



Smithsonian Institution

Smithsonian Institution Archives

Joseph Henry's Record of Experiments, Book 2

Extracted on Oct-27-2017 06:40:03

The Smithsonian Institution thanks all digital volunteers that transcribed and reviewed this material. Your work enriches Smithsonian collections, making them available to anyone with an interest in using them.

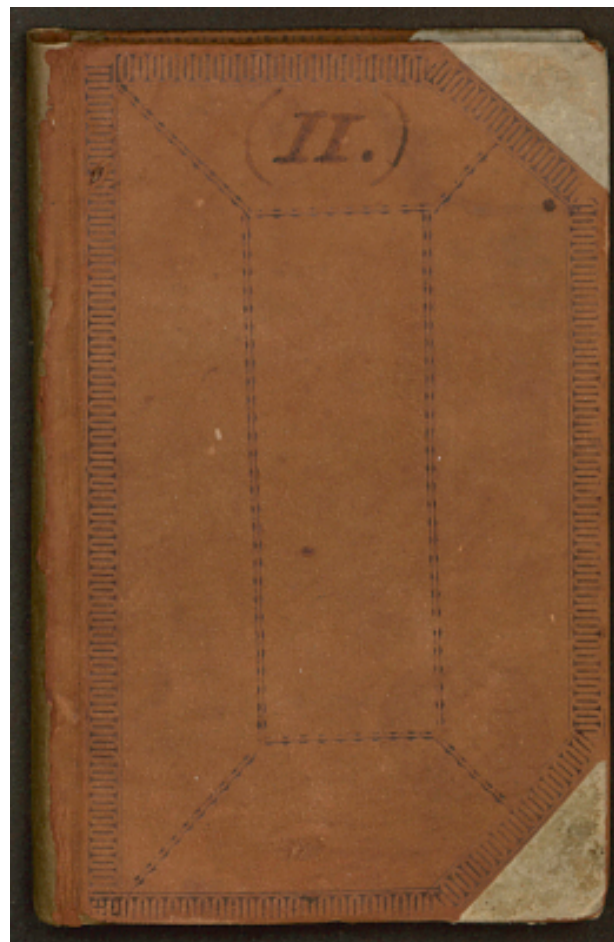
The Smithsonian Institution welcomes personal and educational use of its collections unless otherwise noted;

- If sharing the material in personal and educational contexts, please cite the Smithsonian Institution Archives as source of the content and the project title as provided at the top of the document. Include the accession number or collection name; when possible, link to the Smithsonian Institution Archives website.
- If you wish to use this material in a for-profit publication, exhibition, or online project, please contact Smithsonian Institution Archives or transcribe@si.edu

For more information on this project and related material, contact the Smithsonian Institution Archives. [See this project](#) and other collections in the Smithsonian Transcription Center.

[[Front Cover]]

(II.)



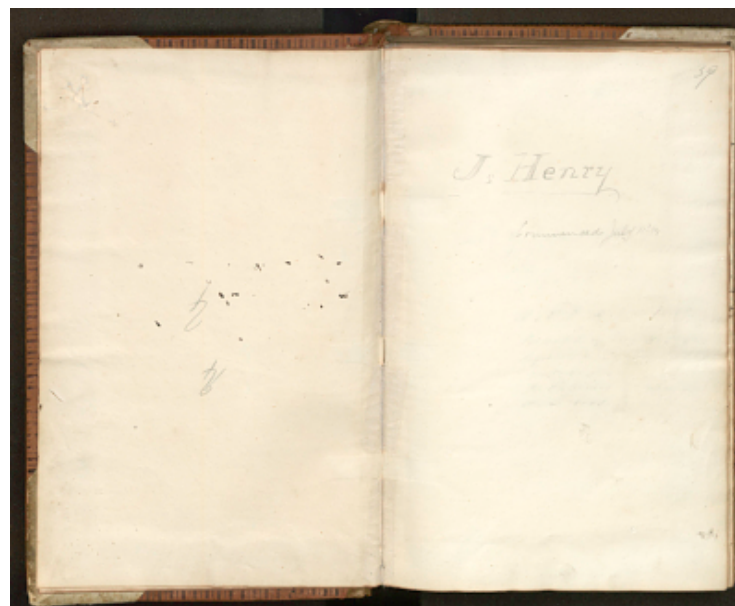
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Approved by Smithsonian Staff
Extracted Oct-27-2017 06:40:03

[[blank page]]
[[end page]]
[[start page]]
[[blank page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Approved by Smithsonian Staff
Extracted Oct-27-2017 06:40:03

[[two symbols]]
[[end page]]
[[start page]]
59
J. Henry
Commenced July 11 - '94

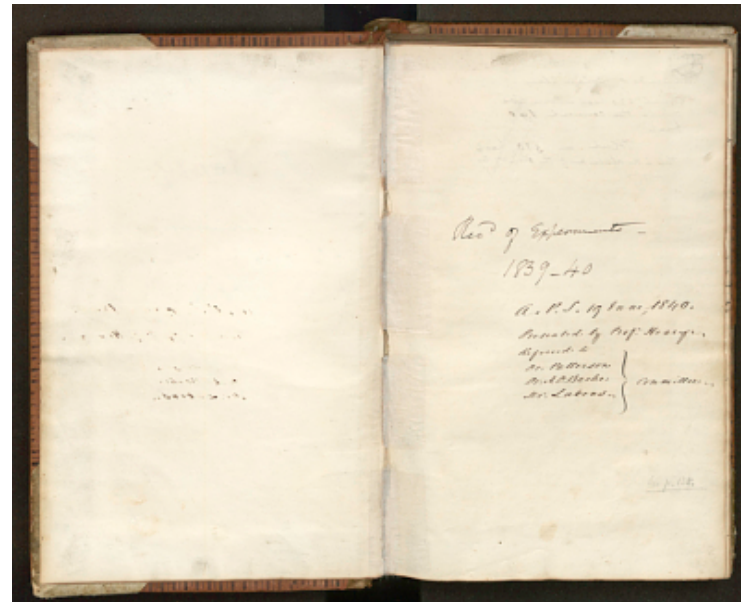


Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Approved by Smithsonian Staff
Extracted Oct-27-2017 06:40:03

[[blank page]]
[[end page]]
[[start page]]

Recd of Experiments -
1839 - 40
A.P.S. 19 June, 1840.
Presented by Prof. Henry
Referred to
Dr. Patterson }
Dr. A.D. Bache } Committee
Mr. Lukens }

[[underlined]] see p. 135. [[/underlined]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Approved by Smithsonian Staff
Extracted Oct-27-2017 06:40:03

Altitude of college plan
Canal 220 feet above tide
above the canal 160
feet

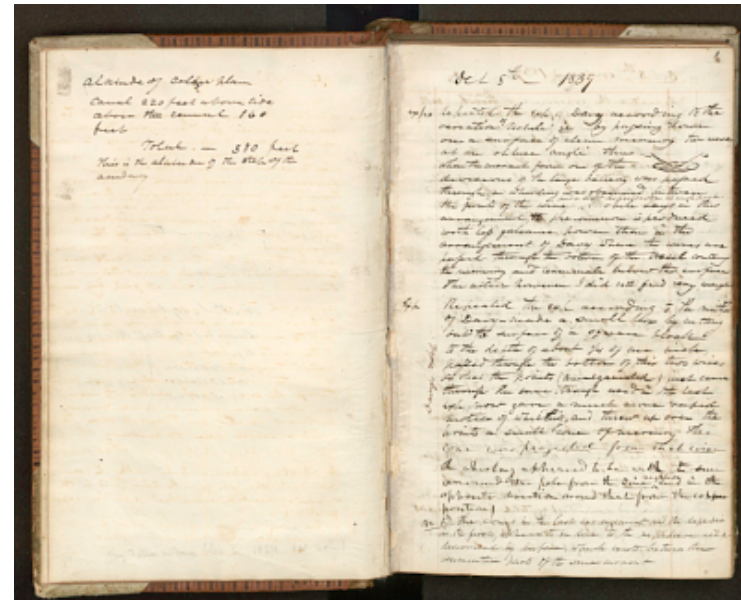
Total - 380 feet
This is the altitude of the step of the academy

My Father in 1834 vol 1
[end page]
[start page]

Oct 8th - 1839
exp. Repeated the exp of Davy according to the variation of Nobele ie by passing down on a surface of clean mercury two wires at an obtuse angle thus drawing — positive and negative wires in pool of liquid when the current from one of the divisions of the large battery was pressed through a whirling was observed between the points of the wire and a slight depression at each point Nobele says in this arrangement the plus omission is produced with less galvanic power than in the arrangement of Davy where the wires are pressed through the bottom of the vessel containing the mercury and terminate below the surface The action however I did not find very energetic.

exp. Repeated the exp according to the method of Davy—made a small box by cutting out the surface of a square block Davy, Exp. to the depth of about 1/4 of cm wide, passed through the bottom of this two wires so that the points (amalgamated) just came through the same-trough used in the last exp, now gave a much more rapid motion of whirling, and threw up over the points a small cone of mercury. The cone was projected from each wire. The whirling appeared to be with the zinc around the hole from zinc and in the opposite direction around that from the copper (positive)

M B The cones in the last exp arrangement and the depression in this first appear to be due to the repulsive action discovered by Ampere, which exists between the consecutive parts of the same current.
[end page]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

2

Oct 8th continued 1839

Repeated the experiment of ~~Nobele~~ Nobele with common electricity (See Nobele's memoirs page) The box used in the last exp served for this In the first attempt with two (gallon) jars, no effect, the stratum of mercury was too thick but could not be made thinner without thrusting up higher the points through the bottom of the box and in this case they required to be guarded by a coating of cement. With these precautions two jars, no effect was produced, but when three jars were employed, the mercury was thrown with so much force from the + point as to strike me in the face. The result was therefore in accordance with the observations of Nobele, and affords another example of the similarity of action of common and galvanic electricity. [[horizontal line]]

Tried to magnetize needles by sticking them into the bottom of the box through the stratum of mercury, but without success. [[horizontal line]]

Attempted to replicate an experiment of ~~spelling? --Pille~~ on the production of electricity by agitation of the particles of a metal, for this purpose attached one end of a thick piece of copper plate to the one wire of a galvanometer, and the other to a rasp then drew the end of the copper plate over the rasp. Needle appeared somewhat agitated but not sufficiently to indicate certainly a current ~~perhapse?~~ with a galvanometer with ~~short?~~ wire, an effect might be produce.

[[end page]]

[[Start page]]

3

Oct 9th 1839

Made a course galvanometer with about 40 turns of bell wire, used for the first time the connectors which I had made by ~~Chelton~~. ~~only?~~ small cylinders of copper of this form . Found they operated very well.

Oct 10th 1839

Arranged Pages little apparatus to produce a secondary current  used with it the part of the large battery used in the exp of the 8th ~~word~~. The motion of the electrometer was exceedingly rapid and the secondary shock too powerful to be taken. The tertiary shock from the Helix no 2 on no 1 was also very intense. When a plate of strict lead was interposed the neutralization was not complete, but when the large plate of Zinc was placed between nothing could be felt. I afterwards arranged the apparatus so as to get shocks from the current of the 4th order by placing coil no 2 on helix no 1 and connecting with the former coil No ~~3?~~, on which was placed helix no 2, Thus  by this arrangement quantity is converted into intensity and intensity into quantity. When a plate of metal was placed between any of the coils adjacent, the screening influence was exhibited from this it appears that the 2nd current from the ~~magnet?~~ ~~electric?~~ machine acts precisely the same as that from the battery.

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

4

Oct 10th

The best way to exhibit the screening influence to a class would be to suspend the coil after the method used by Dr. Hans and then to introduce different substances between the two while they are kept continually at the same distance.

The shock from the tertiary current with the foregoing arrangement was from the rupture of the current and not from the induction at the beginning, for while the tertiary current was so powerful as scarcely to be reduced from the induction at rupture, the same current at forming contact could scarcely be perceived through the tongue?

Sent the current from the little machine through the long wire spool (4 inches) with helix No 1 on top, but found no result.

Sent the current from the little machine through two garded points in the bottom of a box to see if the cones of mercury would be produced as in the experiments of Davy, but no effect was perceived.

Arranged two lead syphons in mercury at the upper end so that a current of galvanism might pass up one and down the other—put the whole away with the shaker battery attached to note the effect on the morrow.

Oct 12th inspected the above, found that but little mercury had come over, but that the greater quantity was on the negative side, the same result was obtained with the arrangement with the large battery

[[start page]]

5

Oct 10th

made some experiments on the light from the little machine. First whirled before the spark a disk with such velocity that figures on it could not be observed by ordinary light, these however were distinctly visible by the spark, showing that its duration was exceedingly small.

2nd the spark was received in the mirror of a whirling apparatus made for me by Mr. Saxton, and which revolves more than 30 thousand times in a second. In this it appeared elongated, which shows that although the duration was ~~not~~ very short still it was not instantaneous. The appearance of objects by the spark was singular, all appeared in a kind of refractory motion which affected the senses very unpleasantly.

3rd the spectrum from the spark was received through a prism and presented a very singular appearance, the red part was small also the blue part, but the yellow and violet quite abundant.

This should be studied again under better circumstances, from a surface of mercury not surrounded with glass as in this case.

As an illustration of the power of the little machine, when in full action and excited by a large battery, I may mention that a labouring man, one of Mr. Clows servants ~~was~~ being



requested to take hold of the handles, immediately fell to the floor, his hands spasmodically grasping the handles.
[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

6

Oct 11th 1839

visited today with Mr. S Alexander Mount Rose where Mr. Hasler has one of the stations for the trigonometrical survey of the coast of the United States. We were much pleased with operation of the heliotope, the instrument for throwing a beam of light to answer as a signal. It consists of a piece of looking glass about 2 inches long by one wide attached to the end of a telescope in such a position that when the telescope is directed to the distant object, a beam of light is thrown on the same object.  To understand the most simple arrangement of this heliotope, let a be a mirror, c a telescope with two screens d e with a hole in each so that the centers of these will be in the same line parallel with the axes of the telescope, now let the telescope be directed to the distant object and at the same time the mirror so turned that a ray of light from the sun shall peep through each hole in the screen of the telescope then it is evident that the beam will keep parallel to the axis of the glass and be thrown on the object to which the instrument is pointed.

From the station at Mount Rose, 8 stations are visible, and from 6 or 7 of these, light was streaming from as many heliopes like so many stars of the first magnitude. They were mostly distinctly visible by the naked eye,
[[end page]]
[[start page]]

7

Oct. 12th

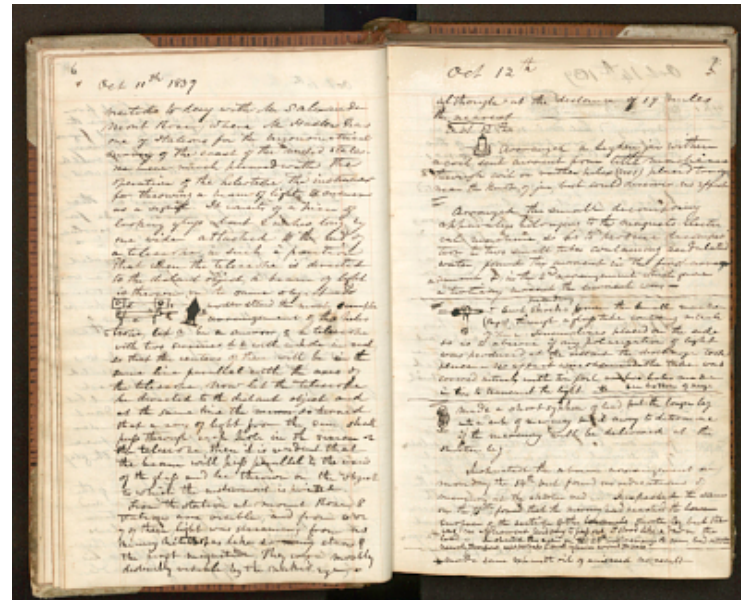
although at the distance of 17 miles the nearest

Oct 12th



Arranged a Leyden jar within a coil sent current from little machine through coil or rather helix (no. 1) placed together near the [[Rush?]] of jar, but could discover no effect.

Arranged the small decomposing apparatus belonging to the magneto-electrical machine, so as to produce decomposition in two small tubes containing acidulated water, found the current in the final arrangement + in the 2nd arrangement which gave a tertiary current, the current was  sent ⁴ shocks from the small machine (Page's) through a glass tube containing nitrate of Zinc. [[Tourmalines]] placed on the side so as to observe if any polarization of light was produced at the instant the discharge took place- no effect was observed. The tube was covered entirely with tin foil and two holes made in this to transmit the light *See bottom of page 
[[image of syphon]] Made a short syphon of lead, put the longer leg into a cup of mercury put it away to determine if the mercury will be delivered at the shorter leg.



Inspected the above arrangement on Monday the 14th, but found no indication of mercury at the shorter end. Inspected the same on the 15th, found that the mercury had reached the lower surface of the section of the shorter leg, but there was no apparent [[tendency?]] to [[peep?]] out, it stood like a dew on the lead - Inspected this again on the 28th with [[word]] the same, lead saturated nearly throughout exp perhaps a small cylinder around the axis.

*Made same exp with oil of aniseed no result

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

8

Oct 14th 1839

Exp 1 [[in left margin]]

a

[[image - a sketch showing coils of wire connected to one another and what looks like a battery, also a coil which is connected by two wires to a cylindrical object]]

Arranged coil no 1 and 2 so as to form a compound coil of two strands, attached the ends of no 1 with the battery and the ends of no 1 with the battery and the ends of no 2 with the ends of no 3, then connected helix no 1 with a galvanometer, this being arranged the battery was plunged into to acid, and afterwards the helix moved up and down over the third coil, the needle was deflected, and by timing the motion of the helix, the needle was made to describe more than 90 degrees. If there be no falacy in this experiment it is very important one and determines the existance of a state of induction called by Mr Faraday electrotonic which has never been shown to exist.

[[two diagonal lines crossing from the right margin to entry]]

see April 17th 1840 [[in left margin]]

Found a falacy in the above experiment, the electricity cut across from one coil to the other, the insulation of the several spires was not perfect. It however establishes the fact of the imperfect insulation between the spires of the coil covered only with cotton cloth, and also that the secondary currents by motion can be produced with a small current, I shall therefore be in possession of a simple method of sending them

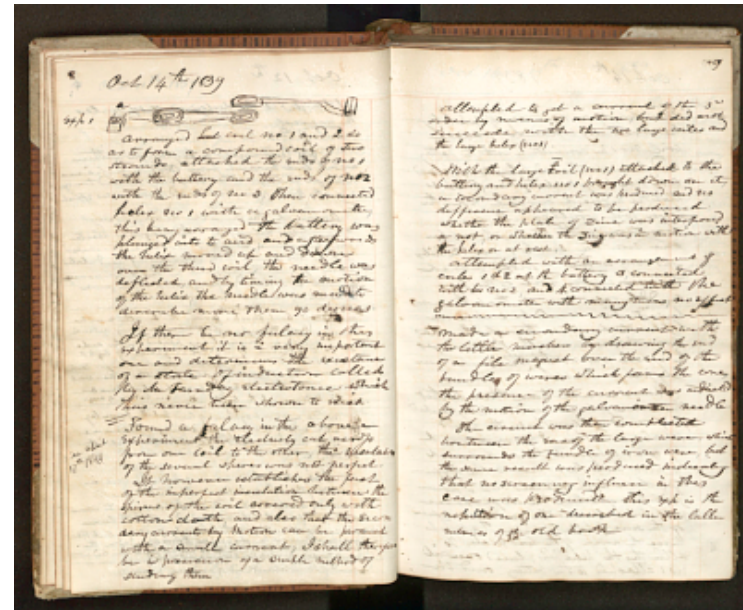
[[start page]]

9

Attempted to get a current of the 3rd order by means of motion, but did not succede with the two large coiles and the large helix (No 1). With the large coil (no 1) attached to the battery, and helix no 1 brought down on it, a secondary current was produced and no difference appeared to be produced. Whether the plate of zinc was interposed or not, or whether the zinc was in motion with the helix or at rest. Attempted with an arrangement of coiles 1 & 2 at the battery 3, connected with no 2, and 4 connected with the galvanometer with many turns, no effect.

[[horizontal line]]

Made a secondary current with the little machine by drawing the end of a file magnet over the end of the bundle of wires which forms the cone, the presence of the current was indicated by the motion of the galvanometer needle. The current was then completed between the end of the large wire, which surrounds the bundle of iron wire, but the same result was produced indicating that no screening influence in this case was produced. This exp is the repetition of one described in the latter entries of the old book



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[top of page]] 10 Oct 14th 1839

Thought of a new way of exhibiting the screening influence--placed coil no 1 in connection with the battery and between this and helix no 1 placed coil no 2 & 3 joined together first, so that the induced current from the lower coil would go in the same direction with that in the upper one, now the shock from the helix was very severe--next turned the lower coil of the two middle ones over so that the current by induction would be sent in an opposite direction through the other from the first with this arrangement the effect was nothing ^[[scarcely?]] the shocks were only just perceptible.

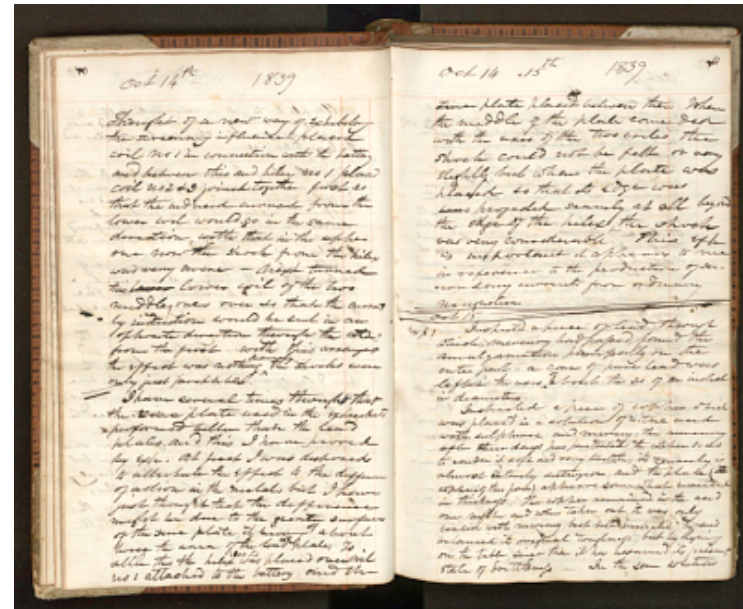
I have several times thought that the zinc plate used in the experiments performed better than the lead plates, and this I have proved by exp. At first I was disposed to attribute the effect to the difference of action in the metals but I have just thought that the difference might be due to the greater surface of the zinc plate, it being of about twice the area of the lead plates. To settle this the helix [[no 1 inserted above text]] was placed over coil no 1 attached to the battery and the [[end page]]
[[start page]] 11
Oct 14 & 15th 1839

zinc plate placed between them. When the middle of the plate connected with the axes of the two coils, the shock could not be felt or very slightly, but where the plate was placed so that its edge was projected scarcely at all beyond the edge of the helix, the shock was very considerable. This exp is important it appears to me in reference to the production of secondary currents from ordinary magnetism

[[horizontal lines across page. "Oct 15" written between lines]]

[[margin - left]]Exp 1[[/margin]]
Inspected a piece of lead through which mercury had passed, found the amalgamation principally on the outer part--a cone of pure lead was left in the axis ^[[of]] about the 20 of an inch in diameter.

Inspected a piece of copper, which was placed in a solution of nitric acid with sulphuric and mercury. The mercury after three days has penetrated the copper so as to render it soft and very brittle, its tenacity is almost entirely destroyed and the plate (the copper is of this form) appears somewhat increased in thickness. The copper remained in the acid one night and when taken out, it was only coated with mercury, but not penetrated by, and retained its original toughness, but by lying on the table since then it has assumed its present state of brittleness. In the same solution
[[page end]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[top of page]]

[[margin]] 12 [[/margin]] Oct 15th

and at the same time, I placed another piece of the same plate of copper, but connected as its upper end with a piece of Zinc. When examined next morning, this was found to have coated the lower end of this in apparently the same manner as the other piece, but the two now appear very differently the one being almost in a disintegrated state, and the other retaining its original toughness. The piece of Zinc was as dissolved off even with the surface of the solution, where I took the ~~metal~~ from the acid. It appears to me that this difference is in some way due to a galvanic action between the ~~lead~~ copper and mercury -- perhaps the copper takes on a polar state similar to that of steel, which prevents the action of the acid and mercury. This idea is in conformity ~~to~~ [^][[with]] the experiment described under the head of Oct 10th. The greatest quantity of mercury was found at the wire connected with the negative pole. The copper is negative pole under the acid, and from the above the mercury should be repelled from it.

Arranged two pieces of wire in the same way as the piece of copper plate before mentioned.

Put away a syphon of tinned iron to determine whether the mercury passes along the surface

Mercury did pass along the surface.

[[end page]]

[[start page]]

[[top of page]]

Oct 15

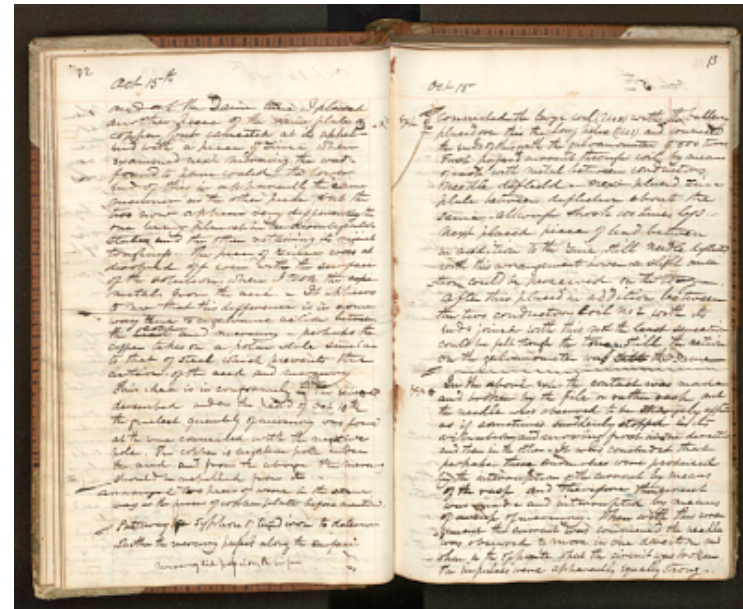
13

[[margin]] Exp 2 [[/margin]] connected the large coil (No 1) with the battery, placed over this the long helix (No 1) and connected the ends of this with the galvanometer of 500 turns. First passed current through coil by means of rasp with metal between conductors, needle deflected-- next placed Zinc plate between, deflection about the same--although shock 100 times less. Next placed piece of lead between in addition to the Zinc, still needle deflected. With this arrangement however, a slight sensation could be perceived on the tongue. After this placed in addition between the two conductors, coil no 2 with its ends joined with this, not the least sensation could be felt through the tongue. Still the action on the galvanometer was ~~still~~ the same.

[[line separator]]

[[margin]] Exp 3 [[/margin]] In the above exp. the contact was made and broken by the file or rather rasp, and the needle was observed to be strangely affected as if sometimes suddenly stopped in its vibration, and moving first in one direction and then in the other. It was concluded that perhaps these anomalies were produced by the interruption of the current by means of the rasp, and therefore the circuit was made and interrupted by means of a cup of mercury. When with this arrangement the current was commenced, the needle was observed to move in one direction and then in the opposite, where the circuit was broken the impulses were apparently equally strong.

[[page end]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
14 [[left margin]]
Oct 15th

This is a remarkable result first, because all the articles to produce the most perfect screening are made to intervene and not the slightest action is perceptible through the tongue 2nd because in the case of the shock this reaction at the commencement of the current is scarcely perceptible, while that at the end is very intense, but in this case as indicated by the needle, they are equally powerful. The directions of these motions were formed as determined by Mr. Faraday, the one at making contact in the opposite direction and the other in the same direction as the primary current.

[[margin]] Exp 4 [[/margin]]

Removed all the metal from between the two conductors, made the contact [[word lined through]] north end of needle swings to right, broke contact north end swing^[[s]] to the left about the same distance, and what appears to be very important, the swing was about the same, full as great [[word lined through]] but not greater than when the screening apparatus was between. The shock however on making contact could only be felt through the tongue while that on breaking contact was felt through the arms. These experiments establish the fact of the existence of two kinds of current in the same induction, one which [[+ sign to indicate footnote described in margin]] produces the shock and the [[margin]] + I have since found a different explanation. See my page No 4 [[/margin]]

[[end page]]
[[start page]]
[[left margin]] 15
Oct 15th

other which affects the needle.

[[margin]] Exp 5 [[/margin]]

Repeated the same with the difference of putting helix No 1 directly on coil No 1 without intervening space, as in the last exp, in this case the shock at making contact was much stronger through the tongue and could be felt in the hands, but the shock at breaking contact was extremely severe. When these were observed by the [[needle, crossed out]] galvanometer they appeared equally intense, the needle ^[[under the influence]] described nearly a quadrant.

[[margin Exp 6]]

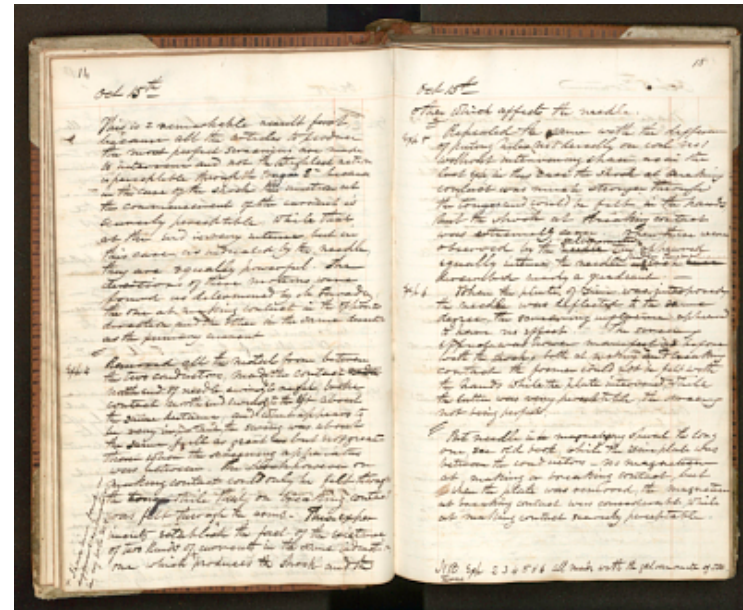
When the plate of Zinc was interposed the needle was deflected to the same degree, the screening influence appeared to have no effect. The screening effect was however manifest as before with the shock, both at making and breaking contact the former could not be felt with the hands while the plate intervened, while the latter was very perceptible, the screening not being perfect.

[[two horizontal lines]]

Put needle in [[word crossed out]] magnetizing spiral the long one, see old book, while the zinc plate was between the conductors--no magnetism at making or breaking contact, but when the plate was removed, the magnetism at breaking contact was considerable, while at making contact scarcely perceptible.

NB Exp 2 3 4 5 & 6 all made with the galvanometer of 500 turns.

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
[[left margin]] 16

Oct 15th continued

Made arrangements with coils no 1 ~~2 & 3~~ and helix no 1 & no ~~2~~ to get the tertiary current, but although the shock was very intense at breaking contact and nearly perceptible at making contact, yet but little indications could be got from the galvanometer of 500 turns and none from those of a smaller number of turns. From this, it appears that although the shocks from the tertiary current is great yet the measurable current is small.

Substituted for Helix no. 1 to measure the tertiary current, coil no 4, which was placed on coil no 3, no effect or next to none with the long galvanometer. Also got none with the next galvanometer in length. Try with the others (Tried this with Clarks galvanometer, succeeded coil no 2)

[[short horizontal line]]

Oct 24th

Since the last experiment, I have visited new New York to view to view the apparatus at the fair of the American Institute, but on the whole I was disappointed in the exhibition

Received a letter from My Friend ~~[[Bach?]]~~ this morning, stating that my letter announcing the result of my last experiment, those of Oct 15th to the society, had been listened to with much interest, and thus a new number of the proceedings was to be printed in order to announce me.
[[End Page]]

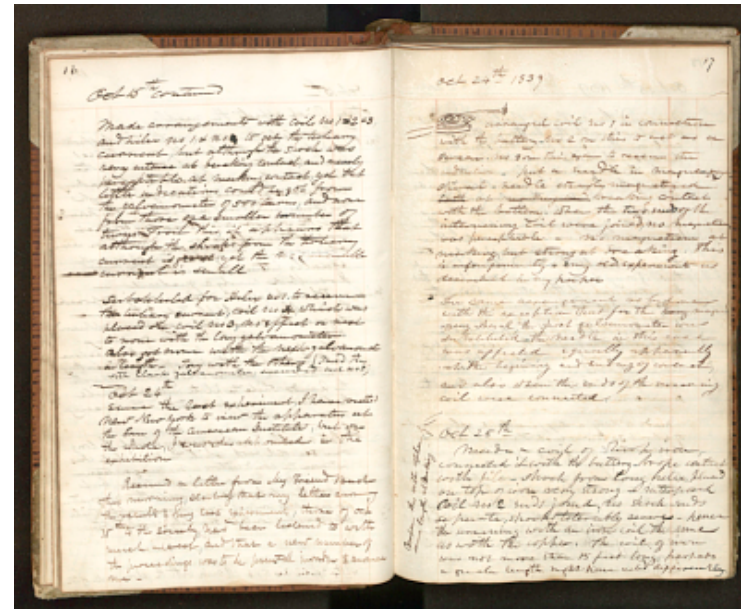
[[Start Page]]
[[left margin]]
Oct 24th 1839

[[image - a coil]] Arranged coil no 1 in connection with the battery - No 2 on this to act as a screen. No. 3 on this again to ~~[[receive?]]~~ the induction. Put a needle in magnetizing spiral. needle strongly magnetized ~~[[both]]~~ at ~~[[making and]]~~ breaking contact with the battery. When the two ends of the intervening coil were joined, no magnetism was perceptible. No magnetism at marking, but strong at breaking. This is in conformity to my old experiments as described in my paper.

The same arrangement as before, with the exception that for the ~~[[long]]~~ magnetizing spiral, the short galvanometer was substituted. The needle in this case was affected equally apparently at the beginning and ending of contact, and also when the ends of the screening coil were connected.

[[margin]] Compare this with copper same length at making
[[/margin]]
Oct 25th

Made a coil of hoop iron, connected it with the battery broke contact with file-- shock from long helix, placed on top of iron very strong -- interposed coil no 2 ends joined, no shock - ends separate, shock tolerably severe - hence the screening with an iron coil the same as with



the copper. The coil of iron was not more than 15 feet long, perhaps a greater length might have acted differently.
[[end of page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

18 Oct 25th 1839

[[Note in margin]] In this experiment, the effect on the shock was not noted by interposing the iron coil with the ends open and shut and in comparison with the copper coil.

Arranged the coils so that no 2 was in contact with the battery. The iron coil on this and helix no 1 on this, the ends of the helix were connected with the long wire galvanometer. The ends of the iron coil were then joined, the contact made, the galvanometer was deflected in the same manner as if a plate of copper or a ribbon of the same metal were interposed. The ends of the iron were next separated, the same result, [[hole in page]] [[in]]duced it appeared that if any difference existed, it was that the action was a little stronger when the ends were opened, but I am not certain of this

It would appear from these experiments that when the current is passing through a coil of iron, no peculiar transverse action is produced, more than in the case of a coil of copper wire under the same circumstances. [[margin]] See page 49 [[/margin]]

Made to day a differential galvanometer of about 30 turns, each strand also a differential magnetizing spiral.

There is a difference in most cases between the two inductions (Oct 15th), one is produced in a definite time, and the other is instantaneous - perhaps this difference may exist even in the induction where both shocks and motion of the galvanometer is observed. The one only affects the galvanometer, because it is of some duration, the other has such intensity, that no effect is produced. [[end page]]

[[start page]]
19
Oct 26th

[[Image]] Coil no. one was arranged perpendicularly, the horizon between coil no 3+4, which were attached to the differential galvanometer. Between coil no one and coil no four, coil no 2 was interposed, so that by uniting the ends of the latter, the screening influence would be exerted. The two coils were then so adjusted in reference to distance, that the two induced currents, passing in different directions, could not move the needle. The ends of coil no 2 were then joined so as to produce the screening influence, the needle still remained stationary - shows that the screening influence amounted to nothing.

[[horizontal line]]

To exhibit the effect of the other kind of induction, the galvanometer was removed and its place supplied with a differential magnetizing spiral. ~~[[strikethrough]]~~ The sho ~~[[strikethrough]]~~ A needle placed in this became strongly magnetic at the moment of breaking contact, but exhibited little or no magnetism at the beginning of the battery current, when only one of the coils was attached. When both coils were attached so that the currents passed in opposite directions around [[two horizontal lines]]

*The battery used in all the experiments thus far in these researches



(Oct 1839) was one of the divisions of the large battery. Observing to day that the action was very feeble, I ordered the old acid to be thrown out, when it was discovered that one of the hand vices used to make the connection had fallen into the acid, and had been acted on by the acid in a singular manner. The iron was so dissolved as to exhibit the stria of the metal. The sketch  in the margin shows the appearance of the nut which before the action of the acid, was perfectly smooth. This resembles the Daniels desication of alum.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

Oct 26th 1839

the needle, then no magnetism was developed. While the distances were preserved at which this effect was produced, the coil no 2, acting as the screen, was closed when the needle was strongly magnetized by a current from no 3, as determined by the direction of the polarity of the needle. The coil was used in the two previous experiments in preference to a plate of metal, because I have always found that the screening influence of it is greater than that of a plate.
 [[horizontal line across page]]

The action was varied by substituting for coil no 4, helix no 1, and removing coil no 3. Also in substituting for the differential, the long galvanometer. [[note in left margin]] Screened apparatus by gradually immersing battery [[/margin]] The current was formed, not by breaking or making contact, but by immersing the battery into the acid. No screening could be observed. The needle moved in one direction when the battery was plunged in and in the other when drawn out. [[note in left margin]] Same old book July 1839 [[13th?]] [[/margin]] This appears to be a modification of the induction produced by the motion of a helix near a coil through which a current is passing. I forgot to mention that the interposed coil was closed and afterwards opened, the same effect however was observed in both cases.

