Extracts from the papers of Sir Charles Wheatstone

WHEATSTONE 3: Series of notes describing experiments to investigate the nature of electricity, magnetism and thermodynamics, [1834-1875]

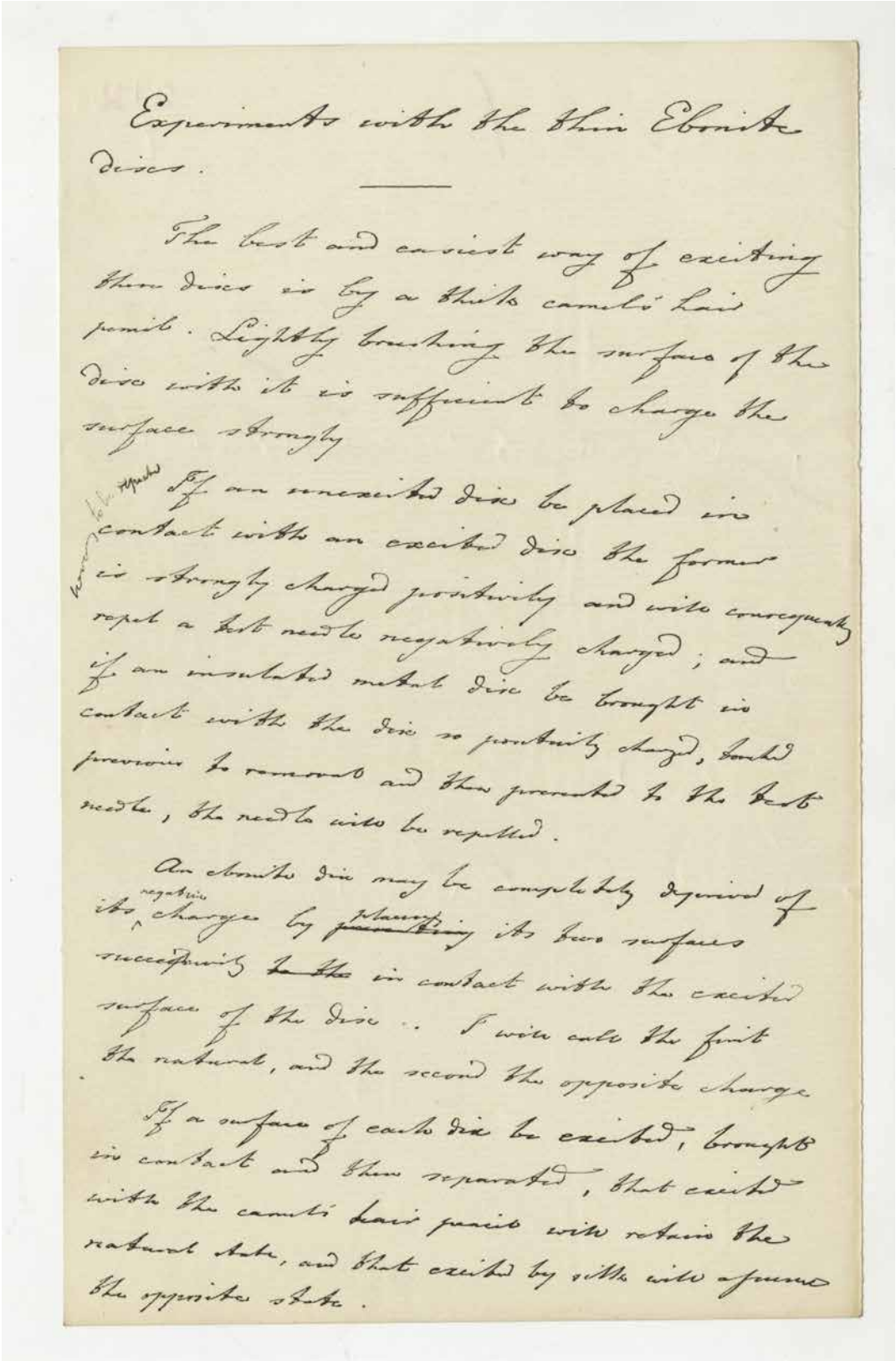
K/PP107/3/3/176-313

[1834-1875]

Papers principally relating to electrical charge, notably including experiments to measure the charge of various materials including ebonite, ivory and rock crystal, 1872; experiments using electromagnets and specifications of components, with diagrams; description of the use of the double electrometer, magnetic gyroscope and an electromagnetic induction coil or inductorium developed by Alfred Apps (1839-1913), optical and scientific instrument maker; notes on experiments described by the mathematician and physicist, Peter Barlow (1776-1862), in *An essay on magnetic attraction* (London, 1823); summaries and commentaries by Charles Wheatstone of then current explanations for magnetic induction, the distribution of magnetism in magnets and electromotive force, including perceived deficiencies in the electrodynamic theory of André-Marie Ampére (1775-1836), French physicist.

The Papers of Charles Wheatstone

K/PP107/3/3 - Papers relating to electricity, magnetism and thermodynamics



Experiments with the thin Ebonite discs.

The best and easiest way of exciting these discs is by a thick camels hair pencil. Lightly touching the surface of the disc with it is sufficient to charge the surface strongly

If an unexcited disc be placed in contact with an excited disc the former is strongly charged positively and will consequently repel a test needle negatively charged; and if an insulated metal disc be brought in contact with the disc so positively charged, touched previous to removal and then presented to the test needle, the needle will be repelled.

An ebonite disc may be completely deprived of its negative charge by passing its two surfaces successively in contact with the excited surface of the disc. I will call the first the natural, and the second the opposite charge.

If a surface of each disc be excited, brought in contact and then separated, that excited with the camels hair pencil will retain the natural state, and that excited by rubbing will assume the opposite state.

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Notes describing experiments in static electricity using ebonite discs, [1834-1875].

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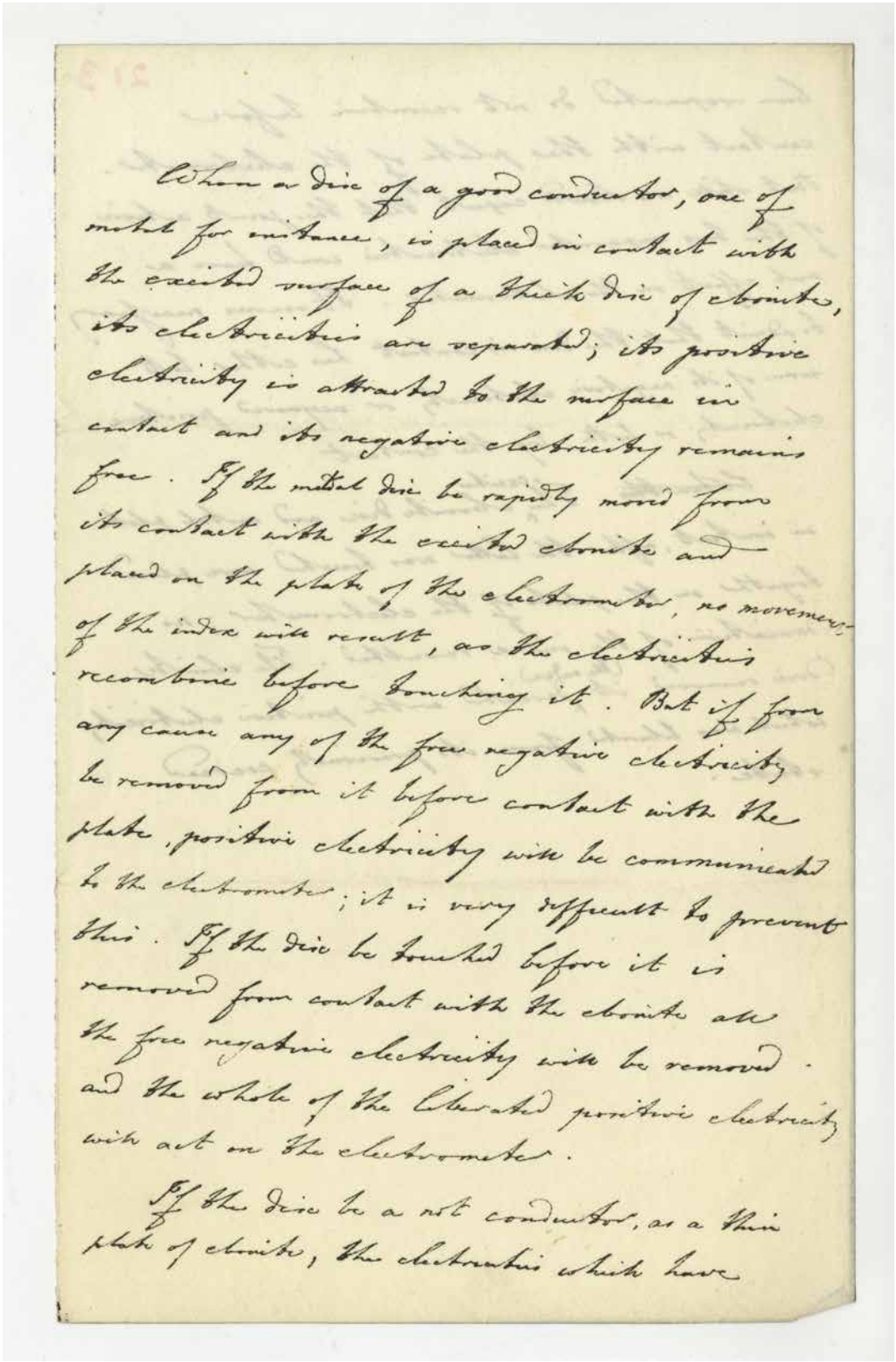

When a disc of a good conductor, one of metal for instance, is placed in contact with the excited surface of a thick disc of ebonite, its electricities are separated; its positive electricity is attracted to the surface in contact and its negative electricity remains free. If the metal disc be rapidly moved from its contact with the excited ebonite and placed on the plate of the electrometer, no movement of the index will result, as the electricities recombine before touching it. But if from any cause any of the free negative electricity be removed from it before contact with the plate, positive electricity will be communicated to the electrometer; it is very difficult to prevent this. If the disc be touched before it is removed from contact with the ebonite all the free negative electricity will be removed. and the whole of the liberated positive electricity will act on the electrometer.

If the disc be a not conductor, as a thin plate of ebonite, the electricities which have

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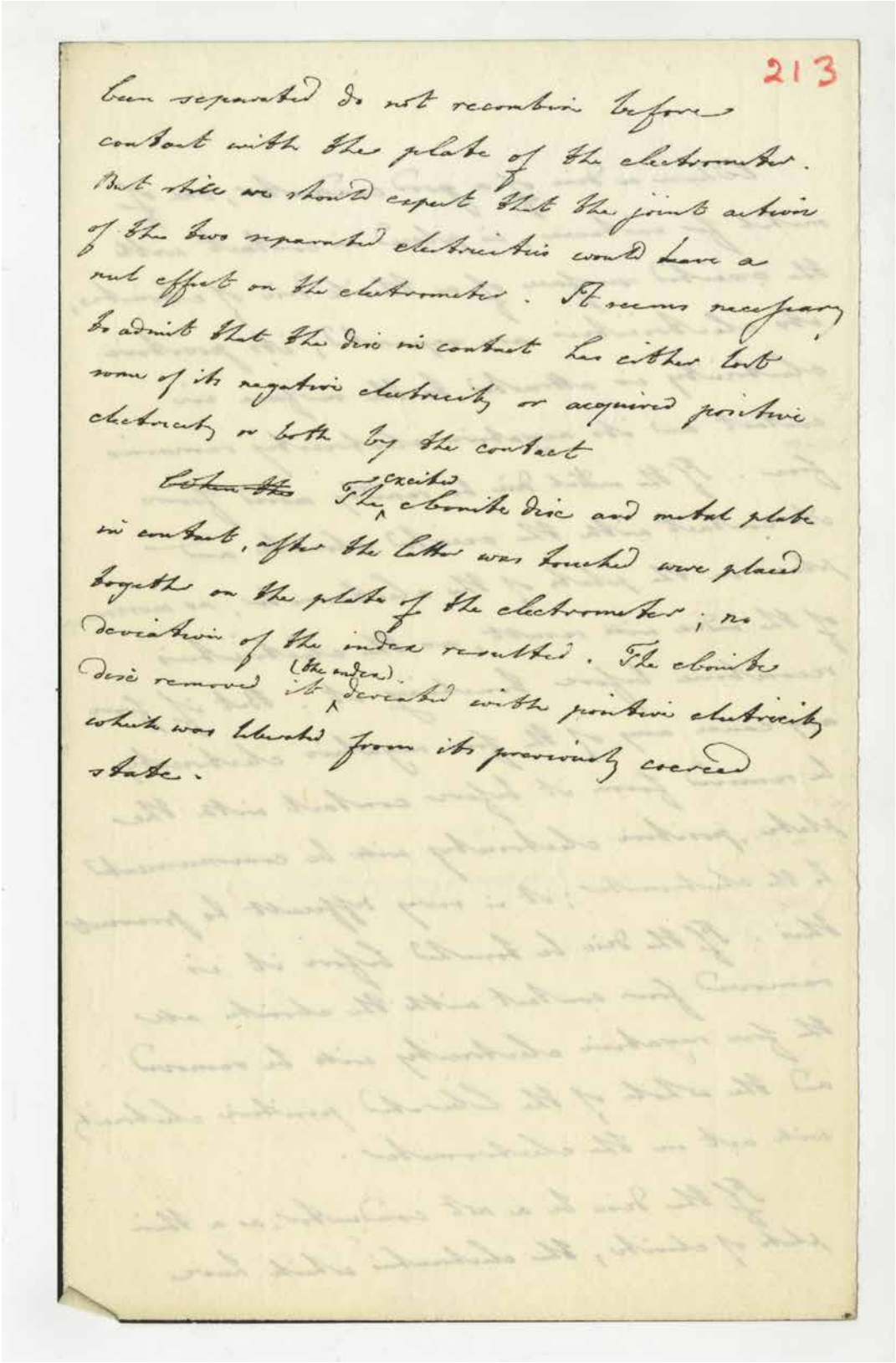
Notes describing experiments in static electricity using ebonite discs, [1834-1875], page 1.



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been separated do not recombine before contact with the plate of the electrometer. But still we should expect that the joint action of the two separated electricities would have a neat effect on the electrometer. It seems necessary to admit that the disc in contact has either lost some of its negative electricity or acquired positive electricity or both by the contact

~~Cotton the~~ The excited ebonite disc and metal plate in contact, after the latter was touched were placed together on the plate of the electrometer; no deviation of the index resulted. The ebonite disc removed (the index) its deviated with positive electricity which was liberated from its previously excited state.

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Amber is negative to Ebonite
Sycamore is negative to Ivory
Ivory is positive to Sycamore
— — — — Tortoiseshell
Ebonite is positive to Amber
Tortoiseshell is negative to Ivory
Ivory is positive to Tortoiseshell.
Mother of Pearl is negative to Ivory.
Ivory is positive to Mother of Pearl.
Nitre is positive to Ivory
Ivory is ~~positive~~ negative to Nitre } uncertain, when not insulated
~~Nitre is positive to Tortoiseshell~~
Tortoiseshell is ~~positive~~ negative to Nitre
Nitre is positive to Tortoiseshell } [illegible]

Nitre is positive to Amber
Amber is negative to Nitre

Glue is negative to Ivory
Ivory is positive to Glue
Glue is positive to Tortoiseshell
Tortoiseshell is negative to Glue
Glue is positive to Ebonite
Ebonite is negative to Glue
Plate glass positive to Ebonite
Glue negative to Plate glass
Plate glass positive to Glue
Tortoiseshell negative to Plate glass
Plate glass positive to Tortoiseshell
Mother of pearl negative to glass
Plate glass to Mother } very uncertain, generally [illegible] little [illegible] shows no charge

List of the positive and negative electrical influence of one material on another, [1834-1875].

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On Electric Conduction, Induction and Excitation.

Method of investigation
Description of the double or universal electrometer.

The ordinary phenomena of induction: variable disc of air – the homonyme attracted and covered; the opposite of repelled and free – the neutral or dormant state – accumulation of electricity – discharge – the equilibrium disturbed according to the distance at which the induction acts – electrical conditions of the two coatings –

The induction of solid bodies – proposed differential method – imperfection theory – shewn by the methods adopted by Faraday and Harris – Means of separating the induction from the conduction effects – The best conductors proved to show the strongest induction – probability that the conjecture of Faraday that induction always precedes conduction is universally true.

