

PHILOSOPHICAL  
TRANSACTIONS:

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**A Method of Making Artificial Magnets  
without the Use of Natural Ones;  
Communicated to the Royal Society by  
John Canton, M. A. & F. R. S. To Which is  
Prefixed the President's Report**

John Canton

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time; but, three or four days after, in dressing the incisions, three or four purple spots were observed about them, which occasioned my being called in. I took notice, that the pustules, which were very numerous, were here and there livid, and in the arms and thighs of a dark colour, tending towards a mortification. Whereupon I immediately prescribed ʒss. of bark to be given, and repeated once in three hours; which was accordingly done for eleven days successively; during which time he took 47 doses of bark, viz. in all, 3 ounces wanting half a drachm. It was really wonderful to see, how soon the bark alter'd the colour of the pustules, brought them on to digestion, supported the patient's strength, prevented a second fever, and carried him thro' the disease without the least difficulty, or bad symptom.

I am, &c.

VI. *A Method of making artificial Magnets without the Use of natural ones; communicated to the Royal Society by John Canton, M. A. & F. R. S. To which is prefixed the President's Report.*

Read Jan. 17.  
1750. **A**T a meeting of the Royal Society on Thursday the 17 day of January 1750, the President acquainted the gentlemen there present, that Mr. John Canton, one of their members, who had for a considerable time, and with great diligence,

diligence, applied himself to the making of philosophical experiments of various sorts, had, among others, attempted to convey a considerable magnetic virtue to bars of hardened steel; and that having therein so well succeeded, as to be able to impregnate such bars with this virtue, to as high a degree at least, as any of the same weight and dimensions; which he had yet seen or heard of; and to as high a degree, as he apprehended the same bars were, in their present state, capable of being impregnated; he was thereupon ready at that time, and prepared, to lay some of his experiments to this purpose before the gentlemen of the Society, and to shew them the whole method and process of his operation: whereby he could, in about half an hour's time, communicate to six bars of hardened steel, at first entirely destitute of any magnetic virtue whatsoever, the utmost virtue they were capable of receiving; and that without the mediation or assistance of any natural loadstone, or of any artificial magnet, to which any virtue had before purposely and previously been conveyed.

The president then delivered to the secretary the following paper, containing, in Mr. Canton's own words, the whole description of his process, with the directions he had drawn up, whereby any other person might readily perform the same. After which Mr. Canton immediately exhibited the main experiment itself, as described in his paper, together with some others: all which succeeded greatly to the satisfaction of the company. But as he feared himself, that he should not be able, by reason of the concern he was under in the presence of so many worthy persons, and for whom he had so great a respect,  
either

either to make his experiments to so good an advantage, as they might otherwise be made, or to give to his bars the same degree of strength, which he had formerly and frequently given to others of the same sort; he was therefore desirous to refer himself for such particulars, to what the president of the Society had already seen and taken minutes of, a few days before; and who thereupon reported, as he said he could faithfully do, to the best of his judgment and observation, the following facts:

That having been in company with Mr. John Ellicot, of the Society, at Mr. Canton's house in Spital-square, Bishopsgate-street; he had there seen him communicate the magnetic virtue, in the manner described in his paper, to six bars of the dimensions therein mention'd, and weighing, one with another, about an ounce and three quarters each, Troy weight. That these bars were at first perfectly indifferent as to either end of a compass needle, but that they did any of them, after their impregnation, lift by one of their ends, strongly and distinctly, full twenty-eight troy ounces; the whole operation of giving them their virtue having taken up nearly thirty minutes.

That Mr. Canton had besides shewn him at the same time two larger bars, each half an inch square, ten inches and an half in length, and weighing nearly ten ounces and twelve pennyweight: and that these, as he was informed, had been, *mutatis mutandis*, impregnated in the same manner as the former. That he had not indeed himself seen their virtue communicated to these bars, but that he had seen a trial made of their strength, by which one of them had lifted

in his presence, by one of its ends, seventy-nine ounces and nine pennyweight.

That he had also been shewn a flat semicircular steel magnet, weighing an ounce and thirteen pennyweight: and that the same had lifted before him, by applying its two ends together to an iron wedge, ninety troy ounces.

That he had likewise been told by Mr. Canton at the same time, in what manner the virtue might readily be taken away from any of his bars, which experiment he had also seen him put in practice. And that Mr. Canton had moreover changed in his presence the poles of a natural loadstone, by placing it in an inverted direction, between the contrary poles of two of his larger bars, laid down at some distance from each other, in the same strait line continued: and that he had even performed this, without touching the stone with either of the bars, and only by placing it, in the manner just mentioned, between their poles, at the distance of about a quarter of an inch from either of them.