[[two short dashed lines in left margin]] While the arrangement of the last Exp remained the same, with the exception of a change for the galvanometer of a magnetizing spiral, no magnetic effects could be produced either with a short or long ~~spiral~~ spiral. [[note in left margin]] No magnet by immersing battery [[/margin]]
 [[end page]]

[[start page]]

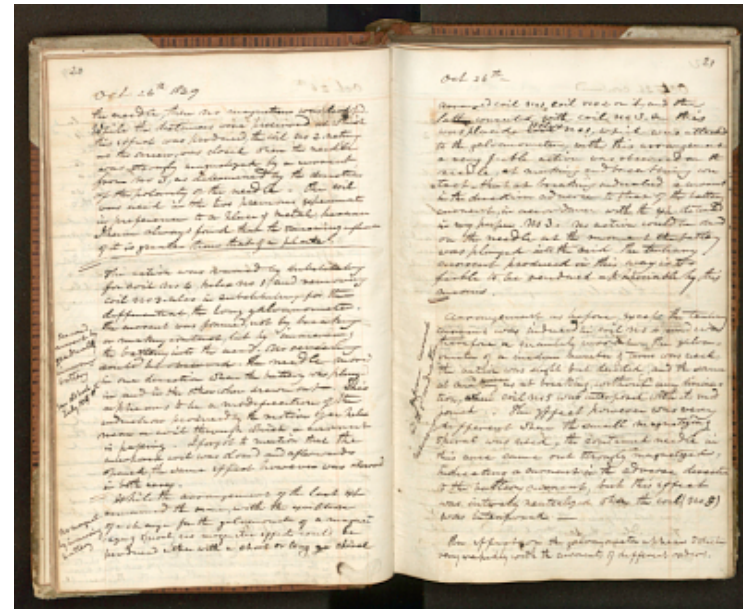
[[right margin]] 21

Oct 26th

Arranged coil no 1, coil no 2 on it and the latter connected with coil no 3. On this was placed ~~coil~~ Helix no 1, which was attached to the galvanometer with this arrangement a very feeble action was observed on the needle, at making and breaking contact - that at breaking indicated a current in the direction adverse to that of the battery current, in accordance with the exp. detailed in my paper. No 3, no action could be observed on the needle at the moment the battery was plunged into the acid. The tertiary current produced in this way is too feeble to be rendered appreciable by this means.
 [[two short dashes in left margin]]

Arrangement as before except the tertiary current was induced in coil no 4 and was therefore a quantity current. The galvanometer of a medium number of turns was used, the action was slight but decided, and the same at making as at breaking, without any diminution, when coil no 5 was interposed with its ends joined.

[[margin]] galvanic current in the 3rd coil conductor no screening
 [[/margin]]



The effect however was very different when the small magnetizing spiral was used - the contained needle in this case came out strongly magnetized - indicating a current in the adverse direction to the battery current, but this effect was intirely neutralized when the coil (no 5) was interposed.

The effect on the galvanometer appears to decline very rapidly with the currents of different orders.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

22
Oct 26. continued

Next attached the ^ [[small horse shoe]] magnet - see my paper no 3 - to the ends of coil no 2, which was placed on coil no 1 connected with the battery. The horse shoe became magnetic for the time, although in a fitful manner. The ends of the interposed coil no 5 was then joined, the screening influence was very perceptible, but was not perfect, since the magnet showed some signs of magnetism, notwithstanding the screen. This is as might have been expected, since the same current which will deflect the needle is generally sufficient to develop magnetism in soft iron.

[[horizontal line]]

[[image - sketch of hollow iron cylinder with attachment]] Connected the hollow iron cylinder, which is surrounded with copper wire, with the battery. Put on this helix no 2 and outside of this helix no 1, and on either side of these ~~helix~~ coil no 3 & 4 ~~for?~~, so as to screen as perfectly as possible. The ends of helix no one was connected with the long wire galvanometer. [[margin notes]] Should be no screen with galvanometer. The needle was thrown 180 degrees around at the making of contact, and the same at breaking, although the ends of all the wires and coils were joined, showing that little or no screening took place. The needle in this exp was very powerfully affected, and the screening was not perfect with two coils, and the helix. The needle in the last trial whirled several times around at making and also at breaking.

[[end page]]
[[start page]]



23

Oct 28th Monday
Attempted, by putting on another coil, to render the screening more perfect, but did not succeed. Observes that at each breaking of the battery current, which surrounds the soft iron hollow cylinder, a spark of electricity passed between the wire and the iron of the tube. Probably due to imperfect insulation, and when this is remedied the action will most probably be still more energetic. The defective screening in this case is probably due to the long wire of the wire helix offering some considerable resistance to the passage of the induced current.

Oct 28th

[[horizontal line]]

[[image - sketch of a cylinder, with a wire coiled around it, with each end of the wire connecting also to a nondescript object, possibly a battery. The negative and positive symbols for polarity are noted as well.]] Put a helix of small wire into the axis of the hollow cylinder of iron, attached the ends of the helix to the long wire galvanometer. Current from battery through wire around the hollow iron needle of galvanometer moved the same when the wire was disconnected, hence inferred that the movement was produced by the magnetism of the hollow iron, although at the distance of 7 feet.

[[horizontal line]]

[[margin note]] Iron does screen [[/margin note]]

Placed the galvanometer at the distance of 14 feet, so that the needle was unaffected by the magnetism of the hollow iron. The needle then remained stationary when the battery current around the iron was made and broken. --The helix of long wire was then withdrawn from the axis of the hollow iron and placed parallel with it along the outside - the needle

was then slightly affected. This exp shows the screening influence of iron. No shocks could be felt.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

Oct 29th 1839 ~~Monday~~ Tuesday

Prepared to day and yesterday a bundle of iron wires about 17 inches long. The wire is of an inch, and the bundle consists of 137 separate wires, they are not insulated for the 1st experiments. Around this bundle, a wire 1/10 of an inch thick, of copper, was wound, passing in two layers. The whole forms a powerful electromagnetic magnet.

[[margin]] Exp 1 [[/margin]]

When ~~coil~~ Helix no 2 was held near the end of the magnet, so that the axis of the magnet was in the ~~same~~ direction of the axis of the helix, the shock could be felt when the helix was at the distance of 6 inches from the end—same effect with helix no. 1, also with helix no. 3 but less in intensity.

[[two short diagonal lines in left margin]]

Exp 2 A cylinder of cast brass - the old pump chamber - was put over the magnet. Shocks were received through this from helix no. 1. The shocks with this arrangement could not be felt, when the helix was at a, but as it approached the middle of the bar, the shocks became  more intense and appeared to be most energetic at b, the middle. The screening was [^] perfect in this case.

[[two short diagonal lines in left margin]]

Exp 3 Compared the hollow magnet with the one of many wires, found the latter much more powerful, the action was felt at a greater distance, showing the advantages of a number of strands of wire.

[[end page]]

[[start page]]

25 Oct 29th 1839

Exp 4  Arranged the magnet of iron wires so that coil no. 3 might surround it. When the ends of this were closed, the shocks from helix No. 1 were much less intense than when the ends were separate. The same effect however was not produced when the ~~hel~~ coil was put on the farther end. Then the shock were quite intense.

[[dashes]]

Exp 5 When several coils were put on one end and helix No. 1 on the other, the shock was not quite as severe when the ends of the coils on the far end of the magnet were joined, as when the same were separated. The difference however was not as striking as I had anticipated.

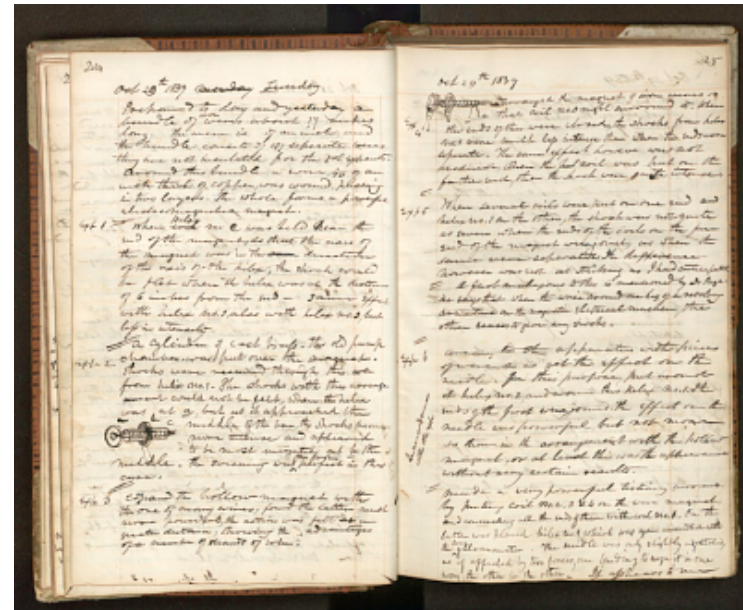
[[dashes]]

A fact analogous to this is mentioned by Dr Page. He says that when the wires around one leg of a revolving armature on the magnetic electrical machine, the other ceases to give any shocks.

[[dashes]]

Exp 6 Arrang  the apparatus with piece of wire, so as get the effect on the needle. For this purpose, put around it helix no. 2, and around this helix no. 1. The ends of the first were joined. The effect on the needle was powerful, but not more so than in the arrangement with the hollow magnet, or at least this was the appearance without very certain results. [[margin]] In accordance with other exp [[/margin]]

[[dashes]]



Made a very powerful tertiary current by putting coil no. 2, 3 & 4 on the wire magnet and connecting all the ends of these with coil no. 1. On the latter was placed helix No. 1, which was again connected with the ^[[long]] galvanometer. The needle was only slightly agitated, as if affected by two forces, one tending to urge it in one way, the other in the other. It appears to me

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

26

Oct 29th 1839

at this stage of the inquiry, that the induction which acts on the needle, partakes of the nature of a continued current, and as such, like the original current from the battery, it produces an induction which does not change its direction as the other induction does. The secondary current being a mere wave, its induction will therefore have little of the nature of that of a continued current and hence little effect will be perceived on the needle.

Next used for detecting the peculiar action of the tertiary current, a short wire galvanometer, but not the least effect could be observed, although the shocks were very intense the action was less than with the long wire and hence if a still longer wire were used, probably an action might be detected.

Replaced the galvanometer [[hole in page]] the long wire, made a break in the tertiary current and put the two ends in acid. The action on the galvanometer appeared greater in this way than when the ends were joined in metallic contact not very decided however. The screening influence in this case appeared to be operating but very feebly. The direction of the current at breaking contact was the same as that determined by my former experiments namely -- minus.

[[note in left margin with line drawn down to next section]] Repeated the exp with distilled water with different result. [[/note in left margin]]

[[dividing line across page]]

This was a tertiary currentb- the other exp. alluded to was a secondary one.

[[end page]]

[[start page]]

Oct 30th 27

[[image-coil with wires extending]] Attached coil no. 1 to the battery and placed a piece of iron in it split open. Connected this with the magnetizing spiral by two wires, one from each ~~edge~~ edge of the opening in the iron - made and broke contact several times with the battery, but no magnetism could be perceived in the needle. -- Next attached the same wires to the short wire galvanometer but little effect was observed on the needle. The needle appeared slightly affected when the piece of iron was raised and lowered from the centre of the coil. This experiment was made before and with the same result (see old book). The failure to get more definite results is probably due to low intensity of so short a circuit as the iron, and probably if the exp. be repeated with common electricity the results will be more marked.

Tried the exp. with ordinary electricity, and got the result anticipated, the needle came out strongly magnetic. In order to insure insulation, placed the iron in a glass cylinder. Still the same result, needle perhaps not as strongly magnetized. Smith, the assistant, stated that he received a shock when the discharge took place, he had one hand holding the wire, & the other grasping the cylinder. In this exp. 3 jars were used. -- Made some experiments in refer[ence?] to the shock above mentioned, but got no definite results.

[[line separator]]

Removed the iron wires from the bundle magnet, and placed into the hollow coil a rasp. This became magnetic feebly, without the swap, but more powerfully with the swap.-- Afterwards put in half round file. This became tolerably strongly magnetic, without

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[Start of page]]
[[that top left corner]] 28 [[/top left corner]]
[[top margin]] Oct 30th 1839 [[/top margin]]

the snap at breaking contact, and did not appear to be much stronger when the snap was formed. I made this experiment with the supposition that the instantaneous induction had much more to do with the magnetism of steel, than the steady current, but the result was not strikingly in accordance with the hypothesis. Indeed from my previous experiments, the fact of the magnetization permanently of hardened steel has been proved to take place with a powerful continued current from the battery. [[two short horizontal lines in left margin]]

Placed in the hollow magnetic coil, used in the last experiment, a permanent steel magnet, first north pole in, then south pole, but found no difference of results. The shocks appeared equally strong, although they were both feeble. [[margin]] See p 124 [[/margin]] Mr. Faraday found that the same effect was produced from the induction of the Earth as from a piece of soft iron. In this experiment, the soft iron produced much the more intense action, without the magnet or the iron, the effect could not be observed. The magnet retained its polarity after the experiment the same as at first. This should be repeated on a larger scale and with a better arrangement, the coil is too long.

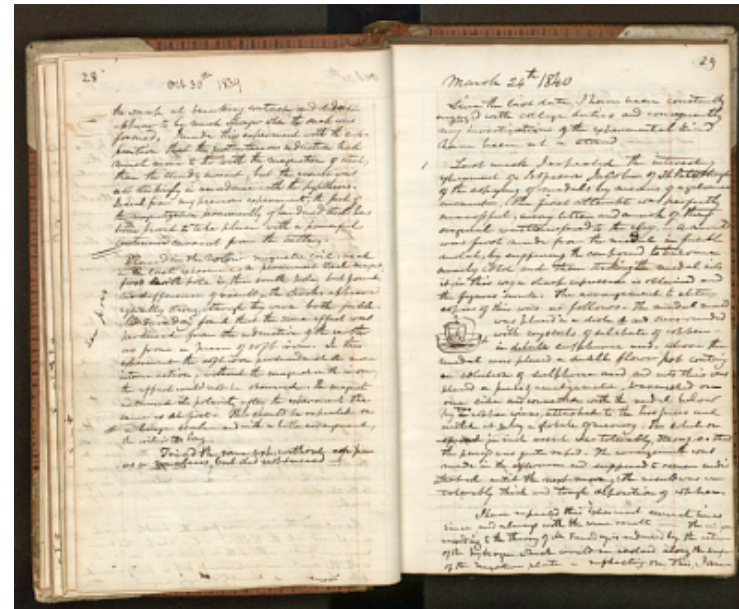
Tried the same exp, without copper as a nucleus, but did not succeed-

[[End page]]
[[Start Page]]
March 24th 1840 29

Since the last date, I have been constantly engaged with college duties and consequently, my investigations of the experimental kind have been at a stand.---

1 Last week I repeated the interesting experiment of Professor Jacobs of St Petersburg of the copying of medals by means of a galvanic current. The first attempt was perfectly successful, every letter and mark of that original was transferred to the copy.-- A mould was first made from the medal in fusible metal, by suffusing the compound to become nearly cold, and then striking the medal into it. In this way a sharp impression is obtained and the figures [[sunk?]]. The arrangement to obtain copies of this was as follows. [[image --experiment jar inside a larger dish filled with liquid. Jar contains a bent wire device. A wire connects the wire device in the jar to an object in the dish. Parts are labeled "a" "b" "d" and "E"]] The medal mould was placed in a dish [[underline]] d [[/underline]] and surrounded with crystals of sulphate of copper in [[underline]] dilute [[/underline]] sulphuric acid. Above the medal was placed a small flower pot containing a solution of sulphuric acid, and into this was placed a piece of amalgamated, varnished on one side and connected with the medal below by [[strikethrough]] a [[/strikethrough]] ^[[two]] copper wires, attached to the two pices and united at [[underline]] E [[/underline]] by a globule of mercury. The solution [[strikethrough]] [[illegible]] [[/strikethrough]] in each vessel was tolerably strong, so that the process was quite rapid. The arrangement was made in the afternoon and suffered to remain undisturbed until the next morning: The result was a tolerably thick and tough deposition of copper.

I have repeated this experiment several times since, and always with the same result -- the copper, according to the theory of Mr. Faraday, is reduced by the action of the hydrogen, which would be evolved along the surface of the negative plate-- Reflecting on this, I am --
[[End Page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

[[top left margin]] 30 [[top left margin]]

lead to think that all cases of the substitution of one metal for another, as in the case of the deposition of copper on iron from a ~~[[striketrough]]~~ solution of the sulphate, the action is due to the decomposition of the water. The union of hydrogen with the oxide of copper and the consequent reduction of the metal. To put this idea to the test, a small quantity of nitrate of silver was found and a piece of copper plunged into it, but no precipitation of silver was effected. The same process was then repeated over the flame of a spirit lamp. The water evolved by the combustion effected the decomposition. The experiment in both cases was made by putting the salt on a piece of mica, and heating it by a spirit lamp in the exp. The salt was put on top of the mica, so that the water from the lamp could not reach it. This exp was made by Dr Torrey as the operator and adviser.

[[two short horizontal lines in left margin]]

The action of the hydrogen on a solution of copper was interestingly show by another arrangement. A dish of a flower pot was ~~[[image -- bowl with liquid - possibly labeled "zinc"]]~~ put into a bowl, and into this sul copper poured and diluted sul acid in the bowl. A piece of zinc was put in the acid under the bowl, and connected with the ~~[[striketrough]]~~ zinc ~~[[striketrough]]~~ [^][[copper]] above. The zinc was not amalgamated, and consequently streams of hydrogen were given off, which rising against the under surface of the porous plate, passed through it in some degree and reduced the copper in the form of a granular powder.

Tried the comparative action of parchment and flower pot action with the former much more energetic

[[end page]]

[[start page]]

March 25th 1840 31

Placed a piece of lead wire in a cup of mercury after the metal had been coated with a thick stratum of hard varnish of shellack in alcohol. The mercury passed over, but I think more time was required than in the case where the mercury is uncoated

[[two short horizontal lines]]

Made a comparative experiment relative to the action of parchment, and unglazed ware (flower pot) as used in a sustaining battery--found that the parchment acted with much more energy. Mr Daniell uses a thin porcelain ware, which answers the purpose quite as well as membrane and lasts an indefinite time

[[two short horizontal lines]]

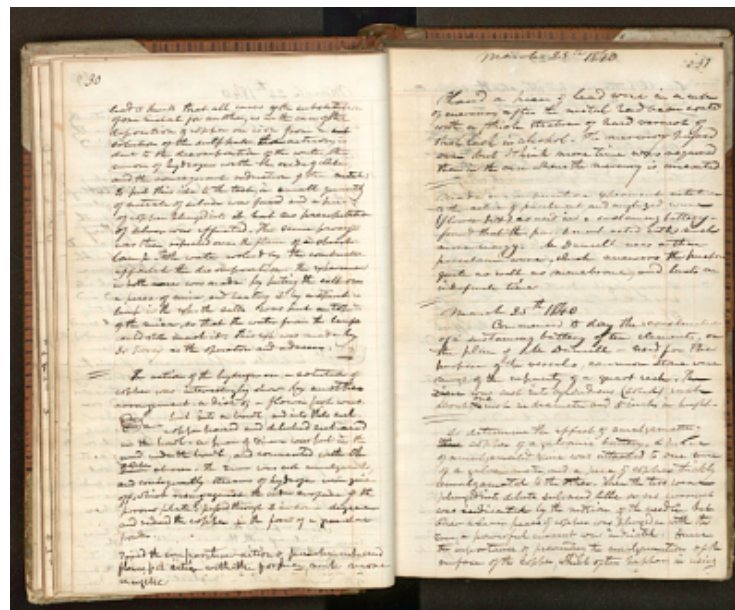
March 25th 1840

Commenced to day the construction of a sustaining battery of ten elements, on the plan of Mr Darnell--used for the purpose of the vessels, common stone ware mugs of the capacity of a quart each. The zinc was cast into cylinders (solid/ each about ~~[[striketrough]]~~ 1 1/2

~~[[striketrough]]~~ [^][[one]] inch in diameter and 5 inches in height.

[[two short diagonal lines]]

To determine the effect of amalgamating ~~[[striketrough]]~~ this ~~[[striketrough]]~~ copper of a galvanic battery. A piece of amalgamated zinc was attached to one ~~[[point ?]]~~ of a galvanometer, and a piece of copper thickly amalgamated to the other. When the two were plunged



into dilute sul. acid little or no current was indicated by the motion of the needle, but when a clean piece of copper was plunged in with the Zinc, a powerful current was indicated. Hence the importance of preventing the amalgamation of the surface of the copper, which often happens in using
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

32
March 25th

small batteries, in which the connections are formed by cups of mercury

[[two short horizontal lines]]

Mr. Daniel supposes that the [^]peculiar [^]action of amalgamated zinc is due to the uniform state of the surface - that the water is decomposed, the hydrogen instead of escaping forms a stratum of [^]indoleic[^] bubbles, which defends the zinc from any further action. When the current is completed, the hydrogen is given off at the negative plate. To test this supposition, two amalgamated plates were plunged into the same acid solution. A very slight indication of a current was noted. The bubbles were then brushed off constantly from the surface of one of the plates, but by this operation the effect on the galvanometer was scarcely increased.

[[two short horizontal lines]]

Made a current through the galvanometer with a piece of amalgamated copper, [^]nitric[^] acid, a slip of clean copper. The clean copper was attacked by the acid, a powerful current was formed, the pure copper acting as the zinc plate - gas was given off at the clean copper pole, but little at the other - when the clean plate was suddenly put into the acid, after the other had been in some time, a sudden action of the needle in the adverse direction indicated that the current for an instant was from the amalgamated plate to the other. The same effect took place when the clean plate was first put in and the action suffered to be fully established.

[[page end]]
[[page start]]

33
March 26

The negative plate of a battery may be formed of charcoal. I find that pine coal is a tolerably good conductor, provided it be well burnt and of compact wood that is pine, which has grown slowly.

Mr. Saxton finds that the [^]copper from the [^]sulphate of copper could be precipitated by means of a galvanic circle on the surface of a piece of plumbago and also on anthracite coal, but that the decomposition of the oxide of copper did not take place when the wire of connection did not touch the liquid. Try this experiment with variations

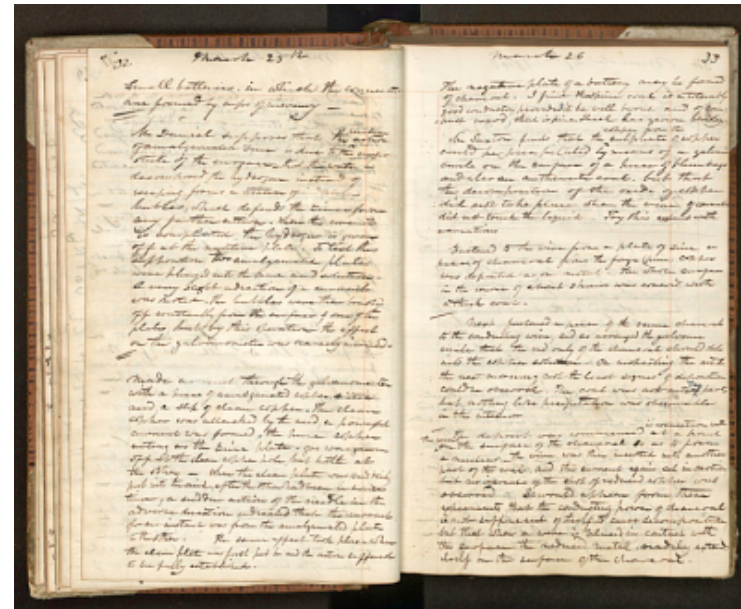
Fastened to the wire from a plate of zinc a piece of charcoal from the forge (pine), copper, was deposited as on metal. The whole surface in the course of about 3 hours was covered with a thick coat.

[[short horizontal line]]

Next fastened a piece of the same charcoal to the conducting wire, and so arranged the galvanic circle that the end only of the charcoal should dip into the copper solution - On inspecting the article the next morning, not the least signs of deposition could be observed. The coal was cut into [^]two [^]parts but nothing like precipitation was observable in the interior.

[[small horizontal line]]

The deposit was commenced [^]in connection with the wire



[[/insertion]] at a point on the surface of the charcoal so as to form a nucleus. The wire was then inserted into another part of the coal and the current again set in motion, but no increase of the spot of reduced copper was observed. It would appear from these experiments that the conducting power of charcoal is not sufficient of itself to cause decomposition, but that when a wire is placed in contact with the surface the reduced metal readily extends itself on the surface of the charcoal.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

34 March 27th 1840

[[left margin]] [[image - galvanic experiment with labels a b c d]]

The same galvanic arrangement as in the last experiment was ~~again~~ made with the exception that a solution of nitrate of silver was substituted for the solution of copper, in this case a copious precipitate of the silver was formed on the charcoal. The arrangement in the exp. is illustrated by sketch in margin.

a coal b cup of parchment with nitrate of silver c Zinc plate d outer disk filled with dilute sul acid
[[line across page]]

after the action in the above mentiond arrangement had gone on for 1/2 an hour, the cup b was almost filled with a beautiful precipitate of brilliant metallic silver. Can not this process have employed at the ? instead of the indirect one of precipitation by Zinc - also will not this be a better method of precipitating silver from its combinations with copper.

[[two short horizontal stacked lines left margin]]

Finished this afternoon the construction of the sustaing battery - put it in operation and found the action much to exceed my anticipation. The battery consits of 10 ten elements immersed in 10 quart mugs of red earthenware, each copper was formed of a plate 6 inches by 11 1/4, or a hollow cylinder of copper, 3 1/2 inches in diameter and 6 inches high. The zinc consits of solid cylinders, each one inch in diameter and 5 inches long. The membrane consisted of sheep bladder, tied to a colander formed in a very simple manner by
[[end page]]

[[start page]]

35

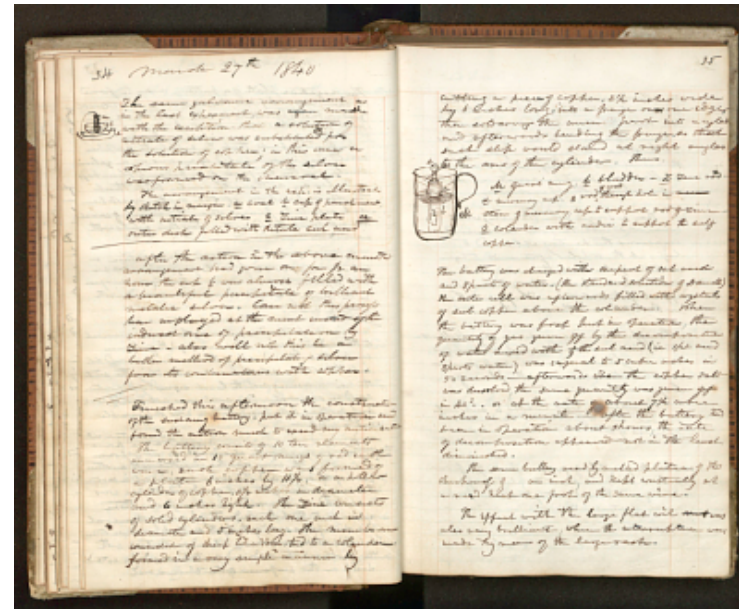
cutting a piece of copper, 2 1/2 inches wide by 6 inches long, into a fringe on ~~e~~ one edge, then soldering the uncut part into a cylind and afterwards bending the fringe, so that each slip would stand at right angles to the axis of the cylinder. Thus.

[[image - large mug with handle to the right. Inserted vertically into the mug is a cylindrical device around the center of which, horizontally, is a fringed membrane. Whole is labeled "M"; Parts are labeled "z" "b" "c" "d" and "E" as described by JH below]]

M quart mug, b bladder z Zinc rod - d mercury cup.

E rod ^ of wood through hole in ~~mercur~~ stem of mercury, cup to support rod of Zinc. c colander with radii to support the sulf copper.

The battery was charged with one part of sul. acid and 8 parts of water. (The standard solution of Daniell). The outer cell was afterwards filled with crystals of sul. copper above the colander. When the battery was first put in operation, the quantity of gas given off by the decomposition of water mixed with 1/9th sul acid (ie 1 pt acid 8 parts water) was equal to 5 cubic inches in 50 seconds - afterwards when the copper salt was dissolved, the same quantity was given off in 40 s c - or at the rate of about 7 1/2 cubic inches in a minute - after the battery had been in



operation about 3 hours, the rate of decomposition appeared not in the least diminished.

The same battery readily melted platina. of the thickness of an inch, and kept constantly at a re a heat one foot of the same wire.

The effect with the large flat coil not was also very brilliant, when the interruption was made by means of the large rasp.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[Page start]]36

an attempt was made to repeat the experiment of Sturgeon, of heating the + pole while the other remained nearly cold. There appeared to be a greater heat at the + than the negative pole, but the result was not sufficiently striking to allow of a positive assertion in reference to the phenomenon.

When a large wire (12 inches) was connected with the poles on several occasions the heating appeared to begin at the + pole, afterwards to begin at the - pole, but these variations seemed to be produced by the cooling effect of the poles accordingly as one or the other was the colder

The effect on charcoal was very brilliant--the burning was small but continuous and may be so adjusted as to give a constant illumination on the plan of Professor Jacobi.

Make an apparatus to support the coil and to graduate the distance by means of a screw

A small quantity of gas was given off from the zinc which was due to the plates of copper which formed the supports of the mercury cups coming in contact with the acid.

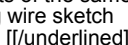
[[end page]]

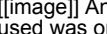
[[start page]]

[[page number upper right]] 37

April 9th

Since the last experiment, my time has been engaged with the semiannual examination. I have however had constructed 20 additional elements of the constant battery.

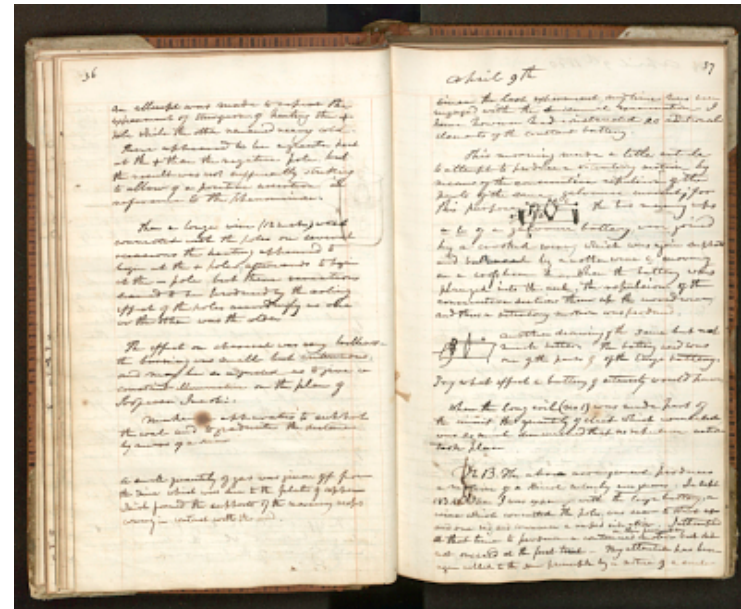
This morning made a little article to attempt to produce a vibrating motion by means of the consecutive repulsion of the parts of the same galvanic current; for this purpose  The two mercury cups a b of a galvanic battery, were joined by a crooked wire which was again supported and balanced by another wire c moving on a cross beam d. When the battery was plunged into the acid, the repulsion of the consecutive sections threw up the curved wire, and thus a vibrating motion was produced.

 Another drawing of the same but not much better. The battery used was one of the parts of of the large battery.

Try what effect a battery of intensity would have.

When the long coil (no 1) was made part of the circuit the quantity of elect which circulated was so much diminished that no repulsive action took place.

NB The above arrangement produces a motion of a kind entirely unlike the motion of the electric. In Sept 1834 When I was experimenting with the large battery, a wire which connected the poles, was seen to start up and one end, and commence a rapid vibration. I attempted at that time to produce a continued motion ^{on this}



premise]], but did not succeed at the first time. My attention has been
again called to the same principle by a notice of a similar
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

38.
April 9th 1840

action observed by Professor Jacobi the connecting wires of a large galvanic battery were observed to rise from the mercury.
[[line across page]]

April 10th

[[image - thin tubular instrument with wider circular base, vertical wire protruding from top]]

I have had constructed by [[circled]] Prosch [[/circled]] of New York an apparatus consisting of a glass tube fitted to a wooden foot and at the upper end closed by a flat plate, screwed onto a collar, through the center of the plate a glass tube of small [[circled]] bore [[/circled]] was passed and fastened

[[left margin]] See [[/left margin]]

by a screw collar. The lower end of the large tube was ~~fastened~~ closed by the cement of the foot. The object of this arrangement was to repeat the experiment of [[circled]] Jay

[[Leisture?]] [[/circled]]

[[left margin]] Exp 1 [[/left margin]]

in reference to the detection of the change in the size of a mass of iron by magnetizing it. The apparatus had been constructed several months, and on account of the shrinking of the wooden foot, the glass was found to be cracked. I found considerable difficulty in adjusting a new tube to the foot and socket - A bundle of iron wire was placed in the tube, so as nearly to fill its capacity - around the outside of the tube a copper ribbon, of about 30 feet long and one inch and a quarter wide, was wrapped. A current from the 8th of the large battery made no impression on the apparent magnitude of the iron - a slight [^][[insertion]] apparent [[/insertion]] diminution of bulk was perceived but this was found to be due probably to the action of the heat on the glass, which would of course expand the vessel and thus cause the water in the stem to fall.

Repeated the same experiment and with same negative result.
[[end page]]

[[start page]]

39

[[underlined]] April 10th 1840 [[/underlined]]

[[image - thin tubular instrument with wider circular base, vertical wire protruding from top. A coil of wire is around the tube, with ends leading to side. A circular magnet is around the tube.]]

Arranged the helix around the glass tube while the water and the wires remained in; with this intense shocks were given. From this it would appear that the water which surrounds the iron [[left margin]] 2 [[/left margin]] is not sufficiently a good conductor to allow the secondary current to be formed of such intensity as to neutralize the ~~pr~~ current in the iron.

Exp 1 was repeated with a bar of solid iron, but no effect could be observed. The iron became strongly magnetic, while under the action of the current.

It is possible that the expansion of the outside glass in this experiment might just equal the expansion of the iron within. When the ~~rod~~ glass was touched by the hand, the water in the small tube was seen immediately



to fall - but when the galvanic current was passed around the tubes without iron in, no sinking of the ~~current~~ water in the stem was perceptible - little heat appeared to be given off by the conductor, which was quite large.

April 13th - Monday

[[image - two bowls connected by a wire]]

Made a few days since a lead syphon, covered the outside with hard cement, to determine if the action of the mercury before observed was not one intirely of surface, since a piece of tinⁿ[[insertion]] n

[[/insertion]]e

$$^{\text{[[insertion]]}} d \text{ [[/insertion]]}$$

^[[insertion]] iron ^[[insertion]] conducted the mercury evidently on the out side. The mercury came over as in the other experiments, without disturbing the coating, although the time of passing appeared to be longer than in the arrangement with [[insertion]] an ^[[insertion]] uncoated wire syphon.

To determine this more accurately, I have today put in operation two syphons, cut from the same piece of lead wire, and of the same length, - one coated the other not - I have also arranged a syphon

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

40 April 13th 1840
of tinned iron coated in the same manner and of the same length - the result will be noted.

made a modification of the apparatus described April 9th. Arranged 4 cups of mercury and attached two wires to a lever, so that the repulsion constantly threw first the one and then the other ~~sup~~ wire from the cup - The operation of this was quite satisfactory - the vibrations were rapid and constant - the spark appearing at each rupture of the current - The exp was made with the 8th large battery.

April 14th examined this morning the several syphons put away yesterday, found that the ~~cord~~ mercury had passed in each - The coated one appeared to have attached to the lower end the greater quantity - The coating however was not very dry on the tin syphon, and the mercury may on this current have found a more ready passage.

April 15th made a galvanometer of the fine wire coil no. of about 2000 turns, worked at it all the afternoon, but when I tried it no effect could be produce with zinc and probably the wire is broken at some point.