Internal conductibility – substances supposed to be the most perfect insulators possess internal conductibility – cylinder of ebonite, shellac &c – ebonite electrometer.

The most imperfect conducting liquids show no induction –

Conduction and Induction of vapours

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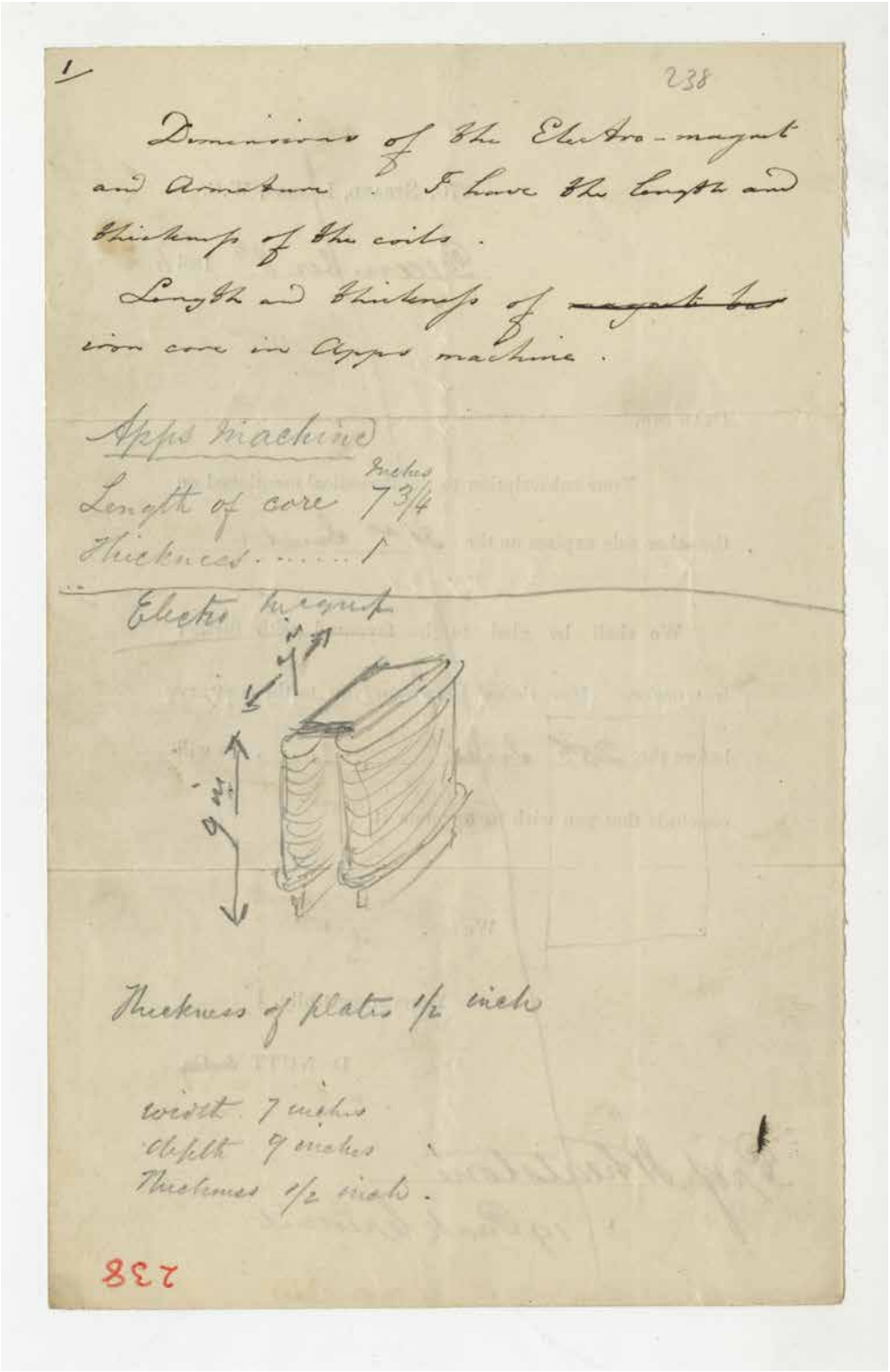

1

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Dimensions of the Electro-magnet and Armature. I have the length and thickness of the coils.

Length and thickness of ~~magnet bar~~ iron core in Apps machine.

Apps machine

	Inches
Length of core	7 3/4
Thickness	1

Electro magnet

Thickness of plates 1/2 inch

width 7 inches
depth 9 inches
Thickness 1/2 inch.

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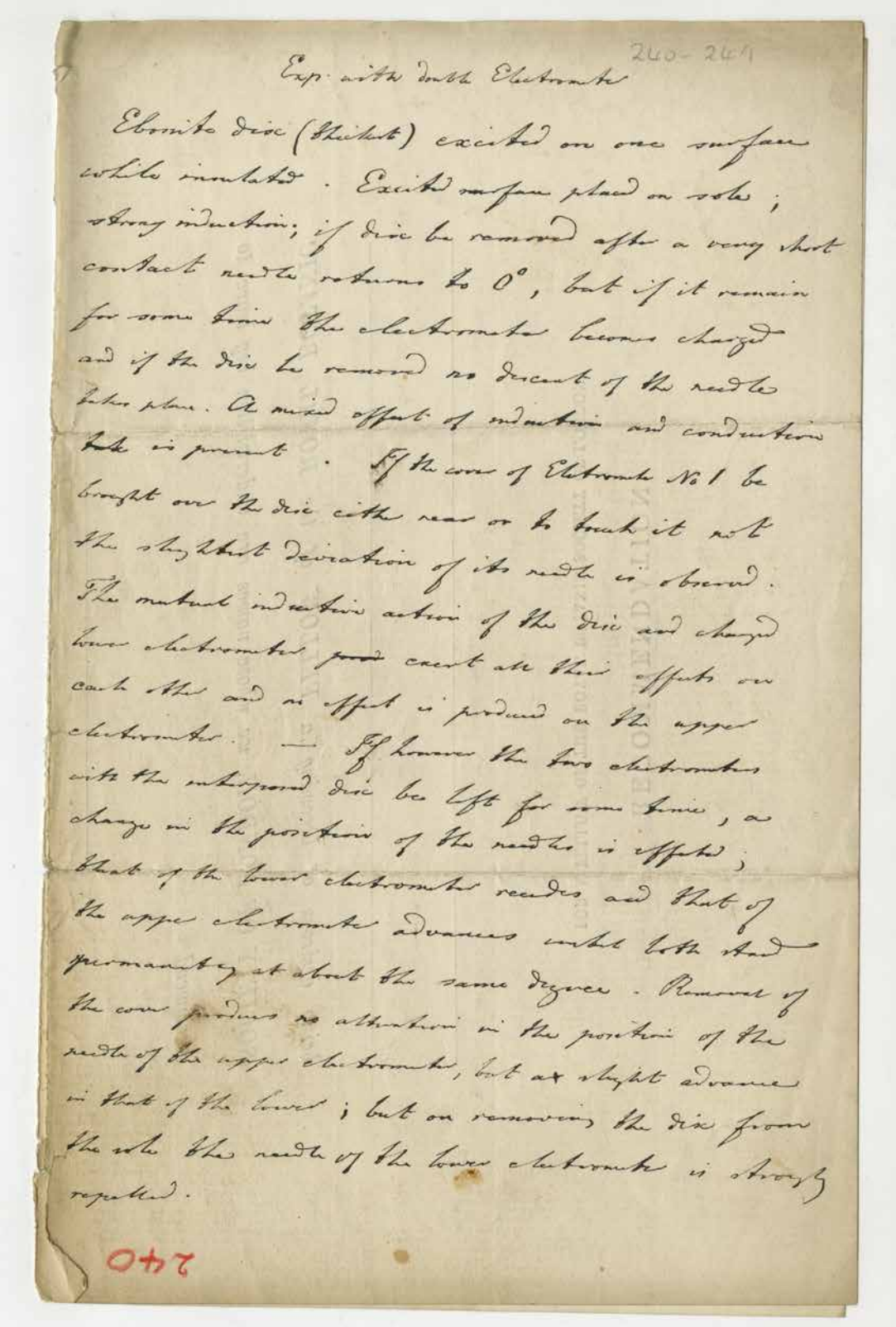
Notes and sketch diagram of an electromagnet and armature for 'Apps Machine' [Alfred Apps (1839-1913), optical instrument maker, London], [1860-1870].



Exp. with both Electrometr 240-241

Ebonite disc (thick) excited on one surface while insulated. Excited surface placed on rods; strong induction; if disc be removed after a very short contact needle returns to 0°, but if it remain for some time the electrometer becomes charged and if the disc be removed no descent of the needle takes place. A mixed effect of induction and conduction takes is present. If the cover of Electrometr No 1 be brought over the disc either near or to touch it not the slightest deviation of its needle is observed. The mutual inductive action of the disc and charged lower electrometer and cover etc their effects on each other and no effect is produced on the upper electrometer. — If between the two electrometers with the interposed disc be left for some time, a change in the position of the needles is effected; that of the lower electrometer recedes and that of the upper electrometer advances until both stand permanently at about the same degrees. Removal of the cover produces no alteration in the position of the needle of the upper electrometer, but a slight advance in that of the lower; but on removing the disc from the rods the needle of the lower electrometer is strongly repelled.

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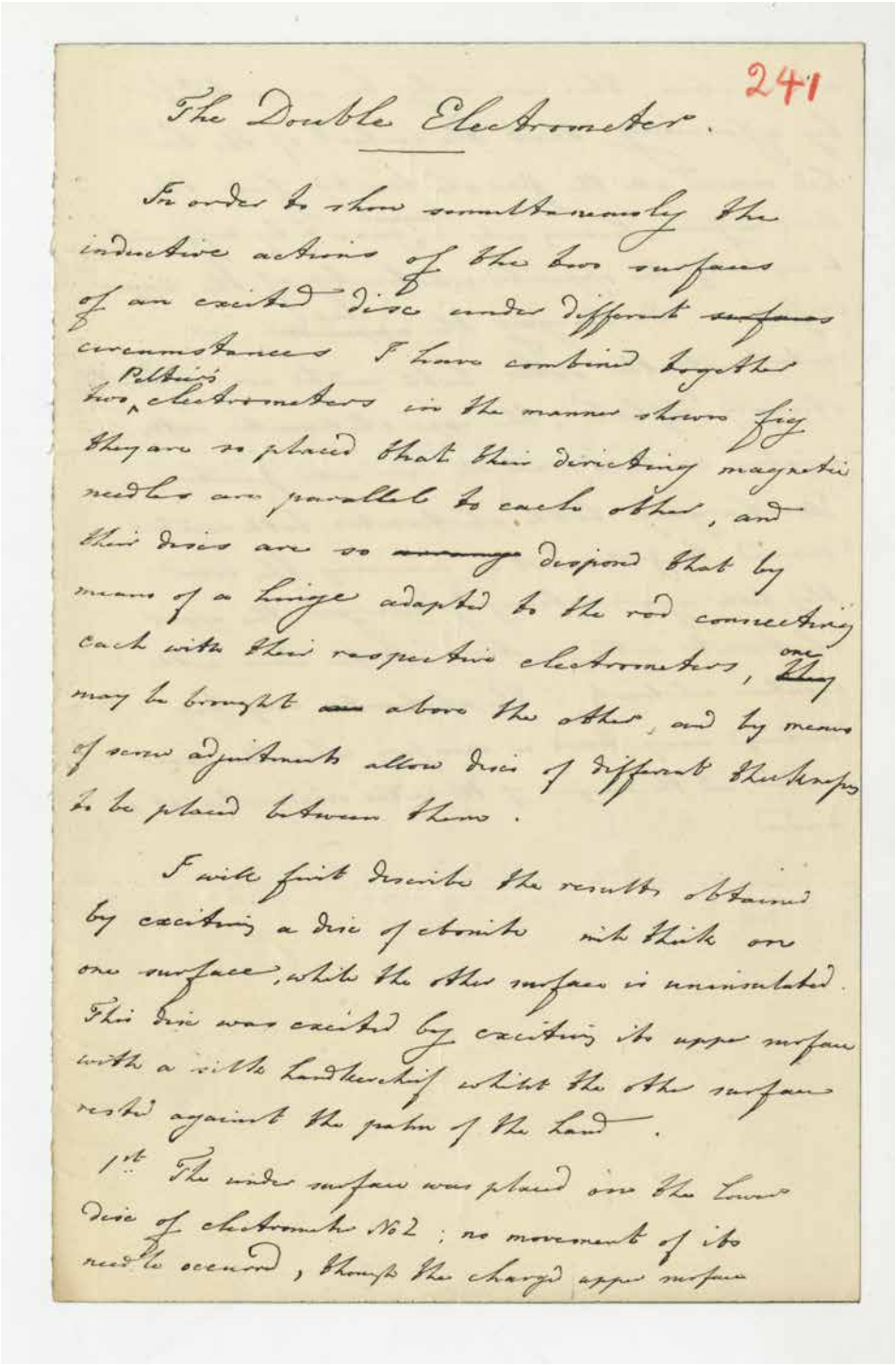
K/PP107/3/3/240
Notes describing an experiment with a double electrometer using ebonite discs, [1834-1875].



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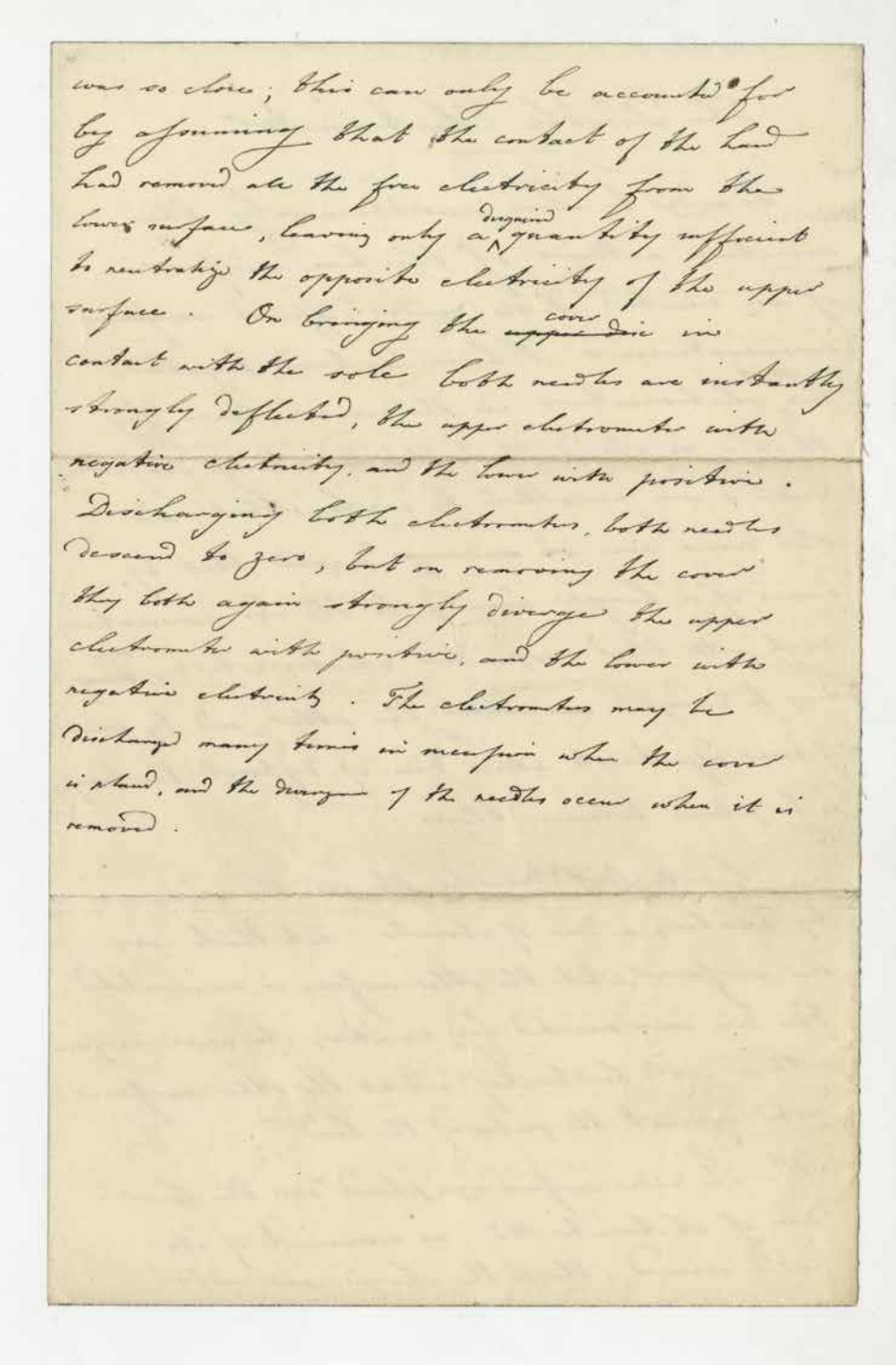
The Double Electrometer.

