

XXVII. *On the Influence of Screens in arresting the Progress of Magnetic Action.* By WILLIAM SNOW HARRIS, Esq. F.R.S.

Read, June 16, 1831.

1. **WHILST** engaged in some experiments with a thin plate of iron, employed as a screen to intercept the action of a magnet, the following curious fact presented itself to my notice. Although the single plate of iron, which was about the  $\frac{1}{16}$ th of an inch in thickness, very effectually screened the action of a revolving magnet on a disc of copper, the magnet and disc being placed at a certain distance from each other; yet the same effect did not follow when the disc acted on by the magnet was also of iron: in the latter case it was found requisite to increase the quantity of intervening iron very considerably. This was done by piling several plates similar to the first, one on the other, by which the quantity of iron requisite to intercept completely the action of the magnet could be in some measure estimated.

From this I have been led to some new inquiries concerning the screening influence of substances generally, which, I trust, may possess some claim to the consideration of persons engaged in scientific pursuits. I have therefore to beg the favour of being allowed to lay them before the Royal Society.

2. Having carefully repeated the experiments from which the result just mentioned was obtained, I subsequently endeavoured to determine if the screening influence of the iron plates depended actually on the mass, or was otherwise confined to the plates immediately on the surface. With this view the interior ones were removed, and a ring of wood equal in thickness substituted in their place; the position of the upper and under plate therefore remained unchanged.

In this instance, however, the magnetic action was no longer effectually intercepted, nor could it be completely shut out, except by restoring all the interior plates as before; that is to say, two plates above and two below were insufficient, and so on.

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3. From this circumstance, it seemed not unreasonable to infer, as was subsequently proved by the fact, that a screening power might possibly be obtained in a similar way, by means of substances not containing iron, provided such substances were employed in large masses, and were in any degree susceptible of a transient magnetic state; notwithstanding that from the few experiments hitherto tried, it was rather to be inferred that such substances were deficient in this peculiar property\*.

4. After a few unsuccessful attempts, I succeeded in making the screening power of several substances, not supposed to contain iron, very evident; the mechanical arrangements resorted to for the purpose were similar to those already described in my paper on the transient magnetic state, of which substances are susceptible, and which has been honoured by a place in the Royal Society's Transactions; it will be unnecessary therefore to describe them again; they will however be easily understood in the detail of the following experiments.

(a). A circular magnetic disc *m*, Plate XIII., fig. 1, being delicately balanced on a fine central point, by means of a rim of lead, was put into a state of rotation, on a small agate cup, at the rate of 600 revolutions in a minute; and a light ring of tinned iron *k* also finely balanced on a central pivot, placed immediately over it, at about four inches distance, by means of a thin plate of glass *G*.

The glass plate was supported on two sliding bars, and stands *FF*, by which it could be set to any required height; it was also furnished with four levelling screws, passing through two clamps of wood in which the extremities of the plate were fixed, so as to be further adjusted with the required precision: when the iron began to move slowly on its pivot, by the influence of the magnet revolving below, a large mass of copper *C*, about three inches thick, and consisting of plates a foot square, was carefully interposed; it being sustained on a convenient carriage *rr*, moveable on a rail-way *RR*, in order to be easily transferred without deranging the subject of experiment.

5. The copper thus interposed soon diminished sensibly the motion of the disc *k*, and at length arrested it altogether: on again withdrawing the copper,

\* See Transactions of the Royal Society for the Year 1825. p. 469.

the motion of the disc was restored, and this effect could be obtained as often as required.

In this experiment both the magnet and disc were very completely inclosed by glass shades adapted to the nature of the experiment, and were also supported on a firmly fixed base.

(*b*). When a mass of silver or zinc of about the same dimensions was substituted for the copper, a similar result ensued; the motion of the disc was completely arrested by the screening power of the intervening mass.

(*c*). The screening property evinced by these substances depended, as in the foregoing experiment with the iron plates (2), on the whole mass interposed, as subsequently appeared by removing the interior laminæ, in which case the motion of the disc was no longer impeded.

6. It may therefore be reasonably inferred that this power of intercepting magnetic action is more or less common to every class of substance, and that to render it sensible it is only requisite to employ different bodies in masses bearing some direct ratio to their respective magnetic energies.

(*d*). Thus in substituting a similar mass of lead in the above-mentioned experiments *a b*, the motion of the disc *k* could not be completely checked, and it was subsequently found requisite to increase the quantity of the intervening mass very considerably before the screening effect became sensible to any great extent; the magnetic energy of lead being so much less than that of copper.

7. The screening influence of substances is best shown by employing a powerful magnet, and by placing the disc *k* just within the limit of the action; thus a sufficient mass may be interposed, and the screening effect made very evident. To exemplify the influence of distilled water in this way at about 32° of FAHRENHEIT'S scale, I am led to believe it would be requisite to obtain a slight action on the disc, at a distance of rather more than thirty feet, so as to interpose, about the same thickness of ice.

8. This curious property seems to be intimately connected with a principle, which may be termed a neutralization of force; by which the magnetic action is, as it were controuled, as in the following experiment.

(*e*). A circular magnetic disc *m*, Fig. 2, being put into a state of rapid rotation, a light ring of copper *k* movable on a fine centre was placed imme-

diately over it as in Fig. 1, on a thin plate of glass  $gg$ , and at such a distance as to be just within the limit of the action ; when the copper disc began to move slowly on its pivot, a mass of iron  $i$  about half an inch thick was carefully raised immediately under the revolving magnet, by means of a nut  $n$  and screw  $n'$  affixed to the block  $s$  on which the whole was sustained ; when the iron  $i$  was near the under surface of the magnet, the action on the disc above began to diminish, so that the motion of the disc was finally checked altogether : by depressing the mass of iron  $i$  the motion of the disc was again restored, and this result could be obtained as often as required.

9. It does not therefore appear essential to place the iron  $i$  immediately between the magnet and disc in order to screen the action of the former ; since the same effect is produced when the iron is placed immediately beneath the magnet.

10. This subject of screens seems to possess great scientific interest, and if fully investigated is not unlikely to bring us further acquainted with one of those wonderful agencies, on which the phænomenon of attraction may be supposed to depend, the more complete elucidation of which is of the utmost consequence in the present state of physical science.

*Plymouth, April 3, 1831.*

Fig. 1.

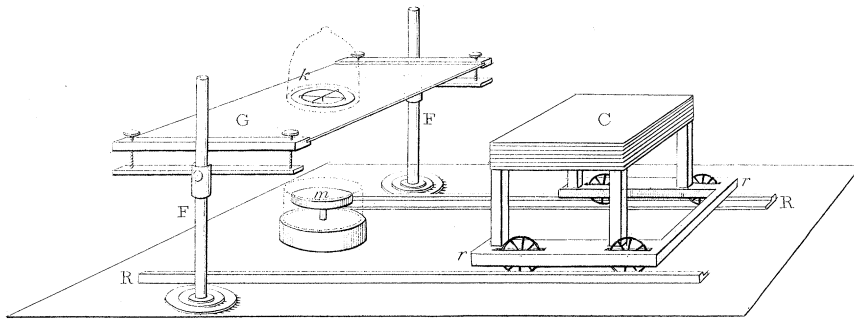


Fig. 2.