41

April 16th 1840

Arranged coil No 1 in connection with apparatus showing arrangement of coils and battery] the battery - coil No 2 on top of this - connected with coil No 3 - on this coil 4 connected with galvanometer of coarse wire and few turns, and also in the same circuit with the magnetizing spiral of double turn. The needle in the spiral was strongly magnetized, at the moment of breaking contact - the direction of the current being as heretofore - minus. The current at the beginning produced no magnetism but deflected the needle (very perceptibly by a current ~~in the opposite direction to the magnetize current~~ - The direction of the not screening current is thus
+ +
+ -
- +

Try this again

The interposition of a plate of zinc between coil No 3 & 4 cut off entirely the magnetizing power, but the deflecting power remained the same -

Made this afternoon another galvanometer of about 11 hundred turns of very fine wire, found it answered very well with the long helix -

April 17th Last night, reflecting on the cause of this falacy in the experiment made oct 14th 1839, it struck me that there might be something interesting in the fact of the elect. cutting across and leaving its direct circuit for a much longer one - I therefore took a thick strip of lead, connected it
 image - sketch of experiment, showing battery and circuit. Battery and



+, - poles labeled.]]
with the poles of the battery, and to the middle of it attached

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

another piece of lead, of the same length and thickness, as shown in the figure, and to the ends of this attached the wires of a galvanometer. When the current passed through the first conductor, a constant current traversed the galvanometer. The direction of the currents is shown by the arrows. [[image: tall striped rectangle (battery) labeled + at top and - at bottom with a sideways U-shaped wire extending rightward connecting top and bottom of battery. A second sideways U-shaped wire is drawn with its ends attached to a small circle at the right. The center of the circle contains a small dash with a short vertical line extending upwards from the dash. Both U-shaped wires are marked with right arrows above and left arrows below. The U-shaped wires touch at the apex of their arcs.]]

Exp 2 Repeated the above experiment with a plate of zinc as the connecting part with galvanometer of 100 turns [[image: striped tall rectangle at left marked + at top and - at bottom; two wires extend rightward from top and bottom to the left side corners of a square; the square is labeled "plate of zinc"; two wires extend rightward from the right side corners of the square, curving slightly to come together at a small circle with a short vertical stripe inside it; circle is labeled "galv". A small sideways rectangle is drawn across the middle of the top line from the square to the circle and is labeled "a"; right arrow drawn under wire from battery to top left corner of square and above wire from top right corner of square to circle. Left arrow is drawn below wire from circle to bottom right corner of square and below wire from bottom left corner of square to bottom of battery. The arrows are not as long as the wires,]] fine wire. Little or no effect, but with the one with coarse wire 30 turns needle by time the dips of the wire into a cup at a was made to oscillate to 40 degrees and more.

Exp 3 No constant current

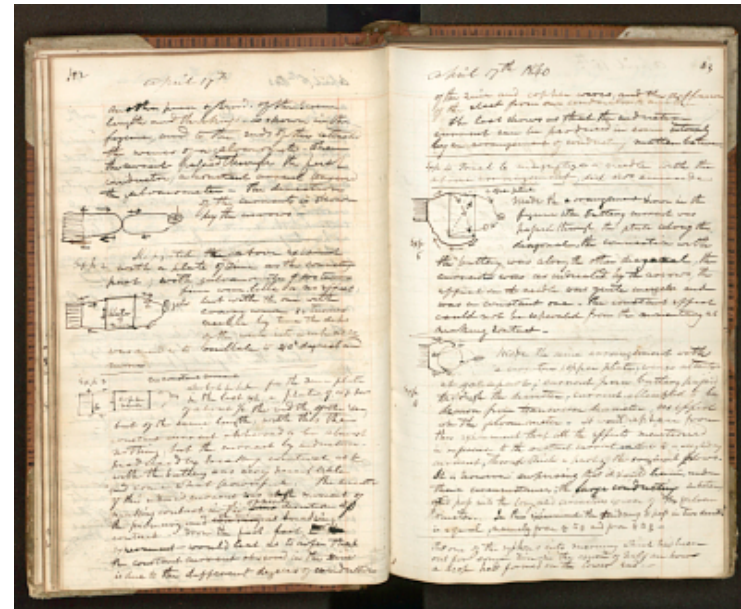
[[image: tall striped rectangle at right (battery) labeled + at top and - at bottom with wires extending rightward from top and bottom to respective left corners of rectangle (same height as battery); rectangle labeled "copper plate"; two wires extend from right corners of rectangle to a small circle with a small dash in its center. The top wire connecting rectangle and circle has a crimp in middle of its length with a U-shaped line under the crimp. The join where the bottom wire from the rectangle meets the bottom of the battery is labeled "b". A right arrow is drawn above the top wire that connects battery and rectangle; a down arrow is drawn outside the left edge of the rectangle; a left arrow is drawn below the bottom wire that connects rectangle and battery.]]

Substituted for the zinc plate in the last exp a plate of copper of about 1/2 the width of the zinc, but of the same length, with this the constant current appeared to be almost nothing, but the current by induction produced by breaking contact at b with the battery was very perceptible and somewhat powerful, the direction of this induced current was at the moment of making contact in the ~~same~~ opposite direction of the primary, and ~~contrary~~ the same ~~at breaking contact~~ at breaking contact. From the first fact ~~in this ?~~ experiment -- would lead us to infer that the constant current observed in the Zinc is due to the different degrees of conduction

[end page]

43

of the zinc and copper wires, and the difference of the elect from one conductor to another.



The last shows us that the induction current can be produced in some intensity by an arrangement of conducting matter between.

[[horizontal line across page]]

Exp 4 Tried to magnetize a needle with the above arrangement, did not succede.

[[horizontal line]]

Exp 5 [[image: tall striped rectangle at left (battery); wire connects top right corner of battery to left corner of a rectangle (copper plate); rectangle is taller than first rectangle. A wire connects top right corner of copper plate to a small circle (positioned half the height of the copper plate rectangle. Circle contains a small dash in its center. A wire runs from the bottom of the circle behind the copper plate to the bottom left corner of the copper plate. A wire runs from the bottom right corner of the copper plate to the bottom right corner of the battery. A dotted line is drawn between the lower left and upper right corners of the copper plate. Three directional arrows, pointing diagonally downward, are drawn from the upper left to the lower right corner of the copper plate. A directional arrow pointing diagonally upward is drawn beside the upper portion of the dotted line that runs between the lower left and upper right corners of the copper plate. A right arrow is drawn above the top wire connecting the battery and copper plate and above the wire connecting the copper plate and the circle. A small circle is drawn over the middle of the bottom wire connecting the circle-with-the-dash (galvanometer) to the copper plate. A left arrow is drawn below the wire between the galvanometer and the small circle. Three left arrows are drawn below the bottom wire connecting the copper plate and the battery. A dotted line arcs from the larger rectangle to the label "coper plate" to the upper left of the image. ((identification of battery and galvanometer assumed from other images on page and text))]]

Made the arrangement shown in the figure. The battery current was passed through the plate along the diagonal, the connection with the battery was along the other diagonal, the current was as indicated by the arrows, the effect of the needle was quite energetic and was a constant one. The constant effect could not be seperated from the momentary at making contact.

[[horizontal line]]

Exp 6 [[image: Left-to-right: A cut away view of tall striped rectangle (battery); a circle of a height equal to the battery; a small circle placed at half the height of the battery and larger circle with a dash in its center (galvanometer). A wire runs from the top right corner of the battery to the top apex of the larger circle. Where the wire meets the circle is labeled "a". A wire runs from bottom apex of the larger circle to the bottom right corner of the battery. Where the wire meets the circle is labeled "b". A wire runs from the bottom left of the galvanometer to the right side apex of the larger circle and is unlabeled. A wire runs from the top left of the galvanometer to the left side apex of the larger circle. Where the wire meets the larger circle it is labeled "c". A right arrow is drawn above the top wire that connects the battery and the larger circle. A left arrow is drawn below the wire that connects the larger circle and the battery. ((identification of battery and galvanometer assumed from other images on page and text))]]

Made the same arrangement with a circular copper plate, wires attached at 90 [[degree symbol]] apart; current from battery passed through the diameter, current attempted to be drawn from transverse diameter, no

effect on the galvanometer. It would appear from this experiment that all the effects mentioned in reference to the constant current, are due to a secondary current, through which a part of the original flows. It is however surprising that it should leave, under these circumstances, the large conducting substance, and pass into the long and circuitous course of the galvanometer. In this experiment the tendency to pass in two directions is equal, namely from a to c and from b to c.
[horizontal line]

Put one of the syphons into mercury which had been out for some time. In the course of half an hour a drop had formed on the lower end.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

April 18th

The long wire galvanometers which I made a day or two since do not act well. I have therefore taken the one with 11 hundred turns from the stand and soaked it in boiling cement. - During the process, a great quantity of air was given off, as the cement by capillary attraction was drawn into the meshes of the wire. The wire might possibly be more fully saturated with the cement by putting the galvanometer into a cup of the melted cement and placing the whole under the receiver of the air pump. When the air is exhausted, the fluid cement would enter and be pressed [^]in in [^]still more ~~in~~ in ~~in~~ by the weight of the atmosphere when the air was admitted into the receiver.

Found that the elect. from the compound helix would no go through the wire of the long galvanometer. Tried the same galvanometer with elect. from the machine, but met with an unexpected difficulty; the wax, with which the wire was impregnated, became strongly ~~electrical~~ magnetic ~~electrical~~ electrical, and consequently the needle, by ordinary elect. repulsion, tended to place closely at right angles to the coil.

[[wavy horizontal line]]

Experiments on the deflection of the needle cannot I presume be made satisfactory, unless the discharge be perfect by means of a wire connected with a well, or with a large surface of moist Earth.

[[end page]]

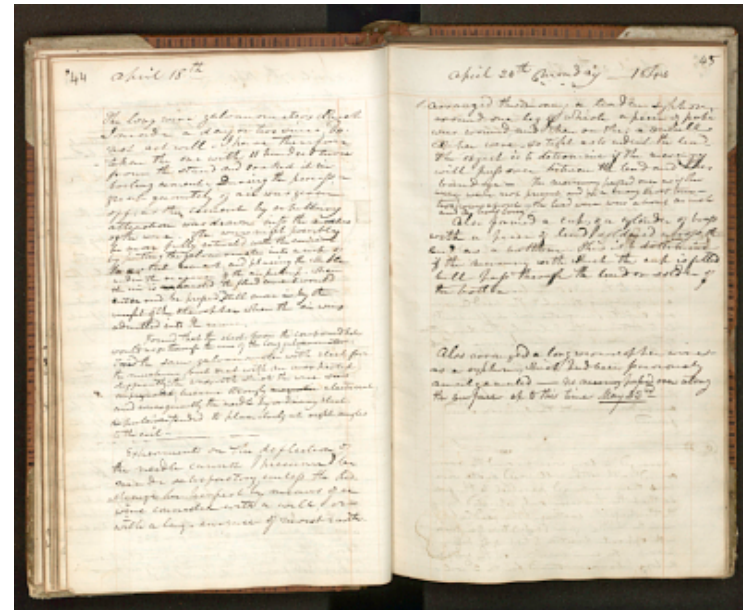
[[start page]]

April 20th Monday - 1840

[[margin]] // [[/margin]]

Arranged this morning a leaden syphon, around one leg of which a piece of ~~[[pape?]]~~ was wound, and then on this a small copper wire, so tight as to indent the lead. - The object is to determine if the mercury will pass over between the lead and this bandage - The mercury passed over as if the wire were not present, and in a very short time - two hours about - the lead wire was about an inch and a half long - Also formed a cup, of a cylinder of brass with a piece of lead soldered across the end as a bottom. This is to determine if the mercury with which the cup is filled will pass through the lead or solder of the bottom.

Also arranged a long wire - copper wire - as a syphon, which had been previously amalgamated - no mercury passed over along the surface up to this time. May 22nd - [[/underlined]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

46
April 20th 1840

Placed all the needles which I have used for determining the direction of the currents, on a little pan made of iron wire gauze, heated the whole to redness, and then threw the whole into cold water; by this means all the magnetism was destroyed and the needles left in a hardened state ready for new use.

[[line across page]]

[[image-sketch of the following described coil and tube placements]]
Placed coil no.2 on coil no.1 and joined the ends of the latter to a spiral around a glass tube, in which was placed another spiral to the ends of the latter was joined a magnetizing spiral. The needle came out slightly magnetic, but sufficiently so to determine the polarity. The direction of the current was the reverse of that of the wire on the outside of the glass tube. This is the first time I have obtained a current from an arrangement of this kind, but the direction of it is not in accordance with the opinion I had formed.

[[line across page]]

[[image-sketch of long wire looped to a smaller coiled wire]]
arranged a long wire around the room covered with cotton, well waxed. Another wire was then arranged parallel to the first, so that the two were only separated by the thickness of the coating. The needle near the middle, gave indications of a current in the opposite direction to that of the battery current. The same disposition of the wires. the long helix was substituted for the 2nd coil,

[[end page]]
[[start page]]

47
April 20th 1840

with this and the short magnetizing spiral no effect was produced - ie no magnetism in the needle. The same arrangement with the long wire ~~helix~~ ~~magnetizing spiral~~.

[[line across page]]

April 21st
[[image-sketch of thick spiral with two wires to left marked + and -, two wires to right attached to ovals]] Exp 1 Coil no 1 was formed into a ring, and within this a loop of iron of about 3 inches ^
1/10 thick wide was placed and the long helix within this. The shock with this arrangement was tolerably severe, but much more severe when the iron ring was withdrawn. The shock was also much more severe when the coil was held up out of the ring with its axis coinciding with that of the ring, than when it was placed within.

[[line across page]]



[[image-sketch of spiral]] Placed coil no 2 in connection with the battery helix no 1 on this, shocks with this very severe--interposed thick iron
[[margin]] Exp 2 [[/margin]] plate shocks less severe much less, plate not sufficiently large in diameter to neutralize the action intirely. Placed on the coil between the iron plate and it, an iron ring. shock with this much less almost imperceptible. Took out ring of iron, substituted one of wood. Shocks much more severe. Iron therefore acts as a common metal.

[[line across page]]

[[image-sketch of experiment as described]] [[margin]] Ex 3rd [[/margin]] Placed coil no.2 in connection with the battery. Helix no.2 over this, at a little distance above. When plate of iron was interposed, the action was considerably less but not intirely screened.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

April 22nd 1840

[[image: sketch of experiment as described]] Coil No. 1 in connection with the battery helix, no 2 in this, connected with the galvanometer. When ring of iron ^{was} placed around helix, no diminution of the effect could be observed. two rings same effect.

[[horizontal line across page]]

April 22nd

[[margin]] Exp 1 [[/margin]]

Inspected this morning the copper cup with lead bottom, found the mercury had passed all through during the night, although the vessel was still air tight. Appeared to pass through along the edge, although the whole lead part was covered with mercury.

[[horizontal line across page]]

[[margin]] Exp 2 [[/margin]]

Placed coil no. 2 in connection with the battery, on this coil no 3. attached to this the galvanometer ~~got~~ of Clark (short wire) - needle moved 20° each way. Plate of Zinc between same result. Hence (See Oct 15) the same result takes place with the short coils ^{with the} intensity current of the long coil

[[horizontal line across page]]

Heretofore, I have not had positive and certain results, relative to the screening effect of iron, but this morning put a plate* of cast iron, about 20 inches square, and 3/4 of an inch thick, - with this the screen was perfect, although the needle of the galvanometer was moved.

[[horizontal line across page]]

* Mr. Iowa griddle for buckwheat cakes

[[end page]]

[[start page]]

April 23rd

20° when the zinc plate was substituted and the coils separated in addition by 3 times the space. The arrangements in this exp. was in every other respect the same as last.

[[dividing line across page]]



[[image: two tall rectangles side by side along their long sides; a dotted concentric circle occupies the center of the near square formed by the joined rectangles. Two lines extend leftward from the near top and near bottom of the left rectangle and are labeled + and - respectively.]]
Placed two large plates of iron, (griddles), on coil no. 2, so that the line ^
[[insertion]] of division [[/insertion]] would pass through the centre of the coil - put coil no 3 on this - The screening was almost perfect, not quite - the griddles were then drawn apart. the action was then quite active, particularly when the distance between the edges was about 5 inches -- This result gives me the means of screening either induction at pleasure, and suffering the other to pass or, at least it appears to do so.

[[dividing line across page]]

Tried the same arrangement with the substitution of the long helix and the long wire galvanometer, the effect of the screening was much less perceptible, the long wire galvanometer is so sensitive, that in the case of a single (griddle) plate, the needle moved considerably, but when two plates were put on each other, the result was very little.
When the two plates were put side to side, the screening was still less perfect.
When the two plats were placed side by side, along the middle the the shock was as intense as without the plates, but when the zinc plate was put on top, then the shock was nothing; --- With the long galvanometer and the short coil no 4, no no effect could be perceived with the

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
[[left margin]] 50,

April 22nd

plats, ~~[[several words strikethrough]]~~ but without the plates there was a motion.

It would appear from this, that the induction measured by the long coil is not as screenable as thus by the short one. ~~[[diagonal line across page]]~~

Another question. Is the action which ~~[[passes?]]~~ through the iron plate, in the case of the long helix, in the same direction as without the plate? The direction with the iron between is the same as without. The ~~[[strikethrough]]~~ residual action is therefore most probably due to an imperfect screening, and not to a new or persistent~~[[?]]~~ action in the iron. Probably of soft wrought iron were used, instead of the cast iron (griddle) plates, the screening would be more perfect--as it is with the short wire galvanometer, and the short coil it is perfect, also with the short coil and the long galvanometer it is perfect. ~~[[horizontal line across page]]~~

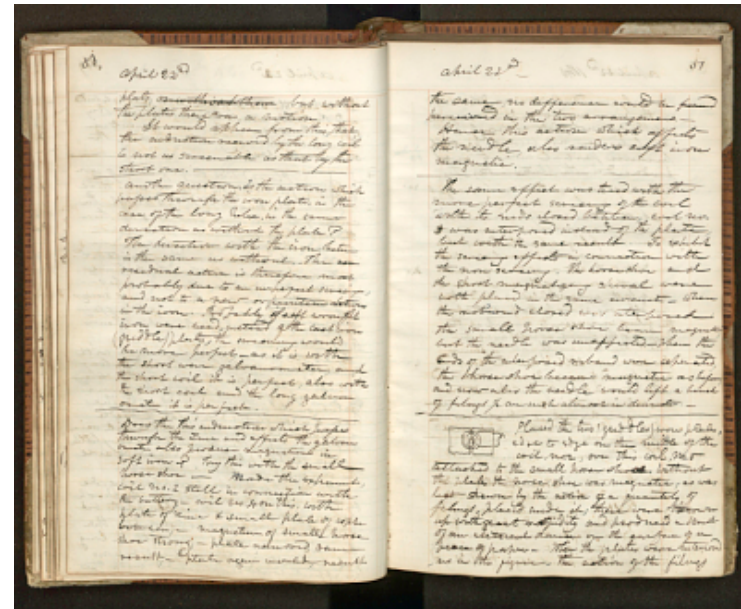
Does then this induction which jumps through the Zinc and affects the galvanometer also produce magnetism in soft iron? Try this with the small horse shoe--Made the experiment, coil no. 2 still in connection with the battery,--coil no. 4 on this, with plate of Zinc + small plate of copper between,--magnetism of small horse shoe strong,--plate moved~~[[?]]~~, same result,--plate again ~~[[word??]]~~, result ~~[[page end]]~~

[[page start]]
April 22nd

the same, no difference could be ~~[[strikethrough word found]]~~ perceived in the two arrangements.--However~~[[?]]~~ this action, which affects the needle, also renders soft iron magnetic. ~~[[horizontal line across page]]~~

The same effect was tried with the more perfect screening of the coil with its ends closed between, coil no.3 was interposed instead of the plate, but with the same result. To exhibit the screening effects in connection with the non screening. The horse shoe and the short magnetizing spiral were both placed in the same current--When the ~~[[word??]]~~ closed way afterward, the small horse shoe became magnetized, but the needle was unaffected.--When the ends of the interposed ~~[[?band]]~~ were separated, the horse shoe became magnetic as before, and now also the needle would left a bunch of filings 1/2 an inch almost in diameter.--~~[[horizontal line across page]]~~

[[image]] Placed the two (griddles) iron plates, edge to edge on the middle of the coil, no. 2, over this coil, no. 5 attached to the small horse shoe without the plates the horse shoe was magnetic, as was ~~[[word??]]~~--shown by the action of a quantity of filings. Placed under it, these were thrown up with great rapidity and produced a small of an electrical dance of the surface of a piece of paper. When the plates were interposed, as in the figure, the action of the filings ~~[[end page]]~~



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[margin]]52[[/margin]] April 22nd 1840

instantly ceased, while a needle placed in the same current, became magnetic, although not quite as strongly as if the plates were not present, probably because partial currents were produced in the plates. By this experiment, we see that an arrangement may be such as to screen one and not the other, as before remarked.

[[horizontal line]]

When the filings were placed on paper, the action was much more distinct, and that the action of the magnetism of the soft iron was of the same kind as that of the current which moved the needle, was shown by the fact that the filings were seen to spring up at the beginning of the current as well as at the end, and apparently with the same force; -- Still when the compound coil formed of 4 + 3 was interposed with the end of each joined, the action was almost nothing, showing a neutralizing influence in this respect, which does not will accord with the other. (make + break) (without the rasp)

[[horizontal line]]

Placed the compound helix, I would say coil, on the table, and in connection with the battery. When the two ends were joined, the small [[horse shoe?]] gave little or no indications with filing of magnetism. It would appear from this and some of the other exp., that this full magnetism is due to a part of the intensity current, although probably principally to the other.

[[end page]]

[[start page]]

April 23. [[margin]]53[[/margin]]

Tried the same arrangement with the Clarks galvanometer found the joining of the end produced no effect. No perceptible screening was observed.

[[horizontal line]]

[[margin]]April 23

Ex1[[/margin]]

Tried with Clark's galvanometer to get an indication of a tertiary current by means of the long helix, and then the short coil, but no motion of the needle was perceptible.

[[horizontal line]]

[[margin]]Exp 2[[/margin]]

Placed coil no. 1 in connection with the battery. helix no

[[underlined]]one[[/underlined]] within this ring of iron (see April 21 last Ex 1) around helix - with Clarks galvanometer - screening not perfect, but perceptible in a diminution of the arch of oscillations - ring of lead substituted, screening nothing - something like [[underlined]]induction around the corner[[/underlined]]

[[horizontal line]]

[[margin]]Ex 3[[/margin]]

tried the magnetism of the same iron ring - with filings and small tacks - magnetism on the out side - none on the inside - tacks attached to the under part of the outside, and to the edge of the inside - but not on the inside within.

[[horizontal line]]

[[margin]]4

new

exp[[/margin]]

Placed coil within. magnetism on the inside none on the out - tack would stick to inside, but not to out.

[[horizontal line]]

[[margin]]5[[/margin]]



Next put part of coil no.2 inside of the ring, and part of the same coil on the outside, but so bent as to be doubled back on itself. With this arrangement, the sparks were brilliant, although the current was passing in opposite directions in the coil. The iron was then taken out, the sparks continued, but the reduction was not as great as I anticipated.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

54 April 23rd - 1840

[[margin]] 6 [[/margin]] The iron was magnetized on the inside and the out, and since the currents were in different directions, the magnet was of course different --
Examine the magnetism.

[[margin]] 7 [[/margin]] Did 20, the magnetism on the inside and outside were the same when the current passed in opposite directions precisely as if the hoop had been a plate put between opposite currents [[image of plate surrounded by opposing currents]] thus. From these experiments, it is clear that the magnetism of a bar of iron only [[neutrals?]] to a small depth, and that the magnetism of iron is [[indent?]] different from the electricity of the same, since the [[Culten?]] radiates from the center towards the surface, or in other words, if a body be electrified internally, the elect. exists only on the surface.

[[horizontal line]]

[[margin]] 8 [[/margin]] When coil No. 2 was placed around helix No. 1, with the iron ring between, the shock was slight, the magnetism [[image of coil, ring, & helix]] of the interior did not come through, or if did, it acted in the contrary direction to neutralize the current of the coil.

[[horizontal line]]

[[margin]] 9 [[/margin]] I have forgot to mention in these experiments on the magnetism of iron, that the magnetism on the inside and outside, within the same direction of the current, gave different polarities at the end, and hence gives a very interesting confirmation [[end page]]

55 April 23rd 1840

of the theory of Ampere of the molecular position of the currents.

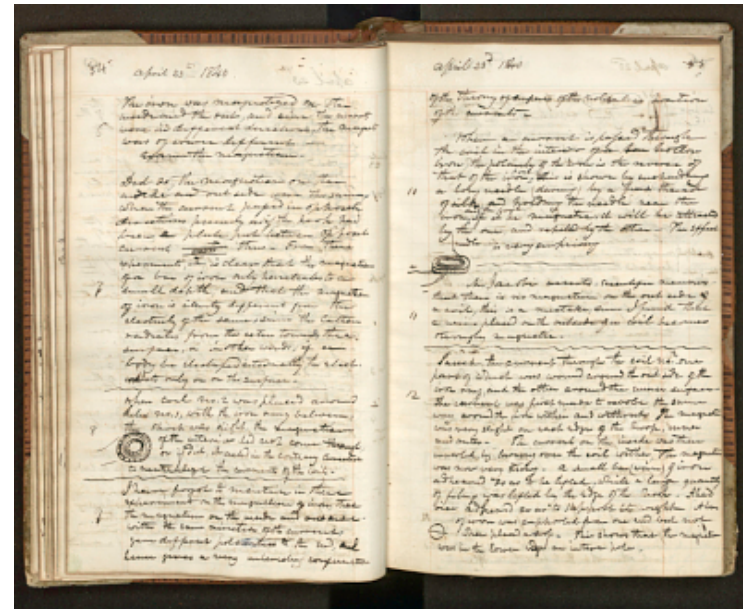
[[margin]] 10 [[/margin]] When the current is passed through the coil in the interior of a hollow iron, the polarity of the iron is the reverse of that of the iron ^ [[insertion]] coil [[/insertion]]. This is shown by suspending a long needle (darning) by a fine thread of silk, and holding the needle near the iron ^ [[insertion]] and the coil [[/insertion]], if it be magnetic, it will be attracted by the one and repelled by the other. The effect is very suprising [[image of needle suspended over coil]]

[[horizontal line]]

[[margin]] 11 [[/margin]] M. Jacobi asserts - Scientific Memoirs - that there is no magnetism on the outside of a coil, this is a mistake, since I find that a wire placed on the outside of a coil becomes strongly magnetic.

[[horizontal line]]

[[margin]] 12 [[/margin]] Passed the current through the coil No. 2 one part of which was wound around the outside of the iron ring, and the other around the inner surface. The current was first made to revolve the same way around the iron within and without. The magnetism was very slight on each edge of the hoop, inner and outer. The current on the inside was then inverted, by turning over the coil within, the magnetism was now very strong. A small bar (wire) of iron adhered so as to be lifted, while a large quantity of filings was lifted by the edge of the hoop. I had vice adhered so as to support its weight -- A bar of iron was supported from one end but not [[image of bar across hoop]] when placed across. This shows that the magnetism was in the lower edge an interior pole.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

56 April 20th

[[left margin]] see page 116 [[/left margin]]

[[image to the left of the text - pen sketch of oblong cylindrical object constructed of wraps of "wires". Three horizontal arrows are too the right of the object pointing to the left. Two horizontal arrows, one above & one below the object point to the right. Two vertical arrows are above the object pointing down. One vertical arrow below the object points up. A horizontal line starts to the left of the center of the object and ends 1/4 of the way across. A horizontal line start at the right end of the objects center, appears as if inside the cylinder and ends approximately halfway through the object]]

The polarity of the ring was of the kind represented in the figure. The whole surface of the end was a smooth hole,
[[left margin]] 13 [[/left margin]]
until the needle was placed within the ring, it then turned around.

This experiment with the one mentioned in the old book, relative to the jumping out of the wires, would lead us to the naturally of the want of magnetism in the intension -

To a certain distance, the ~~[[?]]~~ ~~[[?]]~~

[[left margin]] doubtful See next exp [[/left margin]] magnetism may be considered as neutral, perhaps the influence of the coil may haffed the iron. The outer hollow cylender has its magnetism of the same kind as that of the ~~[[?]]~~ long ~~[[?]]~~ put in, and therefore no magnetism should be ~~[[?]]~~ ~~[[?]]~~ exhibited, since the two are in the same state.

[[horizontal line]]

[[image to the left of the text - tube with needle inside it]]

Needle was placed in the hollow magnet on the end of a stick so as to be near the maddole of the interior of the cyleinder, the current of the battery was looped around, - iron became strongly magnetic, - battery gently drawn from the and needle withdraw, no magnetism.

Placed the needle within two inches of the mouth of the tube, still no magnetism.

[[horizontal line across page]]

[[image - cylinder with wire through it]] Placed in the axis of the hollow tube, two pieces of iron wire, so that the end of each projected one from each mouth of the tube. The two at the projecting ends were of course magnetic. They attracted each other within the tube at the needle, so

[[end page]]

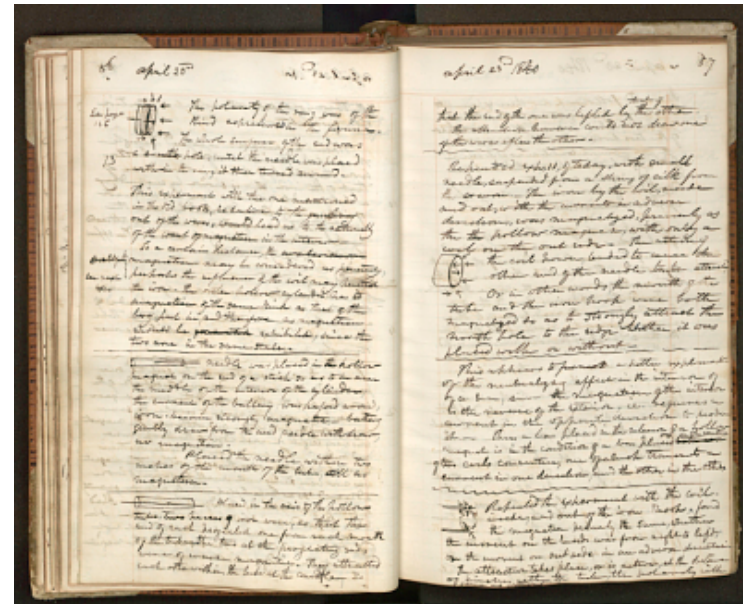
[[start page]]

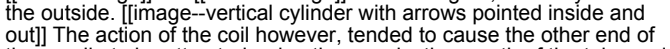
April 23rd 1840 57

that the end of the one was lifted by ^ ~~[[insertion]]~~ that of ~~[[insertion]]~~ the other. The attraction however could not draw one of the wires after the other.

[[horizontal line]]

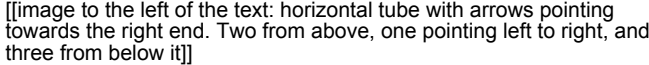
Reheated Exp. 11, of today, with small needle, suspended from a string

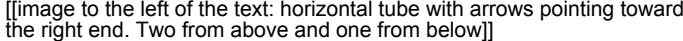


of silk from the cocoon. -- The iron by the coil, inside and out, with the currents in adverse direction, was magnetized, precisely as the ~~the~~ hollow magnet, with only a coil on the outside.  The action of the coil however, tended to cause the other end of the needle to be attracted or in other words, the mouth of the tube and the iron hoop were both magnetized so as to strongly attract the mouth hole to the edge whether it was placed within or without--


This appears to permeate a hotter experiment of the numberalizing affect in the interior of of a line; since the magnetism of the interior is the reverse of the exterior, ie. requires a current in the opposite direction to harden it -- Then a bar placed in the interior of a hollow magnet is in the condition of a bar placed ~~in the centre~~  in the centre ~~of the two coils concentric, one of which transmits a current in one direction, and the other in the other.~~







Repeated the experiment with the coil. inside and out of the iron hoop found the magnetism precisely the same, whether the current on the inside was from right to left, or the current on the outside in an adverse direction. The attraction takes place, or is active, at the distance of 2 inches within the tube, the holding within same and without

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

58

April 23rd 1840

[[image--3 check marks in pencil]]

It would follow from these experiments the absence of magnetism in the interior of a hollowed bar is due to the neutralization of the two forces. The bar within is in the [[image - 14 small circles arranged in a circle with arrows indicating clockwise motion outside & counterclockwise inside]] same condition as if it were ~~between~~ in the center of two concentric circles of galvanism, revolving in opposite directions.

Prof Jacobi notes that Prof. - found that the current within produced a negative result, rendering the magnet less strong. This should be the case if the two currents were in the same direction.

Tried the experiment, found that a key which would readily hang to the interior edge of the hook, fell off when the 2nd part of the coil was inserted, so that the current revolved in the same direction as the outer coil.

There was in this experiment magnetism for an inch in the interior by the action of the exterior, but this was neutralized by the action of the interior coil. From the what of magnetism on the exterior, when a coil is placed within, we infer that with a certain thickness of the iron the more intense magnetism of the inside neutralizes that of the out side. I suppose and the idea is now only for the first time concurred, that inside that no magnetism may be operative on the out or inside of the hollow bar, it is necessary that these be an excess of action on the one side to make up for the thickness of the metal,

[[end page]]

[[start page]]

59

April 24th 1840

or the condition is similar to that of a Leyden jar, charged with + elect. on the inside--a quantity of redundant elect. is necessary to perfectly neutralize the out side.

A very important days work

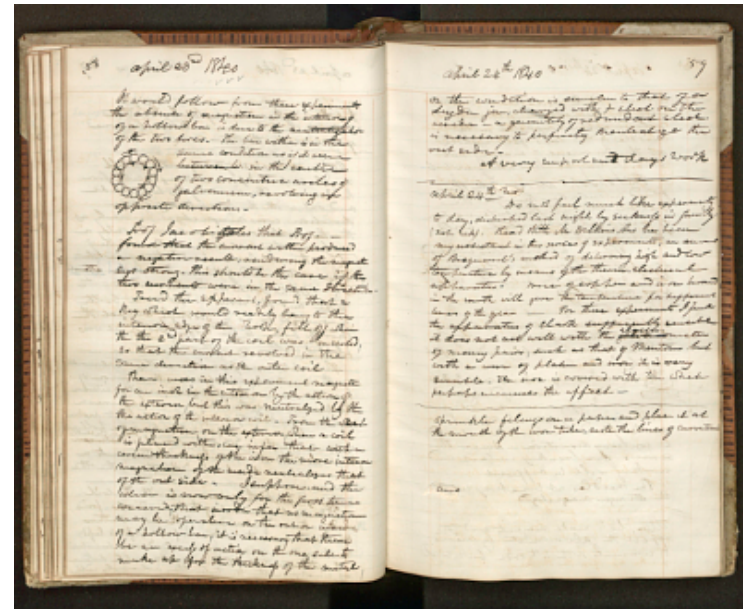
[[horizontal line]]

April 24th

Do not feel much like experimenting to day, disturbed last night by sickness in family (sister sick). Read with Mr Walkins, who has been very consistent in this series of experiments, an account of Becquerel's method of determining high and low temperature by means of the thermo-electrical apparatus. Wire of copper and iron burned in the earth will give the temperature for different times of the year--For these experiments I find the apparatus of Clark sufficiently sensible, it does not act well with the ~~galvanic~~ ~~electro-~~ ~~meter~~ of many pairs, such as that of Mentor but with a wire of platinum and iron it is very sensible. The iron is covered with the tin which perhaps increases the effect.

[[horizontal line]]

Sprinkle filings on a paper and place it at the mouth of the iron tube. note the line of curvature



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

~~very~~ ~~red~~. The shock at breaking contact, it was concluded, would be dangerous to take through the body, and was therefore sent through

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

April 24th ~~[[striketthrough]]~~ Saturday ~~[[/striketthrough]]~~ (Friday)

one finger. The effect was such as to be felt up to the shoulder.

The induction of this current on itself was therefore very intense.

The action of the same coil on helix no. 1 ~~[[image--drawing of device described on this page]]~~ was however quite slight. a feeble shock was felt at breaking contact, but none at making contact. It would therefore appear that when the length of the wire is so great that the sudden discharge of the battery cannot take place. Then the shock at making contact is small.

(Saturday cleaning Hall)

~~[[horizontal line]]~~

If it were not for the results obtained from electricity from the machine in reference to the change of direction by distance, all the facts of the induction which we have discovered could be referred to the operation of Elect - through the wire, on the principle of modulatory movement-

All the first part of an impulse produces electricity in a contrary direction, the waves may succeed each other so rapidly as to produce no effect in the intermediate time until the last undulation, which being in a contrary phase from the first, may tend to throw the impulse oppositely -- In the case of the induction

~~[[end page]]~~

~~[[start page]]~~

April 27th (Monday)

~~[[image--sketch of Daniell battery]]~~ Made an arrangement with 5 elements of the Daniell Battery to determine if a trough of water acidulated would produce the same inductive effect as a long wire. The experiment was not successful, no result was perceptible with the acidulated water alone but, with the small coil no. 4 interposed, the spark of induction ~~[[underlined]]~~ per see ~~[[/underlined]]~~ was perceptible although quite small

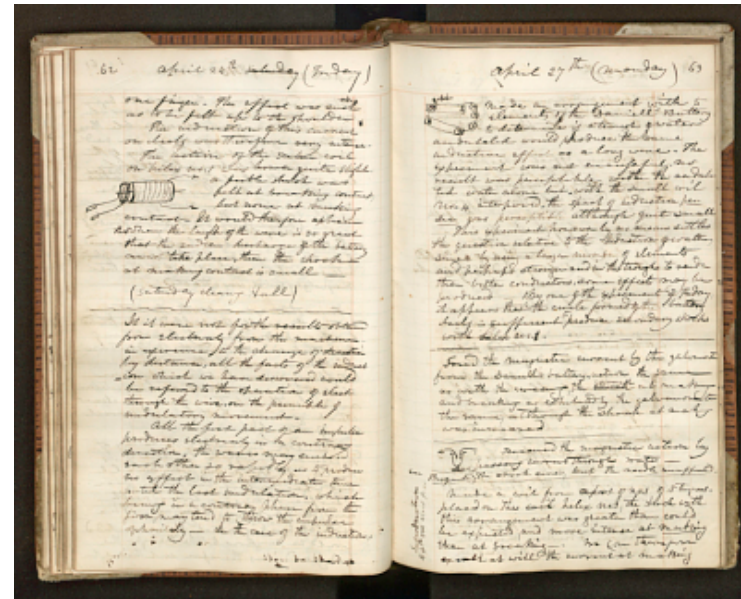
This experiment however by no means settles the question relative to the induction of water, since by using a larger number of elements and perhaps a stronger acid in the troughs to render them better conductors, some effects may be produced -- By one of the experiments of Friday, it appears that the circle formed of the battery itself is sufficient to produce secondary shocks with helix no. 1

~~[[dividing line across page]]~~

Tried the magnetic current by the galvanometer from the Daniell's battery, action the same as with the screening, the ~~[[striketthrough]]~~ shock ~~[[/striketthrough]]~~ ~~[[insertion]]~~ current ~~[[/insertion]]~~ at making and breaking as exhibited by the galvanometer the same, although the shock as making was increased

~~[[dividing line across page]]~~

~~[[image--sketch of goblet with two wires hanging out. Left wire marked +~~



and right wire marked -]] Screened the magnetic action by passing the current through water -- the shock sever, but the needle unaffected.
[[left margin]] see Becquindie [[/left margin]]
[[left margin]] Introduction to 4th vol Elect for [[/left margin]]

[[dividing line across page]]

Made a coil from a part of no.1 of 5 turns - placed on the ~~coil~~ helix no.1, the shock with this arrangement was greater than could be expected and more intense at making than at breaking -- We can therefore extract at will the current at making

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[margin]]64[[/margin]]
April 27th

contact and diminish the one at breaking. The effect however on the galvanometer remained the same.

