

VI. *An Abstract of a Letter, written in Dutch, to the illustrious Royal Society of London, by Arnold Marcel (Nephew to the late Mr. Anthony van Leeuwenhoek, F. R. S.) Communicated by the Rev<sup>d</sup>. Dr. J. T. Desaguliers, F. R. S.*

GENTLEMEN,

**I**N the Year 1726 I had the good Fortune to find out a Way to communicate the magnetical Vertue to Iron and Steel, without the Help of any Loadstone whatsoever; and to make that magnetical Vertue as strong as if it had been done with a very strong Loadstone. I have kept it secret ever since, longing for an Opportunity to communicate my said Discovery (besides some further Observations which I made about the Loadstone) to your Honourable Society; being well assured that that illustrious Society is always used to give the due Honour to the Inventors. I now lately happily came to be acquainted with that worthy Member of your honourable Society, Dr. *John-Theoph. Desaguliers*, who has promised me to be so good as to deliver this to your Hands.

In the Year 1722, I observed that a long heavy Bar of Iron being set upright, and some Filings of Iron, or a Bit of Iron Wire, laid upon its upper End, those Filings or Wire would stick to another Piece of bright pointed Iron, and suffer itself to be lifted up from the standing Bar even to the Height of five Inches.

In the Year 1726, making several further Observations about the magnetical Force, which I found in great Pieces

Pieces of Iron, for want of larger I made use of what Tools I had, namely, a large Iron Vice, about 90 lb Weight, in which I fixed a small Anvil of about 12 lb. Upon the bright Surface of this Anvil I laid the Steel, to which I would give the Vertue, in a Position of North and South, which happened to be in a Diagonal of the square Surface of the Anvil; then I took a Piece of Iron, 1 Inch Square, and 33 Inches long, of about 8 lb Weight, having at one End the Figure here represented (in *p.* 298.) brightly polished at *a*, and taper at the other End: Then I held fast down the Piece of Steel upon the Anvil with one Hand, and with the other I held the Iron Bar aforesaid perpendicular with its Point *a* upon the Steel, and pressing hard, I rubbed the Steel with the Iron Bar towards me, from North to South, several Strokes, always carrying the Bar far enough round about, to begin again at the North, to prevent the drawing back of the magnetical Force: Having thus given 10 or 12 Strokes, I turned the Steel upside down, leaving it in the same Position as to North and South, and after rubbing it and turning it, till I rubbed it about 400 times, it received by degrees more and more Strength, and at last had as much as if it had been touched by a strong Loadstone. The Place where I began to rub was always that which pointed to the North, when the Needle was hung, the End where I had ended the Stroke turning to the South. Sometimes it has happened, that in a few Strokes I gave the Steel its Vertue; nay even in the very first Stroke one may give a great deal to a small Needle. This Way I have given the magnetical Vertue to Needles of Sea-Compasses made of one Piece of Steel, as the Fi-  
 gure annexed B, so strongly, that one  
 of the Poles would take up  $\frac{3}{4}$ , and the other a whole



Ounce of Iron, although these Needles were anointed with Linseed Oil, which made a hard Coat, to keep them from rusting, yet they kept the Vertue; but in Strengthening these Sort of Needles, I rubbed by turns first to the right and then to the left Side.

The same Way I brought the Vertue into the Point of a Knife, so that it would sustain  $1 \frac{3}{4}$  Ounce.

I brought the said Vertue into four small Pieces of Steel, each 1 Inch long and  $\frac{1}{2}$  Inch broad, as thin as the Spring of a Watch. These four Pieces I joined together, as into an artificial Loadstone, weighing them 18 Grains *Troy*, and then it did draw up and sustain an Iron Nail, which weighed 144 Grains *Troy*: This artificial Loadstone has now these six Years been tumbled about, and been lying among Iron and Steel, and in any Position, and yet it has rather got more than lost any of its Vertue.

