as it had received Polarity: So that supposing the very top to be sufficiently heat, and to have lost its South Polarity, it has it still supplied from the parts upwards Magnetick Virtue, as I always observed, tending still toward the Extrems: (as appears from the Edges of the Arms of a Loadstone, which the Virtue seeming from the Surface of every side there to unite, takes up much more Filings of Iron than the middle can.)

7. As to the Conclusions, *First*, That a Drill is naturally a North Pole, I suppose may be true, but it is contrary directly to what is affirmed in the fifth Paragraph, *viz.* That the Drill made by Mr. *Hunt*, was indifferent to either Pole, &c. And I suppose that bare drilling might be able to give a Polarity to a Drill, if it could be made indifferent, as well as filing does, if the Drill be used so briskly as to be made as hot as the File makes the Iron. *Secondly*, That though a S. Pole given by the Magnet cannot be taken off by the Heat of a brisk Motion (as that of drilling); which yet by the Experiment of my Knife seems to be contradicted; yet perhaps the Heat may be great enough to produce a Polarity in an indifferent piece of Iron; as was before said to be done, in little indifferent Drill-like pieces of Steel, by filing.

I have lately try'd several small Experiments referring to what I before have said; but with such Uncertainty, that as I find many things in my Tryals contrary to what others have seem'd to find; so I question whether any thing I have said will universally bear the Test. So that happening to be hindred (as I am like to be) more than usually, with other Concerns, I am forc'd at present to want that Satisfaction I promised my self, till my self hereafter shall endeavour, or some more able,

in the mean time (if at leisure) shall be pleased to give us.

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V. *Part of a Letter from the Reverend Mr. George Lewis, at Fort St. George; to the Reverend Dr. Arthur Charlett, and the late Dr. Edward Bernard; concerning some Indian Manuscripts, lately sent to the University of Oxford.*

*Reverend Sirs,*

IN pursuance to your joint Letter, bearing Date the 3<sup>d</sup> of July, 1695. I have procured you some of the Manuscripts of these parts, wherein it hath been my Care to get such as were of good Note and Esteem among themselves. They are in several Languages and different Characters. The Names of the Particulars I send you in a Note enclosed. If hereafter it should be my Fortune to meet with any of their sacred Books, as the *Vedum, Vedantum, Shastrum* or *Porane*; I shall take care to send them when a Convenience offers.

There comes by the *King William* Three Volumes of *China* Books, stamped on Wood, which is their so much vaunted way of Printing. These are sent to Mr. *Gilbert Dolben* by his Brother here: And Three sent to Dr. *John Evans*, by a Friend come on the *Madrafs* Merchant. I presume, they'll be all presented to your University. Of these you may have what Quantity you shall command, Books being plentiful in *China*.

Mr.