[[horizontal line]]

The screening effect takes place the same with the shock at beginning as ending, by the last arrangement, and a coil with the ends joined interposed. no effect could be felt.

The intensity of the shocks were exhibited by causing them to [[pass]] through a trough of acidulated water, 5 feet long, and 5 by 5 inches in sectional area.

[[horizontal line]]

Magnetized the hollow magnet with the [[Daniell]]. Very powerful magnetism extended 2 or 3 inches into the interior. Placed helix no. one over the end of the hollow [[image]] magnet. Shock at making contact feeble, breaking severe. So that the shock from the apparatus with a core of iron is always greater at breaking than at making contact. Perhaps not. if the wires around the iron were only a few feet long instead of 60, the effect would be otherwise.

[[horizontal line]]

The same result was produced in a more striking manner by putting around the bundle [[end page]]

[[start page]]April 27th[[margin]]65[[/margin]]

of wires, which was mention a long time ago in this book, the end of coil no. 1 about 10 feet. The helix no. 1 was so arranged that the shock at making could not be felt, while the shock at breaking was very perceptible. [[To?]] effect this, the helix was gradually removed from the end of the bundle of wires.

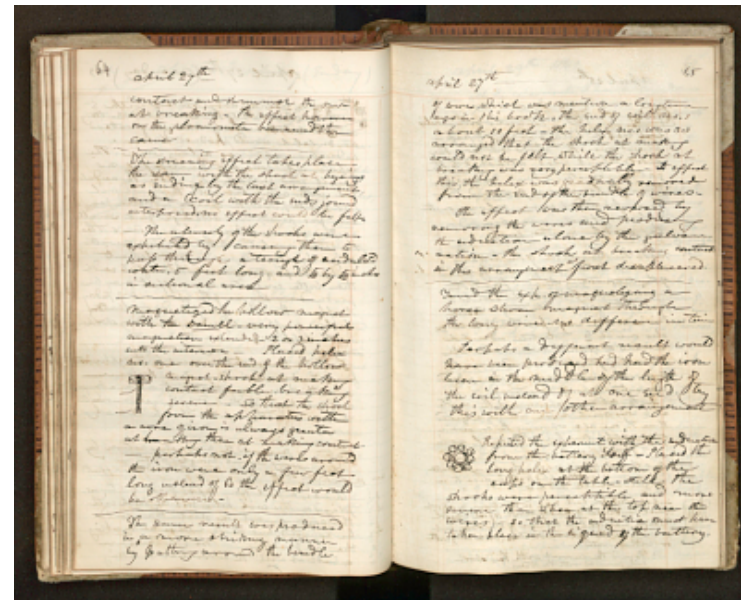
The effect was then reversed by removing the wires and producing the induction alone by the galvanic action. The shock at breaking contact in this arrangement at first disappeared.

[[horizontal line]]

Tried the exp. of magnetizing a horse shoe magnet through the long wire - no difference in [[time?]]

Perhaps a different result would have been produced had had the iron been in the middle of the length of the coil, instead of at one end. Try this with an other arrangement

[[image]] Repeated the experiment with the induction from the battery itself. Placed the long helix at the bottom of the cups on the table. Still the shocks were perceptible and more severe than when at the top near the wires, so that the induction must have taken place in the liquid of the battery.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

66

April 28th

[[image - illustration of apparatus required for experiment described below by J.H.]]

connected with helix

coil no. 1 the little machine of page placed over this, placed coil no 2, the ends of which were attached to the galvanometer.

Sent current through long wire first, and then through short wire galvanometer, but no effect was observed on the needle in either case.

Took the direction of the tertiary current in this arrangement by means of the magnetizing coil, - found the current in opposite direction to that of the galvanic battery. Tested this in another way, put in needle at a, also at b, polarities induced currents in opposite directions. In all cases thus far, all the induced currents from galvanism produce other induced currents in opposite directions.

In the above experiment the needle at b was much more intensely magnetized than the one at a, showing the conversion of intensity into quantity, as in my first experiments

Put the ends of coil no 2 in water in the above arrangement attempted to get indications by galvanometer, did not.

[[image - coil in square outline]]

Substituted for coil no 2 in the above, a short spiral conductor of lead of about 10 feet - needle strongly magnetic at distance of 8 inches, but no effect on the galvanometers (both used) with or without water. - Found the current with this short coil, same as with the others.

[[end page]]

[[start page]]

67

April 29th 1840

From all the experiments I have made during this time of investigation, I must conclude that no magnetic current exists in the currents of the 3rd 4th & c orders. - They all appear incapable of affecting the needle.

April 29th

Made arrangements to attempt to produce currents of the third order by means of motion. - The hollow iron cylindrical magnet was put in connection with the battery and helix no. 1 was suddenly brought over this. A current was produced in the which caused the needle of the galvanometer to pass nearly 90 degrees. - When coil no. one was divided into two parts, one of which formed a hollow cylinder into which the hollow magnet was thrust, while on the other part helix no. 2 connected with the battery no effect was produced on the needle. - Put coil no. 2 on coil no. 1, with the same galvanometer, no effect on the needle.

[[line across page]]



[[image - horseshoe shaped compound magnet]]
Connected spool around armature of compound [[line showing
movement of text]] permanent [[/line]] magnet to the galvanometer,
slightest motion of this gave movement to the needle. Next joined the
[[left margin]] 2 [[/margin]] ends of the spool [[image - coil around 2
rods]] to wire around double glass cylinder, enclosing a spiral, but with
this no effect on the needle was produced. I have not succeeded by any
arrangements which I have yet tried, in producing a tertiary current by
the mere

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
68 April 29

motion of one coil to or from a conductor transmitting a current of galvanism. The currents of the different orders have all be obtained by the instantaneous induction, which takes place a the beginning and the ending of a current. [[horizontal line to end of line then again on line below]]

[[image with + and - identified]] Placed stove-pipe within the coil no. 2, found no magnetism within, and although powerful without-Placed jump plate over end of [[image left margin]] pipe; filings arranged in beautiful radiations from all around the circumference of the metal; within, collected in groups: [[image]] sectional appearance. [[horizontal line across page]]

On reheating this Exp. with the glass plate on the end of the stove-pipe, I was struck with a sound which was given from the plate at each rupture of contact, and this immediately brought to my mind an experiment of, or rather a casual [[left margin/4]] observation, of Dr Page, that galvanism can produce music. To be assured that there was no description[[?]] in the case, the swab was produced with coil no. 1, lying near, but then no amalgamation from the glass was produced. The contact was broken by moving a piece of lead so that the motion might not disturb the glass. (Inexpert result)
[[end page]]

[[start page]]
[[image/self-portrait doing experiment?]]
April 29th [[medium horizontal line/30th]] 69

Connected coil no. 2 with the battery, suspended large crooked bar from wire, the end of which were wrapped around the [[^fore]] finger, and these in the ears. When the current was perfused[[???]] and the bar suspended, - no sound was heard until the iron was brought over the coil and so lowered this one end dipped into the opening, then the sound was very perceptible, when the contact was broken with a rush-
[[horizontal squiggly line across page]]

[[image]] Place within coil no. 2 a tuning fork, with a dish attached to it; when the two legs were in [[^the coil,]] no effect was produced, but when the stem was in [[^the ??,]] the sound was very perceptible. From these experiments it appears that there can be no doubt of the reality of the phenomenon.-- It appears that the effect is greates in the direction of the [[leg???]] the of the bar.--[[underlined/Make Experiments on this point]]
[[horizontal squiggly line across page]]

[[underlined/April 30th]]
[[image]] Place end of long iron bean (6 feet long) in the opening of coil no. 1, rested the bar on the backs of two chairs; cemented a plate of glass to the end of the bar, in order to increase the effect. Sound heard at the moment of making and of breaking contact; louder at the latter, like a small tick, or the effect of a single wave through the glass.
[[page end]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
70 April 30th

The effect was best observed when, the ear was pressed against the ~~[[strikethrough]]~~ glass plate, so as to stop all extraneous vibrations.

To illustrate the fact that it was not the immediate conduction of sound from the ~~[[word??snap]]~~, the bar was put out of the coil between in and the cup, when the spark was made. ~~[[left margin/2]]~~ In this case although the arrangement for the direct conduction was more favorable, yet no sound was heard---I am next to ascertain if the effect be alone due to the iron or connected with the action of the elect. in the coil.
[[horizontal line across page]]

~~[[left margin/3]]~~
Put my ear end of the bar, the effect was still heard but not as loud as before--Try this again
[[horizontal line across page]]

~~[[left margin/4]]~~
Inserted into coil no. 2 a cylinder of ~~[[bill?]]~~ metal which has been used before; with this no sound could be heard.
[[horizontal line across page]]

~~[[left margin/5]]~~
Placed the bar of iron in the same place; sound at making and breaking contact very distinct--~~[[left margin/6]]~~ Put tube into same helix then the bar with this. no sound.--
[[image]] Took out the cylinder; sound very perceptible-but in the cylinder: no sound.

It would appear from this that the sound like the electrical induction, is screen by the presence of surrounding metal ~~[[horizontal line across rest of page]]~~
[[page end]]

[[page start]]
April 30th, 1840 71

In these experiments the ears of others as well as my own, were employed, and those who did not understand the experiments, or what was expected to take place in the several cases. The sound was distinct without the plate, although not quite as loud. ~~[[strikethrough in left margin/6]]~~ There was no ringing sound, but apparently a simple impulse of if the ~~[[??word]]~~ of the iron were suddenly thrown into a new state of arrangement. The same at breaking contact and making, the former however gave the most intense sound. The latter will probably be increased by a battery of a number of pairs. ~~[[horizontal line across rest of page]]~~ Found this to be the case.]]

~~[[horizontal line across page]]~~
United a bundle of wires together by dipping the ends into cement. The wires were of iron covered with a coating of ~~[[word??]]~~. When these were put into the centre of coil no. 1, no sound was perceived, --perhaps the vibrations ~~[[left margin/7]]~~ of the different wires interfered with each other so as to lessen the results. With a thin hollow tube (a gun barrel which had been burned~~[[?]]~~ out) very little effect was produced.



[[horizontal line across page]]

Inserted a straight bar magnet; the effect if any was very small. The greatest and most decided effects were produced by the long iron bar.---
----With the long bar the effect is the greatest of any which I have yet produced. [[left margin/8]] When the coil is advanced towards the middle, the sound appears more distinct, and the tick is converted into a more distinct ringing.

Mr. S. Alexander witnessed the sound today, thinks the small sound, on that breaking contact, is about a note lower then the one
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]

72
April 30th---1840

at making contact. The effect will probably be much increased by surrounding the whole bar with ribbons of copper. For this purpose I will use the larger battery.
[[horizontal line across page]]

Instead of the pane of glass, I placed against the end of the bar, a large drawing board, about 3 feet square. [[left margin/9]] The effect through the board was quite perceptible, both at making and breaking contact, but not [[?]] to be attended to, since the board was more affected by extraneous sounds.
[[horizontal line across page and strikethrough]]

May 1st 1840 Commenced this morning to make preparations for putting in operation the Daniell's battery of 30 elements. I find that the calves bladders are too thick to last long, not more than twice or thrice. The [[left margin/1]] size of the bladders is of little consequence, since a large surface permits a greater amount of action. Although it be ??corriegated I have erred heretofore in making the bladders too small. They are found to shrink after being submitted to the acid.
[[horizontal line across page]]

May 1st
Put the battery in operation at about 1/2 past 2 o'clock. Kept it constantly in operation for 4 hours. The light from [[left margin/1]] burning charcoal was most brilliant, and apparently would keep [[^up]] the same intensity for several hours.
[[page end]]

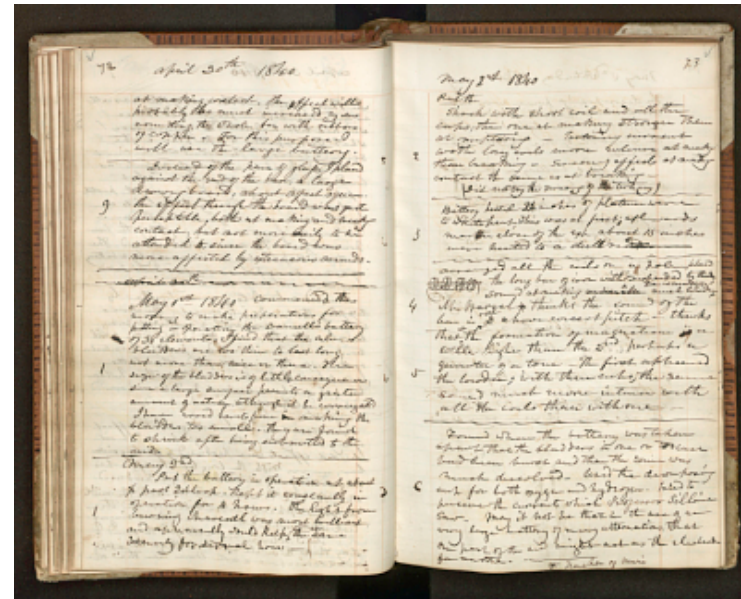
[[page start]]
May 1st 1840 73
Put the

Shock with short coil and all the cups; the one at making stronger than at [[word??]-Tertiary current [[left margin/2]] with long coils more intense at making than breaking--screening effects at making contact the same as at breaking--(Did not try the screening of the tertiary)
[[horizontal line across page]]

Battery heated 24 inches of [[?plate ware]] to white heat. This was at first; afterwards [[left margin/3]] near the close of the Exp., about 15 inches were heated to a dull red
[[horizontal line across page]]

arranged all the coils on a pole, placed [[image]] the long bar of iron with [[^in]] suspended by thread, [[left margin/4]] sound at making [[strikethrough/??]] much louder [[^than at breaking]] Mr. Warsel* thinks the sound of the bar is [[?]] D above concert pitch--thinks that [[^at]] the formation of magnetism is a little higher than the one, perhaps a quarter of a tone--The first appeared [[left margin/5]] the louder; with three cups; the same sound much more intense with all the coils than without--
[[horizontal line across page]]

Found when the battery was taken apart, that the bladders in one or two



case had been burst, and then the Zinc was much dissolved. Used the decomposing [[left margin/6]] cup for both oxygen and hydrogen. Tried to perceive the currents which Profession Sill??? saw. May it not be that in the use of a very large battery of many alterations, that one part of the [[word???]] might act as the electrode for another.----

* Teacher of music

[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
74 May 2nd Saturday 1820

The decomposing power was not tested until the battery had been in operation nearly 2 hours, with the exception of one [[word???]] near the first.

The whole battery in this case gave 4 cubic inch in 20" or 5 inches in 25" after two hours

5 inches in 35
Battery arranged as two sets of 14 each

1 5 inch in 24 } 26 3/4
2 5 inches in 27 1/2

Say 5 in 26" as the mean

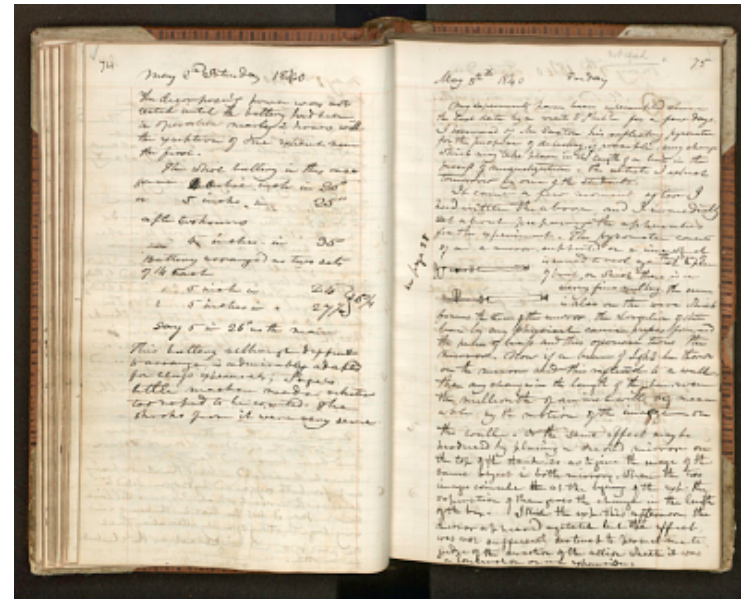
This battery although difficult to arrange, is admirably adapted for class experiments; Page's little machine made vibrations too rapid to be counted. The shocks from it were very severe.
[[end page]]

[[begin page]]
May 8th 1840 Friday 75

My experiments have been interrupted since the last date by a visit to Phil-- for a few days. I borrowed of Mr Saxton his reflecting pyrometer, for the purpose of detecting, if possible, any change which may take place in the length of a bar in the process of magnetization. The article I expect tomorrow by one of the students.

[[margin]] see page 38 [[2 images]] [[/margin]]

It came a few moments after I had written the above, and I immediately set about preparing the apparatus for the experiment. The pyrometer consists of a mirror, supported on a wire, which is caused to [[spool?]] against [[inserted above]] the edge of [[/inserted above]] a piece of brass, on which there is a very fine [[?]]. The same is also on the wire which forms the stem of the mirror. The elongation of the bar by any physical cause pressed forward the piece of brass and this of course turns the mirror. Now if a beam of light be thrown on the mirror, and this reflected to a wall, then any change in the length of the beam, even the millionth of an inch, will be measurable by the motion of the image on the wall. Or the same effect may be produced by placing a second mirror on the top of the stand, so as to give the image of the same object in both mirrors. When the two images coincide [[strike through]] the [[/strike through]] at the beginning of the Exp. the separation of them gives the change in the length of the beam. I tried the exp. this afternoon, the mirror appeared agitated by the effect was not sufficiently distant to permit me to judge of the direction of the action whether it was a contraction or an expansion.
[[page end]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
76 May 9th 1840 Saturday

[[image of connected ring/coil]] Placed an iron ring within coil no. 2, as represented in the figure, with this arrangement a slight ringing was perceived at the moment of making contact, but none at breaking. The sound was conveyed to the ears by Mr Wheatstons apparatus, consisting of two bell buttons, soldered to two wires, [[left margin/Exp 1]] which were again soldered together. [[image]] The bell buttons were inserted into the meatus externus of the ear.

Instead of the sound catcher above described, the ring was suspended from two wires, the ends of which were wrapped around the finger and thrust into the ears. With this, the sound at making and breaking contact was very perceptible, but apparently not so distinct and definite as with a straight bar (sound at making very feeble)
[[horizontal line across page]]

[[image]] Instead of a ring of iron, a large horse shoe was introduced, the same sound was [[left margin/2]] produced ~~at~~ at breaking contact, but a very slight one at making. When the ear was placed against the end of the ~~bar curved/transposition sign~~, no sound could be heard.
[[horizontal line across page]]

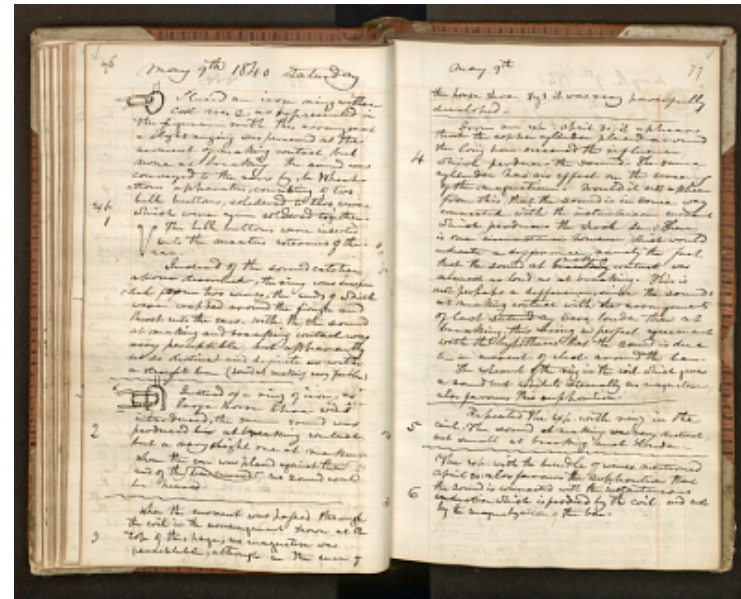
When the current was passed through the coil in the arrangement shown at the [[left margin/3]] top of this page, no magnetism was perceptible, although in the case of
[[page end]]

[[start page]]
May 9th 77
the horse shoe Fig 3, it was very powerfully developed?
[[horizontal line across page]]

From an Exp. April 30, it appears that the copper cylinder placed around the long bar screened the influence, [[left margin/4]] which produces the sound. The same cylinder has no effect on the screening of the magnetism. Would it not appear from this, that the sound is in some way connected with the instantaneous current which produces the shock ~~[[word??]]~~? Then is one circumstance however, which would indicate a difference, namely the fact that the sound at ~~at~~ making contact was almost as loud as at breaking. This is not perhaps a difference, since the sounds at making contact with the arrangements of last Saturday, were louder than at breaking, this being in perfect agreement with the hypotheses that the sound is due to a current of elect. around the bar.

The experiment of the ring in the coil which gives a sound but exhibits externally no magnetism, also favors this supposition.
[[horizontal line across page]]

Repeated the Exp. with ring in the [[left margin/5]] coil. The sound at making was very distinct but small at breaking much louder.
[[horizontal line across page]] The Exp. with the bundle of wires, mentioned April 30, also favors the supposition that [[left margin/6]] the sound is connected with the instantaneous induction, with is produced



by the coil, and not by the magnetization of the bar.
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]

78 May the 9th 1840

[[image]] coil no. 2 was placed around the end of the long bar, and then around the same [[word???]] coils no 3&4 were placed. When the ends of these coils were not joined, [[left margin/7]] a very distinct and clear was perceived at making and breaking contact; but when the ends of the secondary coils were joined the sound was almost instantly [[?]]. I should have mentioned that the neutralizing coils were arranged one on each side of the battery coil. The neutralization was not perfect, since no [[word???]] of the coil was [[?]] between the iron and the battery currents. [[horizontal line across page]]

Repeated the Exp. of the screening with the on another bill metal, [[left margin/8]] large tube, no sound could be heard at making, and only the [[?word???]] at breaking. The screening was scarcely perfect since a slight sound could be heard.

After dinner, repeated the same with the same results.

[[horizontal line across page]]

[[image]] suspended

long rod of iron, about 11 feet 1/2 an inch in diameter, glass on the [[word???]]. The [[left margin/9]] sound of making and breaking with this was more perceptible than with the large bar. This would not favour the substitution of the electrical

[[page end]]

[[page start]]

[[top margin]] May 9th 1840 80 [[top margin]]

induction, since the rod was so small that scarcely any effect could have been anticipated. The increase however may be due to the greater length of this rod. Try this by a longer bar of soft iron.

With the long rod the [[screening]] the same [[striketrough]] as the with [[striketrough]] shorter bar. The sound of making could not be heard but a slight noise of breaking was perceptible.

[[horizontal line across page]]

Cemented a slip of longitudinally on the end of the rod, over the surface of this scattered fine sand, but no motion could be observed. The sand was dry and fine. Made [[left margin/10]] the same Exp. with the exception of the [[word???]] dust, instead of sand, the tendency of the powder appeared to be to arrange [[2 words]] the [[?]]

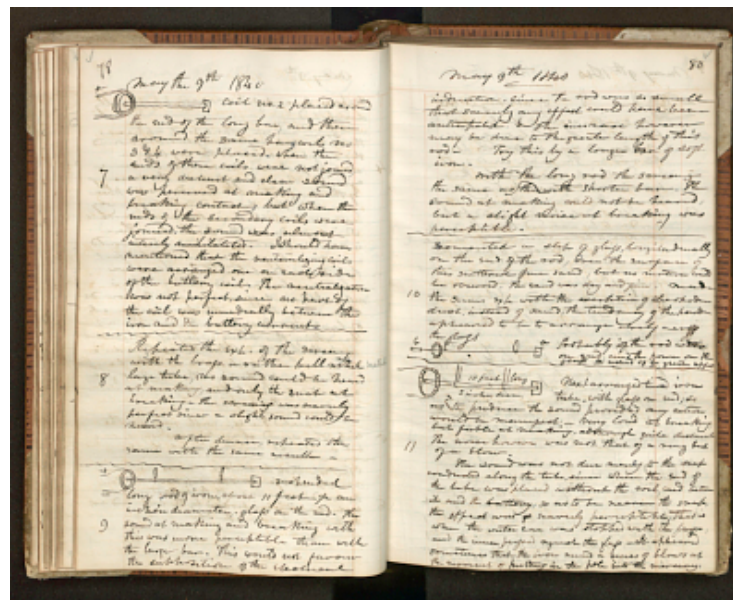
[[image]] Probably if the rod was on end and the power on the glass [[underline]] a [[underline]] instead of [[underline]] b [[underline]] greater effect

[[horizontal line across page]]

[[image with text: 10 feet long / 2 inches diam.]]

Next arranged tinned iron tube with glass on end, so as to produce the sound provided any action would be manifest: very loud at breaking but feeble at making, although quite distinct. [[margin left]] 11 [[margin left]] The noise however was not that of a ring but of a blow.

The noise was not due merely to the snap conducted along the tube since when the end of the glass was placed without the coil, and between it and the battery, so as to be nearer the [[snap]], the effect was scarcely perceptible. That is when the outer ear was stopped with the finger and the inner pressed against the glass--It appeared sometimes



that the iron [[?]] a series of blows at the moments of putting in the pole
into the mercury.
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

May 9th 1840 May 11th
 arranged coil no. 2 with a rod of wood, furnished with a plate of glass. No sound was conducted along the rod. The snap could be heard which was made by the breaking of contact, but only through the air. This was a result which I anticipated, but in order to be assured that the effect was due to some electrical or magnetic action, it was necessary to make the experiment.

May 11th 1840 (Monday)
 Suspended within coil no 2 a stove pipe about 3 and a half feet long, with a piece of glass cemented on the end. Sound perceptible at the breaking of contact but none could be heard at the making. The sound at breaking was of the surging kind. The circuit of the metal was not very perfect, since the iron was riveted together it was also large as nearly to touch the coil. The result of the exp. was no very satisfactory in one way or the other.

Next suspended in the same coil a mercury bottle with an iron tube in the end to the latter a piece of glass was attached. With this arrangements the sound was very perceptible. The making contact gave a very distinct tick - nearly as loud as the breaking. This arrangement favours the position that the effect



82
 May 11th 1840
 is produced by an instantaneous current ---

3
 Next placed in coil no 3 the end of a brass tube about one inch in diameter and 6 feet long. The tube happened to be bent as shown in the figure. It was the same that had been used in my lectures for the water rain. Piece of glass as usual was cemented to the end for the purpose of resting the end.

With this arrangement not the least sound could be heard - the effect must therefore be a negative one but to render this more certain the long iron rod (9) substituted - with this the sound was very perceptible. -- The effect must therefore be magnetic. -- Try this with the telescope tube! I have no solid rod of other metal than iron to make the experiment with but I have found in the case of the turned hollow tube thus- the effect is produced. -

4
 Next suspended within the same coil a gun barrel, which had been shaved? or stoved? out and made thinner than the ordinary gun barrel thickness - The gun barrel was rendered so as to become permanently magnetic but no sound could be heard. The tube however became strongly magnetic at the end near the coil although it showed scarcely any signs of magnetism near the farther end. I know not why the sound should not be produced in this case as in the other unless it be that the glass on the mag have effected the results -- removed the glass still no effect could be perceived ---

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
83 May 11th

next suspended in coil no 2 the tube of a Dolland telescope about 4 feet long--furnished as the other [[left margin/5]] articles were with a plate of glass--with this as in the case of the other brass tube, no sound could be perceived--
[[horizontal line across page]]

Made a contrast between a rod [[left margin/6]] of soft iron and a rod of brass of the same length and thickness. With the soft iron rod the sounds at making and breaking contact were [[^in]] both cases very distinct, but with the brass rod, no sound was perceptible. I think this settles the question relative to the magnetic nature of the sound.--
[[horizontal line across page]]

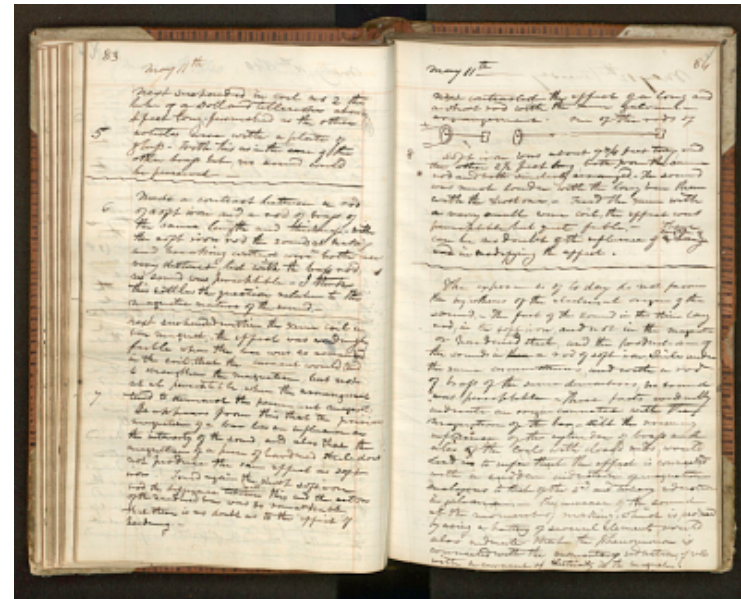
Next suspended within the same coil a bar magnet; the effect was exceedingly feeble when the bar was so arranged in the coil, that the current would tend to strengthen the magnetism, but not at all perceptible, when the arrangement [[left margin/7]] tend to diminish the permanent magnets.

It appears from this that the previous magnetism of a bar has an influence on the intensity of the sound, and also that the magnetism of a piece of hardened steel, does not produce the same effect as soft iron. Tried again the short soft iron rod, the difference between this and the action of the hardened bar was so remarkable thus there is no doubt as to the effect of hardening.--
[[end page]]

[[start page]]
May 11th 84

Next contrasted the effect of a long and a short rod with the same galvanic arrangement. One of the rods of [[image across page]] [[left margin/8]] soft iron was about 7 3/4 feet long, and the other 2 1/2 feet long, both from the same rod and both similarly arranged. The sound was much louder with the long bar than with the short one. Tried the same with a very small wire coil, the effect was perceptible but quite feeble.--There can be no doubt of the influence of [[^length of]] & ~~[[length of]]~~ in modifying the effect.
[[horizontal line across page]]

The experiments of today do not prove the hypothesis of the the electrical origin of the sound.--The fact of the sound in the thin long rod, in the soft iron, and not in the magnetic or hardened steel, and the production of the sounds in ~~[[strikethrough]]~~ them ~~[[strikethrough]]~~ a rod of soft iron, while under the same circumstances, and with a rod of brass of the same dimensions, no sound was perceptible. These facts evidently indicate an origin connected with the magnetism of the bar,--still the screening influences of the cylinder of brass and also of the coils with closed ends, would lead us to infer that the effect is connected with a sudden induction of magnetism analogous to that of the 2nd and tertiary inductions in galvanism.--The increase of the sound at the moment of making, which is produced by using a battery of several elements, would also indicate that the phenomenon is connected with the momentary induction, if not with a current of electricity in the magnet.
[[end page]]

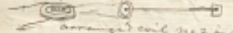


Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

May 12th/ Tuesday

Put in operation this morning ten of the elements of the Daniell Battery for the purpose of repeating some of the experiments of yesterday with elect. of different projectile power.

[[line across page]]

1. First, placed the one part of the compound horseshoe magnet within a coil, suspended from two wires.  terminated in bell buttons which pressed against the opening of the ear. With this a feeble sound was produced. But with a straight magnet in the same arrangement no sounds were perceptible.

[[dividing line across page]]

[[image]]

[[note in left margin]] see p 98.4 [[/note]]

[[in left margin]] 2 [[/in left margin]]

arranged coil no 2 in connection with Daniells battery of 10 elements and on this placed helix no 1 and connected this again with helix no 2 and in the middle of the latter placed the end of the long iron rod - The sound with this arrangement was very much weakened. - I should say when a drop of distilled water was introduced into the secondary current the effect although still perceptible was much more feeble.

[[end page]]

[[start page]]

[[underscore]] May 12th [[/underscore]] 86

[[in left margin]] 3 [[/in left margin]]

Placed in the same circumstances the brass rod - The telescope tube but no sound could be perceived with these. When the tin tube was substituted a sound was heard as in the experiments of yesterday.

Also with the large bar the sound was produced but very feeble

[[dividing line across page]]

[[in left margin]] 4 [[/in left margin]]

The arrangement was now change. The large bar was introduced into coil no 2 and Mr James Alexander who happened to come in was requested to give the pitch of the sound. He stated that it was precisely the same as the bar when struck on end. When the bar was struck on its side a much graver tone was produced -

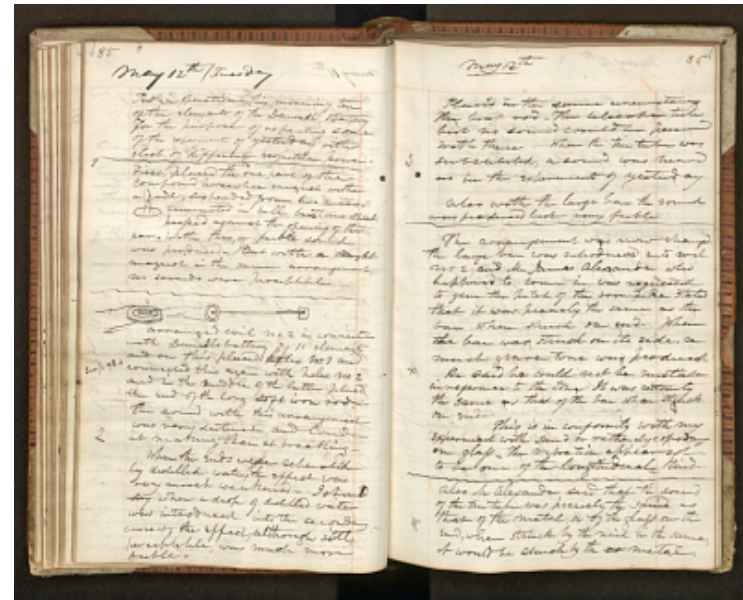
He said he could not be mistaken in references to the tone. It was certainly the same as that of the bar when struck on end -

This is in conformity with my experiment with sand or rather Lycopodium on glass - The vibration appeared to be one of the long [[?]] kind.