*A Method of making Artificial Magnets  
without the use of, and yet far superior to,  
any natural ones.*

**P**ROcure a dozen bars; six of soft steel, each three inches long, one quarter of an inch broad, and one-twentieth of an inch thick, with two pieces of iron, each half the length of one of the bars, but of the same breadth and thickness: and six of hard steel, each

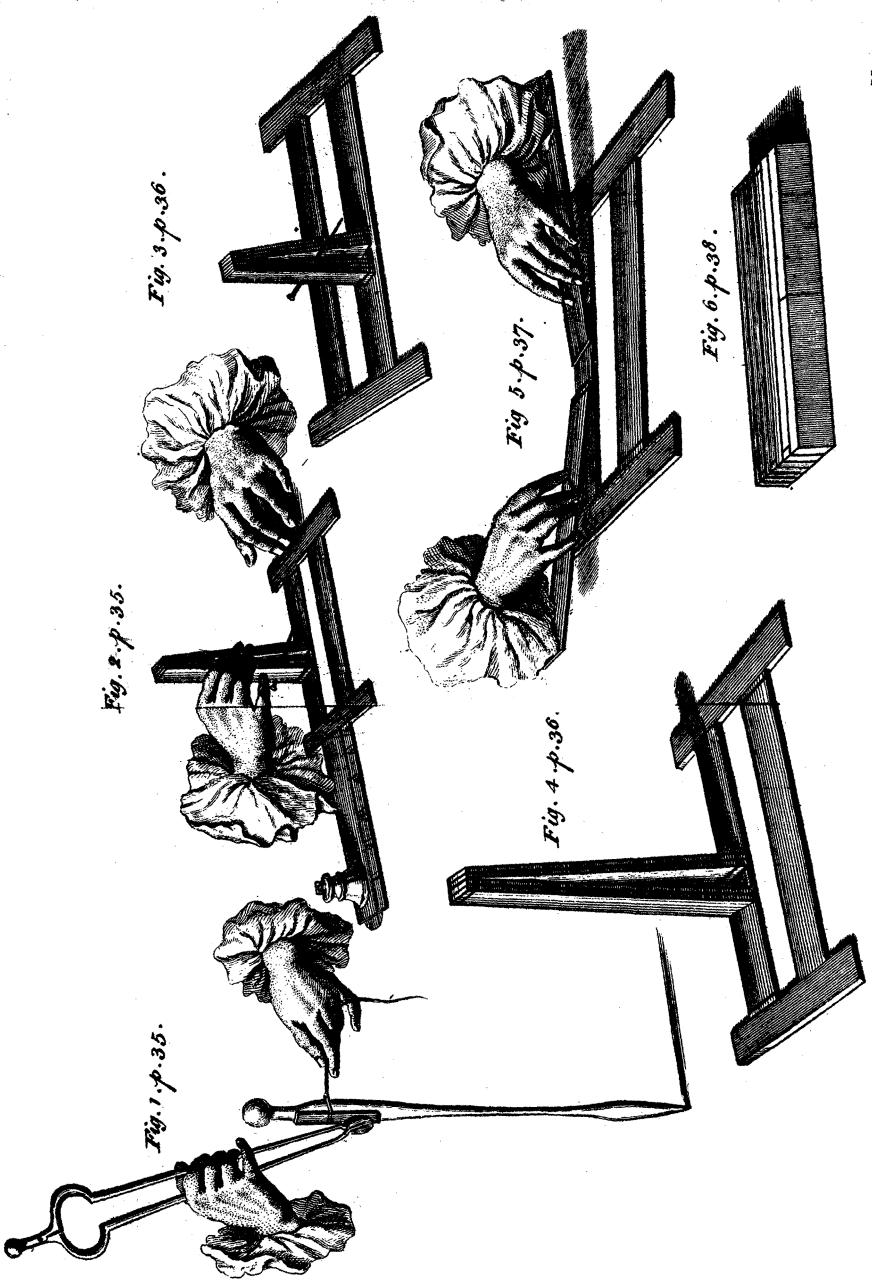


Fig. 1. p. 35.

Fig. 2. p. 35.

Fig. 3. p. 36.

Fig. 5. p. 37.

Fig. 4. p. 36.