In order to show simultaneously the inductive actions of the two surfaces of an excited disc under different circumstances I have combined together two Peltier's electrometers in the manner shown fig they are so placed that their directing magnetic needles are parallel to each other, and their discs are so disposed that by means of a hinge adapted to the rod connecting each with their respective electrometers, one they may be brought above the other, and by means of screw adjustment allow discs of different thicknesses to be placed between them.

I will first describe the results obtained by exciting a disc of ebonite with thick on one surface, while the other surface is uninsulated. This disc was excited by exciting its upper surface with a little Leadkerchief whilst the other surface rested against the palm of the hand.

1st The under surface was placed on the Lower disc of electrometer №2; no movement of its needle occurred, though the charged upper surface



was so close; this can only be accounted for by assuming that the contact of the hand had removed all the free electricity from the lower surface, leaving only a ~~quantity~~ quantity again sufficient to neutralize the opposite electricity of the upper surface. On bringing the ~~upper disc~~ cover in contact with the sole both needles are instantly strongly deflected, the upper electrometer with negative electricity, and the lower with positive. Discharging both electrometers, both needles descend to zero, but on removing the cover they both again strongly diverge the upper electrometer with positive, and the lower with negative electricity. The electrometers may be discharged many times in succession when the cover is on hand, and the charges of the needles occur when it is removed.

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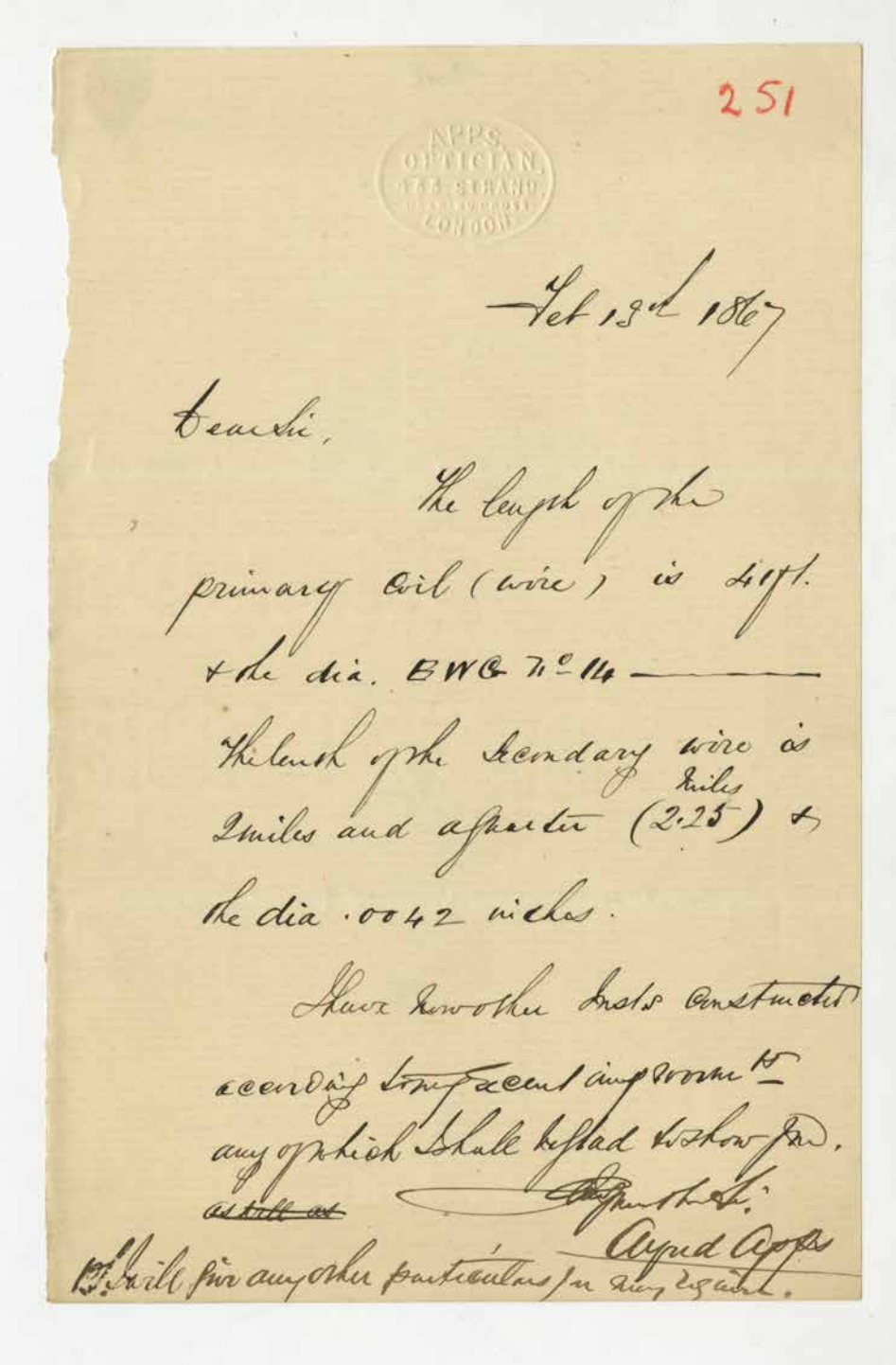

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APPS
OPTICIAN
244 STRAND
LONDON

Feb 13th 1867

Dear Sir,

The length of the primary coil (wire) is 40ft. & the dia. BWG No 14 ——

The length of the secondary wire is 2 miles and a quarter (2.25 miles) & the dia .0042 inches.

I have known the best constructed secondary coils exceed any power to any which I shall be glad to show you, as well as

Yours truly
Alfred Apps

P.S. I will give any other particulars in my power.

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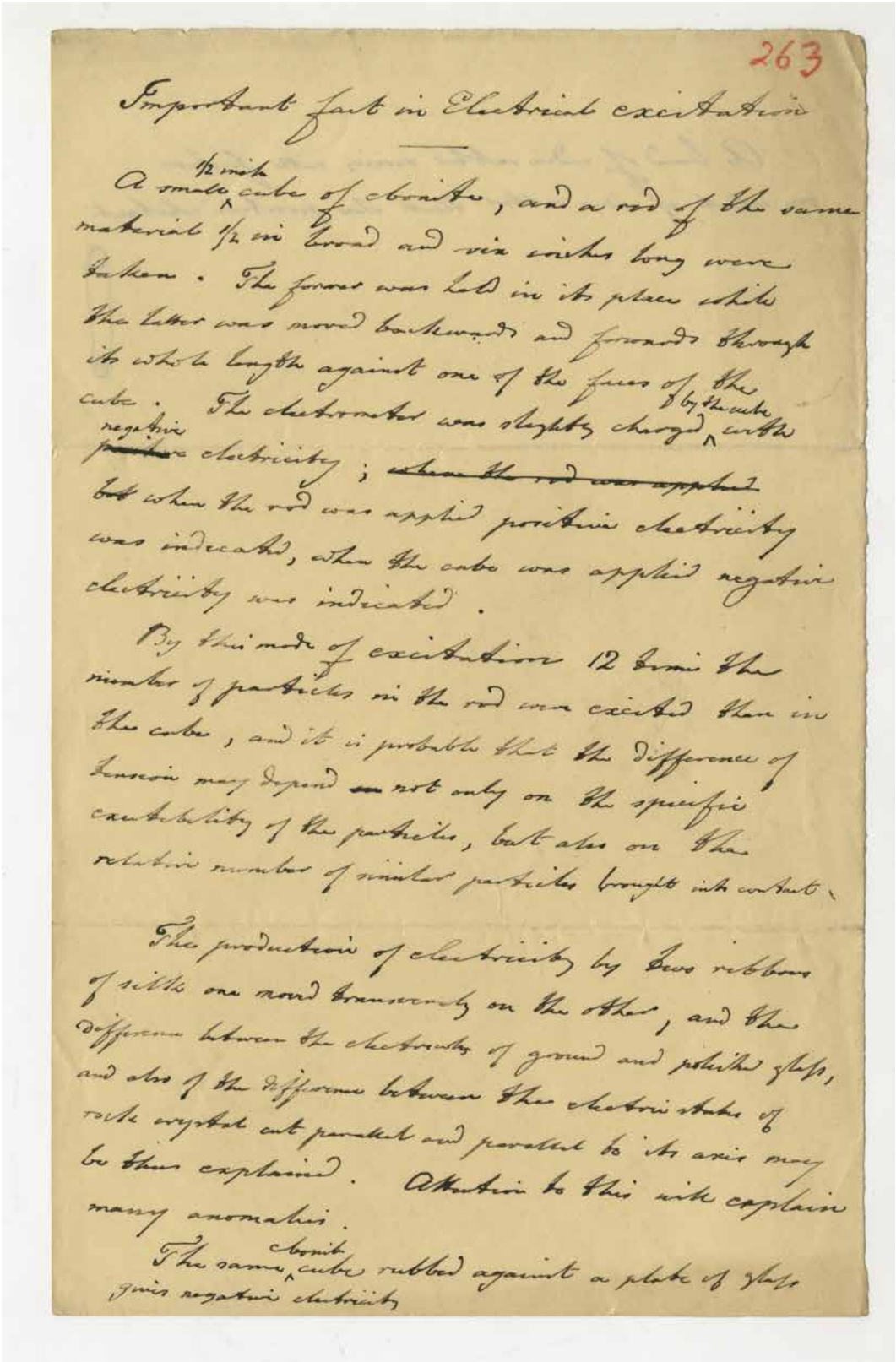

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Important fact in Electrical excitation

A small ½ inch cube of ebonite, and a rod of the same material ½ in broad and six inches long were taken. The former was held in its place while the latter was moved backwards and forwards through its whole length against one of the faces of the cube. The electrometer was slightly charged by the cube with negative electricity; ~~when the rod was applied~~ but when the rod was applied positive electricity was indicated, when the cube was applied negative electricity was indicated.

By this mode of excitation 12 times the number of particles in the rod were excited than in the cube, and it is probable that the difference of tension may depend ~~on~~ not only on the specific excitability of the particles, but also on the relative number of similar particles brought into contact.

The production of electricity by two ribbons of silk one moved transversely on the other, and the difference between the electricity of ground and polished glass, and also of the difference between the electric states of rock crystal cut parallel and perallel to its axis may be thus explained. Attention to this will explain many anomalies.

The same ebonite cube rubbed against a plate of glass gives negative electricity

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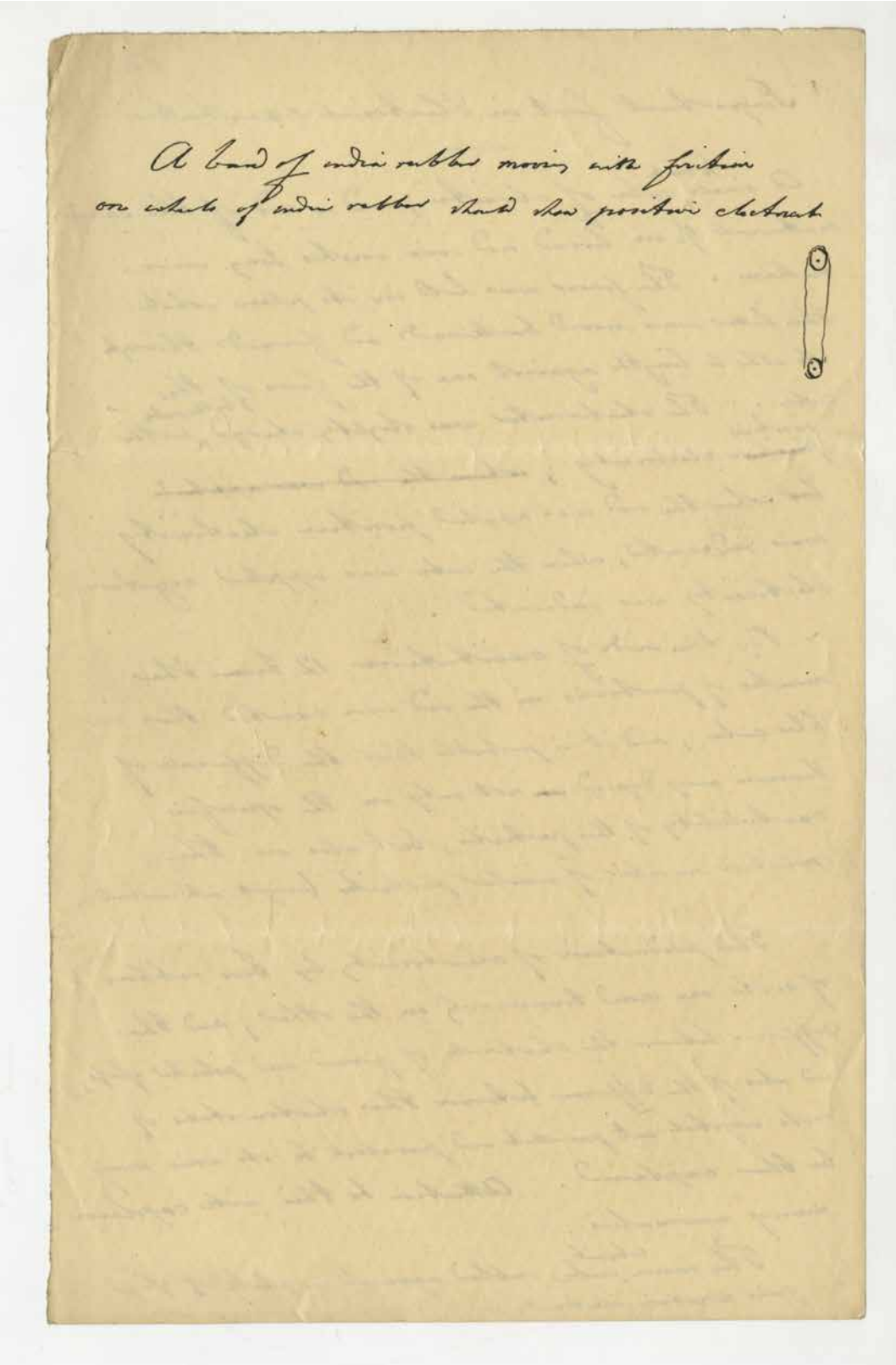

K/PP107/3/3/263
Notes describing 'Important fact in electrical excitation' using a cube and rod of ebonite and an electrometer to measure the electrical activity, [1834-1875], page 2.

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Galvanometer – Apps' Inductorium – Platina wire –
Small but electro-magnet – Voltameter.
or telegraph.

Try the various effects in the Primary circuit.
Do . . . in the secondary circuit.
Do . . in the compound circuit.
Do . . in the cross wire.

Why does not the Inductorium act in the compound circuit. Is it that it introduces too great a resistance into the circuit?

An electro-magnet with rotating armature power applied to the armature and the breaking currents of the electro-magnet cut out – First alternating the armature currents

K/PP107/3/3/264
Notes asking questions and listing experiments to try using a galvanometer, Apps' Inductorium [induction coil developed by Alfred Apps (1839-1914), optical and scientific instrument maker] and platinum wire [1865-1870].