[[dividing line across page]]

[[in left margin]] ~~5~~ [[/in left margin]]

Also Mr Alexander said that the sound of the tin tube was precisely the



same as that of the metal or of the glass on the end when struck by the nail in the same it would be struck by the ~~ro~~ metal.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
87 May 12th

Since the sounds are produced by instantaneous currents, as well as by the current of the battery, it would appear that the same effect should be exhibited by a discharge from the electrical machine.
[[horizontal line across page]]

Placed helix no. 2 within ~~coil no. 2~~ coil no. 2 and the long rod in the centre of the latter. When the ends of the helix was joined no sound was produced, when the same ends were separated, sound very perceptible. The screening or neutralizing effect in this arrangement, was more perfect than in any other which I have yet tried.
[[horizontal line across page]]

Tried again to get indications of the direction of the vibration by Licopodium or on the glass, on the end of the short rod, but no indications were exhibited by this arrangement. Indeed none could be expected. Since a smart blow on the end with a stick was not indicated by the motion of the powder.
[[page end]]

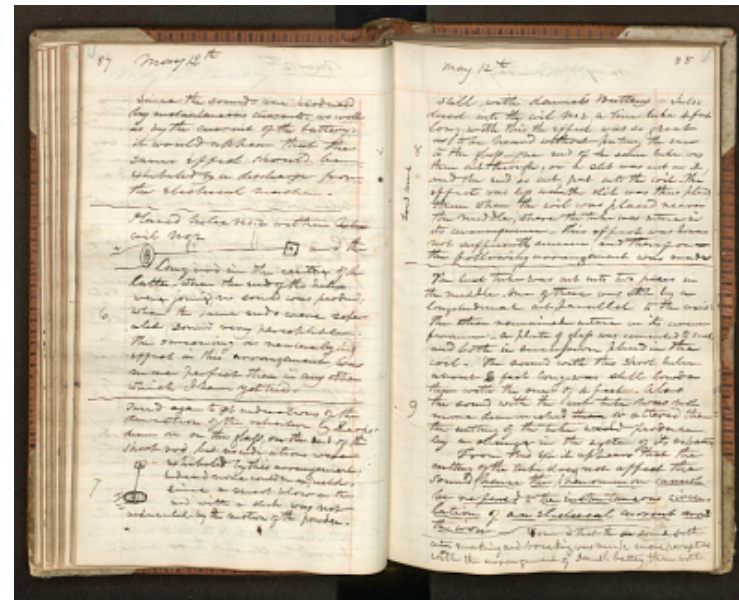
[[page start]]
May 12th 88

Still, with Daniels Battery--Introduced into the coil no 1, a fine tube 4 feet long, with this the effect was so great as to be heard without putting the ear to the glass--: one end of the same tube was then cut through, or a slit was cut in it, and the end so cut, put into the coil. The effect was less when the slit was thus placed, than when the coil was placed nearer the middle, where the tube was entire in its circumference.--This effect was however not sufficiently decisive and therefore the following arrangement was made.
[[horizontal line across page]]

The last tube was cut into two pieces in the middle. One of these was slit by a longitudinal cut, parallel to the axis. The other remained entire in its circumference.--A plate of glass was cemented to each and both in succession placed in the coil. The sound with this short tube about 2 feet long, was still louder than with the one of 4 feet. Also the sound with the cut tube was not more diminished than ~~or altered~~ than the cutting of the tube would produce by a change in the system of its vibration.

From this Exp. it appears that the cutting of the tube does not affect the sound, hence the phenomenon cannot be referred to the instantaneous circulation of an electrical current across the iron.
--
[[horizontal line across page]]

Found that the ~~sh~~ sound both at making and breaking was much more perceptible with the arrangement of Daniels battery, than with
[[page end]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
89 May 13 (Wednesday)

a battery of a single element--also that the short rod gave almost as loud a sound as the long one--The rods of iron are here referred to--

[[left margin/10]] The short tin tube gave a greater effect than the long one.

I did not try the effect on the hard and soft bars, perhaps in this case, the difference would be less than with the arrangement of a single battery.

[[horizontal line across page]]

May 13th

Placed the end of the long tin tube in coil no. 2, then sent through the coil a discharge from a single jar of common electricity--I was led to make this experiment from the analogous operations of ordinary elect. and the secondary current produced by galvanism. By the experiments of yesterday, I find that the sound is produced by the secondary current, and therefore I was led to believe that a similar result would follow from the use of the discharge from a Leyden jar.

With this arrangement, the effect was very doubtful, sometimes the hand felt a slight shock but this was perhaps due to a lateral discharge. The elect. appeared to cut across--to [[left margin/Exp. 2]] obviate this, a wire was coiled around a glass specie-jar so as to make 8 or 9 turns, the end of the long tin tube was inserted  into this, and the discharge made several times, but no sound from the tube could be heard. [[page end]]

[[page start]]
May 13th (Wednesday) 90

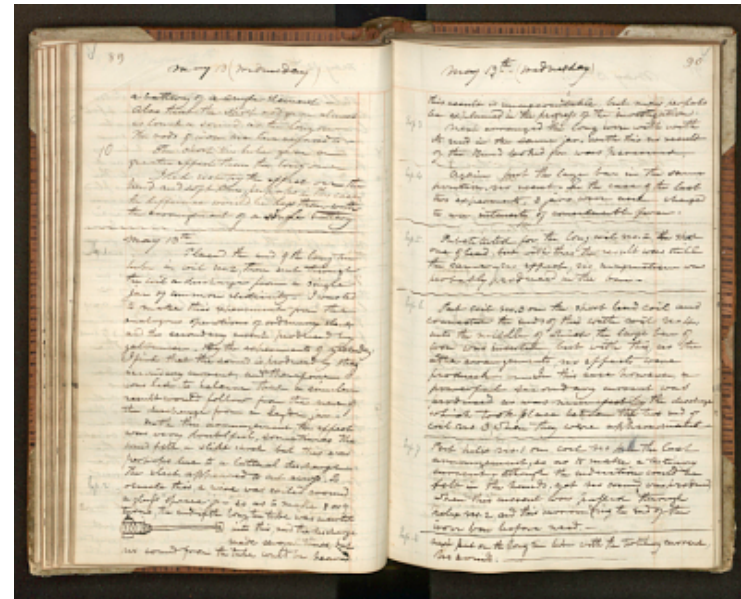
This result is unaccountable, but may perhaps be explained in the progress of the investigation.

[[left margin/Exp 3]] Next arranged the long iron with its end in the same jar. With this no result of the kind looked for was perceived. [[horizontal line across page]]

[[left margin/Exp. 4]] Again put the large bar in the same position. no result. In the case of the last two experiments, 3 jars were used charged to an intensity of considerable force. [[horizontal line across page]]

[[left margin/Exp.5.]] Substituted for the long coil no. 2, the short one of lead, but with this the result was still the same--no effect, no magnetism was probably produced in the bar. [[horizontal line across page]]

[[left margin/Exp.6.]] Put coil no. 3 on the short lead coil and connected the ends of this with coil no. 4, into the middle of which, the large bar of iron was inserted, but with this, as the other arrangements, no effects were produced.---In this case however, a powerful secondary current



was produced as was manifested by the discharge which took place between the two end of coil no 3, when they were approximated.
[[horizontal line across page]]

[[left margin/Exp.7]] Put hilx no. 1 on coil no 4 in the last arrangement, so as to make a tertiary current, although the induction could be felt in the hands, yet no sound was produced, when this current was passed through helix no. 2, and this surrounding the end of the iron bar before used.--
[[horizontal line across page]]

[[left margin/Exp. 8]] Next put on the long tin tube with the tertiary current, no sound,-----
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
91 May 13th

[[left margin/Exp.9.]] The cut tube was next put in place of the long tin tube with the thought that possibly the current in the tube, in case of common elect., might affect the result, although nothing of the kind was observed in the Exp. with galvanism.--No sound with this, unless so faint as to be merged in the noise of the discharge.

The results of the experiments of today with common elect., would lead me to infer that the magnetizing power of this modification of the electrical principle is less than that of the [[word?]] and [[word?]] currents of galvanism.--

[[horizontal line across page]]

[[left margin/Exp 10]] The apparatus of the last experiment being arranged, I repeated one of my old experiments relative to the direction of the currents with the arrangement of the coils. The effect was as many times before determined. Each coil transmitted a current in an opposite direction to the current which generated the one in the coil. The needle however in the extreme coil, was however more powerfully magnetized than in the secondary coil. To determine the cause of [[left margin/Exp.11]] this, the helices were exchanged. That is the one which was attached to the 2nd coil was removed to that which transmitted the tertiary current, the same effect was observed the last needle was still magnetized the stronger. The last coil however was more massive than the first, and had a shorter circuit, when the other coils were removed so as to shorten the 2nd circuit, the magnetism was stronger.

[[page end]]

[[start page]]
May 13th 92

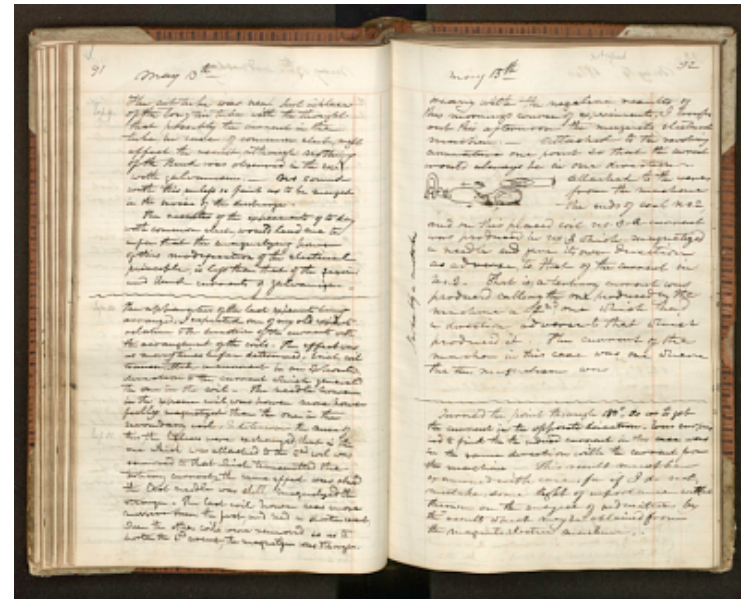
[[note in left margin beside lower portion of this paragraph]] Probably a mistake [[/note]]

Weary with the negative results of this mornings course of experiments. I brought out this afternoon the magnetic electrical machine. -- Attached to the revolving armature one point so that the current would always be in one direction.

[[Image]] Attached to the wires from the machine the ends of coil no.2 and on this placed coil no. 3 - a current was produced in produced in no.3 which magnetized a needle and gave its own direction as adverse to that of the current in no.2 - That is a tertiary current was produced calling the one produced by the machine a 2nd one of which had a direction adverse to that which produced it. The current of the machine in this case was one where the ~~the~~ the ~~the~~ magnetism was

[[dividing line across page]]

Turned the point through 180° - so as to get the current in the opposite direction - was surprised to find that the induced current in this case was in the same direction with the current from the machine -- This result must be examined with care for if I do not mistake some light of importance ~~[[?]]~~ thrown on the subject of induction by the results which may be obtained from the magneto electric machine.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

May 14 1840

I forgot to note in this book a fact, communicated to me by Mr Olden, relative to a spark of elect. which he saw from a stove, on board of a steam boat on the Ohio. The stove was an ordinary one of cast iron, and used for burning bituminous coal. It gave a spark to every person who touched one of the corners with his knuckle - during, I think he said, the time of burning; - it sood on a dry floor immediately above the boiler. The sparks were drawn when the boat was at rest and had no respects to person. It was a common amusement and shown as a curiosity.

This is one among several instances in which sparks have been known to be given off from stoves in dry weather. One case in Albany, in the house of Dr. Beck, was stated to me and another in Phil^d in Dr Haye house. These however were refined to the silk dress worn by the persons, but the same explanation could not be applied to the case narated by Mr Olden.

I am inclined to think that there is some means of developing heat elect. which is not yet understood, but which is operative in these cases, and which also produces the shocks which have been felt in putting down long ranges of iron pipes for the conduction of water.

[[note encircled in footer]] This fact is connected most probably with the development of electricity from steam - I have mentioned it in connection with this subject at a meeting of the society Jan 1842 [[/note]]

[[end page]]

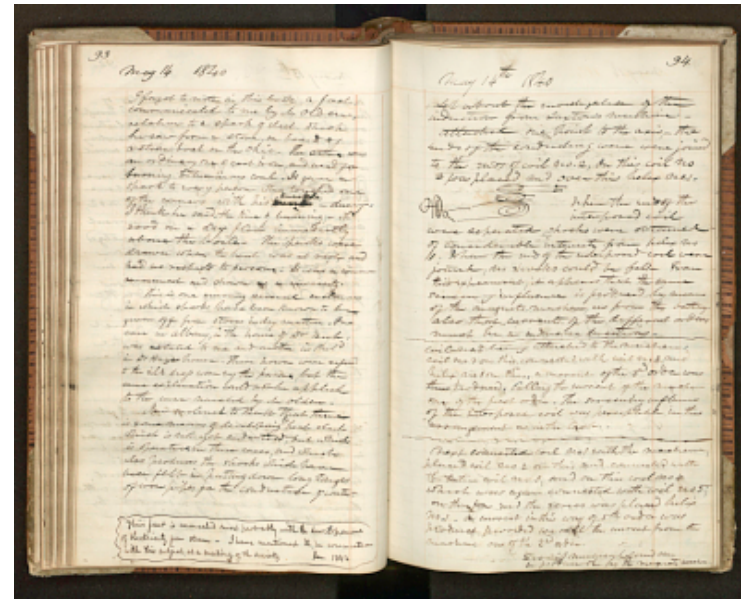
[[start page]]

May 14th 1840

Set about the investigation of the induction from Saxton's machine.

Attached one point to the axis, - the ends of the conducting wire were joined to the ends of coil no.2, on this coil no 3 was placed and over this helix no. 1

When the ends of the interposed coil were seperated, shocks were obtained of considerable intensity from helix no 1. When the ends of the interposed coil were



joined, no shocks could be felt. From this experiment, it appears that the same screening influence is produced by means of the magneto machine as from the battery. Also that current of the different orders must be in adverse directions.

[[dividing line across page]]

Coil no. 2 being attached to the machine, coil no 3 on this connected with coil no 4, and helix no 1 on this, a current of the 3rd order was thus produced. Calling the current of the machine one of the first order. The screening influence of the interposed coil was perceptible in this arrangement as in the last.

[[dividing line across page]]

Next connected coil no 1 with the machine, placed coil no 2 on this and connected with the Outer coil no 3, and on this coil no 4 which was again connected with coil no 5; on the far end, the screen was placed helix no. 1. A current in this way of 5th order was produced provided we call the current from the machine one of the 2nd order.

[[Note in footer]] See if musical sound can be produced by the magneto machine? [[/note]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

95
May 14

Next set about ~~to~~ ~~determining~~ the direction of the several currents.

1st direction of the current in the first coil with the sun.

2nd coil, on the 1st, direction of the current also with the sun.

3 current in the 4th coil on the 3rd in the direction against the sun.

current from the machine +
current next the machine +
current next in order -
current next in order +

[[dividing line across page]]

In the above experiment, a double magnetizing spiral was used, or one with the spers in two layers.

To render the needle in the last spiral more susceptible, it was heated to redness, or very nearly to that point in a lamp. The magnetism then was weak but decided.

[[dividing line across page]]

The point for breaking contact was now turned through 180 degrees, so that the break should take place out the moment when the revolving armature was in an opposite position, - (relative to the poles of the magnet.

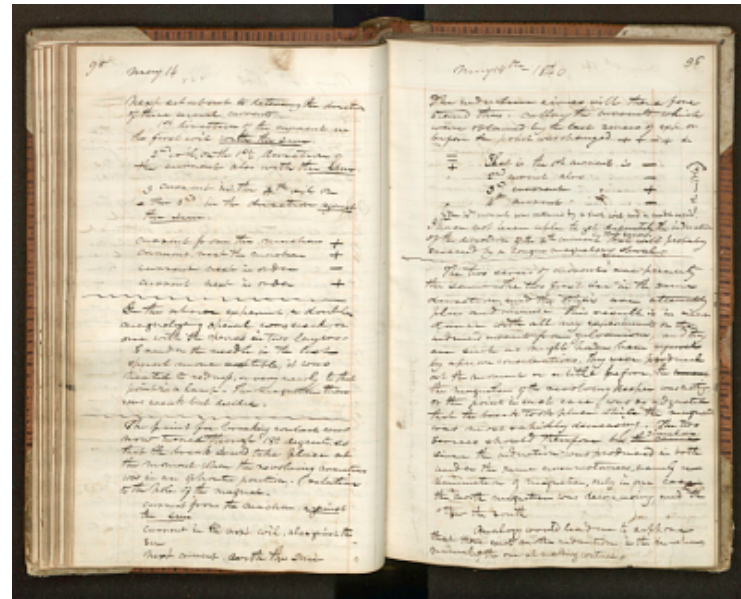
Current from the machine against the sun
Current in the next coil, also against the sun
Next current with the sun
[[end page]]

[[start page]]
May 14th- 1840 96[[page number]]

The induction series will therefore stand thus - ~~cutting?~~ or calling? the currents which were obtained by the last series of exp. or before the point was changed +-+ [[?]]

-
-
+

Thus is the 1st current is -
2nd current also -
3rd current +
4th current -



{ The 4th current was obtained by a short coil and a needle softened in the ~~the~~. I have not been able to get definitely the indication of the direction of the 4th current in this series but will probably succeed by a longer magnetizing spiral-

[[dividing line across page]]

The two series of currents are precisely the same. The first are in the same direction and the others are alternately plus and minus. This result is in accordance with all my experiments on the induced currents from galvanism and they are such as might have been referred by ~~the~~ considerations. They were produced at the moment or a little before the ~~current~~ the magnetism of the revolving keeper was nothing, or the point in each case was so adjusted that the break took place while the magnetism was most rapidly decreasing. The two series should therefore be ~~the same~~ [^]~~the same~~, since the induction was produced in both under the same circumstances, namely a ~~of~~ of magnetism, only in one case the north magnetism was decreasing and the other south.

Analogy would lead me to suppose that there exists another induction in the machine namely the one at making contact.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
97 May 15th 1840

Made arrangement to study the currents [[^produced]] at the beginning of the magnetism.

The point remaining as it was in the last experiment, the direction of the current was found to be against the same. Point changed so as to make the break when the magnetism is increasing. The direction of the current was in this case [[underline/with]] the [[underline/same]].

[[left margin/1]] The spark was much smaller than in the arrangement where the break took place, while the intensity of the magnetism was decreasing. The fact is precisely analogous to the small spark at making contact, in the induction of the battery of a single element.
[[underline/Probably with the coil]] for intensity, the shock in this case may be more intense than the other, or perhaps the [[underline/destruction of the bar is much quicker than the magnetisms]].

The second current in this above arrangement, was also with the same.

The third current was [[underline/against]] the same, 4 current opposite direction.

We have thus in this induction as in the other ~~[[striketrough]]~~, the following ~~[[series?]]~~:-
[[left margin in front of large open bracket/Induced currents at breaking while magnetism increasing---]]
[[to right of large open bracket/
currents from the ~~[[?mach]]~~ +
next current +
Third current -
Fourth current +

[[short vertical line]] N. B. I find that-by heating a needle red hot in the middle it is rendered much more easily magnetized and the currents of the higher orders are by ~~[[text continues up right margin vertically]]~~
a needle more easily detected
[[page end]]

[[page start]]
May 15th 1840 98

The results of the experiments indicate that the currents from the magnetic electrical machine partake of the nature of the current from the battery, since they all give the same ~~[[screens?]]~~.

And on a little reflection, this from analyzing might have been inferred, since the induction were produced all ~~[[^at]]~~ the moment of interrupting a current which was an appreciable ~~[[word??]]~~, namely ~~[[left margin/2]]~~ it exists and is increasing, while the aperture is moving through 90 degrees of its revolution.-Then ~~[[word?]]~~ two inductions at each half revolution of the aperture, namely one which the magnetism is increasing, or while the iron is approaching the poles of the magnet and the other while the same iron cone is passing from the magnet. There was therefore during each entire revolution of the spools, 4 induced



currents, and these for the reasons above given must all have the properties of the terminal currents in the galvanic induction.
[[horizontal line across page]]

[[left margin/3]] attempted to get the sounds in iron from the magnetic elect. machine with the long bar + the tube, but the results were not very definite
[[horizontal line across page]]

Next attempted the same by means of the 2nd current from the machine. Coil no 2 being in connection with the machine, hilex no 1 [[left margin/4]] was placed on this, with its ends joined to hilex no 2, and the end iron put in this,--with this arrangement the sound was very perceptible. The effect was then produced by a current of intensity, and probably intensity is required. The battery of 30 elements gave the greatest results. Try if the 2nd current of [[quantity?]] will produce the same result as intensity.
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
99 May 15th 16th 1840

In my experiments on the sound produced by the 2nd current of galvanism p 95, I only used the intensity current to determine if the quantity second current would produce the same effect was desirable. Tried the Exp. The effect appeared nearly the same with the intensity and the quantity secondary coil a little louder with the intensity.

Perhaps the intensity of the action of the current immediately from the machine in the last experiment was not sufficient to produce the effect, although there might be nothing in the nature of such a current to prevent the action.

[[horizontal line across page]]

May 16

[[image]] [[left margin/1]]

Made arrangements to study the two inductions as produced by the magnets. Electric machine--connected the could no 1 with the machine, and coil 2 on this, with the ends united with the galvanometer of Clark. The needle was deflected and apparently changed in the polarity--

Attached ends of same coil to the long wire galvanometer needle appeared unaffected.--Also made experiment the hilex no 1 substituted for coil no 2, but with the same result. Through these experiments it appears that the amount of the [[word?] induction is an [[transposition sign/induced current]] from the machine, is very small
[[horizontal line across page]]

[[left margin/2]]

Tried the shocks from the above arrangement quite severe, but the action on the galvanometer appeared little if any.
[[end page]]

[[start page]]
May 16th 100
[[left margin/3]]

[[image]] Connected Pages little machine within the magnets electra machine. When the connection was completed, so that the iron wires became magnetic by the inner coil, very powerful shocks were produced, which were so intense as to paralyze the hands and prevent them from relinquishing the handles. The gads grasped the usual handles.

[[horizontal line across page]]

[[left margin/4]] Next connected the end of the little machine with the ~~[[striketrough]]~~ [[^end of could no 2 going 2nd]] current from the machine, the effect was less than with the former arrangement, but still the shocks were tolerably severe. The shocks in these case, were [[word?]] due to the sudden magnetism of the soft iron. This however must be shown in a different way, by an apparatus by which will enable me to draw out the iron cone, and to put in one of other metal; also one of solid iron and of wires--
[[horizontal line across page]]

These experiments afford a method of modifying the magnets electrical



machine, and giving shocks of any required intensity by means of different-sized spools of wire, with the iron cones of bundles of wires. One cone will survive for many different spools.--The intensity of the shock may be verified by the distance to which the wire cone is pushed into the coil.

[[left margin/ words???]]

[[horizontal line across page]]

[[left margin/6]]

When the second current was produced, by connect the little machine with no. 1, instead of coil no 2, as in Exp. 4, the induction could not be felt. In this case, a current of intensity was passed into a coil of quantity.

[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
101 May 15th 16th (Saturday)

[[left margin/7]] Revised the portion of the little machine, so that the induced current from the ~~[[striketrough/second coil]]~~ helix no 1. was passed through the long wires of the machine. The short wires of the same were then united with coil no 2, and on this was placed, slight shocks could thus be produced. This Exp is precisely analogous to the one given in my paper.
[[horizontal line across page]]

[[left margin/8]] It would be easy, I think, to ~~[[word?]]~~ all my experiments with the different sources of currents by the magneto-Elect. machine, using small helices with cones of bundles of iron filings. A smallness of helices so arranged thus one might fit into the other, to be connected with the machine, would be a good accompany article for ~~[[my?]]~~ purpose, and among others, for graduating the intensity of the current when used for medical purposes.
[[horizontal line across page]]

[[left margin/9]]
The shock might be graduated by means of a cone of iron wire, put in and out, according to the intensity required
[[page end]]

[[page start]]
May 18th 1840 (Monday) 102
[[left margin/1]]
[[image]]

Attached the magnet0-Elect. machine, the tube of glass, around which a Zinc wire was wound and also a wire in the axis.--This apparatus with the Elect machine gives currents in the same direction with the machine.--The current with the is was the same as with the large coil,--namely in the same direction as the current from the machine.--
[[horizontal line across page]]

[[left margin/2]]
In the last Exp, the magnetism of the needle at ~~[[underline/b]]~~ was feeble and could only be determined heating the needle to redness in the middle so that it would be more susceptible of receiving the magnetism.--A bundle of 4 wires was inserted into the axis of the tube,-- the needle no came from the same magnetizing spiral quite strongly magnetized.-- This Exp shows the effect of iron increasing the intensity of the action of the magneto-Elect. machine.
[[horizontal line across page]]

Attempted to get the current from the 3rd order with coil no. 1 in connection with the machine, Helix no 1 on this, and the ends of the same connected with the tube apparatus mentioned at top of page--no result--
[[horizontal line across page]]

[[left margin/3]]
Substituted for the Helix in the last Exp the coil no 3, ~~[[image]]~~ with this arrangement the needle came from the spiral magnetic, provided it had been softened in the middle previous to being put in.--The direction of the current was--minus--or the ~~[[word?]]~~ of the ~~[[word?]]~~ currents was 1st +2nd+3rd--



[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

103

May 18th Monday 1840

[[margin]]4[[/margin]]

To determine the effect of iron on the currents of the 3 orders, 4 wires were introduced into the tube.

Hard needles were then put into the ~~gl~~ magnetizing spiral in succession and the wires withdrawn and inserted alternately. The result was that without the reaction of the soft iron, no magnetism was produced in the ~~soft~~ needle ~~hard~~ needles, but with the iron, the effect was always produced. the magnetism was determined by that most unequivocal test - the attraction of soft iron filings. this experiment, although on a small scale, settles the fact of the influence of a core of soft iron even on currents of the different orders.

[[horizontal line]]

[[margin]]5[[/margin]]

Since the reaction of soft iron increases the induction of a tertiary current, I [^][[was]] led to suppose that the same effect would be produced by a discharge of ordinary electricity. ~~[[words crossed out]]~~ bringing this to the test of experiment, the short lead coil was connected with a jar. Coil no 3 placed on this, and the double spiral tube attached to the latter. The needle was a hard one, and came from the magnetizing spiral, when the soft iron wires were not in the tube, with not sufficient magnetism to support a ~~[[word?]]~~ of iron filings. When the iron wires were put in the hollow tube, the needle was in ~~[[end page]]~~

[[start page]]

104

May 18th Monday

every case much more strongly magnetized. The experiment was repeated many times, and always with the same results. the magnetism of the needle was always, when influenced by the reaction of soft iron, than when not thus influenced. From this experiment, it appears that the instantaneous current from the elect. reactions may be modified by the magnetism of soft iron.

[[horizontal line]]

[[margin]]6[[/margin]]

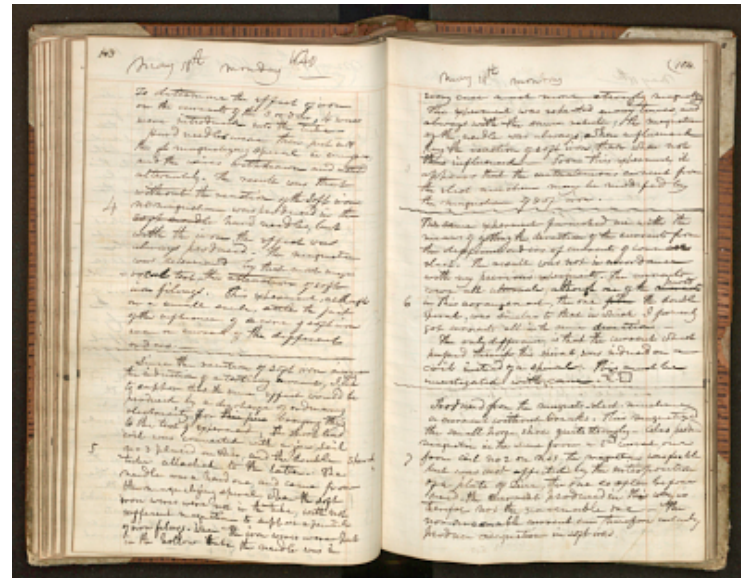
The same experiment furnished me wit the means of getting the direction of the currents from the different orders of currents of ~~[[common?]]~~ elect. The result was not in accordance with my previous experiments. The currents were all alternate, although one of the ~~currents~~ parts in the arrangement, the one ~~from~~ of the double spiral, was similar to that in which I formerly got currents all in the same direction. The only difference, is that the current which passed through this spiral, was induced on a coil instead of a spiral. This must be investigated with care ~~[[image - hand pointing at the last line of the paragraph]]~~

[[horizontal line]]

[[margin]]7[[/margin]]

Produced from the magnet. elect. machine a current without breaks.

This magnetized the small horse shoe quite strongly. Also produced magnetism in the same from a 2nd current, one from coil no 2 on no 1. The magnetism was feeble but was not affected by the interposition of a plate of zinc, the one so often before used. the current produced in this way is therefore not the screenable one. the nonscreenable current can therefore certainly produce magnetism in soft iron.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
105 May 18th May 19th

Produced the current from the machine without [[?rupture]]. This current in this and the last experiment was generated by connecting the end of the coil no 1 against the end of the shaft and the other in connection with the mercury through which [[moves?]] the continuous wheel [[left margin/8]] in this arrangement, there was no [[word?]], but at each revolution currents in different directions 2 in each were produced. Helix no 1 placed on coil no 1, gave slight shocks which could be felt by the tongue. The same result was produced when the place of Zinc was interposed.

[[horizontal line across page]]

May 19th

Made preparations this morning for experimenting on the Elect. from iron, and also with common Elect. [[left margin/1]] Made a spiral of tin foil on each side of a large pair of glasses. Sent shock through the spiral on one side, caught current from the other side, found the direction the same as that from the larger coil, namely * adverse to that of the jar current.

[[horizontal line across page]]

[[image with X and Y labeled]] Sent charge through coil in glass tube [[?containing?]] and the spiral,--current produced always in the same [[left margin/2]] direction as that from the jar. This is only a repetition of one of my old exp.

[[horizontal line across page]]

*Probably the effect produced by the action of the magnetizing spiral used. See page 145 Sept 23 1840
[[page end]]

[[page start]]
May 9th 1840 106

[[image with - and + marked]] Connected coil no 1 with the battery, placed helix no 1 on this, the end of the helix being joined [[^one end]] to the handle and helix no 2 at the other. A bundle of iron wires was then introduced, but the shocks were not [[left margin/3]] materially increased, indeed it appeared that the wire in this case produced rather a sedative effect. The effect however one way on the other was very little. The form of the coil however was not of the kind to exalt in a great degree the effects from the magnetic [[word?]]

Make a new arrangement with a long coil for this Exp--
[[horizontal line across page]]

[[image with - and + marked]] Connected again coil no 1 with the battery, placed coil no 2 on this, and connected its ends with a small coil of about 2 inches in diameter, and formed of 60 feet of copper wire. With this arrangement, and [[strike through/coil]] helix no 2 placed on the bundle of wires, and these inserted into the opening of the small coil, then [[left margin/4]] shocks were very disagreeable. Without the iron, no shocks or at most very feeble ones, could be felt--The effect appeared to be consistently greater when the long bundle which is about 14 inches long was used. The shorter bundle is not more than 5 inches in length. This experiment proves conclusively that the current of the 3rd order are increased by



adding the reaction of soft iron to that of the 2nd current.

By this experiment, I am lead to form a method of which is more
extended since
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

107
May 19th 1840

of inductions may be produced and then direction determined by the needle and perhaps by the galvanometer. Such a series I will set about making preparations for tomorrow (or as soon as I can procure the iron wire.

[[dividing line across page]]

[[in left margin beside paragraph below]] 5 [[/in left margin]]
Attempted by another arrangement than that of (Exp 3) to produce an effect on a current by its [[own ?]] induction on iron but without success. Still the soft iron probably does have some effect, since in the case of an electro-magnet the action is much exalted by the introduction of a core of iron.

[[dividing line across page]]

[[in left margin beside paragraph below]] 6 [[/in left margin]]
[[image]] Connected coil no.2 with the battery. Within this put two pieces of stove pipe so as to make so as to make a perfect screen of iron but not a perfect circuit. Within the iron placed ~~coil~~ helix no 2. When the connection with the battery was broken shocks were obtained but of much less intensity than with the coil and helix alone.

[[dividing line across page]]

[[in left margin beside paragraph below]] 7 [[/in left margin]]
[[note sideways in left margin beside paragraph]] Not correct, see p. 1095 [[/note]]
The direction of the current was now taken and it was formed to be adverse to that of the battery or to that which would be produced on the outside of the coil. This result much tested with a coil of intensely with in. It is in accordance with
[[note in right margin beside paragraph above]] Exp [[?]] page [[64? or 54?]] [[/note]]
[[end page]]

[[start page]]
108
May 20th
Induction from ordinary electricity

[[note in left margin beside paragraph]] * [[W. sod? or M. Dod?]] [[/note]]
[[in left margin beside paragraph]] 1 [[/in left margin]]
Mr Dod made for me yesterday a spiral around a glass cylinder to replace the one which was used to get currents of induction form common elect. Which had been working. [[image]] Current from a single jar was passed 1st along the outer spiral and the induced current from the inside the direction of both the same. Next, the discharge was passed through the inner spiral current on the outside again the same as on inside -----
This is in conformity with all my old exp.



[[in left margin beside paragraph]] 2 [[/in left margin]]

Repeated the exp found that with a very small charge that the current with the above apparatus was adverse with a charge of a single turn. This was the case - with 3 turns the reverse.

[[sideways note at left]] These are in conformity with my old experiments on the same points with the exception of the 1st discharge ----
[[/sideways note]]

With 1 turn current inverse *

"	2 turns	"	feeble
"	3 turns	"	direct
	4 turns	"	direct
	5.6.7.8	"	direct
	12 13	"	direct by feeble
	15 - -	"	direct strong

[[sideways note at right]] *The first time I even produced an adverse current with an arrangement of this kind [[/sideways note]]

[[dividing line across page]]

[[in left margin beside paragraph]] 3 [[/in left margin]]

see page 232

With the spiral on the glass plate described yesterday found that a powerful discharge gave a different direction from that of a weak one

With 2 turns -- +

3	"	+
10	"	-
19	"	+

[[note at right of list above, outlined top, bottom and left]] In the expermts on this page a magnetizing spiral of double set of turns was used - see p 145]]

These are only sporadic experiments. The whole of this must be studied at an other time Was studied May June 1842

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

May the 20th Last day of the [[continued on next page]]

[[marginal notation]] NB [[marginal notation]]

[[marginal notation]] 4 [[marginal notation]]

I observed in making the two foregoing experiments, that a piece of tin foil, connected with the outside of the jar, was strongly attracted to another piece into which the elect. was flowing, so as to produce an oscillations.

Perhaps there was nothing in this different from the ordinary action of elect. but I must examine it at my leisure. See March 19 1836 old book Mr Masons observation

[[dividing line across page]]

[[marginal notation]] 5 [[marginal notation]]

Repeated the experiment of 6 & 7 of yesterday by putting into the centre of the stove pipe, one of the short coils - With this the needle, in one of the short magnetizing spirals was rendered highly magnetic; but the current as indicated by it was uniformly in the opposite direction to that determined yesterday - The current was always + or the same as the battery current. The experiment of yesterday was not [[best guess]] decisive [[/best guess]] since the needle might have been slightly magnetic before

[[dividing line across page]]

[[marginal note]] 6 [[marginal note]]

In the last experiment the iron was open so that the magnetic induction might be neutralized by the elect. current on the outside. The sides of the iron were now screwed together but still the needle came out magnetized in the same direction it would have had were the iron not present. -----

[[dividing line across page]]

[[marginal note]] 7 [[marginal note]]

Repeated the same with the narrow iron ring and with the same result. The needle was again magnetized by a current in the same direction as the battery coil.
[[end page]]

[[start page]]

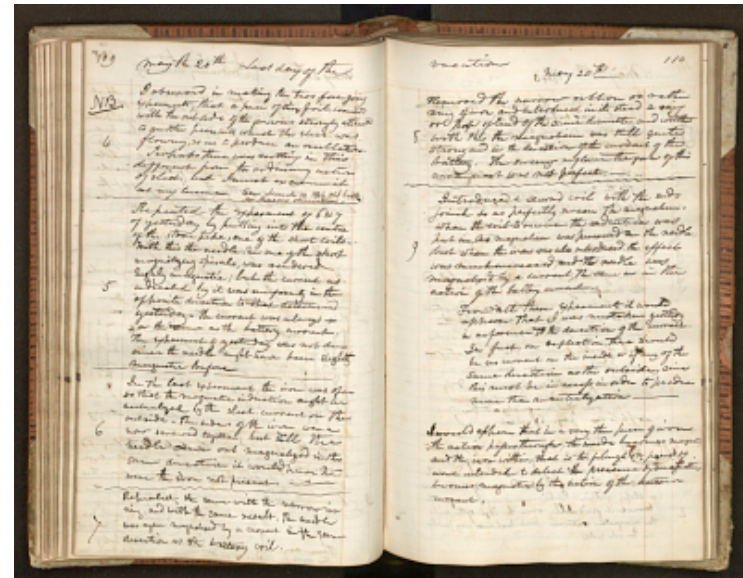
[[continued from opposite page]] vacation [[/continued]]

May 20th

[[marginal notation]] 8 [[marginal notation]]

Removed the narrow ribbon or rather ring of iron and introduced in its stead a ring or hoop of lead of the same diameter and width with this the magnetism was still quite strong and in the direction of the current of the battery. The screening influence therefore of this arrangement was not perfect --

[[dividing line across page]]



[[marginal notation]] 9 [[/marginal notation]]

Introduced a second coil with the ends joined so as perfectly screen the magnetism. When the coil to receive the induction was put in, no magnetism was perceived on the needle but when the iron was also introduced the effect was much increased and the needle was magnetized by a current the same as in the action of the battery current.

From all these experiments it would appear that I was mistaken yesterday in reference to the direction of the current. In fact, on reflection, there should be no current on the inside, or if any, of the same direction as the outside, since this must be in excess in order to produce more than a neutralization ---

It would appear that in a very thin piece of iron the action passes through the inside becomes magnetism and the iron within that is the filings or pecis of wire intended to detect the presence of magnetism becomes magnetic by the action of the exterior current
[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

111

May 21st 1840

[[image - diagram in left margin]]

[[in margin]] Repetition of Exp 6 p 107 [[/in margin]]

[[marginal notation]] 1 [[/marginal notation]]

Placed within the sheet iron cylinder which was cut so as to permit the induction of coil no 2 to pass through helix no 2 when the iron was around

a considerable reduction was perceived in the intensity of the shock, although with the same arrangement and a cylind of any other metal than iron no effect would have been perceived

The reduction was therefore due to the peculiar action of the iron or to the development of its magnetic state - But why should the magnetization of the cylinder affect in this way the ~~cor~~ induction on the coil within, while had the coil been placed on the outside as it is well known, the induction would have been exalted?