The magnetical Vertue being thus brought into Iron or Steel, I have farther observed, that that End where the Stroke was begun, would draw to the North, and where the Stroke ended to the South, in whatever Situation the Steel had been laid upon the Anvil to give it the Vertue. I took a Piece of Steel and rubbed it from one End to the Middle, and then from the other End to the Middle, and found it had two North Poles, one at each End, and the Middle a South Pole.

Further, beginning to rub from the Middle towards each End of another Piece of Steel, I found it to have at each End a South Pole, and in the Middle a North Pole.

I have put a pretty heavy Compass-Needle after I had given it its Vertue, into the Fire, and made red hot three times one after another, letting it grow cold every time: It lost some Vertue every Heat, but at the third it had a great deal still left, and making it for the fourth time white hot, it lost it all.

When

When I covered the Anvil with a Piece of Woollen Cloth, and the End of the Iron Bar with a Piece of Shamoy Leather, it gave no Vertue to the Steel ; then covering only the Bar, and leaving the Anvil uncovered, it gave not any Vertue that way neither : But covering the Anvil, and leaving the Bar uncovered, it gave the full Vertue.

I have tried whether my Vice had any fixed Pole by standing long in one Position, but I found it had not.

I have tried to do this with an Anvil of about 30 lb Weight, being fixed in Wood ; but could not come up to the other Proofs.

I believe if one took an Iron Bar of three Inches square, and 10 or more Feet long, or several of them upon each other, and a suitable Piece or Bar of Iron to rub withal, and giving the under Part of the standing Bar the Figure aforefaid, represented by B, it might be brought to a vast Strength. *N. B.* The Steel for the Needles is always of a Spring-Temper.

I have made two Pieces of Iron, at one End  $\frac{3}{4}$  of an Inch, and so Taper to  $\frac{1}{4}$  of an Inch square each [*the Length was not mentioned*] and fixed these two Pieces of Iron to a Piece of Wood in the Shape of an armed Loadstone, at about 8 Inches one from the other, applying to the under Part of these Irons, or Legs, a Piece of Iron with a Hook to it, as to an armed Loadstone. I hung this armed Piece of Wood with each Leg over an Iron Bar (at a Distance that something might hang between them) then placed the Piece of Iron with the Hook to it to the two Feet, and I found it to draw very strongly ; but my Trial was but with small Tools. I suppose if one did this in a larger Proportion, I doubt not but it would have a great Effect.

Having

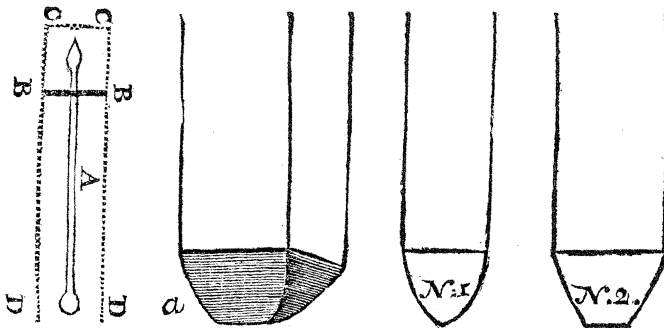
Having ground some Loadstones with Emmerly, I have saved the Grindings, and mixing them with Water, so that they might easily be moved, I put them into a Bottle to sink, placing on each Side a Loadstone, one with its North, and the other with its South Pole towards the Bottle, and found, after the Matter was settled and dried, it formed itself into a Sort of Loadstone, which had a moderate Strength, and two regular Poles.

I have found several Niceties in arming of Loadstones; but not to be tedious, I shall herewith conclude; not doubting but that if I have discovered any thing, yet unknown, you will own or record me to be the Inventor of it. I am, with humble Respects,

GENTLEMEN,

*Your most humble Servant,*

**Arnold Marcel.**



*a* the End of the Iron Bar, with which the Vertue is rubbed into the Steel or Iron.

N<sup>o</sup> 1. the Figure of the Point, on one Side.

N<sup>o</sup> 2. The Figure of the Point, on the other Side.

A The Needle of a Compass.

B B The End or Edge of the Bar, with which the Needle is rubbed, beginning at

C C, and proceeding to D D.

F I N I S.