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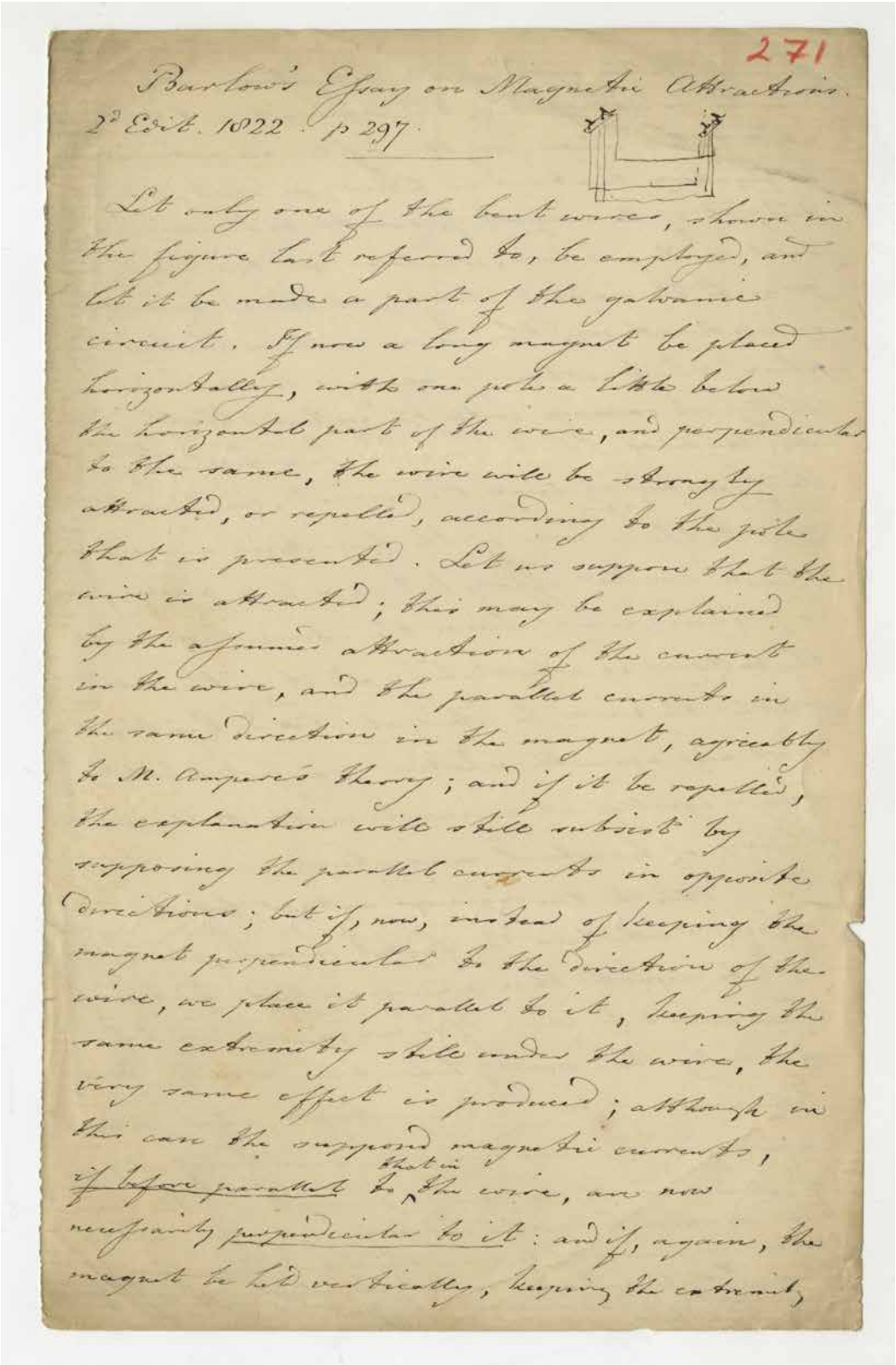

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Barlow's Essay on Magnetic Attractions.
2d Edit. 1822. p 297.

Let only one of the bent wires, shown in the figure last referred to, be employed, and let it be made a part of the galvanic circuit. If now a long magnet be placed horizontally, with one pole a little below the horizontal part of the wire, and perpendicular to the same, the wire will be strongly attracted, or repelled, according to the pole that is presented. Let us suppose that the wire is attracted; this may be explained by the mutual attraction of the current in the wire, and the parallel currents in the same direction in the magnet, agreeably to M. Ampere's theory; and if it be repelled, the explanation will still subsist by supposing the parallel currents in opposite directions; but if, now, instead of keeping the magnet perpendicular to the direction of the wire, we place it parallel to it, keeping the same extremity still under the wire, the very same effect is produced; although in this case the supposed magnetic currents, if before parallel to that of the wire, are now manifestly perpendicular to it: and if, again, the magnet be held vertically, keeping the extremity

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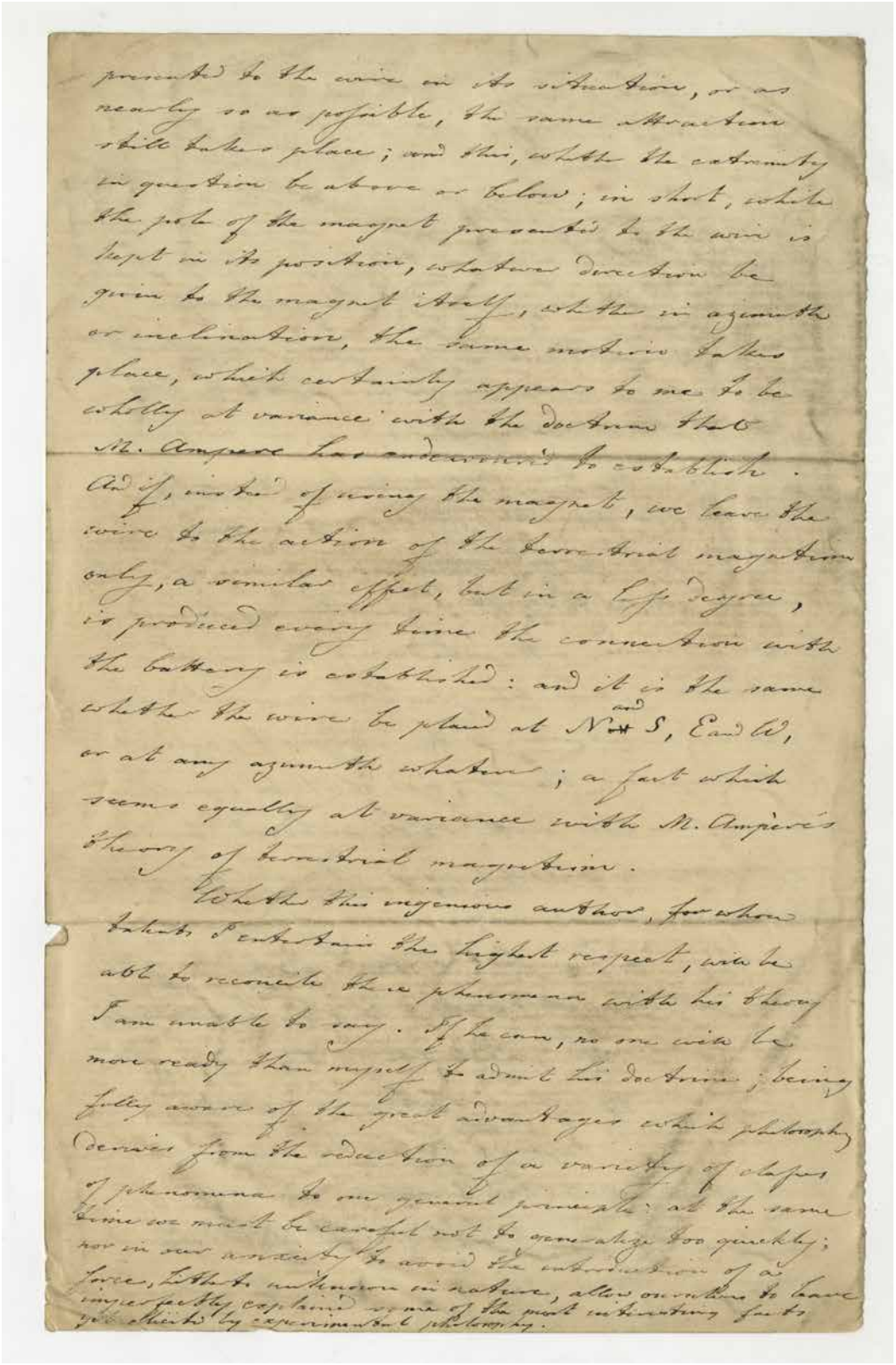

presented to the wire in its situation, or as nearly so as possible, the same attraction still takes place; and this, whilst the extremity in question be above or below; in short, while the pole of the magnet presented to the wire is kept in its position, whatever direction be given to the magnet itself, whether in azimuth or inclination, the same motion takes place, which certainly appears to me to be wholly at variance with the doctrine that M. Ampere has endeavoured to establish.

And if, instead of giving the magnet, we leave the wire to the action of the terrestrial magnetism only, a similar effect, but in a less degree, is produced every time the connexion with the battery is established: and it is the same whether the wire be placed at N and S, E and W, or at any azimuth whatever; a fact which seems equally at variance with M. Ampere's theory of terrestrial magnetism.

Whether this ingenious author, for whom I shall ever entertain the highest respect, will be able to reconcile these phenomena with his theory I am unable to say. If he can, no one will be more ready than myself to admit his doctrine; being fully aware of the great advantages which philosophy derives from the reduction of a variety of classes of phenomena to one general principle: at the same time we must be careful not to generalize too quickly; nor in our anxiety to avoid the introduction of a force, [illegible] nothing in nature, allow ourselves to leave imperfectly explained some of the most interesting facts yet elicited by experimental philosophy.

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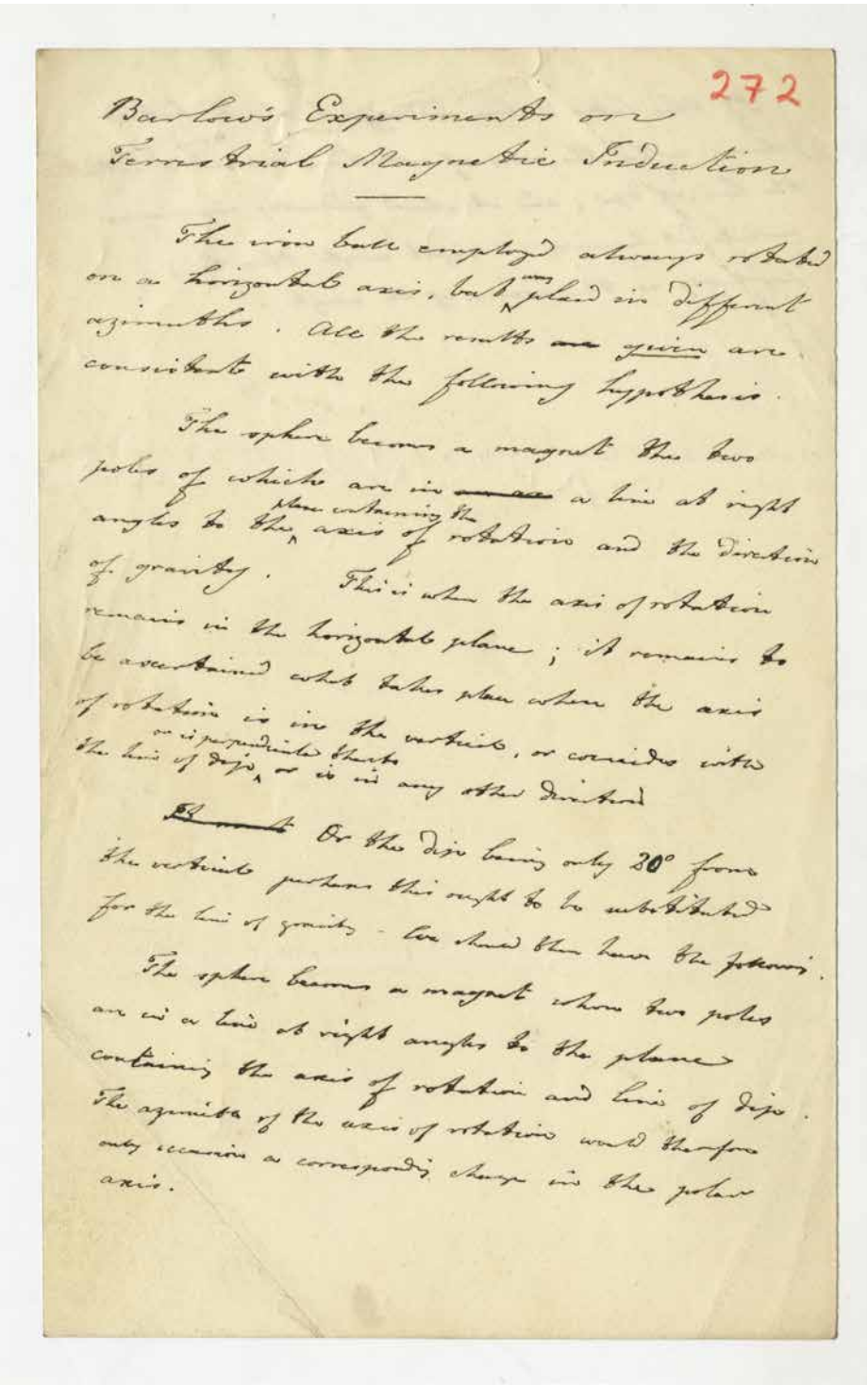
Extract from *An essay on magnetic attraction* (2nd ed, London, 1822), Peter Barlow (1776-1862), mathematician and physicist, [1834-1875], page 2.



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Barlow's Experiments on
Terrestrial Magnetic Induction

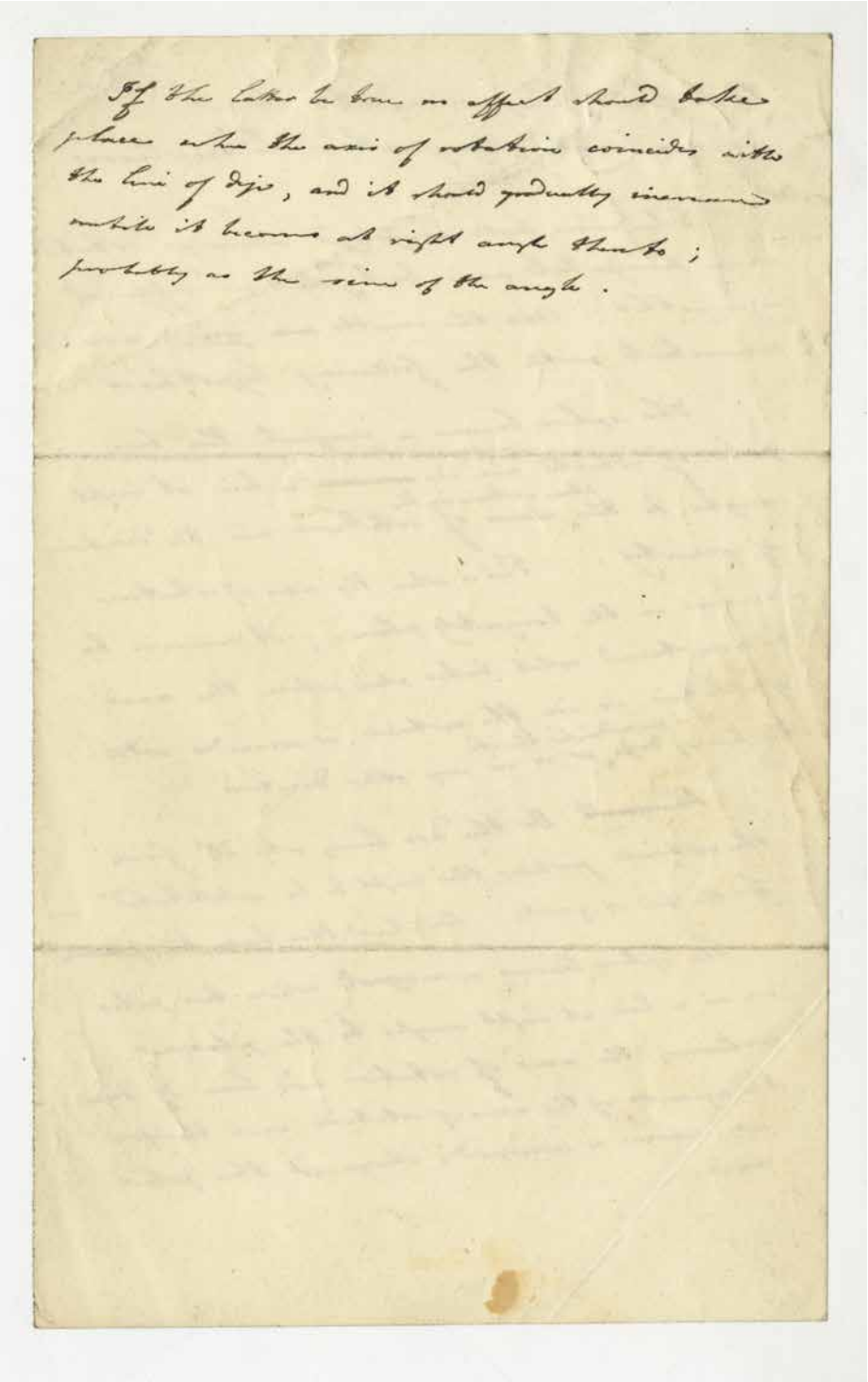
The iron ball employed always rotated on a horizontal axis, but placed in different azimuths. All the results ~~are~~ given are consistent with the following hypothesis.