This question is answered by the experiments which I have before made on the magnetization of soft iron page 68 et cet

[[dividing line across page]]

[[image - diagram]]

[[in margin]] 2 [[/in margin]]

Repeated some of the experiments with the magnetism of soft iron by means of the coil - Made coil no 2 into a ring - placed piece of sheet iron (a slip) within. It became strongly magnetic, turned it gradually over the edge of the coil, the magnetism continues, but becomes very feeble on the out side.

[[start page]]

112

May 21st First day of the session

[[in margin]] 3 [[/in margin]]

[[image - diagram]]

When a very ~~short~~ coil of small diameter was employed the magnetism on the inside was almost imperceptible or rather very feeble when compared with that of the inside and this will not be surprising when we reflect that the currents on the opposite sides of the centre of the coil are revolving ~~at~~ in different directions or I should say moving in opposite directions and consequently tend to neutralize

[[image - diagram]] the effect of each other - but when the iron is placed within the coil, then the currents on each side then to cause the currents to move in the same direction around the iron.



[[dividing line across page]]

[[in margin]] 4 [[/in margin]]

[[image - diagram]] When the circuit was made about two feet in diameter the difference between the inside and the out side was much less than with a smaller circuit although there was still a difference. And that this difference should exist is certain since the opposite side of the coil must still have some effect and also the action of a given portion of the circuit is nearer the iron within than without That is, all the particles in a given arc of the current are together nearer the inner than the outer piece of iron [[image - diagram]]

[[dividing line across page]]

[[in margin]] 5 [[/in margin]]

[[image - diagram]]

When the coil was bent into the form shown in the margin the action was as strong on the outside as in a slight concavity ~~around~~ on the outside served to neutralize the effect of the whole circle.
[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]] 18~~32~~40
113

May 21

[[marginal notation]] 6 [[/marginal notation]]

[[image--wavy line across page]]

[[image: circle with leading lines top and bottom on the diagonal each labeled "4".]] With a small hollow coil of [[image--two concentric circles]] two inches in diameter, and an inch and a half high, considerable magnetism was exhibited on the outside with a slip of sheet iron, and iron filings. [[image--a ridged cylinder with a shorter, wider cylinder around the middle]] When a small [[turned?]] iron cylinder ^[[for tube]] was placed inside of this, but little magnetism appeared on the inner side of the tube-

[[image--wavy line across page]]

[[note in margin-7]]

[[image--two concentric ovals with a dotted c-shape on the left]] A part of of [[sic]] a stove pipe was placed within coil no 2 while in the form of a ring- Magnetism appeared on the concave side as well as on the convex but not quite so intense - The side of the iron in all cases not to the current, always becomes the most strongly magnetized.

[[image--wavy line across page]]

[[note in margin-8]]

[[image--several concentric circles with a small oval to the left]] This is shown in the experiments with the small [[colose?]] coil made of coil no 6. The piece of iron on the outside always supported more filings on the outside, than on the inside. - --- That is, more filings on inside of the iron or the side next the coil than on the outside. - In all cases however, where any magnetism appeared in a piece of iron on the outside of a circuit, it was magnetized intirely around, but this is not the case with a tube which is complete in the circuit, since it may be magnetized strongly within, and yet show no signs of magnetism without.

[[end page]]

[[start page]]

1840

114

May 21 22nd

[[marginal notation]] 9 [[/marginal notation]]

To exhibit a with something of a variation the magnetism of a hollow cylinder within, and not without, put coil within stove-pipe, put paper over top of this and on the paper, strewed iron filings - This exp is the reverse of the one given at page 68.3.

[[image-square filled with dots, with circle filled with radiating lines in the middle of the square]]

The result of this experiment is intirely at variance with the deduction of Prof. Jacobs (see scientific memoirs), and also with the theory which would assign a similarity of action to magnetic distribution and electrical. The latter it is well known, is intirely superficial. Magnetize inside and out as one with two coils DS Battery filings.

[[image--wavy line across page]]

May 22nd

[[note in margin beside section]] 1 [[/note]]



[[image-diagram: Three narrowly concentric wires form an oblong circle. A helix of wire is wound around the oblong circle's left end and the ends of the wires extend to the left. Top wire is labeled "+"; bottom wire is labeled "-" outside the oblong circle. Inside the circle at the bottom of the helix where it touches the circle's wires is labeled "a"; the curve of the oblong circle below "a" is labeled "b" and the center of the bottom of the oblong circle is labeled "c". Around the center of the right end is a thick ring with wires extending horizontally to the right from the ring's right edge outside the oblong circle. The wires off the ring have two small rectangular ends a their terminals. Above where the top wire extends from the ring is labeled "d".]]

Made a large hank of iron wire 1/12 of an inch thick. The [[hew?]] was a circle of about 2 feet in diameter, around one side of this a thick copper wire was wound, and on the other directly opposite coil, I would say helix, no. 2 was placed. It was supposed by this arrangement the the [[sic]] electricity due immediatly to the action of the iron, would be produced, and that it could then be seperated from the action of the galvanic current.

When the helix was placed at d, scarcely any effect in the way of shocks could be felt, except through the tongue, but as it was moved towards the coil a in the direction c b a, the shock increased much in severity, and when the helix was placed over a, the shocks were too severe to be borne. The intense shocks can be produced by the iron alone, since when the helix d

[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

115 May 22nd 1840-

was placed at b at right angles to the coil a and which therefore could have no inductive influence on it a powerful shock was given

2 Next placed coil No 1 in connection with the battery and coil No 2 on this with its ends joined to those of the coil around the iron. This arrangement was intended to produce shocks by the sudden magnetization of the iron by the secondary current. When the d was placed at b, no effect was produced, even through the tongue, but when at b and at right angles to the coil, the shocks were tolerably severe. From this exp. it would appear that the intensity from the 2nd current, of the induction by soft current, is feeble.

3 Connected the large hank of wire with the outside of 3 Leyden jars, that is sent discharge from 3 jars through the coil around the large hank. No shock was felt when the handles were grasped, unless it were in the case when the direct action of the elect. favoured the effect.

4 Next removed the ~~helix~~ helix which gives ~~handles~~ handles and fastened the ends of the helix to the long wire galvanometer. With this, a powerful current was indicated at the d where no shock could be felt. The needle swung one way as far at making as the other at breaking ?

116 May 22 1840

5 The arrangement of the apparatus being the same as before, an attempt was made to get a current after the battery current had been closed a few seconds by the gradual magnetization of the bar, or rather hank of iron. The short wire, and also the long wire galvanometer, but no different results were attained, the needle appeared to move a little.

6 Removed the hank of iron wire from the cylindrical coil attached to the battery, introduced in its stead the long iron bar --  When the helix was within 6 inches of the end of the coil at a, shocks could be felt, but when it was removed further than this, little or no effect could be produced although the magnetization of the bar take place through the whole length, yet the sudden action necessary to produce the shock, is at a small distance. Probably the same effect could take place at as great a distance on the opposite side of the coil in ? without magnetism. The shocks were quite strong with the helix over the coil.

Next tried same exp with galvanometer, also put on quantity coil on the iron instead of ? helix.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

117 June the 4th 1840

Since the last date, I have been constantly engaged with my class. Have finished lecturing on elect. in all its branches & have commenced the subject of light.

[[horizontal line]]

1 [[image of coil]] Connected the coil used in the last days experiment with the battery, noted the spark which was very feeble. Then introduced a bundle of iron wire varnish, the spark was astonishingly increased showing the great action of the iron when placed on the inside of a coil.

[[image]] Next put the coil within helix No 2 without iron, the ends of the helix were then connected with the galvanometer, the needle of which when contact was made and broken, moved about 15 degrees. [[2]] The iron was next introduced - the needle now whirled 6 or 8 times entirely around with great velocity both at making and breaking the contact. This shows the great influence of the reaction of soft iron in producing the the galvanometer induction.

[[horizontal line]]

3 The action of the induction was so energetic with the last arrangement, that I attempted to get a current from two spirals near each other, [[image of spirals and glass tube]] with the small glass tube, but did not succeed.

[[horizontal line]]

4 I [[image of coil around bundle of wires]] put another coil around the first used in the above experiment, with this arrangement was enabled to get induced currents of the 5th order. [[end page]]

[[start page]]

118 June 4th 1840

Put a stove pipe around the coil used in the last experiment and around this helix No. 2, the ends of which were connected with the long wire galvanometer. [[image of stove pipe apparatus]] The iron of the pipe produced in this arrangement but little screening. The needle was not [[power?]] apparently quite as much deflected as without the iron, still little difference could be observed. When the iron wires were put into the axes, the needle as in exp, whirled entirely around.--

5 The iron tube should produce a screening influence, since since the currents in the outside [[image]] of the iron must be revolving in the opposite direction to that in the coil within, but since the magnetism produced by a coil within is much less powerful than when the coil is without the iron, therefor the action of the coil in part may go through. If the coil were put into the hollow of a cylinder of steel, or some metal not susceptible of becoming magnetic, then no currents would be made to circulate, and no screening would take place.

The shocks with this arrangement were not intirely screened, and when the wires were put in, the shock was quite intense.

[[horizontal line]]

6 I have observed that when a current is formed by bringing one coil down on an other, which was transmitting a galvanic current, the needle was less deflected than when the same coil was lifted up. This appears to have been a falacy, since when I connected the ~~long wire~~ galvanometer with helix No 2, and put this on and off the end of the magnet formed by wires and coil, as in exp (4), the needle was deflected to the same degree on each side namely 30 [[degree symbol]].



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

119 Jun 4th 1840 [[top margin]] [[?]] storm for several days [[/top margin]]

7 [[left margin]] see exp with [[girdles?]] [[/left margin]] Repeated exp. 5 with the short wire [[clarks?]] galvanometer. When the iron was out, the deflection of the needle at making and breaking contact was about 10 degrees - when the iron was within the helix and around the coil, the deflection was about 3 [[degree symbol]] - this indicates very clearly the screening influence of the iron. The direction of the current with and without the iron was carefully noted, but no difference could be perceived.

The iron tube therefore, although it evidently in part [[neutralizes?]] the effect, does not invert the direction of the current.
[[horizontal line]]

8 [[left margin]] see apr. 23 exp 8th [[/left margin]] Next studied this action by putting coil No 4 around a broad ring of thick plate iron, and ~~coil~~ helix No 1 within,  This with arrangement the shock was very small on account of the closed circuit and on account of the action of the iron, the induction to affect the galvanometer was also small although very perceptible, causing the needle to move through 2 or 3 degrees. The plate iron of the ring is about 1/10 of an inch thick but the direction of the current as indicated by the clarks galvanometer was the same whether the iron was between or not. This result is in accord with that of the last experiment.

With the long wire galvanometer, the screening influence of the iron was not well marked. [[end page]]

[[start page]] 120 June 4th 1840

9  Placed the cylindrical coil within helix No 2, and between these put a cylinder formed of varnished iron wire. The effect was increased when the iron was removed, or in other words, the presence of the iron on the outside of the coil partially neutralized the shock. The current set in motion in the iron on the outside would be in an opposite direction to that of the coil within, and hence the result. Iron therefore placed between two coils does not act precisely as other metals, since it has a neutralizing influence independent of the conduction of a closed circuit.

[[horizontal line]]

10  Put the cylindrical coil within helix No 2, and within the former a bundle of magnets formed by magnetizing ^ [[6?]] large flat files. The shock was much increased by the introduction of the files, but no different appeared to be produced by so placing the files that their magnetism would be increased or diminished by the action of the galvanic current around them. Repeated this exp., put the helix at the end of the coil  so that without iron in, scarcely any shock could be felt, the magnets were then gradually introduced and first one end put in and then the other, but no difference could be perceived in the intensity of the shock. [[?]] this by the galvanometer also by the artificial magnet.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[Mathe ?]] clean and [[blossoms ?]] [[?]] NW

121 June 5th 1840

[[marginal notation beside section]] 1 [[/marginal notation]]

From the last Exp of yesterday, it appears that hundred steel magnets produce a reaction as well as soft iron, and that it makes but little if any difference whether the magnet be placed in the coil in one or the other direction.

I now proceed to inquire what results will be produced on the galvanometer by inserting the magnet in different directions. For this purpose, the cylindrical coil rod was connected with the battery, [[image]] and another cylindrical coil no 2 was connected with Clarks galvanometer. With out the iron or rather the magnets, the needle moved about 4[[degree sign with dash on top]] at putting in and the same out--with the magnet in conformidable 10° in and out. With the magnet reversed in position, the effect was the same.

Another set with the magnets at making contact + breaking } 2°

With the iron ^[[magnets]] in conformidable at making and breaking } 5°

With the magnets non conformidable at making and breaking } 5

[[horizontal line across page]]

[[marginal notation beside paragraph]] 2 [[/marginal notation]]

With a small number of wires, the effect was much greater than with the magnetic files. When the wires was put in to about the same distance as the magnets, the effect was 12°.

[[page end]]

[[page start]]

5th June 1840 122

[[marginal notation beside section]] 3 [[/marginal notation]]

Another Exp with the iron ^[[magnets]] placed in the middle of the coil

Magnets conformable at making and breaking } 42°

Non conformable at making and breaking } 43°

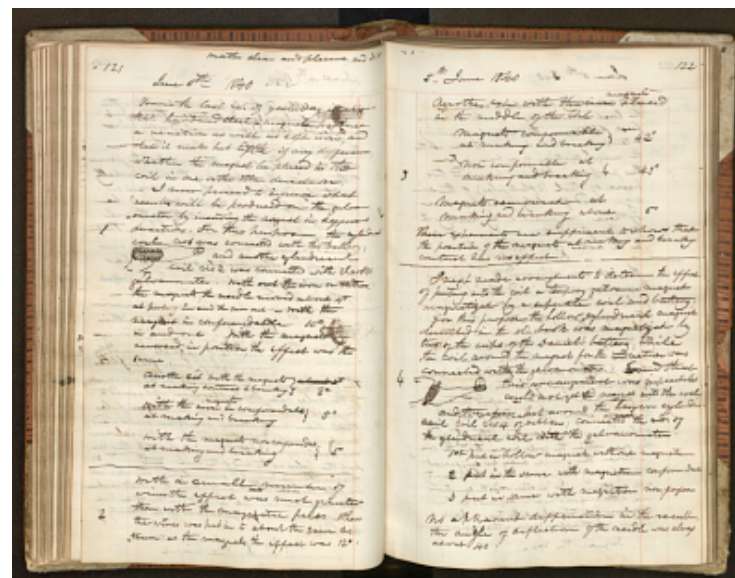
Magnets removed at making and breaking about 5°

These experiments are sufficient to show that the position of the magnets at making and breaking contact has no effect

[[horizontal line across page]]

[[marginal notation beside section]] 4 [[/marginal notation]]

I next made arrangements to determine the effect of putting into the coil a tempory galvanic magnet magnetized by a sepearte coil and battery; for this purpose, the hollow cylindrical magnet described in the old book was magnetized by two of the cups of the Daniel's battery, while the coil



around the magnet for the induction was connected with the galvanometer. Found that ~~[[image]]~~ this arrangement was impracticable could not get the magnet into the coil, and therefore put around the larger cylinder ~~coil~~ coil no 4 of ribbon, connected the ends of the cylindrical coil with the galvanometer.

1st put in hollow magnet without magnetism.

2 put in the same with magnetism conformidable

3 put in same with magnetism non ~~[[conformable??]]~~

No apparent difference in the result the angle of deflection of the needle was always about 40

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

123

June 5th 1840

5

It is necessary perhaps to repeat the last experiment - I will however first determine the effect of hardening or tempering steel in connection with the magnetization of a bar - For this purpose I have procured two pieces of steel (2 flat files) of the same size and quality of metal, one of these was annealed by heating it to redness and then suffering to cool in the ashes gradually -

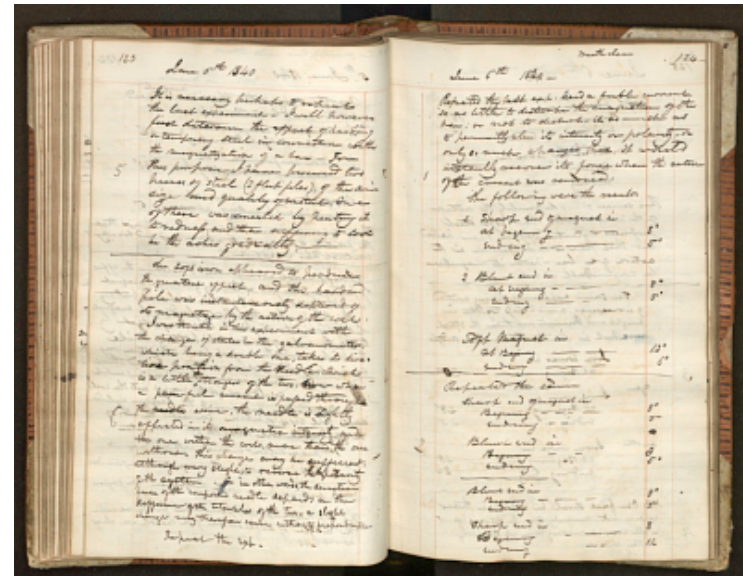
[[line drawn across page]]

6

The soft iron appeared to produce the greatest effect and the hardened file was instantaneously deprived of its magnetism by the action of the coil I was trouble in this experiment with the change of states in the galvanometer, which being a double one, takes its directive position from the needle, which is a little [^][[the]] stronger of the two. Now when a powerful current is passed through the ~~[[crossed out]]~~ needle ~~[[/crossed out]]~~ wire, the needle is slightly affected in its magnetic intensity and the one within the coils, more than the ones without. This change may be sufficient, although very slight, to reverse the polarity of the system for in other words, the directive force of the compound needle depends on the difference of the intensities of the two - a slight change may therefore cause either to preponderation

Repeat the exp.

[[end page]]



[[start page]]

Weather clear

124

June 6th 1840 --

[[marginal notation beside section]] 1 [[/marginal notation]]

Repeated the last exp. used a feeble current, so as little to disturb the magnetism of the bar; or not to disturb it so much as to permanently alter its intensity or polarity - or only so much change that it would instantly recover its force when the action of the current was removed.

The following were the results

1 Sharp end of magnet in

at beginning --- 8°

ending ----- 5°

2 Blunt end it

at beginning --- 8°

ending ----- 5°

Soft magnet in

at beginning --- 12°

ending ----- 6°

[[dividing line across page]]

[[marginal notation beside section]] 2 [[/marginal notation]]

Repeated the same

Sharp end of magnet in

Beginning ---- 8°

Ending ----- 5°

Blunt end in
Beginning ---- 9
Ending ----- 5°
[[short dividing line]]
Blunt end in
Beginning ---- 8°
Ending ----- 5

Sharp end in
Beginning ---- 8
Ending ----- 5 1/2

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
125 June 6th 1840

Soft bar in
Beginning - 18°
Ending - 12
Without the iron in
Beginning - 2°
ending - 2°

This series shows definitely the action of the iron - Also that soft steel produces a greater effect than hardened, and that there is no difference in the action of a bar whether its magnetism be ~~conformable or not~~

conformable or not -

[[line drawn across page]]

[[in margin]] 3 [[/in margin]]

The same experiment being continued

9 [[ironsoires ?]], much less together in weight and dimensions than the steel [[were ?]] put in with these. The angle

Iron wires in
at Beginning - 30°
again

Iron wire in
at Beginning - 28°
Ending - 25

another
Iron wire in
at Beginning - 28
Ending - 24

[[line drawn across page]]

[[in margin]] 4 [[/in margin]]

NB One fact should be noticed in these experiments - namely that the action is less in all cases at making than at Breaking battery contact

[[end page]]

[[start page]]
June 6 - 1840 126

The same result does not appear to be produced when iron is not used, since in this case, according to my previous experiments, the effect is the same

as shown by the galvanometer at Breaking as at making.

Make more definite experiments on this point - use constant battery -

Repeated the exp. with the galvanometer and 3 cups, found no

difference when the end and beginning were observed.

During the time I was writing this [^][[the above]] I could see but the right hand side of each word - I was seized a few moments before with a violent pain in the head.

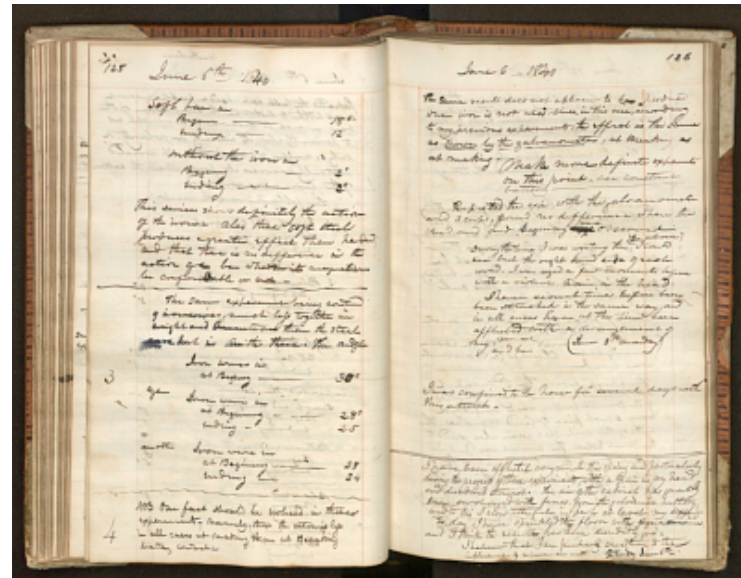
I have several times before been been attacked in the same way and in all cases have at the time been afflicted with a derangement of my

[[hole in the page]] (June 8th Monday)

I was confined to the house for several days with this attack.

[[double line drawn across page]]

I have been afflicted very much this spring and particularly during the progress of these experiments, with a pain in my head and disordered stomach. The air of the cabinet has generally been surcharged with fumes from the galvanic battery, and to this I now attribute in part at least my



suffering

To day I have sprinkled the floor with aqua ammonia and I think the result has been decidedly good.

I believe that I am particularly susceptible to the influence of impure air -
- Saturday June 6th

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[line across page]]

[[left margin]] 1 [[/left margin]]

Experiment 2 - on the opposite side of the page - has some bearing on the phenomenon of the change of the direction of the induced current, probably in ordinary elect., it is therefore important that more conditions of the same action should be discovered. For this purpose I have constructed a spiral of bell wire

[[image - pen sketch of square with coil inside]] to configure ^[[insertion]] it [[/insertion]] in its action with the leaden spiral. I suppose on account of its being smaller, possibly the induction at beginning will not be as great. While the shock at breaking will possibly be nearly the same. The shock was feeble both at making and breaking, but still some powerful at making, but the difference did not appear to be as great as in the arrangement with the leaden spiral. [[line to margin]]

[[line across page]]

[[left margin]] 2 [[/left margin]]

To determine if the [[sh?ness]] of the coil just under the helix was the cause of the increase of the shock at beginning or the [[shortness?]] of the whole coil - no 3 was divided into two parts, the helix placed on one of them. By this arrangement, while the whole resistance to conduction remained the same, the part of the coil which produced the induction was shortened. No increase in the beginning shock was observed.

[[line across page]]

Probably some variation would be produced in the result if the crankshank battery was used, and the contact made at the ends [[current?]] of the ~~beginning~~ middle of the circuit - contact made at a instead of at b.

[[image - pen sketch of two 3 dimensional narrow rectangular boxes, drawn end to end separated by a small space. The tops have 8 lines at a diagonal. The two adjacent ends are connected by a small curved line labeled a and the opposite ends connected by a curved line labeled b. The labels are at the connection to the right hand box]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

129 June 15 1840

[[left margin]] 3 [[/left margin]]

Next to determine if the addition of a long coil to a short one would increase the induction at the end when the long coil [[closely?]] made no part of the inductions current. For this purpose, the leaden spiral was placed under helix no. 1, and the shock passed through this. It was unpleasant at making, but scarcely perceptible at breaking contact.

Coil no 2 was then introduced into the circuit without being active in its conduction on the helix. With this change, the current at making contact was scarcely perceptible, while that at breaking was quite intense. The term quite intense may be a little too strong, but the effect of the increase could not be mistaken. The induction of the long coil is therefore passed through the shorter one.

[[line across page]]

[[left margin]] 4 [[/left margin]]

To determine what effect a variation in the position of the coil would make, I wound 11 feet of flat copper ribbon, one inch 1/4 wide around helix no 1. With this the shock at making contact was quit severe, but at breaking small. The effect was greater than with the leaden spiral - hence the idea that the form of the spiral is more favourable does not appear well founded.

[[line across page]]

[[left margin]] 5 [[/left margin]]

Same coil used in the last exp. was now lengthened by an other addition of 11 feet, and now the shock at making and breaking appeared about the same - the shock at making had [[circled]] determnd [[/circled]] a little. [[end page]]

[[start page]]

June 15 1840 130

Again the coil was increased by an addition of 11 feet. the shock at making was now only scarcely perceptible, While that at breaking agitated the whole frame.

[[line across page]]

[[left margin]] 6 [[/left margin]]

To find the minimum length for a single battery two turns of the copper ribbon were placed around helix no. 1 with only these two turns, the effect appeared to be the greater at making contact, if not the greatest of any before tried, at least it was I should say, equal - The different lengths of the coil were connected to the battery by means of 1 a leaden strap -

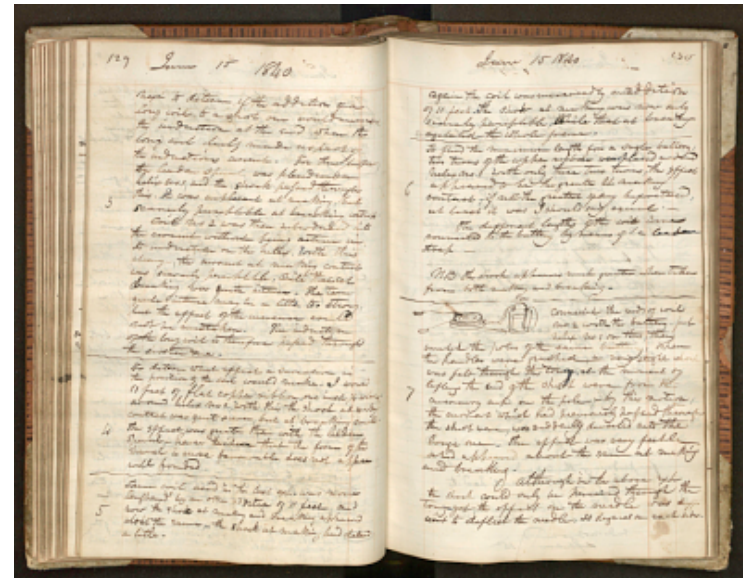
NB The short appears much greater when taken from both making and breaking.

[[line across page]]

[[left margin]] 7 [[/left margin]]

[[image - sketch of the coil hooked up to the battery]]

Connected the end of coil no. 2 with the battery - put helix no 1 on this, then curled the poles of the same battery. When the handles were grasped, a very slight shock was felt through the tongue at the moment of lifting the end of the shaft were from the mercury cup on the pole, - by this motion the current which had previously passed through the short wire, was suddenly diverted into the longer one. The effect was very feeble and appeared about the same at making and breaking. Although in the above exp the shock could only be perceived through the tongue yet, the effect on the needle was sufficient to deflect the needle, 20 degrees on each side.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

131

June 15th 1840

[[left margin]] 8 [[/left margin]]

Next experimented on the deflection of the needle at making and breaking contact with the helix and coil no 2. The long wire galvanometer was used with a dial plate. The deflection

1st Exp. at making contact

was - 50 [[degree symbol]]

Breaking contact 20 [[degree symbol]]

It was supposed that this result was

produced by the variable action of the battery which was not as great at breaking as at making contact, and this was proved by joining the poles of the battery [[with?]] short wire, and at the moment before the contact with the long coil was made, the short wire was withdrawn so as to leave the battery in the same state of exhaustion at beginning as at ending.

Now the results were as follows

Beginning 20 [[degree symbol]]

Ending 20 [[degree symbol]]

[[line drawn across page]]

[[left margin]] 9 [[/left margin]]

The same effects were produced when the experiment was arranged for producing the two inductions.

When the interposed coil had its ends joined

The deflection each way

was 15 [[degree symbol]]

Ends not joined

deflection 15 [[degree symbol]]

[[end page]]

[[start page]]

132

June 15th 1840

[[left margin]] 10 [[/left margin]]

Put around helix no. 7 a single turn of copper ribbon, connected the apparatus with the long wire galvanometer. The deflection of the needle at making and breaking contact was the same. The effect at making with a very short coil, appeared greater than at breaking.

[[line drawn across page]]

[[left margin]] 11 [[/left margin]]

Next repeated some of the experiments on the sound in bars (Mr Ames of Albany was with me this afternoon)

Put the large 6 foot bar in the coil no 2, through which a current from the battery was sent. Joined the poles of the battery by a short slip of lead - then made and broke contact by means of the lead. This prevented the sudden action of the current and no sounds were produced.

When the lead was removed, the sounds were quite loud.

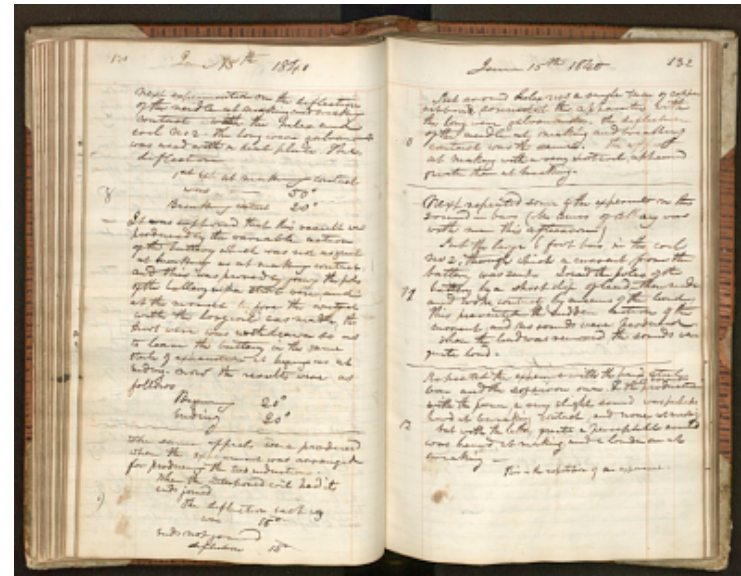
[[line drawn across page]]

[[left margin]] 12 [[/left margin]]

Repeated the experiment with the hard of round steel bar and the soft iron one. In the production with the former, a very slight sound was perhaps heard at breaking contact, and none at making, but with the latter quite a perceptible sound was heard at making, and a louder one at

breaking -

This is the repetition of an experiment.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

133

June 16th 1840

[[left margin]] 1 [[/left margin]]

First exp this morning repeated the exp of yesterday with the hardened steel and soft iron of about the same length. Steel gave us sound at making, iron a very perceptible one. This appears settled.

[[line drawn across page]]

[[left margin]] 2 [[/left margin]]

Next experimented on the shock at making and breaking, with the introduction of soft iron; for this purpose used a compound coil, which had been formed around a file. Around this was placed helix no 1, without the iron the shock at making was apparently a little greater than at breaking. - with 4 wires of iron inserted, shocks about equal, with 8 wires of iron about the same, with 15 wires inserted, shock at breaking decidedly the greater. With 20 wires a very sudden increase of the intensity at breaking.

[[line drawn across page]]

NB It also appeared in the above experiment that the shock at making and breaking were both exalted by the introduction of the reaction of soft iron.

[[end page]]

[[start page]]

134

June 16th 1840

[[left margin]] 3 [[/left margin]]

Attempted to detect sounds in the conduction through which a current of elect. was suddenly begun or ended, - did not succeed, - a [[image - diagram]] piece of glass was cemented on the end of the long wire around the cylindrical

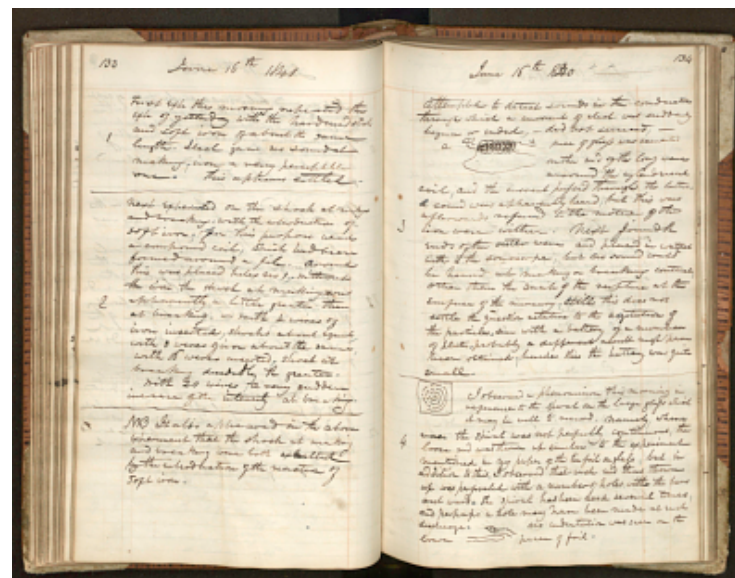
coil, and the current passed through the latter. A sound was apparently heard, but this was afterwards referred to the motion of the iron wire within. Next joined the ends of the outer wire and placed in contact with it, the sonoscope, but no sound could be heard at making or breaking contact, other than the [[?]] of the next [[rupture?]] at the surface of the mercury - still this does not settle the question relative to the agitation of the particles, since with a battery of a number of [[plates?]], probably a different result might have been obtained, besides this the battery was quite small.

[[line drawn across page]]

[[image - diagram]]

I observed a phenomenon this morning in reference to the spiral on the larger [[glass?]] which it may be well to record. Namely, wherever the spiral was not perfectly continuous, the loose end was thrown up similar to the experiment mentioned in my paper of the tin foil on glass, but in addition to this, I observed that each end thus thrown up was perforated with a number of holes with the bars out ward. The spiral has been used several times, and perhaps a hole may have been made at each discharge.

[[image - diagram]] no indentation was seen on the lower piece of foil.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

135

June 16th 1840

[[in margin]] 5

Repeated the experiments with the coils and ~~[[striketrough/Daniel]]~~ Clarks galvanometer, in reference to the direction of the currents - The motion of the needle with the 3rd current was very slight, but still perceptible if ^{it} was only a single, start not 1/2 a degree, but the direction was well marked.

The direction of the current as given by this experiment was in accordance with all the previous ones. The final current was passed around the bundle of iron which increased the effect.

First current +

2nd Do ^{[[Do means ditto for "current"]]} -

3 Do ^{[[Do means ditto for "current"]]} +

at making

[[lines drawn across page]]

1st current +

2nd Do ^{[[Do means ditto for "current"]]} +

3rd Do ^{[[Do means ditto for "current"]]} -

at Breaking

[[line drawn across page]]

[[in margin]] 6

Attempted with the above arrangement to get a current of the third order, by means of introducing suddenly the bundle of wires, but could perceive no motion of the needle.

[[different handwriting]] Presented thus far to American Philosophical Society, June 19th 1840, and referred to

R.M. Patterson

A.D. Bache

[[Comm?]] ^{[[different handwriting]]}

[[end page]]

[[start page]]

136

[[top margin]] Amer. Phil. Society - ^{[[?]]} Meeting June 17. 184^{[[?]]} read by its title & referred to Prof. Bache Dr. Patterson & Mr. Lukens.

Committee P. B. G.

[[/top margin]]

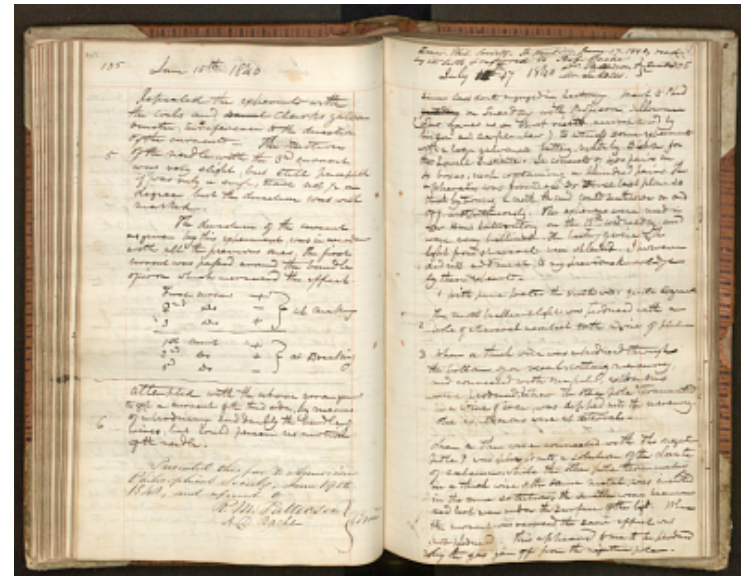
July 17th 1840

Since last deate engaged in Lecturing. Went to Phid ~~[[crossed out]]~~ yesterday ~~[[/crossed out]]~~ on Tuesday with Professor Silliman (who gave us a short visit accompanied by his son and daughter in law) to witness some experiments with a large galvanic battery, made by Bishop for the Lowell Institute. It consists of 400 pairs in 4 boxes, each containing a hundred pairs. The apparatus was formed on Dr Davis last plan, so that by turning a crank, the ^{[[aud ?]]} could be thrown on and off instantaneously. The experims were ^{[[read?]]} in Dr ^{[[Harris?]]} laboratory on the 15th Wednesday, and were very brilliant. The heating of wire and the light from charcoal were splendid. I however did not add much to my previous knowledge by their experiments.