Fig. 6. p. 38.

each five inches and an half long, half an inch broad, and three-twentieths of an inch thick, with two pieces of iron of half the length, but the whole breadth and thickness of one of the hard bars: and let all the bars be marked with a line quite round them at one end.

Then take an iron poker and tongs \* (Tab. II. Fig. 1.) the larger they are, and the longer they have been used, the better; and fixing the poker upright between the knees, hold to it near the top one of the soft bars, having its marked end downward, by a piece of sewing filk, which must be pulled tight with the left hand, that the bar may not slide: then grasping the tongs with the right hand a little below the middle, and holding them nearly in a vertical position, let the bar be stroked by the lower end, from the bottom to the top, about ten times on each side, which will give it a magnetic power sufficient to lift a small key at the marked end: which end, if the bar was suspended on a point, would turn toward the north, and is therefore called the north pole, and the unmarked end is, for the same reason, called the south pole of the bar.

Four of the soft bars being impregnated after this manner, lay the other two (Fig. 2.) parallel to each other, at the distance of about one-fourth of an inch, between the two pieces of iron belonging to them, a north and a south pole against each piece of iron: then take two of the four bars already made magnetic, and place them together, so as to make a

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double

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\* Or two bars of iron.

double bar in thickness, the north pole of one, even with the south pole of the other; and the remaining two being put to these, one on each side, so as to have two north and two south poles together, separate the north from the south poles at one end by a large pin, and place them perpendicularly with that end downward, on the middle of one of the parallel bars, the two north poles towards its south, and the two south poles towards its north end: slide them backward and forward three or four times the whole length of the bar, and removing them from the middle of this, place them on the middle of the other bar as before directed, and go over that in the same manner; then turn both the bars the other side upward, and repeat the former operation: this being done, take the two from between the pieces of iron, and placing the two outermost of the touching bars in their room, let the other two be the outermost of the four to touch these with: and this process being repeated till each pair of bars have been touched three or four times over, which will give them a considerable magnetic power, put the half dozen together after the manner of the four (Fig. 3.) and touch with them two pair of the hard bars, placed between their irons at the distance of about half an inch from each other: then lay the soft bars aside; and with the four hard ones let the other two be impregnated (Fig. 4.) holding the touching bars apart at the lower end near two tenths of an inch, to which distance let them be separated after they are set on the parallel bar, and brought together again before they are taken off: this being observed,



observed, proceed according to the method described above, till each pair have been touched two or three times over. But as this vertical way of touching a bar will not give it quite so much of the magnetic virtue as it will receive, let each pair be now touched once or twice over, in their parallel position between the irons (Fig. 5.) with two of the bars held horizontally, or nearly so, by drawing at the same time the north of one from the middle over the south end, and the south of the other from the middle over the north end of a parallel bar; then bringing them to the middle again without touching the parallel bar, give three or four of these horizontal strokes to each side. The horizontal touch, after the vertical, will make the bars as strong as they can possibly be made: as appears by their not receiving any additional strength, when the vertical touch is given by a greater number of bars, and the horizontal by those of a superior magnetic power. This whole process may be gone thro' in about half an hour, and each of the larger bars, if well-hardened \*, may be made to lift twenty-eight troy ounces, and sometimes more. And when these bars are thus impregnated, they will give to an hard bar of the same size, its full virtue  
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\* The smith's manner of hardening steel, whom I have chiefly employed, and whose bars have constantly proved better than any I could meet with beside, is as follows: having cut a sufficient quantity of the leather of old shoes into very small pieces, he provides an iron pan, a little exceeding the length of a bar, wide enough to lay two side by side without touching each other or the pan, and at least an inch deep. This pan he nearly half-fills with the bits of leather, upon which he lays the two bars, having fastened to the  
end

in less than two minutes: and therefore will answer all the purposes of magnetism in navigation and experimental philosophy, much better than the loadstone, which is well known not to have sufficient power to impregnate hard bars. The half dozen being put into a case (Fig. 6.) in such a manner, as that two poles of the same denomination may not be together, and their irons with them as one bar, they will retain the virtue they have received: but if their power should, by making experiments, be ever so far impaired, it may be restored without any foreign assistance in a few minutes. And if, out of curiosity, a much larger set of bars should be required, these will communicate to them a sufficient power to proceed with, and they may in a short time, by the same method, be brought to their full strength.

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end of each a small wire to take them out by: he then quite fills the pan with the leather, and places it on a gentle flat fire, covering and surrounding it with charcoal. The pan being brought to somewhat more than a red heat, he keeps it so about half an hour, and then suddenly quenches the bars in a large quantity of cold water.