The sphere becomes a magnet the two poles of which are in ~~the~~ a line at right angles to the plane containing the axis of rotation and the direction of gravity. This is when the axis of rotation remains in the horizontal plane; it remains to be ascertained what takes place when the axis of rotation is in the vertical, or coincides with the line of dip, or is in any other direction.

~~But~~ Or the dip being only 20° from the vertical perhaps this ought to be substituted for the line of gravity. We should then have the following.

The sphere becomes a magnet whose two poles are in a line at right angles to the plane containing the axis of rotation and line of dip. The magnetism of the axis of rotation would therefore only exercise a corresponding change in the polar axis.

K/PP107/3/3/272
Notes describing experiments on terrestrial magnetic induction carried out by Peter Barlow (1776-1862), mathematician and physicist, [1834-1875], page 1.



If the latter be true no effect should take
place when the axis of rotation coincides with
the line of dips, and it should gradually increase
until it becomes at right angles thereto;
probably as the sine of the angle.

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Notes describing experiments on terrestrial magnetic induction carried out by Peter Barlow (1776-1862), mathematician and physicist, [1834-1875], page 2.

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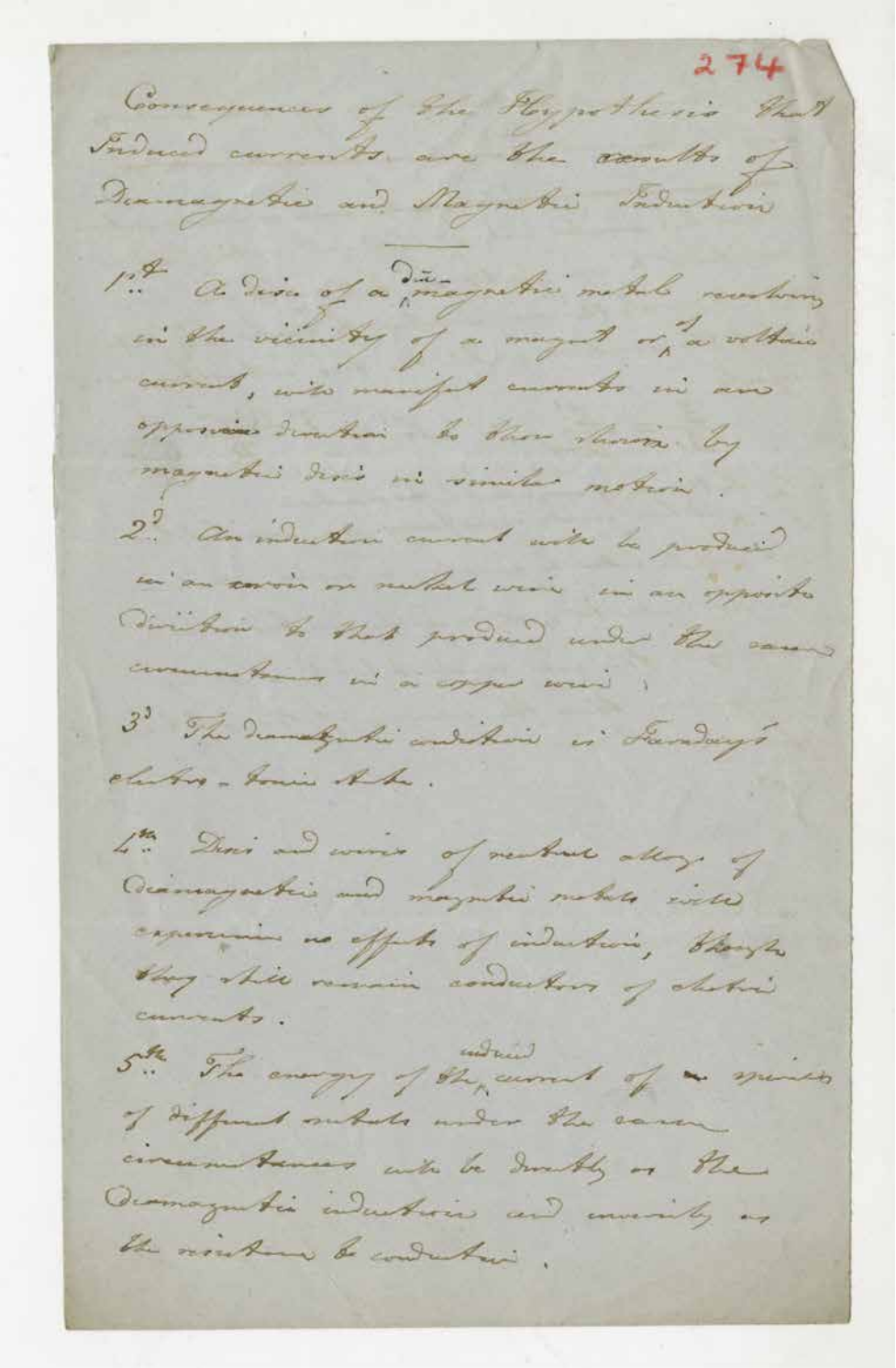

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Consequences of the Hypothesis that Induced currents are the results of Diamagnetic and Magnetic Induction

1st. A disc of a diamagnetic metal revolving in the vicinity of a magnet or of a voltaic current, will manifest currents in an opposite direction to that given by magnetic iron in similar motion.

2d. An inductive current will be produced in an arc or metal wire in an opposite direction to that produced under the same circumstances in a copper wire;

3d The diamagnetic conductors in Faraday's electro-tonic state.

4th. Disc and wires of metallic alloy of diamagnetic and magnetic metals will exhibit no effects of induction, though they still remain conductors of electric currents.

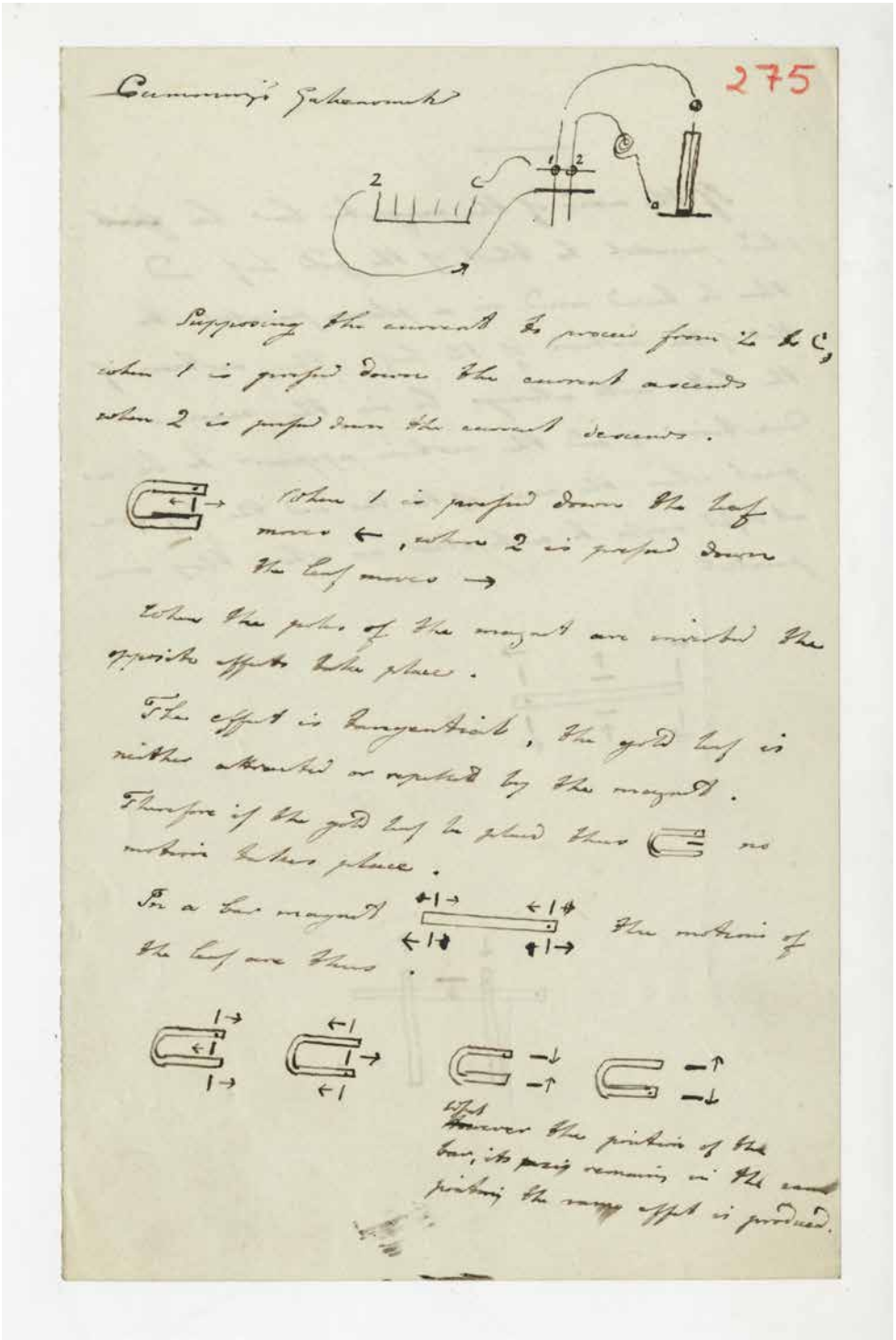
5th. The energy of the induced current of a spirals of different metals under the same circumstances will be doubly as the diamagnetic inductive and inversely as the resistance to conduction.

6. The electromotive force of the metals may be measured they ~~by having two wires with the same resistance, and with the same inductive action~~ Procure two similar wires of different metals, add a resistance to one until the two resistances are equal; apply the same induction to each and alter one of the resistances until the two intensities are equal

$$\frac{E}{R} = \frac{E'}{R+r} \quad \therefore \quad E' = E\,\frac{R+r}{R}$$

7. In the case of magneto-electric machines where small resistances are available it will be better to employ a wire which is a good conductor, when large resistances are employed the good conductibility is of less consequence than the energy of the electro-motive force.

8.



K/PP107/3/3/275
Notes and diagrams describing a galvanometer developed by James Cumming (1777-1861), chemist, page 1.

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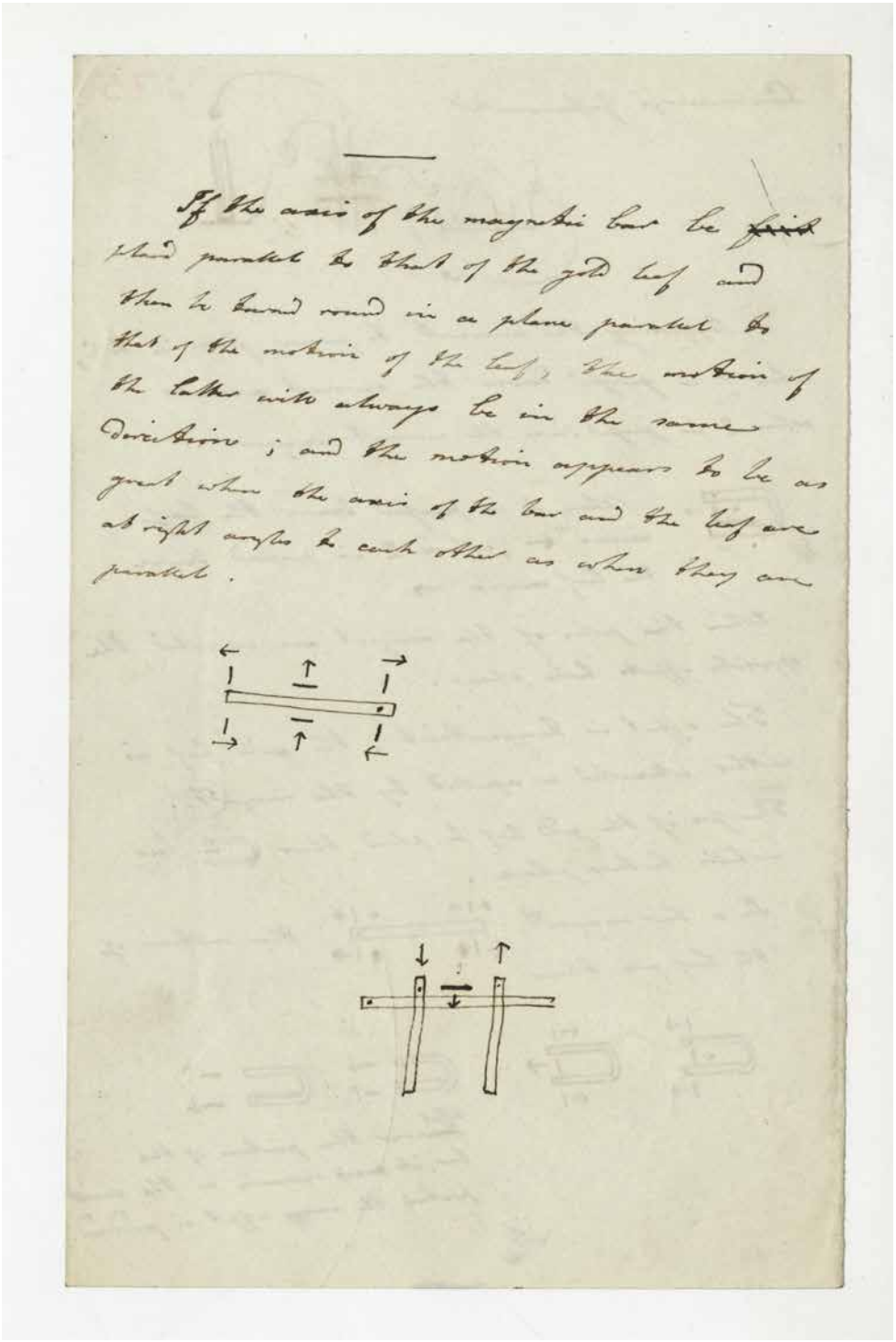

If the axis of the magnetic bar be ~~first~~ placed parallel to that of the gold leaf and then be turned round in a plane parallel to that of the motion of the leaf, the motion of the latter will always be in the same direction; and the motion appears to be as great when the axis of the bar and the leaf are at right angles to each other as when they are parallel.

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Notes and diagrams describing a galvanometer developed by James Cumming (1777-1861), chemist, page 2.