1 With pure water the shock was quite disagreeable.

2 The most brilliant light was produced with a pole of charcoal in contact with a wire of platinum

3 When a thick wire was introduced through the bottom of a vessels



containing mercury, and connected with one pole, explosions were produced. When the other pole terminated in a wire of iron, was dipped into the mercury, the explosions were at intervals.

When a thin wire connected with the negative pole? was plunged into a solution of the chlorate of calcium, while the other pole terminating in a thick wire of the same metal, was inserted in the same solution, the smaller wire became red hot even under the surface of the liquid. When the current was reversed, the same effect was not produced. This appeared to me to be produced by the gas given off from the negative pole.

[[end page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

137

July 17th

serving to insulate it as it were from the liquid when the current was reversed [[?]] thick wire [[?]] the negative pole and the insulation was not consequently as perfect, [[?]] the decomposition would, relative to the [[size ?]] of the [[hole?]] be as [[magnetic ?]]

When the flame, which was about an inch long, was produced between two charcoal points and a magnet (horseshoe) brought near it a whirling took place attended with a peculiar explosive sound or rather a whizzing noise. The flame appeared constantly agitated at the moment of the approach of the magnet. The whirling was best seen at the moment of ceasing of the flame.

Will not this noise be interesting in reference to the sound said to be produced by the [[Aurora?]]?

Tried the experiment of Mr Sturgeon of the unequal heating of two wires at the poles. Did not succeed, the platina wires appeared not to be of the proper thickness.

I made some experimt on the motion of mercury when submitted to the galvanic current, after having been slightly amalgamated with zinc. A solution of sul acid was poured over the surface and after a short time I succeeded in throwing the whole mass of metal into strong commotion.

After the action and commenced with the battery, it could be again produced after the wires were removed by throwing on to the surface a small crystal of sul. [[copper ?]] which as I had before observed, moved with great

[[end page]]

[[start page]]

138

July 17th

rapidity like the motions of an insect - but a still more lively action was produced by throwing on to the same surface a few crystals of chromate of potash. make experiments on this [[paced ?]].

It appears to me that some clue to this mysterious action may be obtained by taking into consideration the fact that the [[amalgam-- ?]] the mercury and the acid forms a galvanic arrangement which decomposes the sul of [[copper ?]] [[strikehrough]] into [[/strikehrough]] by the nacent hydrogen given off by the decomposition of the water. Study this at leasure

[[underlined]] Aug 3rd 1840 7 o'clock PM [[/underlined]]

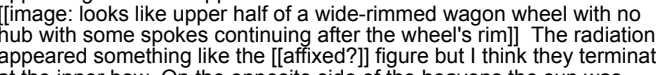
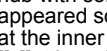
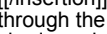
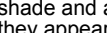
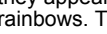
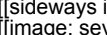
We have just had and - the effect [[?]] continues - one of the most beautiful meteorological which I have ^[[myself]] witnessed or perhaps will ever see. For two hours past we have had a succession of thunder showers which although very [[icoed ?]] have not given very loud reports. The sun broke out at about ten or 15 minutes ago, and as it was just setting, The sky on the opposite side was covered with a thunder cloud of uniform density. On this, two most beautiful rain bows were projected. The space between them appeared much darker than the sky generally and that within the inner bow appeared

[[end page]]

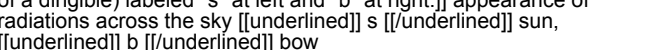
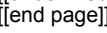
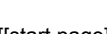
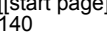
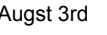
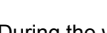


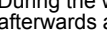
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

139
Aug 3rd

appeared lighter than the surrounding sky. But the most striking and beautiful appearance was that of large radiations springing from the centre of the bows and extending up into the heavens. They appeared to stop however at the circumference of the inner bow and then to appear again on the opposite sides of the heavens next the sun.  The radiation appeared something like the  figure but I think they terminated at the inner bow. On the opposite side of the heavens the sun was setting with great brilliancy  and appeared in  through a cloud which was very dark. The sun shining through the holes in the cloud gave  because of light and shade and as these were projected onwards against the  of the sky they appeared to  on the opposite side or in the centre of the rainbows. The  could be traced intensely across --

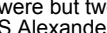
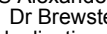
 sideways in left margin

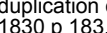
 appearance of radiations across the sky  s  sun,  b  bow  end page

 start page

140
Aug 3rd

During the whole time of this appearance and for more than an hour afterwards an almost continued coruscation of lighting was kept up. After this appearance passed off the same about 15 minutes afterwards came out and produced another single bow on a ground of red cloud which had also a very interesting appearance.

I observed a fact this evening which I also saw some months ago but which I do not find in the books, namely that the violet of the inner bow was repeated, is the exhibition of this  it was separated more distinctly than when I last saw the same phenomenon. To night there were 3 violets some of the senior class said they could see 4 stripes of this colour. When I saw the same at the time before mentioned, there were but two strikes. The repetition of the  colours was seen by Mr. S Alexander.

Dr Brewster describes a bow seen with an other in which there was a duplication of colour. Annals de  1828, archives des Lacorwere 1830 p 183.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

141
August 20th

To day, with Dr Ten Eyck from Albany attempted to detect an alteration [^][[in length]] of a bar of metal by current of galvanism and also by a charge of ordinary elect. -
For this purpose a rod of brass 1/2 an inch in diameter and 30 inches long was placed between the screws of Saxton's apparatus but no effect could be observed when a current of galvanism was passed through. Also the same negative result was obtained when the same rod in the same condition and situation was placed in connection with the electrical machine. No increase or diminution of length could be observed when the bar was charged or when it was discharged.

It is perhaps unnecessary to state that the whole apparatus was insulated.

The experiments were made on account of a statement in the Electrical journal that a diminution of length had been observed when a rod of metal was charged with elect.

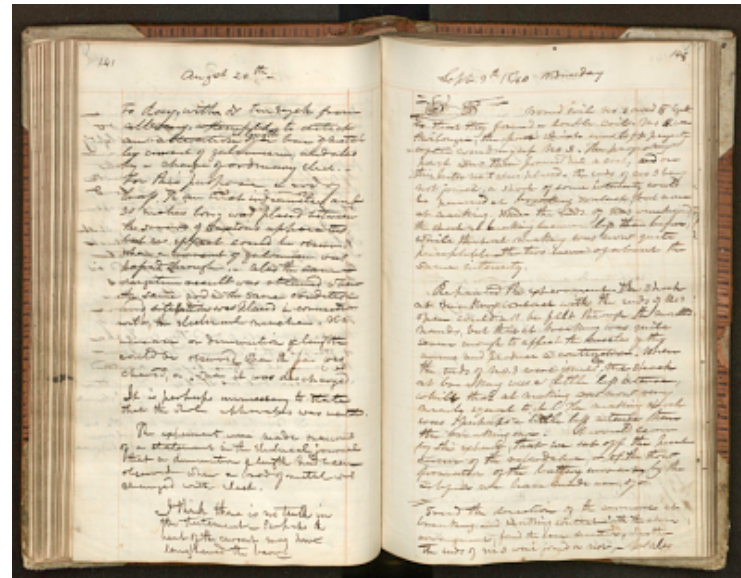
I think there is no truth in the statement - Perhaps the heat of the current may have lengthened the bar -
[[end page]]

[[start page]]
142
Sept 9th 1840 Wednesday

[[image]] Wound coil no 3 and 5 together so that they formed a double coil. No 5 was the longer, the part which was left projecting after winding up no 3. The projecting part was then formed into a coil and on this helix no 1 was placed. The ends of no 3 being not joined a shock of some intensity could be perceived at breaking contact but none at making. When the ends of no 3 were disjoined the shock at breaking became less than before while that at making was now quite perceptible. The two were of about the same intensity.

Repeated the experiment. The shock at making contact with the ends of no 3 open could not be felt through the moistened hands, but that at breaking was quite severe enough to affect the muscles of the arms and produce a contraction. When the ends of no. 3 were joined, the shock at breaking was a little less intense, while that at making was now very nearly equal to it. The making shock was perhaps a little less intense than the breaking one. It would seem by this expermt that we cut off the peculiar ^{[[curren ?]]} of the ^{[[retardation]]} or of the slow ^{[[formation ?]]} of the battery current by the artifice we have made use of -
[[short dividing line]]

Tried the direction of the current at breaking and making contact with the above arrangement, found the same direction whether the ends of no.3 were joined or not - but also



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

143

Sept 9 1840

the direction was in accordance with my previous expermnts. namely the terminal 2nd + [[?]] second was not sufficiently intense to produce much magnetism. until the ends were joined of no 3 and then the needle was powerfully magnetized in the minus direction.

Repeated the last with same result, no magnetism in the needle when the ends of No 3 were sepearte, powerful when joined. --

Next made an observation on the galvanometer but the needle was deflected to an equal degree (9°) at making or breaking, with the ends of no 3 joined or disjoined.

Put drop of water between the end of the wire - most of the effect was destroyed on the galvanometer, some motion was still perceptible.

Next tried the little [[diagram]] [[-iggerling ?]] apparatus with the battery found the repulsion energy not as great when the ~~shock~~ long coil no 1 was introduced into the current as before. This [[fine ?]] therefore appears to depend on the quantity of electricity and not on the [[inductive ?]] [[forces ?]]. The snap was quite loud when the contact was broken by the hand, but the repulsive energy was not sufficient to throw up the wire itself.

[[note in left margin]] I have tried this before with the same result see p 37 - [[/note]]
[[end page]]

[[start page]]

144

Sept 9th 1840

Repeated the last expermnt the motion of the instrument stopped when the coil was introduced into the circuit.

Next [[diagram]] Put short coil 9 turns around helix no one with this shock at making greater than that at breaking. Next introduced long helix into the current the shock at making nothing, at breaking about the same as before, scarcely at all if any [[?]]. (Compare this with 3 p 199) The battery was very feeble and soon ran down.

[[dividing line across page]]

Sept 18th Repeated the experiment of Mr [[Somervell ?]] which as it is stated has been lately verified by Myers Knox of Ireland; the result was negative, not withstanding all the precautions necessary to success were used. The needles were carefully examined by iron filings to determine previous to the experiment, if they contained any traces of magnetism. Some of them were half roughend with nitric acid, others left bright - some placed under red glass, some under blue violet &c, some with the large ends to the south others with the small ends in the same direction, others at right angles to the magnetic meridian, but in no case could the developement of the least trace of magnetism be observed, although the needle was examined in contact with iron filings under the magnifying power of a compound microscope -
[[circled note]] Iron filings, although a certain test for magnetism, is not a very delicate one. Jun 1842 [[/circled note]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

145 Common Electricity See page 235

~~Ex~~ ~~Sept~~ 23rd 1840

[sideways note in left margin beside first two sections] Had this irregularity due to double magnetize spiral *[/sideways note]*

Exp with ordinary elect.

[image] 2 jars, small glass cylinder with ribbons on inside and out, small magnetizing spiral.

2 jars

1st 6 turns needle N strong +

2 12 " " S strong -

3 7 " " S strong -

4 4 " " S very strong -

[short line, possibly indicating insertion of notation in right margin]
turned the spiral

small *[with ?]*

5 3 " " S feeble +

[at end of line between entries 5 and 6] *

6 4 " " N v. strong -

7 6 " " N strong -

8 3 " " N feeble -

[dividing line across page]

7 *[Jan? or Jar?]* ~~9~~ 2 " " N feeble

[plus sign turned to minus sign?]

3 *[turns]* *[needle]* N v strong -

5 " " N feeble -

1 " " S strong +

1 " " S strong +

1 1/2 " " S strong +

4 " " N v strong -

1 " " N *[?]* strong +

1/2 " " S strong +

[sideways note in right margin beside this section] This result is in conformity with my present views The small needle was mag. + *[?]*
1842 *[/sideways note]*

[dividing line across page]

Introduced extra spiral put a needle in each

[in left margin]

1 *[Jan? or Jar?]*

[image: vertical cylinder with horizontal stripes. A wire extends from the top to the right and bends downward in a spiral of 3 loops followed by a straight section followed by another spiral of 3 loops before bending back to connect with the bottom of the vertical cylinder.]

[image or ink blot shaped like a sun or star with rays radiating out from the center -- (possibly a large asterisk)]

[similar to image above only smaller and followed by text] Important Result

[end in left margin]

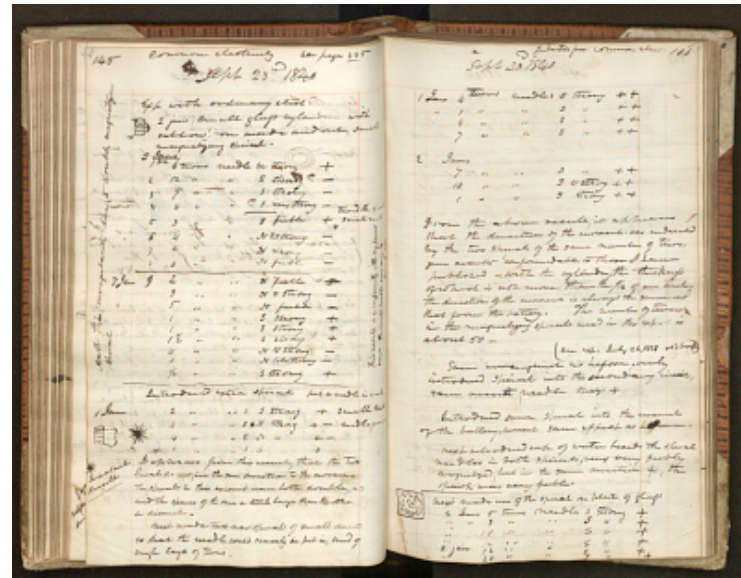
2 *[turns]* *[needle]* S S strong + small *[?]*

4 " " S & N strong + - needle same

4 " " S N " + -

[not greater than sign? / written over >] 1 " " S S +

It appears from this result that the two spirals do not give the same direction to the current. The spirals in this expermt were both double and the spires of the one a little larger than the other in diameter.



Next made two new spirals of small diameter so that the needle could scarcely be put in and of single length of turns.
[[end page]]

[[start page]]

Induction from Common Elect. 146

Sept 23rd 1840

1 Jar 4 turns needles S strong ++

" 1 " " S " ++

6 " " S " ++

7 " " S " ++

2 Jars

7 " " S " ++

10 " " S v strong ++

1 " " S strong ++

From the above result it appears that the direction of the current, as indicated by the two spirals of the same number of turns, give results conformidable to those I have published - with the cylinder the thickness of which is not more than the 1/16 of an inch; the direction of the current is always the same as that from the battery. The number of turns in the magnetizing spirals used in this expermt is about 50 -
(see exp. July 26, 1838 old book)

Same arrangement as before, only introduced spiral into the secondary circuit, same result, needle Mag +

Introduced same spiral into the current of the battery current same effect as [[smudged]] before [[/smudged]].

Next introduced cup of water beside the spiral needles in both spirals, very very feebly magnetized but in the same direction [[< overwritten with /]], the spark was very feeble.

[[short dividing line]]

[[image: square containing dashes arranged in a flat (concentric) spiral]]

Next made use of the spiral on plate of glass

2 Jars 5 turns needles S strong +

" " 3 " " S " +

" " 10 " " S " +

" " 12 " " S " +

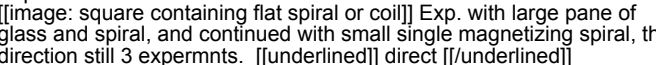
3 Jars 12 " " S " +

" " 20 " " S " +

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

147

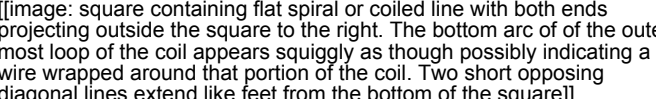
Sept 24th 1840

 Exp. with large pane of glass and spiral, and continued with small single magnetizing spiral, the direction still 3 expermnts. direct

Put the place ? of the electrophorous over the spiral which received the induction, but the effect was still there ? -- the direction was still --- -- direct

Placed short coil on the plate of glass, with its ends joined, but still the direction was direct

[in left margin]

 Placed on the plate coil no 1, first with its ends joined, then with the same closed, but the result was again the same, the needle was magnetized so as to indicate a current ---- direct

[in left margin]

[in left margin] NB

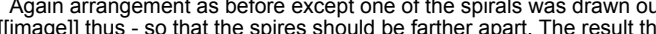
[in left margin]

[in left margin]

In all these experiments, the small single magnetize- ? spirals were used, two at once, - 3 jars were used, and generally 20 turns of the machine given - (compare this with exp. bottom of page 150)

[short dividing line]

While the apparatus remained as before, the spirals were taken from the tinfoil on the top of the plate and connected with the ends of the coil no 1, now the current was inverse

Again arrangement as before except one of the spirals was drawn out  thus - so that the spires should be farther apart. The result the same, current with both needles --- adverse

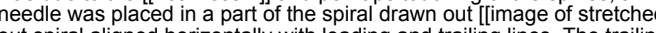
Next substituted for the coil no 2, short ribbon, coil of 2 1/2 turns on the glass, the coils or spines

[end page]

[start page]

148

Sept 24th 1840

being on edge, the distance of the centres or middle line of the spines was then in reference to distance as before. The result was now intensely different from what I anticipated, one of the spirals gave a magnetism in one direction, and the other in the other - It will be recollected that I had drawn out the spines of one. To prove that this was due to the nearness ? and perhaps touching of the spines, a needle was placed in a part of the spiral drawn out  out spiral aligned horizontally with leading and trailing lines. The trailing line extends to the right. The leading line of a second horizontal spiral begins under the first's trailing line. Where the two lines overlap another, tighter spiral is drawn, also aligned horizontally. This tight spiral is labeled "b".] as it wich ? had the turns close together, now the magnetism was the same as that of the needle in the spiral with it spines in close connection - With the close spiral, the current appeared to be - - direct

With the more open one, it was adverse



The expermnt was repeated 3 times, the needles in the two spirals always differently magnetized.

Repeated the same again, except lifted the middle spines up from the glass so as to have but a little more than one spine on the glass. Now the small spiral gave but very feeble signes of magnetism, while the one with close spines was very descended in its effects - The direction of the induced current by the latter was again direct

Repeated the exp again, open spiral gave magnetism to the needle, close one considerably strong - and current direct

Now that I find that indications of the spiral can be changed by merely drawing out the spirals, I must repeat my experiments on the magnetism by the different orders of currents from galvanism.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

149
Sept 25th 1840

From the result of yesterdays expermnt, I was led to suppose that perhaps the direction indicated by the magnetizing spirals might ~~perhaps~~ depend on the spiral itself, but after arranging the large coil [^][no 1] in connection with the battery, and coil no 3 & 4 so as to produce a tertiary current, four different spirals were used, namely:

- 1st A long fine wire one of 100 turns
- 2nd A larger double wire one
- 3 An open wire
- 4 and a closed wire

All gave the same result, namely a current in the direction ~~dv~~ adverse to that of the battery current. The irregularities appear confined to the electricity from the machine, and probably to the primary current -

[[sideways note in left margin beside paragraphs above]]
Oct 1843

These experiments exhibit the difficulty of passing from the known to the unknown, and by what almost insensible gradations the truth is presented to the mind.

[[sideways note]]

Raised the ~~helix~~ coil no ^{[[3 ?]]} from the coil no 1 so as to produce the induction at a greater distance, the result however was the same, the spirals all gave the same direction to the current as before.

[[dividing line across page]]

Next repeated the exp page 144. A coil of three turns was put around the helix no 1 - The shock at making was much more intense at making than at breaking - connected with this coil no 1 - Now the shock at making could not be felt, while that at breaking was about the same as before -

[[end page]]

[[start page]]

150

Sept 25th 1840

Repeated the exp given page 142 - found the result about the same, the shock at making could not be felt at first, but when the ends of the interposed coil were joined, the shock was quite perceptible. The shock at making about the same as before.

[[dividing line across page]]

[[image: square containing coiled line]]

Put the spirals on one side of the flat place - needles all magnetized with 10 and 20 turns, ^{[[2 ?]]} the small close one and the open one in the same direction, indicating a direct current. The third spiral gave a contrary result is was a double one consisting of two strata of wire.

with 3 turns of machine all needles same

- | | | | | | | |
|----|---|---|---|---|---|----------------------------|
| 4 | " | " | " | " | " | <u>direct</u> |
| 4 | " | " | " | " | " | <u>direct</u> |
| 5 | " | " | " | " | " | <u>direct</u> |
| 6 | " | " | " | " | " | <u>direct</u> |
| 7 | " | " | " | " | " | direct |
| 10 | " | " | " | " | " | double galvanometer needle |
- feebly magnetized adverse



[--her ?] two needles
direct
 [dividing line across page]
 [in left margin] shut [in left margin]
 [begin text encompassed by open brace on left]
 Next put short ribbon coil of 8 turns on the spiral plate, 5 turns, all the
 needles of all the spirals -- -- direct

 with 10 turns -- ~~all~~ adverse
adverse
 In the above the ends of ribbon shut
 [end text encompassed by open brace on left]
 [begin text encompassed by open brace on left]
 With ends open, same effect
 all the needles --- adverse
 with 4 turns open, ~~all~~ direct
direct
 [end text encompassed by open brace on left]
 Coil removed, double spiral, adverse
 with 10 turns, other two direct ---
direct
 The influence of the ~~spiral~~ is ~~coil~~ when
 near is [here ?] [perceptible ?]

Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

151

Sept 24th 1840

It would appear from all the experiments that I have made on the action of the ongoing matter ~~that~~ ~~on the~~ magnetism of the needle in the spiral by common electricity, that there is an influence, and that this is first exhibited by the compound spiral. ~~dividing line across the page~~

Sept 26

Repeated the exp with the short coil and the addition of long one, when long one was added, shock at making diminished, shock at breaking about the same, battery this time in good condition - It would appear from this experiment, that the shock is not due to the ~~action~~ of a long wire spiral from effects of the multiplication of the coils.

Repeated this again, the shock ~~at~~ at making nor breaking was as severe with the long coil - shock at making I should say was nothing

Tested the same in an other way. Connected the wire of the galvanometer with the short ribbon. Without the long coil, the deflection was 25° . With the long ribbon introduced, the deflection was only 10° each way.

This is a good expermnt; it shows that by increasing the length of the conductor the induction is diminished in total ~~around~~ ~~?~~ ~~end page~~

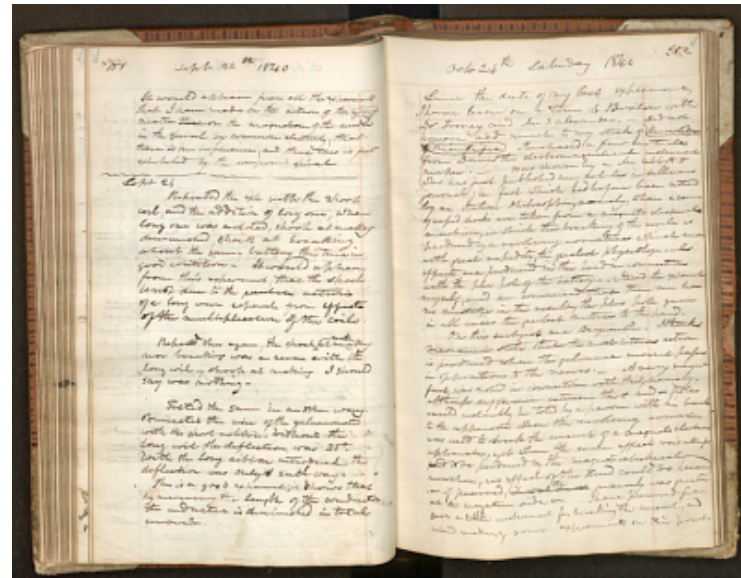
~~start page~~

152

Oct 24th Saturday 184~~0~~~~?~~

Since the date of my last experiment, I have been on a tour to Boston with Dr Torrey and Mr S Alexander - Did not however add much to my stock of scientific knowledge. Purchased a few articles from Davis the Electromagnetical instrument maker - Was shown by a Mr Abbott (who had just published an article in Sillimans journal a fact which had before been noticed by an Italian philosopher, namely, when a series of rapid shocks are taken from a magneto electrical machine in which the breaking of the circle is produced by a revolving armature which moves with great rapidity the greatest physiological effects are produced in the hand in connection with the plus pole of the battery. I tried the expermnt myself and am convinced that there can be no mistake in the result, the plus pole gave in all cases the greatest ~~intensity~~ to the hand.

On this subject see ~~the~~. I think ~~the~~ states that the most intense action is produced when the galvanic current passed in opposition to the nerves. - A very singular fact was noted in connection with this, namely, although differences between the + and - poles could instantly be toted by a person with his back to the apparatus when the revolving armature was used to break the current of a magneto electrical apparatus, yet when the same effect was attempted to be produced by the magneto-electrical machine, no effect of the kind could be perceived or if perceived ~~it was much~~ ~~the~~ intensity was greater at the negative side - I have procured from Davis a little instrument for breaking the current and intend making some experiments on this point.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

153
Oct 24th 1840

The induction of a coil on a coil is very much increased by putting a ~~[[surge ?]]~~ wire of iron or two into the axis. The idea occurred to me if the same space were occupied by a galvanic current would the effect be the same. I tried this, but little or no difference could be perceived. If any, the action was some what less when the circuit of the inner galvanic current was completed. I think it probably that this was timely the case since by joining the circuit, the secondary induction would take place in this. Now [^][[that]] I [^][[have]] reflect on the subject, I think the effect if any exists can best be detected by the galvanometer since the screening influence [^][[with]] ~~[[with]]~~ of ~~[[with]]~~ this does not interfere.

Experimented on this point June 30th 1841.

Oct 13 exp. on this point but could perceive no difference of result whether the extra coil was added or not.
[[end page]]

[[start page]]
154
Oct 30th

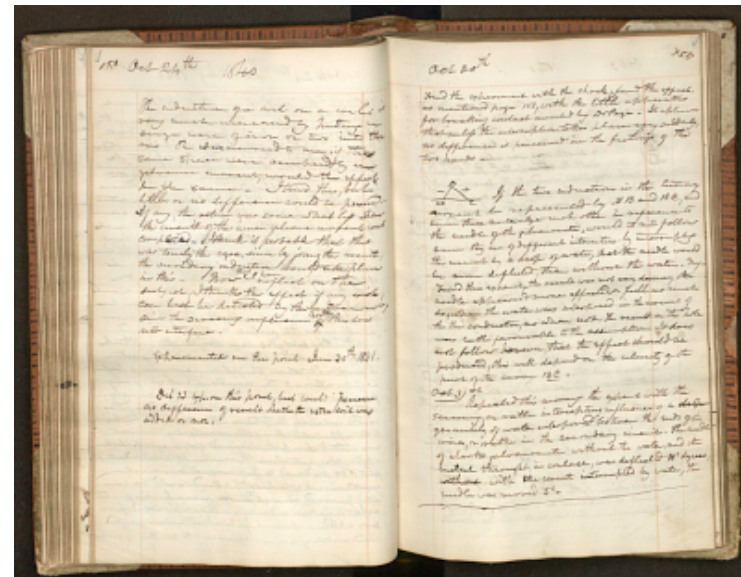
Tried the experiment with the shock - found the effect as mentioned page 151, with the little apparatus for breaking contact invented by Dr Page. It appears that unless the interruption takes place very suddenly no difference is perceived in the feelings of the two hands -

[[image: a horizontal line upon which rests a nearly equilateral triangle pointing upwards. The horizontal line extends to the left and right of the triangle. The points of the triangle are labeled: left point A; top point B; right point C. The left side of the triangle is labeled -; the right side +]]
If the two inductions in the tertiary current be represented by AB and BC and since these neutralize each other in reference to the needle of the galvanometer, would it not follow since they are of different intensities by interrupting the circuit by a drop of water that the needle would be more deflected than without the water. Try -

Tried this expermnt - the result was not very decisive. The needle appeared more effected or full as much so, when the water was interposed in the current of the third conductor as when not. The result on the ~~[[pole? or hole?]]~~ was rather favourable to the assumption. It does not follow however that the effect should be produced this will depend on the intensity of the part of the curve BC.

Oct 31st

Repeated this morning the expermnt with the screening or rather intercepting influence of a ~~[[with]]~~ drop ~~[[with]]~~ quantity of water interposed between the ends of the wires, or rather in the secondary circuit. The needle of Clarks galvanometer without the water and the metal through in contact was deflected 10° degrees ~~[[with]]~~ without ~~[[with]]~~ with the circuit interrupted by water the needle was move 5° -
[[dividing line across page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

155
Oct 31 1840

Repeated the expermnt of the poles joined with a short thick wire in the following manner - The first end of coil no 1 was connected ~~[[image]]~~ with pole A of the battery, a short wire was ~~[[strickethrough]]~~ also ~~[[strickethrough]]~~ connected with the ~~[[strickethrough]]~~ ~~[[?]]~~ ~~^[[?]]~~ ~~[[strickethrough]]~~ pole ~~^[[B by its first end.]]~~ The 2nd end of the coil was then joined to the second end of the short wire so as to make one termination when these two were together. ~~[[strickethrough]]~~ plunged ~~[[strickethrough]]~~ The battery current was thus completed through both wire and conductor, but when the double end was thrust into the cup of mercury, ~~[[?]]~~ the pole A of the battery the elect. would pass through the short wire and leave the long conductor. Or perhaps the arrangements may be better described as follows - ~~[[image in left margin]]~~ A loop was made in the coil no. 1. about 6 inches from the end, so as to make two terminations at one extremity, the extreme ends of the coil ~~[[overwritten]]~~ was ~~[[overwritten]]~~ were put into ~~[[strickethrough]]~~ one ~~[[strickethrough]]~~ ~~^[[the]]~~ cup~~[[s?]]~~, and the double so arranged that it could also be plunged into the cup, which had the single termination when this was plunged in the whole length of the coil all but the 6 inches was excluded from the battery circuit and the electricity passed through the shorter wire. No shock could be felt with this arrangement when the double was plunged into the cup - Although the deflection of the galvanometer was as great in this case as when the end was drawn from the mercury. ~~[[end page]]~~

~~[[start page]]~~
15 ~~[[page torn - piece missing]]~~

~~[[image]]~~ Place the helix on a coil of two or three turns then introduce into the current one of the long coils ~~[[?]]~~ the shock. next introduce into the same circuit instead of the coil a ~~[[?]]~~ of equal length extended along the floor - By this exp perhaps the influence of the induction of the long coil on the short one will be manifest.

~~[[image]]~~ Arranged compound coil so that it might be between ~~[[strickethrough]]~~ one part of the ~~[[strickethrough]]~~ a part of the circuit with a short coil which acted on the galvanometer. Closed the ends of ~~[[strickethrough]]~~ the ~~[[strickethrough]]~~ one of the ~~[[strickethrough]]~~ shorter ~~[[strickethrough]]~~ strands of the compound coil while the other formed the part of the circuit. The shock at making was now felt when the same strand was open no shock at making - Shock at breaking the same whether the ends joined or not - This was tested by raising the coil not the least difference could be observed. Also ~~[[strickethrough]]~~ shock at ~~[[strickethrough]]~~ indications of the galvanometer the same at breaking with end of the aforementioned strand open or shut deflection 5° in each case - long wire galvanometer ~~[[strickethrough]]~~ shock ~~[[strickethrough]]~~ ~~^[[galvanometer]]~~ at making also same in both cases.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[15]]7 [[page torn - missing a piece]]

4th Jan'y 1841

A very cold morning, thermometer at 4+ at 9 o'clock; - observed, just before sun rise a beautiful exhibition of accidental colours. The sky to the east was of a pale orange and on this was projected a cloudy smoke from a chimney at the distance of about 250 yards from me. The smoke assumed the colour of purple with a slight mixture of red. This is a fact relative to the philosophy of the colour of clouds and of the sky. For an article on the subject, see Sillimans Journal.

[[dividing line across page]]

~~March 24~~ Feby 25th 1841

I gave this evening a lecture on electrical light and showed for the first time the interesting experiment of ~~[[Buquent]]~~ in reference to phosphorescence by the electrical discharge.

A quantity of Homburg's phosphorous was prepared by ~~[[culuming ?]]~~ a quantity of clam shells with an equal quantity of sulphur - A small quantity of this article was placed in two paper trays - each of about 2 inches square - then one of these was covered with a thin and very transparent piece of glass the other with a piece of rock crystal of several times the thickness of the glass but of about the same transparency - The two were placed side by side on the table of the universal discharge

[[end page]]

[[start page]]

158

March 1841

and immediately under the balls of the discharge so that the light from the discharge between the balls would equally illuminate each. When the discharge was made from a single galon jar, the room being darkened, the phosphorous under the rock crystal was seen to glow with such a brilliancy as to render it visible in the most distant part of the lecture room, while that under the equally transparent glass was dark and indicated no phosphorescence.

This experiment may be varied in reference to different kinds of light, also in regard to the fact of the polarization or not of the emanation which produces the phosphorescence. (See my paper on this subject)

[[dividing line across page]]

March 14th. The idea has occurred to me that the phenomena of the change in the direction of the current with a change in the distance can be explained by the fact discovered by Mr Wheatstone in connection with the action of the spiral which contains the needle - 1st the ending induction in the case of the ordinary elect. should be as powerful as the beginning since the wave ~~[[striethrough]]~~ needs ~~[[/striethrough]]~~ arrives last at the middle, the two ~~[[smudged]]~~ halves ~~[[smudged]]~~ of the wire must be in different states, hence if the + be the most powerful, the - minus will be neutralized and a + current proved



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

159
June 19th 1841

When the two are very near, but a - minus current will appear when the two conductors are far apart on account of the tendency of the spines of the helix to produce an opposite kind of magnetism --

Perhaps the two ends of a long wire may indicate different kinds of induction [[image: long horizontal line with dots under it along its length.]]

Try this experiment

[[dividing line across page]]

June 19th

Made a series of experiments with the [[Dagu--?]] apparatus to determine if an impression could be made on a prepared plate by means of the spark from the electrical machine. The apparatus employed was that belonging to a person who was taking portraits in the village. It was well arranged and the plates prepared by ~~him~~ were very sensitive to solar radiation but no effect could be observed although the operation was kept from one minute to five or six. Afterward succeeded with this exp. See vol 2nd p 44)

Vi ~~him~~ were very sensitive to solar radiation but no effect could be observed although the operation was kept from one minute to five or six. Afterward succeeded with this exp. See vol 2nd p 44)

[[dividing line across page]]

NB I made no experiment last vacation my duties had been so arduous during the winter that I was obliged to take a trip to the north in the way of recruiting.

[[end page]]

[[start page]]

160

[[underlined]] June 24th 1841 [[/underlined]]

I commence to day the investigation of the subject of electrical induction. Since last Oct. I have been much engaged in college duties. My time has been almost constantly occupied until within the last four weeks since Dr Torrey commenced his summer course on chemistry. this time I have devoted to the study of light and to the repetition of the ordinary expermnts on interference polarization [[?]]

I have succeeded in nearly all that I have attempted and have registered the processes employed in another book.

[[short dividing line]]

Preparatory to the experiments on induct &c I arranged [[7 ?]] cups of the constant battery - substituting for the bladder a cylinder of paper with a wooden bottom - the paper [[image: upright cylinder]] was cemented at the edges with sealing wax and the bottom which was formed of a piece of round stick was tied with wire at the lower end of the cylinder and made so tight as to hold water. The whole wire charged with a saturated solution of sulphate of soda on the side next the zinc and a saturated solution of sulphate of copper on the side next the copper. This arrangement was made at the suggestion of Dr. Torrey but the effect appeared to be very feeble. A slight spark was produced with the large coil in the circuit - When a small quantity of sulphuric acid diluted with 12 times its bulk of water was poured into the paper cells the action was instantly increased - The action appeared to be increased after the



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

161

June 24th 1841

apparatus had stood some 20 minutes the effect was however much less than with strong acid on each side of the diaphragm - The arrangement of the apparatus may answer pretty well for large batteries where the action is to be continued for some time.

[dividing line across page]

[image]

Placed rod of round iron $\frac{3}{4}$ inch in diameter 3 feet long in the thick wire spiral put microphone on the end - sound very distinct - When the ends of outside coil were joined the sound decidedly less but not entirely neutralized --

When the large iron bar was put in no sound could be heard - The arrangement with the microphone is much superior to that with the plate of glass, a less sound is perceptible

[dividing line across page]
Next with Dr Torrey made some comparative experiments on the action of 6 cups charged with paper sulphate of soda and sulph of copper and six other cups with bladders sul acid and sul acid and sulphate of copper. The six first gave 5 cubic inches of gas in 3 minutes, the 6 last gave the same quantity in one minute The paper diaphragm appears to act tolerably well.

[end page]

[start page]

162

June 24th, 1841

[short dividing line]

With the six jars charged with acid and sul. of copper attached to the large coil no. 6 the ~~s~~ noise or sound from the rod of iron was like the stroke of a small hammer - and when the rod was held in the hand at the moment at making and breaking contact something like a blow of concussion was felt in the hand. Dr T. compared it to the sensation produced by a small shock - This effect might possibly be produced by the action of the wire on the iron in the way of attraction.

[dividing line across page]

[image] Suspended against the end of the rod which projected from the end of the large spool an ivory ball but could see no motion produced by the striking of the rod against the ivory ---

[dividing line across page]

Large glass tube put into large coil [image] with this the sound could be heard at putting in as well as out.