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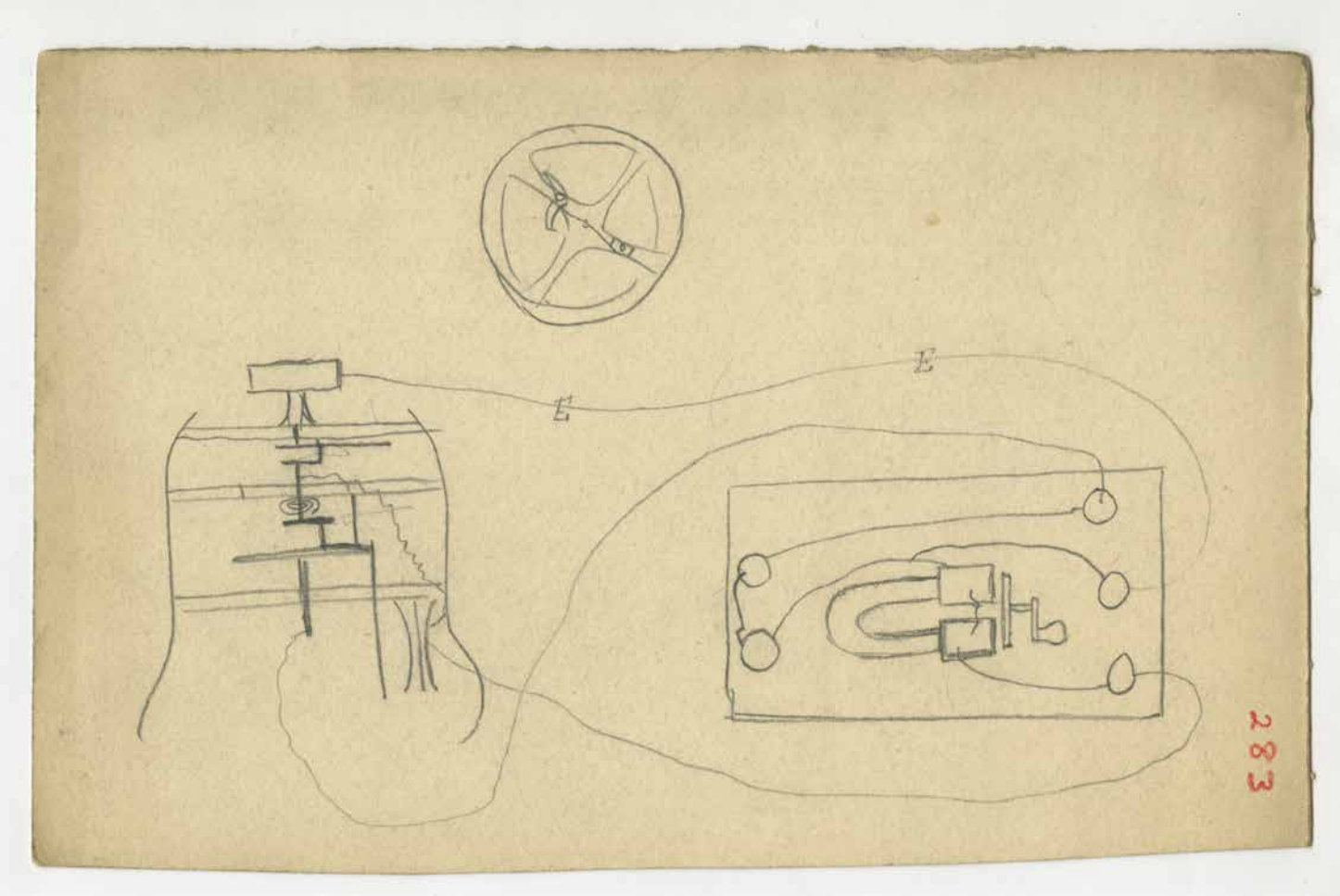

K/PP107/3/3/283

Notes and diagram of an electromagnetic apparatus with a dial and using a step by step mechanism [not in Wheatstone's handwriting], see also K/PP107/1/3/73, [1834-1875].

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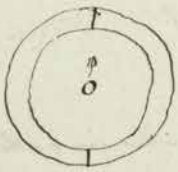
Thermo-electric Magnet



A hollow cylinder half an inch in thickness and three inches in external diameter and three inches in length, is formed of two equal semicylinders of bismuth and antimony. It is to be placed horizontally, and corresponding with its axis must be placed a small tube with three apertures forming the jet of a gas spirit lamp. A coil of wire an inch and a half in breadth must be made to fit the external circumference. On moving this coil in a direction parallel to the axis, no electric current will be produced in it. It is probable that the cylinder will be a real magnet having the lines for its two poles.

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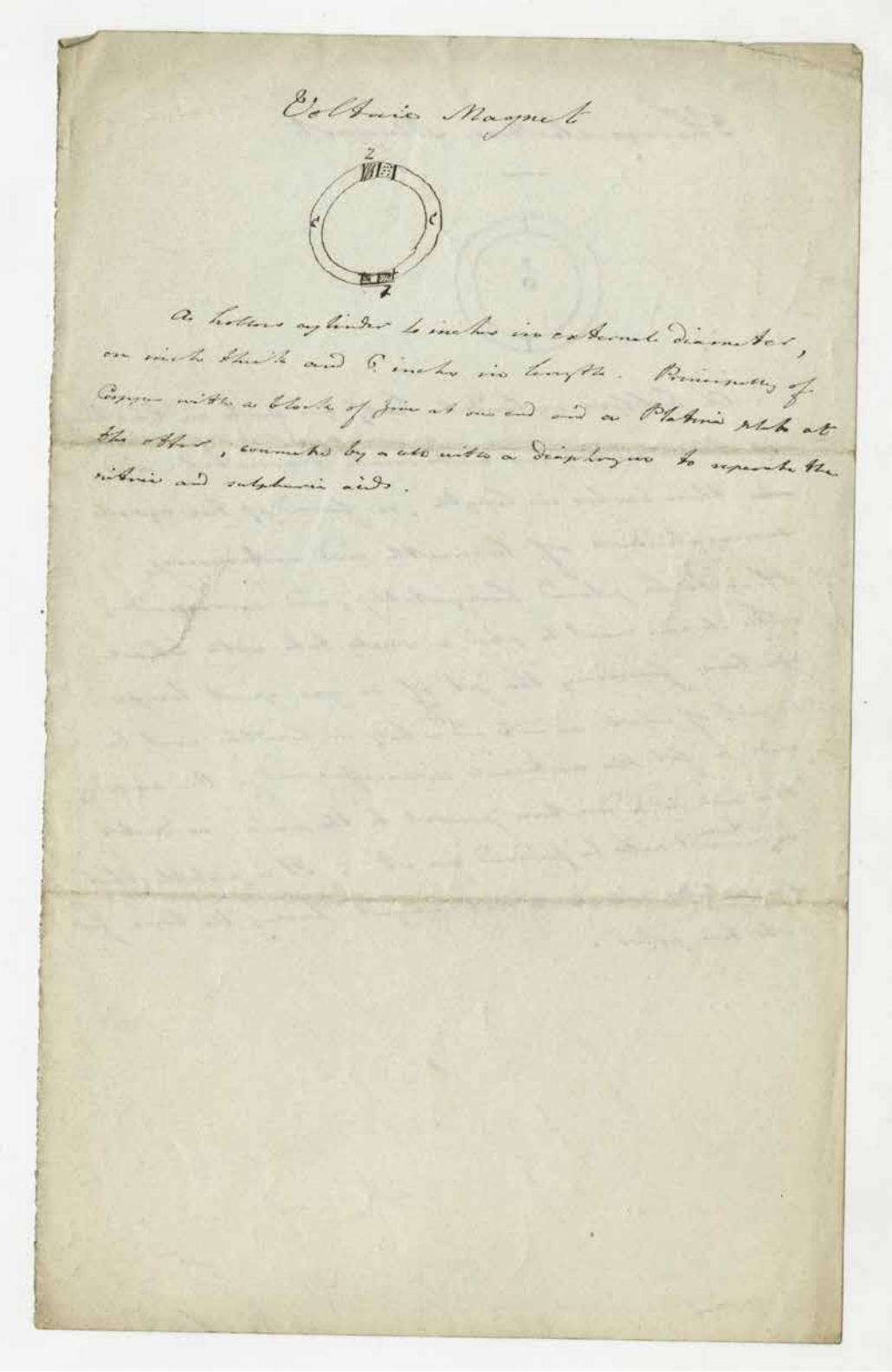
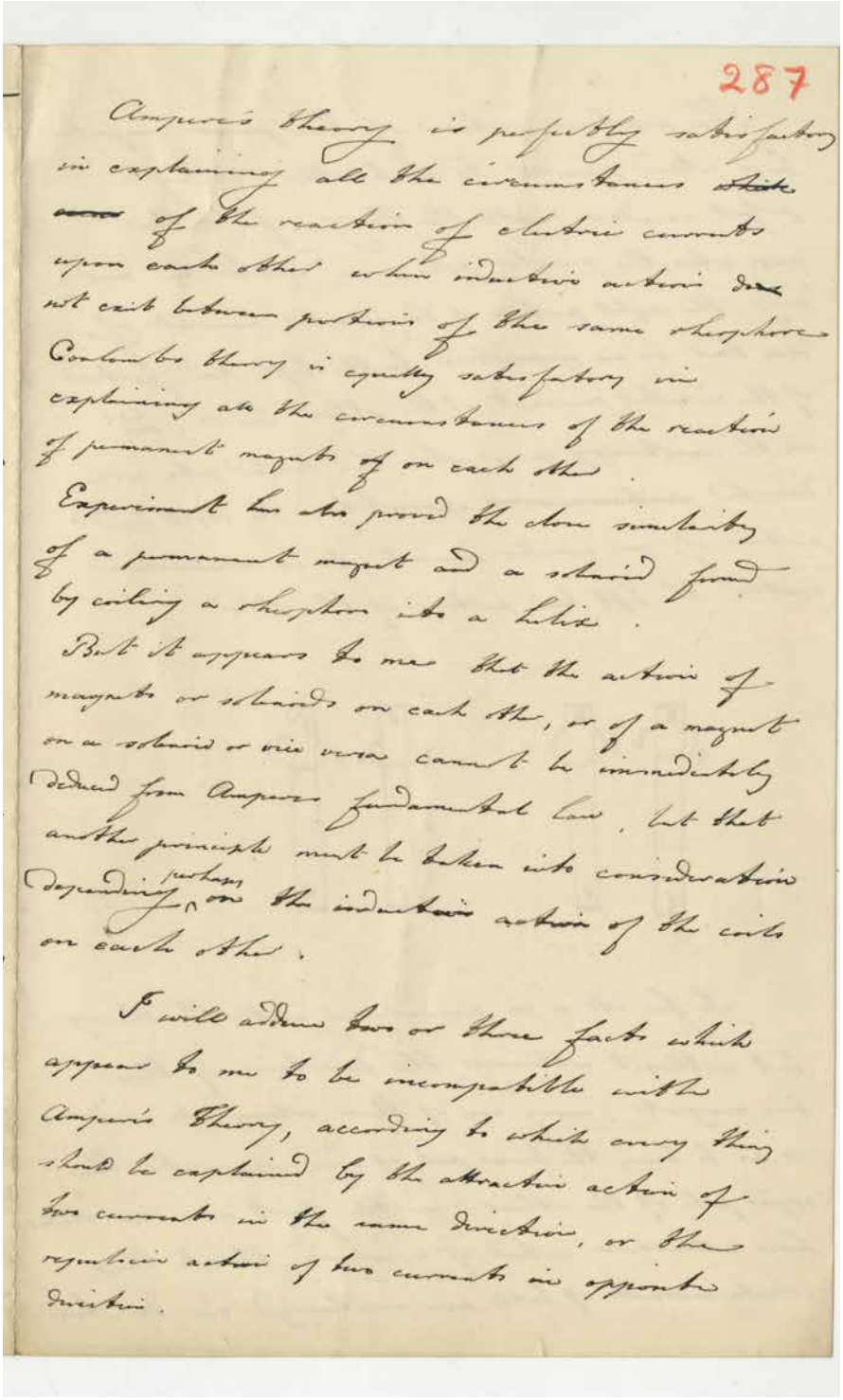


Voltaic Magnet

A hollow cylinder 6 inches in external diameter, one inch thick and 6 inches in length. Principally of Copper with a Block of Zinc at one end and a Platinum plate at the other, connected by a wire with a Galvanometer to separate the nitric and sulphuric acids.

K/PP107/3/3/286
Notes and sketch diagrams describing a thermoelectric magnet and a voltaic magnet, [1834-1875], page 2.



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Ampere's theory is perfectly satisfactory in explaining all the circumstances of the reaction of electric currents upon each other when inductive action does not exist between portions of the same conductor. Coulomb's theory is equally satisfactory in explaining all the circumstances of the reaction of permanent magnets on each other.

Experiment has also proved the close similarity of a permanent magnet and a solenoid formed by coiling a conductor into a helix.

But it appears to me that the action of magnets or solenoids on each other, or of a magnet on a solenoid or vice versa cannot be immediately deduced from Ampere's fundamental law, but that another principle must be taken into consideration depending perhaps on the inductive action of the coils on each other.

I will adduce two or three facts which appear to me to be incompatible with Ampere's theory, according to which every thing should be explained by the attractive action of two currents in the same direction, or the repulsive action of two currents in opposite directions.

K/PP107/3/3/287
Sketch diagrams and notes commenting on the electrodynamic theory of Andre-Marie Ampere (1775-1836), French physicist, [1834-1875], page 1.

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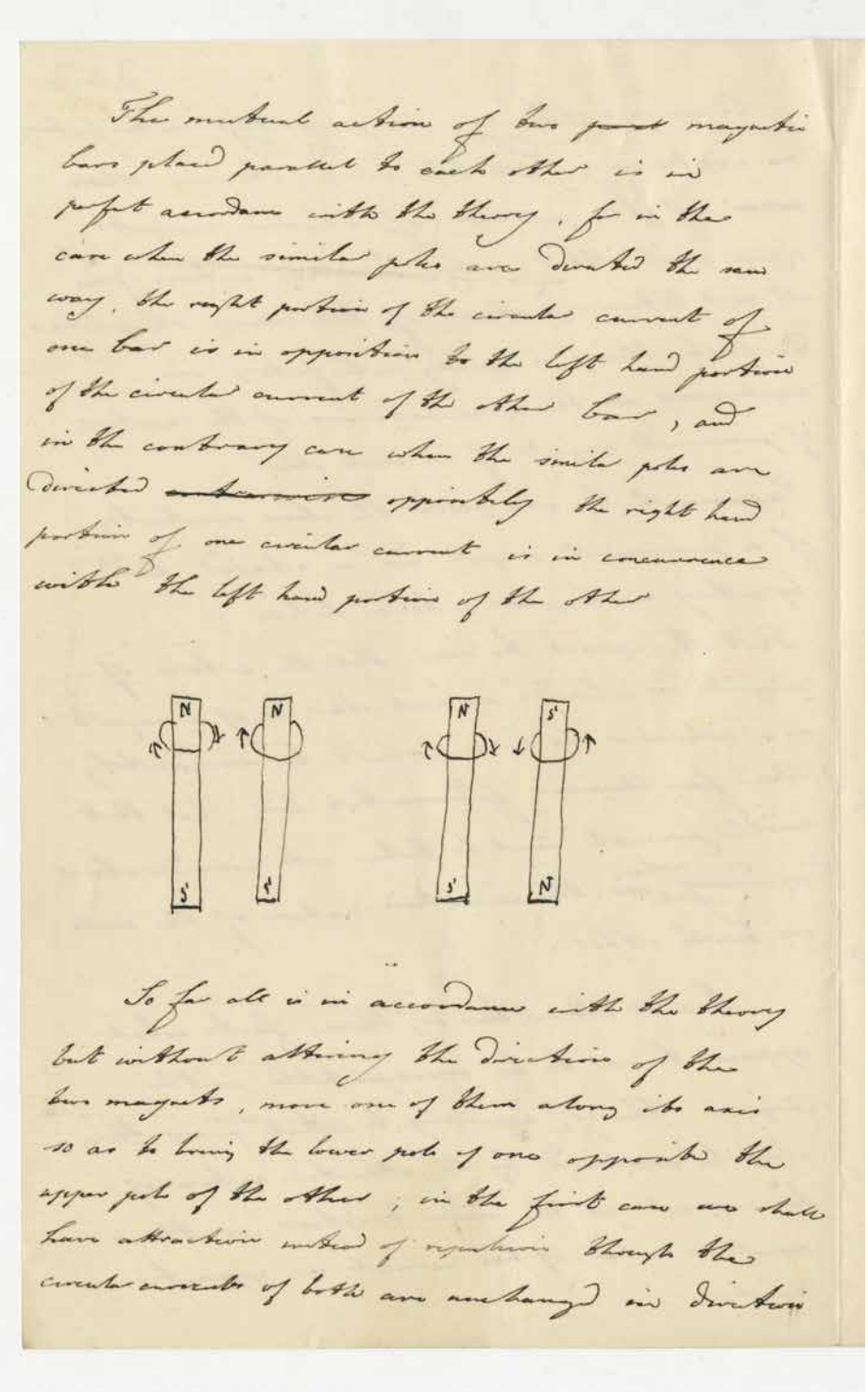
K/PP107/3/3 - Papers relating to electricity, magnetism and thermodynamics



The mutual action of two parallel magnetic bars placed parallel to each other is in perfect accordance with the theory, for in the case when the similar poles are directed the same way, the right portion of the circular current of one bar is in opposition to the left hand portion of the circular current of the other bar, and in the contrary case when the similar poles are directed ~~contrariwise~~ oppositely the right hand portion of one circular current is in concurrence with the left hand portion of the other

So far all is in accordance with the theory but without altering the direction of the two magnets, move one of them along its axis so as to bring the lower pole of one opposite the upper pole of the other; in the first case we shall have attraction instead of repulsion though the circular currents of both are unchanged in direction

K/PP107/3/3/287
Sketch diagrams and notes commenting on the electrodynamic theory of Andre-Marie Ampere (1775-1836), French physicist, [1834-1875], page 2.

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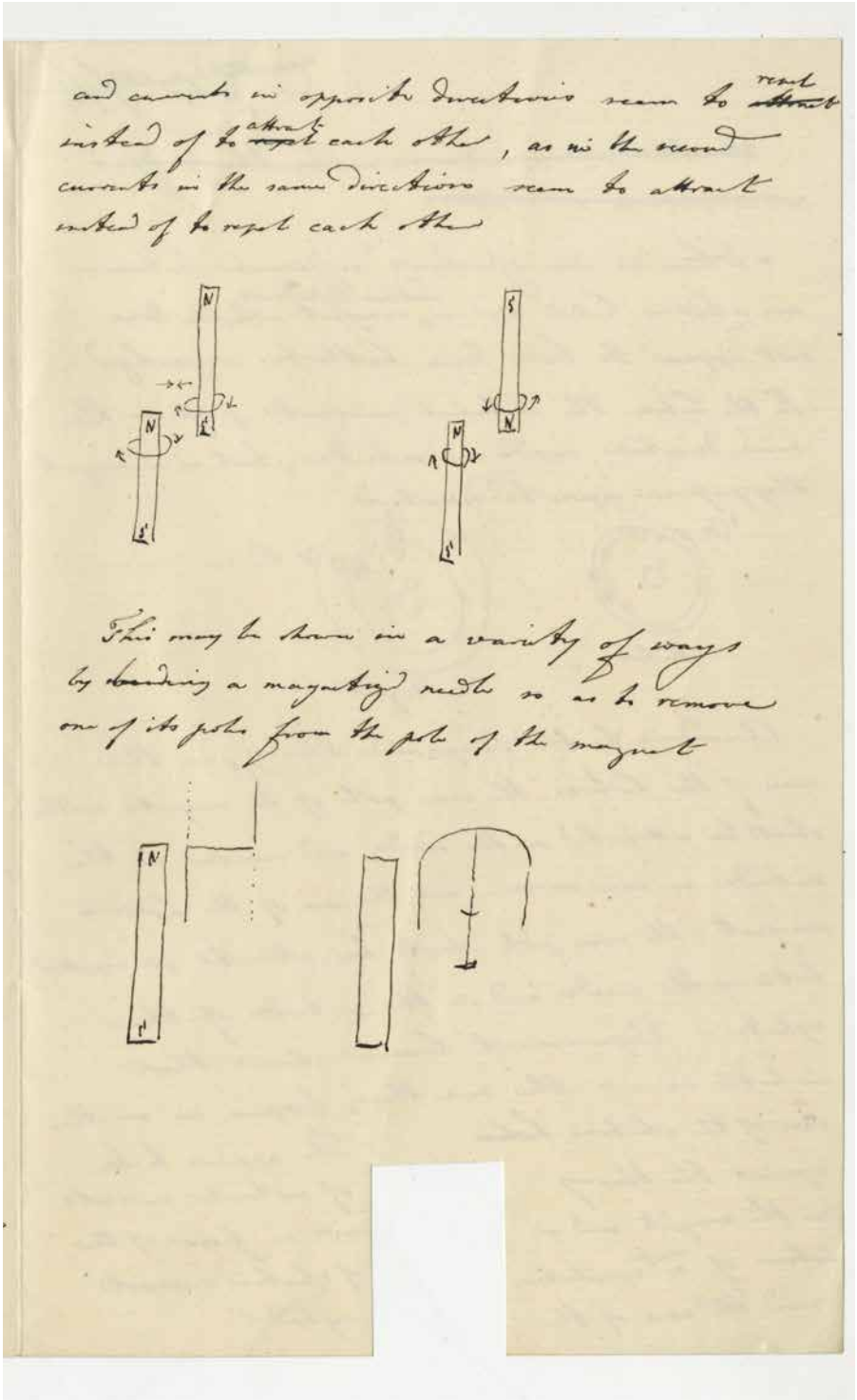

K/PP107/3/3/287
Sketch diagrams and notes commenting on the electrodynamic theory of Andre-Marie Ampere (1775-1836), French physicist, [1834-1875], page 3.

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~~Another circumstance the theory does not explain is that~~

There is an essential difference between an electric helix and a hollow cylindrical magnet which does not appear to have been hitherto signalized. In the helix the external currents pass in the same direction inside and outside, but in a magnet they pass in opposite directions

Helix

Magnet

According to the Amperian theory, in the case of the helix the same pole of the magnetic needle should be attracted on the inside and repelled on the outside or vice versa, and the case of the hollow magnet the same pole should be attracted or repelled both on the inside and on the outside of the cylinder. Experiment however shows that in both cases the same thing happens as in the case of the electric helix. This appears to be against the theory of molecular currents in the magnet and is more in favour of the notion of a single circulation of electric currents round the axis of the cylinder.

K/PP107/3/3/287

Sketch diagrams and notes commenting on the electrodynamic theory of Andre-Marie Ampere (1775-1836), French physicist, [1834-1875], page 4.

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Experiment

Two similar ~~Inductoriums~~ ~~Rhumkorff coils~~ were taken, and the primary coils were joined together, as also were the secondary coils. The sparks were taken from the secondary coil under three different circumstances. 1st The iron cores were insulated from each other 2nd The two were connected together by an iron armature at one end. 3d They were connected by iron armatures at both ends. In the first case the sparks was ~~3/4 5/8~~ of an inch in length; in the second 5/8 of an inch; and in the third 1/2 of an inch

Exps to be made

Repeat the same three experiments

1st with the wires respectively of the primary and secondary coils join side by side.

2d With one end two armatures when the wires are in one length but connected crossways

X

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Excited by 1 magnet

One armature

A Primary quantity arrangement, secondary intensity arrangement
armature joins opposite poles - - 5/10 inch

B Primary intensity arrangement, secondary intensity arrangement
armature joins opposite poles - -

C Do armature joins similar poles - - 1/2 inch

- - - 1/2 in

D Primary & secondary quantity arrangement - - 3/10 [illegible] sparks.

without armature

A - Pq - Si - - - - - - - - 3/4

B Pi Si - - - - - - - - 9/16

E Primary intensity arrangement, secondary quantity - - - 5/16
Pi Sq

D - Pq Pq - - - - - - - 9/16

Two armatures
opposite poles

A - Pq Si - - - - - 9/16

B Pi Sq - - - - - 3/16

D .. Pq Sq - - - - - - 5/16

E Pi Si - - - - - - 5/16

Two armatures
similar poles

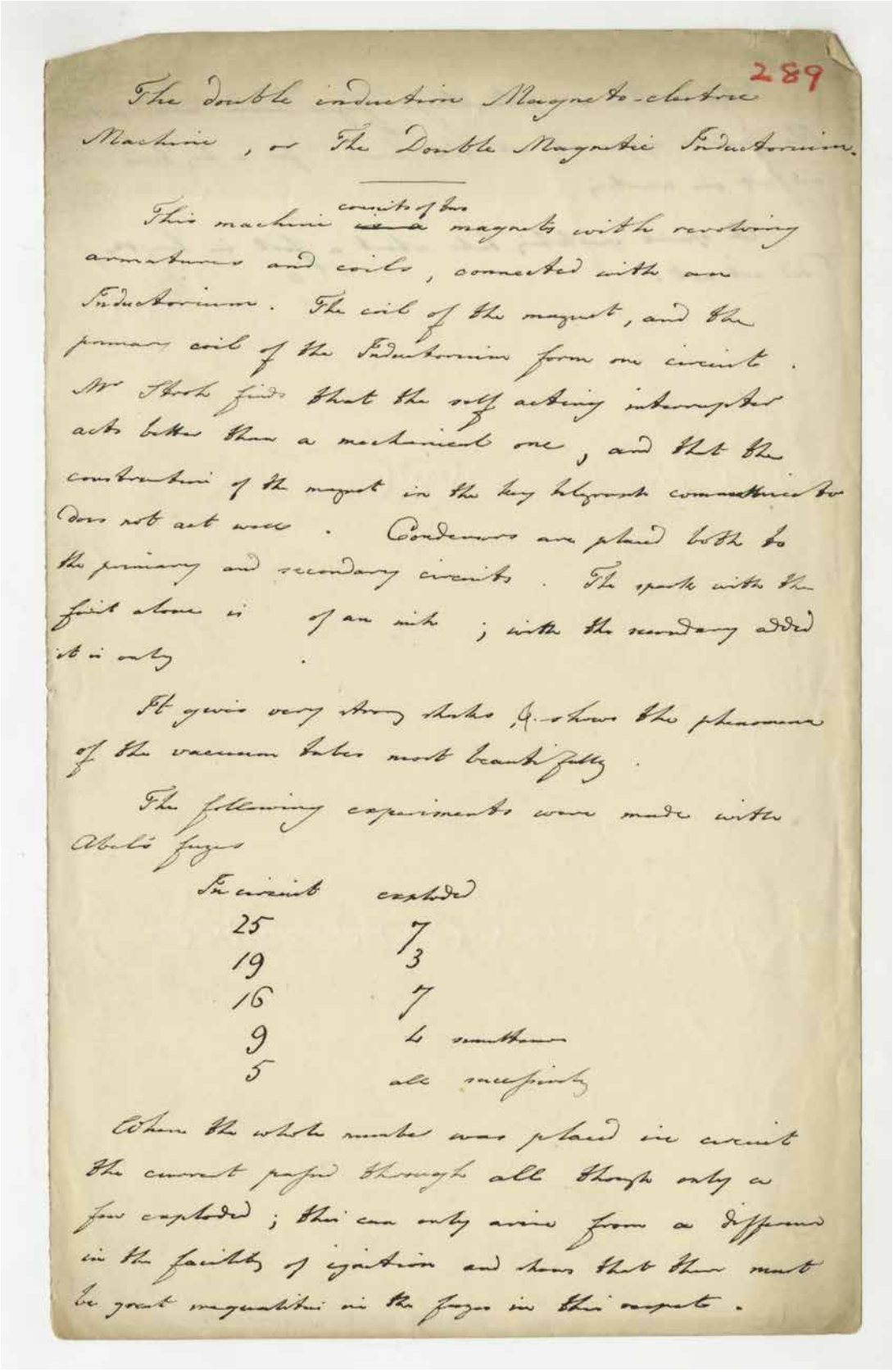
A .. Pq Si - - - - - - - 9/16

B Pi Sq - - - - - - - - - 5/16

D Pq Sq - - - - - 9/16

E Pi Si - - - - - 0/16

Primary 1/10 diameter . 50 feet
Secondary 0.006 - - 5000 yards.



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The double induction Magneto-electric Machine, or The Double Magnetic Inductorium.

This machine consists of two magnets with revolving armatures and coils, connected with an Inductorium. The coil of the magnet, and the primary coil of the Inductorium form one circuit. Mr Stark finds that the self acting interrupter acts better than a mechanical one, and that the contraction of the magnet in the key telegraph connecting box does not act well. Condensers are placed both to the primary and secondary circuits. The spark with the first alone is of an inch; with the secondary added it is only .

It gives very strong shocks, & shows the phenomena of the vacuum tubes most beautifully.

The following experiments were made with Abel's fuzes

In circuit	exploded
25	7
19	3
16	7
9	4 numbers
5	all respectively

When the whole number was placed in circuit the current passed through all though only a few exploded; this can only arise from a difference in the facility of ignition and shows that there must be great irregularities in the fuzes in this respect.

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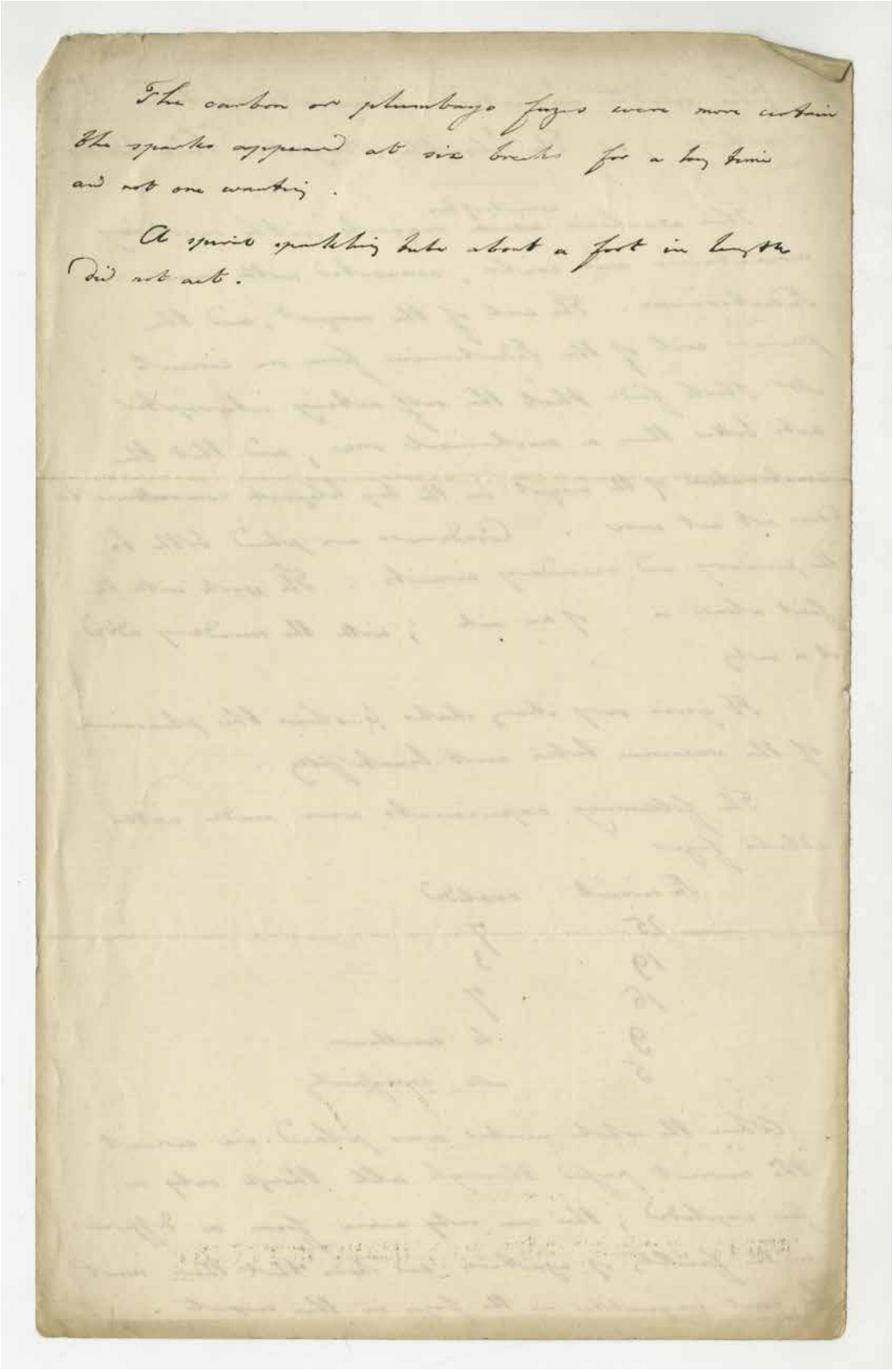
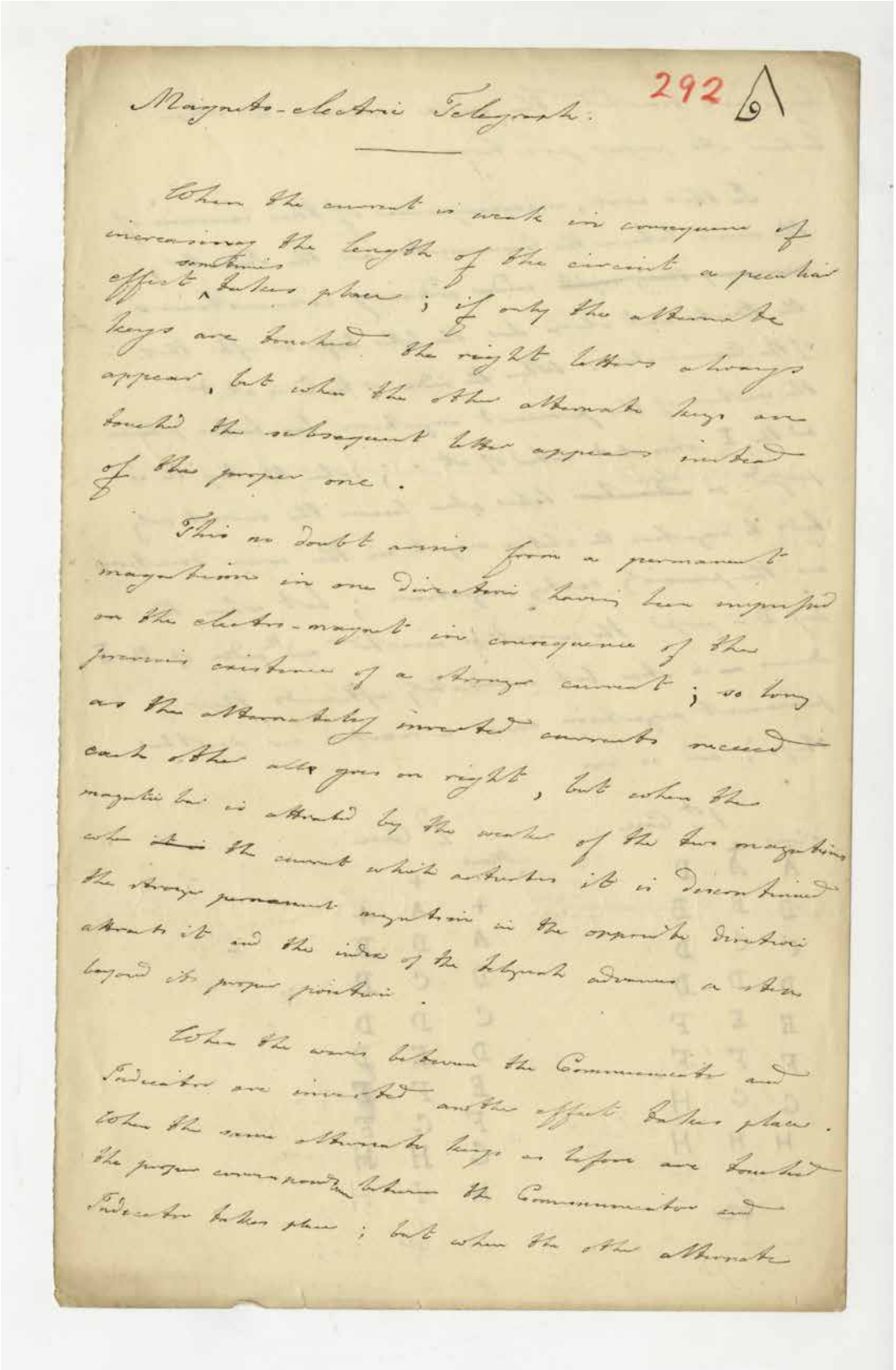


The carbon or plumbago pieces were more certain
the sparks appeared at six inches for a long time
and not one wanting.

A spirit sparking tube about a foot in length
did not act.

K/PP107/3/3/289
Notes describing the 'double induction Magneto-electric machine, or The Double Magnetic Inductorium' [type of induction coil], [1834-1875], page 2.



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Magneto-electric Telegraph.

When the current is weak in consequence of increasing the length of the circuit a peculiar effect takes place; if only the alternate keys are touched the right letters always appear, but when the other alternate keys are touched the subsequent letter appears instead of the proper one.

This no doubt arises from a permanent magnetism in one direction having been imparted to the electro-magnet in consequence of the former existence of a strong current; so long as the alternately inverted currents succeed each other all goes on right, but when the magnetic bar is attracted by the action of the two magnetisms when the current which actuates it is discontinued the strong permanent magnetism in the opposite direction attracts it and the index of the telegraph advances a letter beyond its proper position.

When the wire between the Communicator and Indicator are inverted and the effect takes place. When the same alternate keys as before are touched the proper correspondence between the Communicator and Indicator takes place; but when the other alternate

keys are touched. the index remains a step behind its proper position

In this case, in consequence of the inversion of the wires between the Communicator and the Indicator, ~~were every thing right~~ under ordinary circumstances the Indicator would always show the letter before or after that of the Communicator. When the index of the C is at + the reaction of the permanent magnetism has taken place and the I shows at + instead of at · ; when the key A is pressed no change ~~alteration~~ takes place because the current only tends to magnetise the electro magnet in the same direction as the previously existing magnetism ; but when the key B is pressed the current is inverted and the index of the I advances — a step but immediately afterwards the permanent magnetism causes a reaction and another step ; and so on

1st Case

Normal		
+ A	+ A	B
B	B	B
C	C	D
D	D	D
E	E	F
F	F	F
G	G	H
H	H	H

6c

2d Case.

Normal		
·	+	
+	A	+
A	B	B
B	C	B
C	D	D
D	E	D
E	F	F
F	G	F
G	H	H
H	I	H

6c

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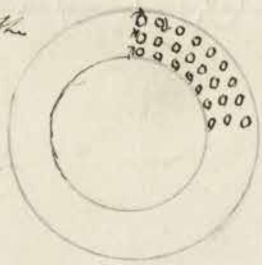
Magneto-electricity

The well ascertained fact that a helix placed within a hollow ~~magnetic~~ bar of soft iron does not magnetise the bar, whilst it renders it strongly magnetic when ~~placed~~ coiled round it externally, ~~admits of the following explanation~~ probably depends in some manner on the following circumstance

In the first case, the most remote circle of particles is magnetized as ~~the~~ strongly as the nearest row, their diminished number compensating for their greater distance



In the second case, the most remote circle of particles receives a much weaker magnetism than the nearest row, their distance and number both being greater.

Experiments to be tried

1. A hollow soft iron bar; one helix coiled externally, ~~the~~ another coiled internally the same resistance in each. Observe the magnetism of the bar when either helix is in action, or both in the same and opposite directions. Ascertain also the induction current when on the current passes through one or other of the helices.

2 Make a hollow ~~soft iron~~ magnetized steel horseshoe, coil a helix externally and internally; observe the induction currents in either helix when a soft iron armature revolves before it.

K/PP107/3/3/295
Notes with sketch diagram relating to 'Magneto-electricity' including a list of experiments to be tried, [1834-1875].

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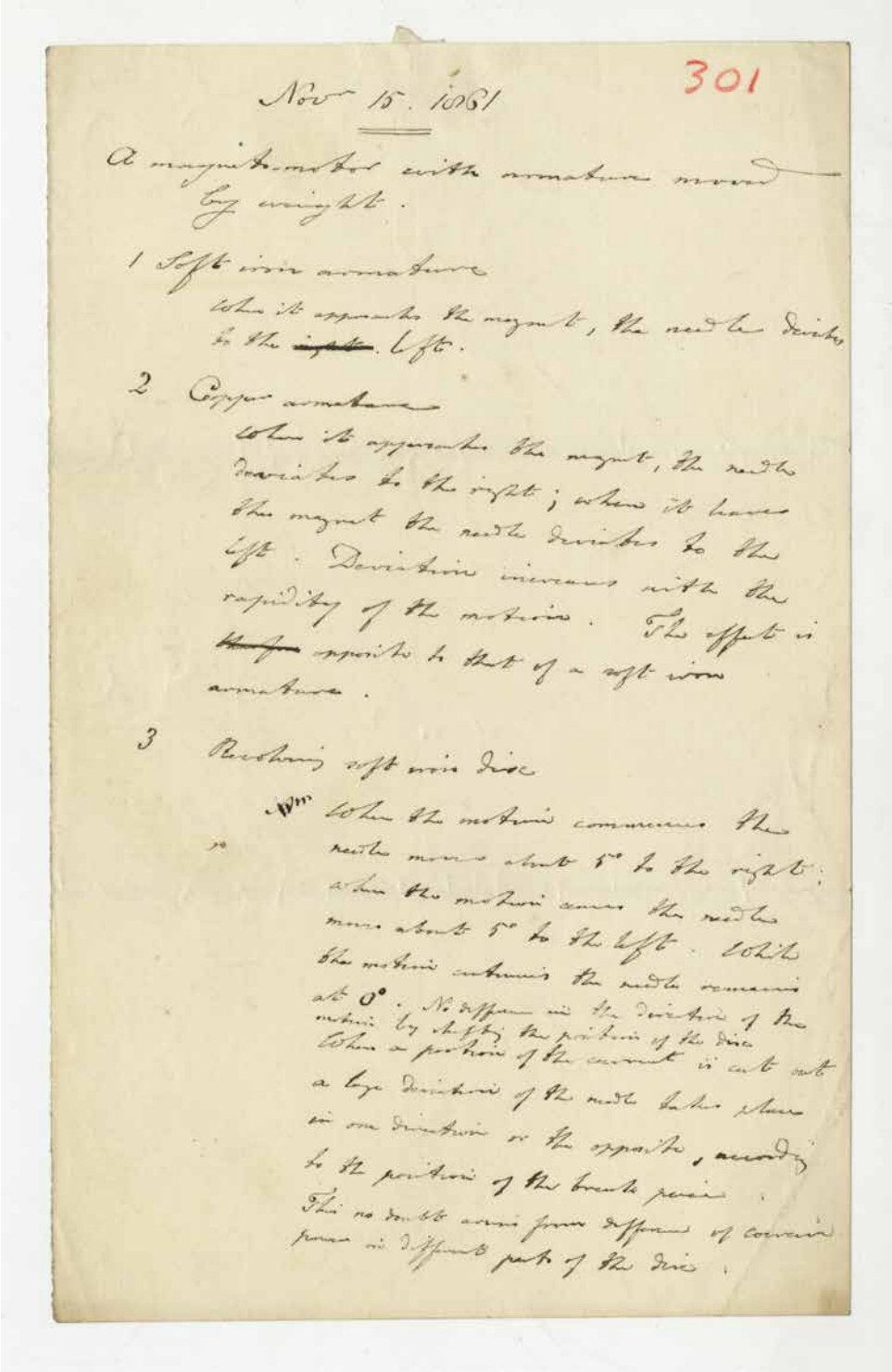

Nov 15. 1861 301

A magneto-motor with armature moved by weight.

1 Soft iron armature

When it approaches the magnet, the needle deviates to the ~~right~~ left.

2 Copper armature

When it approaches the magnet, the needle deviates to the right; when it leaves the magnet the needle deviates to the left. Deviation increases with the rapidity of the motion. The effect is ~~the~~ opposite to that of a soft iron armature.

3 Revolving soft iron disc

When the motion commences the needle moves about 5° to the right; when the motion ceases the needle moves about 5° to the left. While the motion continues the needle remains at 0°. No difference in the deviation of the motion by altering the position of the disc. When a portion of the current is cut out a big deviation of the needle takes place in one direction or the opposite, according to the position of the brush piece. This no doubt arises from difference of current power in different parts of the disc.

K/PP107/3/3/301

Notes describing a 'magneto-motor with armature moved by weight', possibly Wheatstone's experimental weight-driven magneto now in the Science Museum, 1861 Nov 15.

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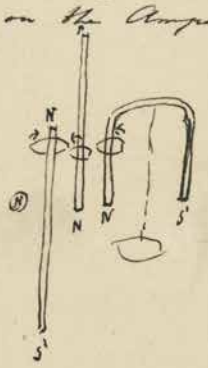
The following experiment is difficult to explain on the Amperian theory



A magnetized needle is bent so that its two branches shall be vertical and parallel to each other, and is mounted on a pivot parallel to its branches. The N half of a straight magnetic bar with equally rapid the N branch of the bent magnet whether the N pole of the former be upwards or downwards, though in the former case the opposed currents are in opposite directions, and in the latter are in the same direction. The ends of the two magnets with equally rapid each other whatever their inclinations to each other may be, even when they are at right angles to each other.

K/PP107/3/3/302

Notes on perceived deficiencies in the electrodynamic theory of Andre-Marie Ampere (1775-1836), French physicist, [1834-1875].

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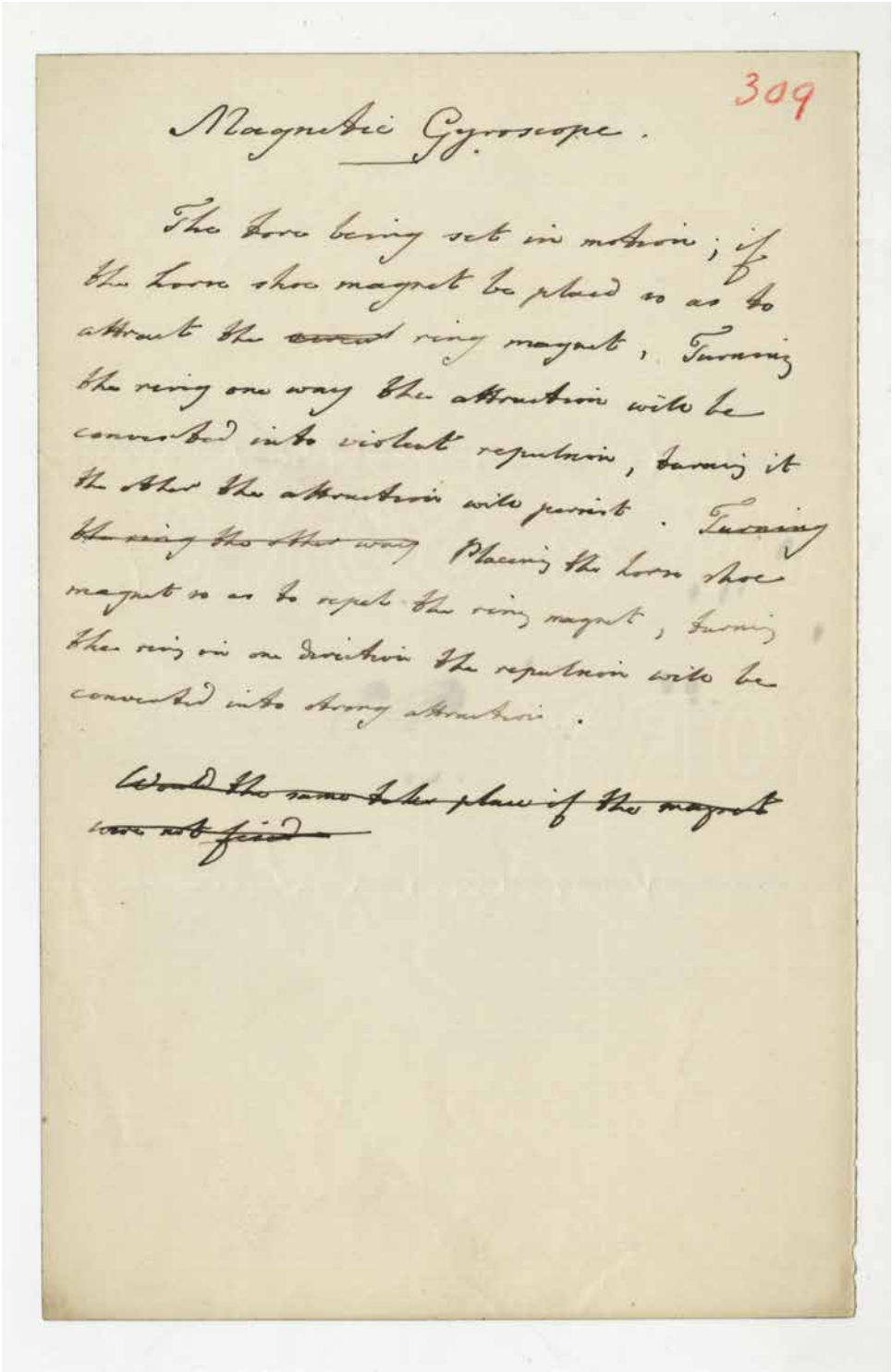

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Magnetic Gyroscope.

The bore being set in motion; if the bore shoe magnet be placed so as to attract the ~~ring~~ ring magnet, Turning the ring one way the attraction will be converted into violent repulsion, turning it the other the attraction will persist. Turning ~~the ring the other way~~ Placing the bore shoe magnet so as to repel the ring magnet, turning the ring in one direction the repulsion will be converted into strong attraction.

~~Would the same take place if the magnet was not fixed~~