When the discharge of the battery was sent through the outside wire of coil No 6 no sound was produced at beginning the action but only at ending. Have the length of the wire ready but too ~~long~~ [^] for the ~~production~~ [^] of the magnetism on which the sound depends.

[dividing line across page]

NB This spool or reel consists of 9 wires each 60 feet long ^{[[rolled ?]]} around a cylinder of wood and each wire so soldered to the others that the whole transmits a current as if ~~of~~ [^] ~~one~~ wire were used.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

163

June 24th 1841

When the glass tube [[wheld?]] against the out side on the end of the iron rod, the same noise was heard.

[[line drawn across page]]

The sound was the loudest when the iron rod was suspended in the centre of the coil with the ~~[[crossed out word]]~~ buttons of the microphone in the ears.

[[line drawn across page]]

With the large iron bar, the sound with 12 cups was very distinct - I should have mentioned that the last experiments were made with 12 cups.

[[line drawn across page]]

[[image - diagram]]

Large iron bar put into the middle of coil No 6. helix no 1 was put on the end of this but no shocks could be felt. The helix was then moved up toward the end of the reel when the shock became perceptible.

The same effect was produced when the bundle of insulated wires were put in where these projected about a foot beyond the reel then no shock when the helix was placed on their ends, but when the whole was pushed in so that the helix was near the end of the reel, a powerful shock was obtained.

The bar in the above experiment was magnetic more powerful at the ends, but it was also so along the whole length

[[end page]]

[[start page]]

June 24

164

With twelve cups, the iron wires in the reel No 6 so that the end wire in the place of the end board of the reel, and Helix no 1 placed on this - the shock at the making was feeble, but at breaking quite severe - The wires were then taken out the intensity of the shock was now reversed, the more intense one was felt at the moment of making the contact, although both were feeble. The shock is therefore not as much ~~[[?]]~~ at the beging by the induction of soft iron as at the ending. This is in accordance with results previously obtained.

[[wavy line drawn across page]]

[[image - diagram]]

globule of mercury placed between the two wires, a palpitating motion took place on the principle of the little vibrating machine which I have described in this book page ~~[[space]]~~ 1. The spark and motion was produced at the positive pole of the battery. There was a small quantity of water around the drop as the power of the battery declined the effect could not be produced.

[[wavy line drawn across page]]

[[image - diagram]]

Observed today in using the volometer of Mr Faraday, that the apparatus became boiling hot, and this was the case 2 or 3 hours after the arrangement was put in operation. It is a well known fact that the action of the acid on the zinc in the generating cells, generates heat, but I have not before heard it stated that the same effect is produced in the decomposing cell. As a liquid is converted into two gases at first sight we might suppose that cold would be produced.

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

165

June 24th 1841

After the battery with acid, as described on page - had been in action more than 3 hours, its decomposing power was again tested. The six jars then gave 4 cubic inches in a minute of the mixed gases. - This battery was fitted up with bladders. It was found that the papers which were substituted for the bladders in the other set of jars stood very well. The paper was of the stout brown kind, used for wrapping books - I will now set about constructing a single battery of considerable size with paper.

[[wavy line drawn across page]]

June 25th

Made no experiments to day, was engaged in directing the making of a larger single battery, also made a model of a crystal of carbonate of lime to explain double refraction.

In the evening, returning from Dr Hodges with Dr Torrey, we were much surprised to perceive something like a heavy shower, when we were under the trees along the road, but not in the open space. At the time the air was almost opaque with a dense fog, but no rain was falling. We attempted to make some observations which would tend to explain the phenomenon of the shower under the trees, but not with much success. The cause of the fog was however readily made out. We placed

[[end page]]

[[start page]]

166

a thermometer on the grass and found that it stood after a few minutes at the temperature of 72 [[degree symbol]] Fah. The same thermometer swung in the air for a short time sunk down to 69, showing a difference of 3 [[degree symbol]] between the temperature of the air and that of the ground. The vapour ~~thus~~ given off from the moist earth would thus be condensed, and the fog formed in the same way that the fogs are generated over rivers, the waters of which are warmer than the air immediately above. The temperature of the ground would be kept up by the non radiation on account of the fog - Perhaps the dripping from the trees may be explained on the principle of surface action, the capillary attraction, or rather the attraction of cohesion would infilm the leaves with with the water from the fog, this would attract others until the weight would form a drop which would fall, and the dripping be thus produced -

[[line drawn across page]]

The battery which was made on this day (June 24), was formed of a cylinder of zinc of about 5 1/2 inches in diameter, one foot high, it was surrounded by copper with a diaphragm of paper between the two metals, and then plunged into a stone-ware pot, filled on one side of the paper with strong acid, and on the other with the same adde to Sul

coper

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
167

June 26th 1841

Put 12 cups of the battery in operation.

put into the spool No 6, 5 wires of soft iron, the ends of the secondary wire being connected with the galvanometer. The deflection at putting in and taking out the end of the wire from a cup of mercury forming one of the poles of the apparatus were nearly equal, particularly when the poles had been previously joined with a short slip of ~~cop~~ cop

[[/crossed out]] lead to discharge the accumulation.

[[line drawn across page]]

The merely putting in and drawing out of the bundle of wires (the whole bundle) produced a greater deflection of the needle than the making or breaking of the battery contact.

[[line drawn across page]]

When the wires were not in the spool, the shock at making the contact, with the arrangement of 12 cups, was the more intense. When the iron wires were put in, the shock at breaking was the most intense, the intensity however of both was increased by the reaction of the iron

[[but?]] that of the ~~ending?~~ the most ~~[[symbol - asterisk]]~~

[[line drawn across page]]

In the experiments, a very singular phenomenon was observed. When the bundle of wires was inserted into the axis of the spool, and the two handles brought into contact with the tongue,

[[end page]]

[[start page]]

168

June 26 (Saturday)

a series of pulsations were felt as if the battery gradually accumulated ~~[[strikethrough]]~~ in ~~[[/strikethrough]]~~ electricity, and when the quantity increased to a certain degree, a discharge took place. The effect was quite novel, and will require further investigation.

[[line drawn across page]]

Placed hollow gun barrel in the spool, noted the deflection of ~~[[old?]]~~ ribbon galvanometer, it was 60° , next placed in a bundle of wire of little less diameter, the deflection was now 52° . The handles were substituted, and the shock to be softened was passed through a cup of water, the shock with the wires was much the more intense.

[[line drawn across page]]

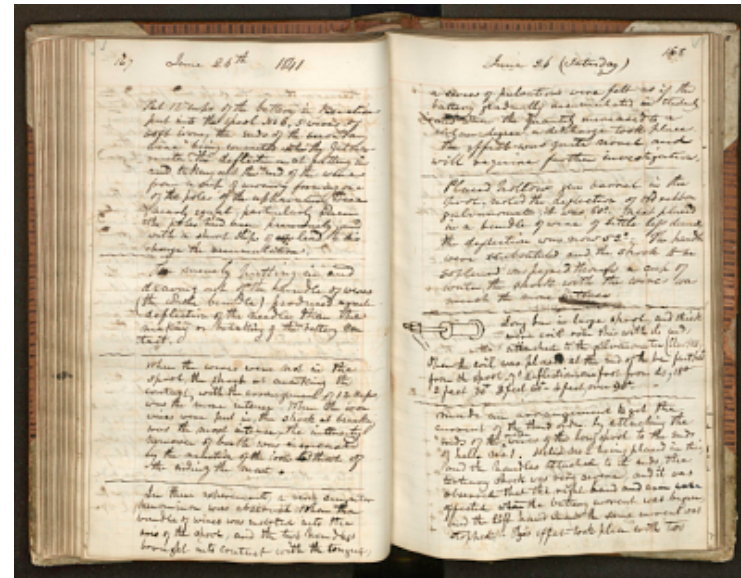
[[image - diagram]]

Long bar in large spool, and thick wire coil over this with its end, attached to the galvanometer (Clarks) When the coil was placed at the end of the bar farthest from the spool, 7° deflection - one foot from do, 18° 2 feet, 30° 3 feet, 60° - 4 feet, over 90° .

[[line drawn across page]]

Made an arrangement to get the current of the third order by attaching the ends of the outer wires of the long spool to the ends of helix no 1. Helix no 2 being placed in this, and the handles attached to its ends, the tertiary shock was very severe, and it was observed that the right hand and arm were affected when the battery current was begun, and the left hand when the same current was stopped. This effect took place with two

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

168

June 26 & 28th

assistants, and it would seem to furnish a new method of determining the direction of the shock, the motion involuntarily given to either hand may serve as an indication of the direction of the current.

With the primary current the effect was also the same, but on account of the severity of the shock, the difference became imperceptible,

[[line drawn across page]]

June 28th

Monday

To repeat the experiment of the effect of putting a steel magnet into a coil, so as to react on the secondary current, see page -

For this purpose, put two small coils  on a magnetized file and connected these with 2 cups of the Daniell battery, also placed a third coil of wire between the other two on the same file, and connected it with the Clark's galvanometer.

Magnet put in with currents non conformable and conformable and contact made with the battery.

[[list follows]]

[[line 1]] 1 Non conformable contact made 15° +

[[line 2]] 2nd Do Do 8° +

[[line 3]] 2 Conformable Do 15° +

[[line 4]] 2nd Do Do 10° +

[[line 5]] 3 Non conformable Do 14° +

[[line 6]] 2nd Do Do 10° +

[[end page]]

[[start page]]

170

June 28th 1841

[[line 1]] 4 Conformable contact made 15 +

[[line 2]] 2nd Do Do 10° +

[[line 3]] 5 Non conformable Do 15° +

[[line 4]] 2nd Do Do 10° +

[[line 5]] 6 Conformable Do 14 3/4 +

[[line 6]] 2d Do Do 10° +

[[line 7]] 7 Non conformable 14 3/4°

From these results it appears evident that the effect depends on the change in the state of the magnetism, and it is indifferent in which direction this is - The second contact in each case gives less induction than the first, and this appears to be due in one case - the conformable - to the increase of the strength of the magnet, which arrives near to the point of maximum magnetism for the force of the coil, and therefore [[where?]] the next induction is made the change in the magnet, will not be as great as before, there is not magnetic force left for so great a development - Also in the nonconformable case, the pull of the magnetism is the greater at the first and the curve of descent will be less the next time.

[[line drawn across part of page]]

the file was magnetized more strongly, and the contact made - file conformable

Deflection - 8°

this in accordance with the above view.

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]

171

June 28th 1841

If a magnet could be perfectly saturated before being placed in the coil, no increased effect would be produced, and if a piece of iron not susceptible of magnetism were put in, the same result would follow.

[[line drawn across page]]

A piece of soft iron was put in at the contact of the battery, and the conduction, the needle was deflected - 20 [[degree symbol]]. When the iron was suddenly pulled out of the coil, the deflection was also 20 [[degree symbol]] -

[[line drawn across page]]

But with magnetized file, when the contact was made the deflection was 8 [[degree symbol]]

When the same file was drawn out the deflection was 15 [[degree symbol]]

The change of magnetism in the drawing out was total in the putting in, the bar received magnetic force, but only a small addition to what it had before, and as the effect was due to the change, the result was not as great as before.

[[end page]]

[[start page]]

172

June 29th

For the continuation and extension of the experiments made yesterday, I prepared this morning a double coil; ~~of wire~~

~~the inner part consisting of a coil of bell wire 60 feet long, the outer one of finer wire from helix no 3 of about the same length - The inner one was connected with the battery, and the outer with clark's galvanometer.~~

[[list follows]]

[[experiment 1]] 1 Coil without magnet or iron and 2 cups of the battery - circuit formed 5 [[degree symbol]], circuit Broken 5 [[degree symbol]]

[[line drawn across half of page]]

[[experiment 2]] 2 Do Do circuit formed 4 [[degree symbol]]

- - broken 4 [[degree symbol]]

[[line drawn across half of page]]

[[experiment 3]] 3 Magnet thrust in without battery 11 [[degree symbol]]

Do Drawn out " - 12 [[degree symbol]]

[[line drawn across half of page]]

[[experiment 4]] 4 Do Thrust in " 13 [[degree symbol]]

Do Drawn out " 13 [[degree symbol]]

[[line drawn across half of page]]

[[experiment 5]] 5 Magnet conformable with battery

Do Do Circuit made R 13 1/2 -

Do Do Circuit broken L 13 1/2 +

[[experiment 6]] Do Do circuit made R 12 [[degree symbol]] -

Do Do " broken L 12 [[degree symbol]] +

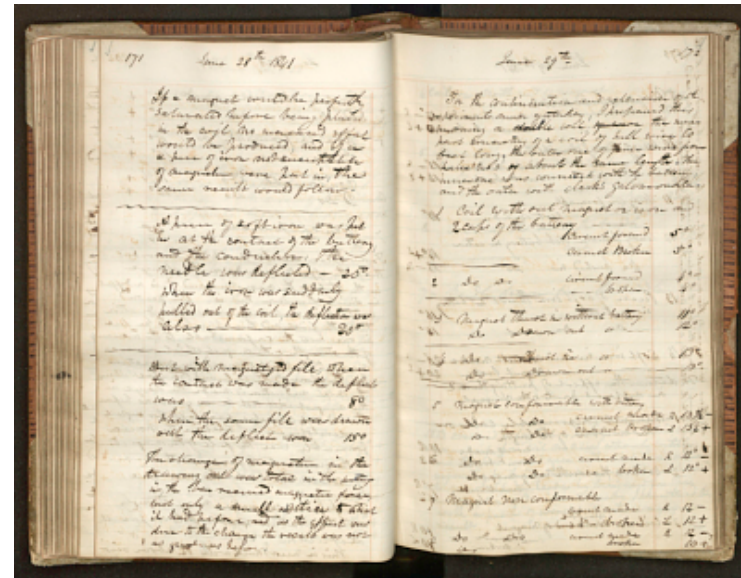
[[experiment 7]] 7 Magnet non conformable circuit made R 12 -

" broken L 12 +

[[experiment 8]] 8 Do Do circuit made R 12 -

Do broken 10 +

[[end page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page not quite flat, some characters along the bound edge of left page are not quite legible.]]

173

June 29th 1841

9 Mag non conformable
circuit made 12° - [[R?]]
circuit broken 10 + [[L?]]

10 Mag conformable
circuit made 13° - [[R?]]
circuit broken 12 + L

11 Mag conformable
circuit made 10°

12 Mag drawn out battery in action
----- 14° + L
Do pushed in Do 13 - R

13 Piece of soft iron [[Nuarst]] in battery in action ----- 16°
Do Drawn out " 15°

14 Soft iron in and ~~[[overwritten]]~~ circuit ~~[[overwritten]]~~
contact made 20° - [[L?]]
circuit broken 20 + [[L?]]

[[dividing line across page]]

[[note in margin]] all these experiments the magnet appears to have changed but little its intensity and this was to be expected because but one coil was used where as in the other exp 2 coils were placed on the length of the magnet. [[/note in margin]]

To determine the effect of putting the coil on different parts of the magnet

1 Magnet conformable coil on the middle of the length
circuit made 10 R
circuit broken 10 L

2 Coil on the south end of magnet
circuit made 7° R
" broken 6° L

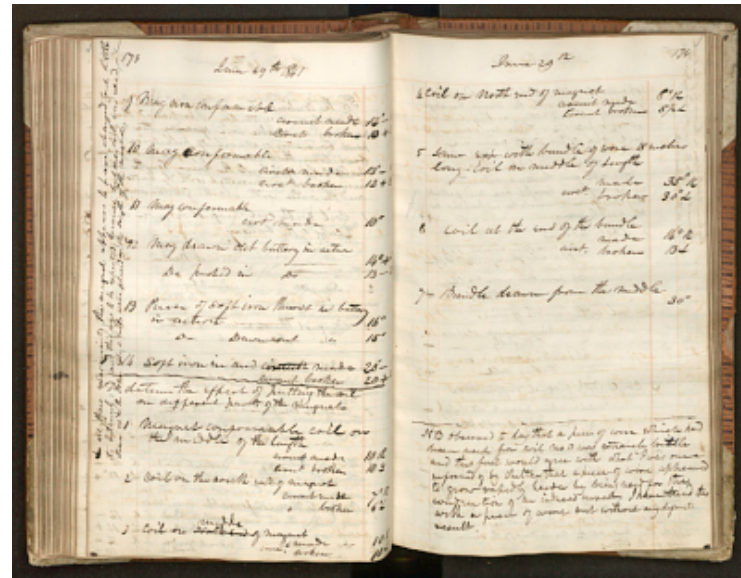
3 Coil on ~~[[striketrough]]~~ North end ~~[[striketrough]]~~ midde of magnet
circuit made 10 R
" broken 10 L
[[end page]]

[[start page]]

174

June 29th

4 Coil on North end of magnet
circuit made 6° R
circuit broken 5 1/2 L



5 Same exp with bundle of wire 18 inches long - coil on middle of length
circuit made 35° R
circuit broken 30° L

6 Coil at the end of the bundle
cirt. made 14° R
cirt. broken 13° L

7 Bundle drawn from the middle
30°

[[blank space]]

[[dividing line across page]]

NB observed to day that a piece of wire which had been used for coil no 3 was extremely brittle and this fact would agree with what I was once informed of by Chilton that a piece of wire appeared to grow rapidly harder by being used for the conduction of an induced current. I have tried this with a piece of wire but without any definite result.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

175
June 29th 1841

[[note in margin]] sky beautifully clear on the evening of this day copious dew under the open sky but under trees in the campus none. [[/note in margin]]

Experiments with needles instead of the galvanometer, with the same arrangement of coil and battery as described at top of page 172 - Three coils were used, one of two strata of wire, one with the strands widely separated, the other with the same close together.

They all gave the same indication in every case except one and probably this was from a mistake in putting in the needle wrong.

1 Coil alone
at making circuit 1 & 3
spirals magnetized slightly - [[negative sign]]

at breaking current all
strongly - +

2 Coil with bundle of wires
at making circuit 1° [[spine? spere? spire?]]
slightly -- - [[negative sign]]

at breaking circuit very
strong - all - +

3 Coil with magnet conformable
at making circuit all slightly - [[negative sign]]
at breaking Do. all strong +

4 Coil mag. non conformable
at making circuit all slightly - [[negative sign]]
at breaking Do all strongly +

With one cup of the battery, the magnetism of the needles at the completing of the circuit was scarcely perceptible but at the breaking of the same it was quite strong.
[[end page]]

[[start page]]
176
June 30th 1841

[[in side margin centered beside section below]] Exp 1 [[/in side margin]]
From the experiments of yesterday and the day before, I am inclined to think that some reaction should be produced on the secondary current by a second current which should represent the currents in the magnet which produces the reaction of soft iron this idea has occurred to me before, as I find by referring to page 153. (Oct 24, 1840)

To bring this to the test, a triple coil was [[pursued?]] by
[[/strikethrough]] [[rooting?]] ^[[winding]] about 40 feet of bell wire over the out side of the compound coil, used in yesterday's experiments; - the inner one of these, the same used in last experiments, was connected with a battery of one ^[[cup]] [[TC]] element, - [[/strikethrough]] end
[[/strikethrough]] the middle coil of small wire (from helix No 3) was



connected with Clark's galvanometer, and the out side coil was placed in the circuit with 6 cups of the battery - The contact was then made and broken with the battery of one cup, - while the circuit of 6 cups was suffered to remain constant, but no peculiar effect could be perceived. the induction with this apparatus was very feeble and did not deflect the needle more than 2 or 2 1/2 degrees.

[[dividing line across page]]

Exp 2 Arranged the batteries in two sets - one of 3 cups, the other of 4, - the former was connected with the circuit to be ruptured. the effect appeared in this case to be greater with the compound circuit, of this however, I am not certain.

[[short dividing line]]

Made new arrangement with three of the large coils.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

177
June 30th

Coils No 1, 2 & 3 were arranged in the order mentioned. [image] No 1 was connected with the battery of 3 elements, No 2 with that of 4 and No 3 with the galvanometer -

Exp 3 Contact broken with No 1, while No 2 was disconnected from its circuit deflection
at beginning of circuit 5°

Exp 4 Coil No 2 put in connection with its battery
at beginning of circuit 5°
at ending of circuit 5°

Reversed the current in No 2
at beginning of circuit of No 1 5°
at ending -- " 5°

The action was here very feeble and in order to increase it a coil of bell wire much longer than coil No 3 was substituted for it with this the deflection was stronger

Exp 5
No 2 alone at beginning gave 10°
No 1 " " " " 10°

No 2 in also
No 1 put in after 10°

No 1 alone ----- in 10°

Reversed No
at beginning of No 1 ----- 10°

No 1 alone ----- 10°
[[end page]]

[[start page]]

173
June 30th
Thermometer at 86 in study in the Hall
In the Lecture Room thermometer at 93°

From these experiments which were very carefully made, I am unable to infer any action of a current analogous to the reaction of soft iron. This would appear to establish a difference between the action of a soft iron magnet, and a current - .

Exp 6. Arranged the battery in two sets - 13 cups in one and one cup in the other - Placed the coils No 1 & 2 as before, but on these, helix No 1 with handles, then closed the circuit of No 2 and the 13 cups, while the circuit of No 1 was ruptured, but no difference could be perceived, except that the shock was less in all cases ~~than with the~~ than with the ~~compound circuit~~ with the compound circuit, than with the single one of No 1. This was the case also when the circuit was reversed. That the shock should be less with the circuit of No 2 closed is plain, since it then forms a shut current, through which a closed current can circulate, and



this will tend to neutralize a part of the induction of No 1 - It was in reference to the action that I arranged the 13 cups in connection with coil No 2, so that the secondary current would find more difficulty in passing the increased ~~[[?]]~~ ^{^[[number]]} of alternations of the acid in the cups - I am therefore thus far unable to get any indication of the reaction of a current on another current analogous to the action of soft iron on a current.
[[dividing line across page]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

179 June 30th 1841

Exp. 7. Next made experiment in reference to the action of soft iron between the conductors.

[[image]] Used the two concentric thick wire coils, connected the inner with the galvanometer outer with the battery placed between the two a number of soft iron wires. When the contact was made with the battery the needle was found to make a slight movement which was in one case noted to be 2° to the R and then to swing 5° to the L. This effect was produced several times in succession.

The wires were next withdrawn and now I was surprised to find that the deflection was only 2° R.

The results were obtained from 5 experiments with the wire in each gave deflection 5°

and with two with iron wire out each gave deflection 2°

In this experiment the action of the iron was greater than that of the coil the 2° of motion at first to the R was due to the sudden action of the coil and the 5° to the L immediately to the adverse action of the iron - - Interesting exp.

Exp fourth on this point

See in connection with this experiment, see one top page 120 June 4 1841 [[end page]]

[[start page]]

180

June 30th 1841

Exp. 9. Made experiment on the rate of decomposition with the large spool in the circuit first with iron wire in the hollow axis and again without wire the number of cups eleven.

Iron wire in {1st 5 inches of gas in 55"

[[Iron wire in]] {2nd 5 inches of gas in 55"

Wire out {1st 5 inches of gas in 55"

[[Wire out]] {2 5 inches of gas in 55"

In the battery of cups I have used for some time past paper cylinders these stand very well when made of thick brown paper - the cylinders require occasionally to be reamalgamated - otherwise they are rapidly acted on by the acid -

[[dividing line across page]]

[[underlined]] July [[/underlined]] 1st 1841 Made arrangements to repeat the experiment of the last page. For this purpose tied around coil No 2 the wires so as to form a perfect cylinder and around the outside of this placed coil No 2 ^[[which]] was connected with the battery

[[image]] and [[overwritten]] [[coil ?]] [[/overwritten]] [[helix ?]] No 2 with the galvanometer.

The battery consisted of 12 cups.

1 All the iron in deflection of the needle at [[underlined]] making the current [[/underlined]] 3° R

at breaking current 2 L

2 at making again 2 1/2 R

A slight agitation was noticed in this exp as if the needle first attempted



to move in the other direction and then obeyed the greater force -

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]]
181 July 1st 1841

[[left margin]] 3 [[/left margin]] The shock was next tried with all the wires, in this was feeble, scarcely perceptible, when ~~the circuit~~ circuit was made, but more sensible when the current was broken.
[[horizontal line across page]]

4 Next about 30 degrees of the wire were removed. The deflection of the needle at making the circuit was about 3 $^{\circ}$ R.
On breaking the circuit - 3 L
Shock stronger, but the one at breaking the circuit more intense.
[[horizontal line across part of page]]

[[left margin]] 5 [[/left margin]]
Next one 1/2 the wire removed
action of the needle about the same as the last
Shock increased in both
[[line across part of page]]

[[left margin]] 6 [[/left margin]] All the wire removed, shock much increased, as strong at beginning as at ending of the circuit.
Deflection of the galvanometer
at the beginning 4 $^{\circ}$ R.
at the Ending 4 $^{\circ}$ R

From the last result compared with the others, it appears that the direction of the current is reversed by withdrawing the wires. The deflection obtained above 1,2,4 are due
[[page end]]

[[page start]]
[[image - diagram]] July 1st 1841 [[image - diagram]] 182

to the action of the inner current of the iron. When therefore the coil is enclosed in a cylinder of rods of iron, the compensation is not completed between the inside and the out, and that the inner induction of the cylinder is the stronger. The spaces without the circle passing through the cylinder of wires  in the annexed figure, are greater in the out side than those within, and then if the difference be insufficient, a want of compensation will be the result. Suppose in the first place that the sum of the forces within and without the circle just balanced each other, ~~when the whole~~ ^{the whole} space was filled ~~the whole~~, and then equal qualities were subtracted from each space, it is plain that the remainder would no longer be in Equilibrium, since the remainder the out side would be in Excess. If a wedge contained between two radii of the large circle were withdrawn, then equilibrium would be still maintained, and if the part without the inner circle were greater than that drawn from the inner circle, then the currents of the inner would prevail. The problem may be solved mathematically, at least approximately without much difficulty.
[[line across page]]

Put long coil of thick wire, see figure p 179 into ^{an} Exp. 7. a stove-pipe, attached the ^{the} extreme compound ends to the galvanometer.



When the current was formed the battery deflection was---3¹/₂°

1 circuit broken---3 1/2 L

2 circuit made---3R

---circuit broken 3L

The iron pipe was next removed, and now

[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start page]] 183 July 1st 1841

the deflection at making the circuit:

- 1 was still---3R
at breaking circuit 1L
- 2 at making circuit 3R
at breaking [[?]] 2L

From this result, it appears that the direction of a current from the inside of a full cylinder of iron is the same as from the coil without the iron. This result is in conformity with what I obtained in [[word?]] last see. In this arrangement, it appears that the circles of the iron within and without perfectly [[word?]] each other, so that the same amount of induction is shown whether the iron is in or out. It would appear however from the Exh pages that the same compensation is not quite [[^perfect]] in reference to the shock.

[[horizontal line across page]]

Next made arrangements for studying the action of induction from within out through a continuous cylinder of iron. Coil no 2 [[image]] was rooled up so as to fit into a spool cylinder of thick sheet iron, and a coil formed of a part of the wire from the large spool was put on the out side.

- 1 Current through inner coil
Circuit made 8R
Circuit broken 5L
 - 2 Current through inner coil
Circuit made 8R
do broken 5L
- [[page end]]

[[page start]]

July 1st 1841 184

- 3 Current through outer coil
Circuit made 6[[degree]]R
Circuit broken 5L

- 4 Current through outer coil made 6R
circuit broken 5L

- 5 Current through inner coil
Circuit made 8R
Circuit broken 5L
- [[line across page]]

- 6 Iron takeⁿ out circuit through inner coil
Circuit made --14R
Circuit broken 10L

- 7 same arrangement
Circuit made 13R
do broken 10L

- 8 Through inner coil the current
Circuit made 13R



Circuit broken 10L

9 Current through outer coil
Circuit made 12[°]R
Circuit broken 10L

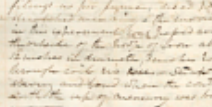
From these results, it appears that a certain thickness of iron exerts a real screening influence in the case of the thin stove pipe iron, the effect appears to be the same with or without the iron, [°] the effect is different.

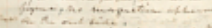
The difference at the beginning and ending of the circuit is due to the accumulation of the battery, this is shown by using a single cup--the deflection with 2 cups as one, was 13[°] at [°] in, and take out the wire.
[[page end]]

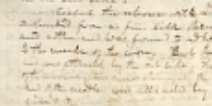
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

185
July 8th 1841

My experiments since the last date have been interrupted by the college duties consequent on the celebration of the 4th of rather on this year of the 5th of July. The evening of the 5th was ~~cloudy~~ ~~the fire works ---~~


Current from single battery the one from Boston arranged with diaphragm and sulphate of copper strong magnetism on the out side more on the inside filings as per figure used paper stretched over ring - The current in this experiment was passed around the outside of the hoop of iron about 12 inches in diameter, 3 inches wide through coil no one - Snap was strong and loud when the contact with the cup of mercury was broken.




Coil No 2 was placed inside the iron and the current from the same battery sent through this. The appearance of filings of iron when scattered or sifted on the paper, was as in the figure - no magnetism appeared on the out side.

Tested the above with a ~~magnetized~~ needle suspended from a fine silk thread and either end was found to adhere to the inside of the iron. But the north end was attracted by the outside. The direction of the current was now changed, the South end of the needle was attracted by the out side of the ---

This subject requires more investigation.



186
July 9th 1841

Passed large current or rather current from the large battery through the inside coil and current from two cups through the outside - with this arrangement the filings were arranged on the outside and inside when the currents passed in the same or in different directions.



9th Passed the current through coil no 2 on the inside of the iron ring.

The filings arranged themselves as in the last figure on the last page.

The iron was then removed and the paper placed at the same distance from the coil as before, the iron was removed -

Fig 1 
The filings now arranged themselves as in the figure in this 

radiating from the center in every direction and not bounded by the coil as in the last arrangement. Hence something of the force which arranges the filings is due to the action of the coil.

Fig 2 
A small round cluster of randomly placed dots occupies the center of the



square. The dashes occur between this cluster and the borders of the square.]]

In another an other experiment the arrangement of the filings was as in Fig 2 in the middle where the coil did not reach the filings were arranged in lines perpendicular to the plane of the paper.

[[dividing line across half of page]]

Tested magnetism with needle

[[image: a circular coil several lines deep surrounds a hoop or circle. A small horizontal bar in the center of the circle is labeled S at left and N at right. A dotted line extends upward from the bar to the outer edge of the coil around the hoop. A second horizontal bar appears outside the coil to its right and is labeled N at left and S at right. A solid line extends upward from the bar to a level even with upper limit of the coil. Two lines (the ends of the wire forming the coil) extend separately from the lower right quadrant of the coil's circle.]]

Put the iron hoop into coil no 1 magnetism strong on the outside apparently feeble on the inside but the polarity in the same direction on both - When the direction of the ~~needle~~ current was changed the magnetism also changed. The magnetism of the upper and lower edge of the ring ~~were~~ was opposite. This is in accordance with the theory of Ampere.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

187
July 9th 1841

[[image: An O-shaped ring of small adjacent circles; one circle along the right side of the ring contains a dot in its center. Arrows to the left and right outside this circle point to its surface.]]

Suppose the magnetism to consist of circles of electricity at right angles to the axis of the bar, then the needle should point to the centre of each circle with the same end in going intirely around the circumference above the plane of the circle - an in passing around in the same way in a plane below the plain of the ring, the opposite point of the needle should be directed to the same centre. See figure in margin.

[[dividing line across page]]

[[image: A large circle is ringed and bordered by a ring of smaller circles. An arrow inside the large circle at upper right points toward the circle's edge or "outside". (If this were a compass the arrow would be indicating approximately northeast.) A second arrow outside the circle and ring of circles but in line with the first arrow points in the same direction.]]

Place coil no 2 inside of the hoop of iron - tested the magnetism with a needle - the north end of the needle was constantly and powerfully attracted by the inside and the opposite end by the out side - This effect was farther proved by changing the direction of the current the south end of the needle was now attracted by the inside and the north by the out side.

[[image: A large circle at left; smaller circle to its right and touching the first circle; an arcing line like a closing parenthesis the height of the large circle is drawn to the right of the smaller circle. In the space between the smaller circle and the arcing line is a downward arrow. Along the circumference of the larger circle above where it meets the smaller circle to its right is drawn an arrow indicating a counter-clockwise direction. The large circle contains in its center another circle. A horizontal bar connects the center of the inner circle with the outer circle in the direction of the adjoining smaller circle to the right, but doesn't quite touch the border of the outer circle. The center of the inner circle is labeled "S" at the bar's left end. Short vertical lines cross the bar. Below the vertical line at the right end of the bar is labeled "N".]]

[[dividing line across page]]

Sent same current through outside and inside coil but in opposite direction. The magnetism was now by the needle the same on the inside as on the outside - on in other words the north end of the needle was attracted by the [^][[edge of the]] iron on the out side and inside, or it was affected as if the coils alone acted on it.
[[end page]]

[[start page]]
188
July 12th 1841

[[Sam ?]] my assistant produced a piece of the long gut of an ox - this was filled with acid and a current of electricity was passed through it from the battery of 12 cups. The current was feeble but gave a small



spark when the current was broken. The connection of the gut with the battery was made by means of two wires of the bell wire size - the spark was less than when the current was completed without the introduction of the gut. The result of this experiment was that not the least effect could be felt in the tongue from ~~coil~~ ~~coil~~ Helix no 1 when placed in the ring formed by the gut. This experiment however is not entirely satisfactory since the conduction of the acid was so small as to transmit to little electricity to produce a shock.

[[short dividing line]]

Coil no 2 was next substituted for helix no 1 in the last arrangement and the ends of the coil connected with the galvanometer but no effect could be observed when the circuit was broken - When helix no 1 was placed inside of the circuit of the battery without the gut forming a part, a very slight sensation could be perceived on the tongue. The shock was not in the least increased by introducing coil no 2 into the circuit, this is in accordance with what I have published in my last paper.

[[dividing line across page]]

Next compared coil no 3 with an iron coil of a little less length but of greater sectional area. The snap from the two appeared about the same; if any difference existed to me it appeared that the iron coil gave the louder snap. The difference was very small.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]
189 July 12th Monday

Next wound coil no 3 and the iron coil together, so as to make a compound coil of two strands, the ends of the iron coil being separated, the copper ends were connected with the battery. The sparks appeared about as before on as in the last experiment. The iron ends were next connected with the battery, the snap appeared also as before so that the iron ribbon appeared to produce us peculiar effect.

The end of the copper ribbon was now joined, so as to make a short circuit, and the contact with the cups broken with the end of the iron ribbons the spark was feeble very little noise. The ends of the iron were now joined so as to form a short circuit, the effect appeared the same as before. From all these results, it appears that an iron ribbon produces no peculiar effects. The magnetism on the opposite sides of the ribbon must be neutralized.

The current was next pulsed passed through the copper coil, and the magnetism of the interposed iron coil or ribbon tested. It was very feeble, as was shown by bringing near it the end of a long wire of iron. This was scarcely attracted, although a small bar magnet attracted it readily at the distance of 1/2 an inch. Compare this with an account of a magnet [[unreadable]].

[[page end]]
[[page start]]

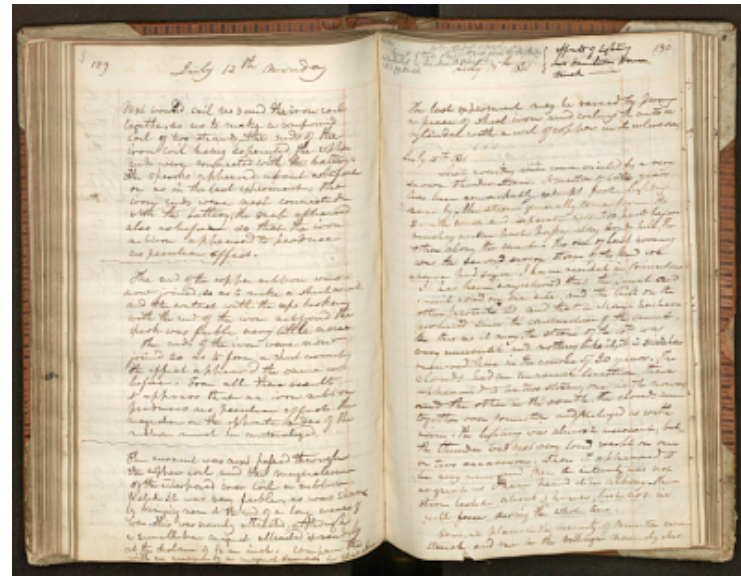
[[top margin]] [[?]] 5, 1841 pp 190-197. Not copied
Account of these observations given by Prof. [[?]] and published in Prot.
Amer. Ph. Sci
vol ii. pp. 111-116.

July 15, 1841 Effects of lightning where Hamilton's House
struck _____

The last experiment may be varied by [[procuring?]] a piece of sheet
iron, and coiling it onto a cylinder with a coil of copper in its [[?]], vvv

July 15th, 1841

Last evening ~~[[strickethrough/were]]~~ we were visited by a very severe
thunder storm. Princeton of late years has been remarkably exempt
from lightning nearby, the storms generally come from the south west
and separate into two parts before reaching us. One part passes along
Rocky hill, the other along the canal. The one of last evening was the
second severe storm of the kind we have had since I have resided in
Princeton. It has been conjectured that the canal and mail road on one
side, and the hill on the other, protect us and that a change has been
produced since the construction of the canal. Be this as it may, the
storm of the 14th was very unusual and nothing like it, it is said, has
occurred here in the course of 20 years. The clouds had an unusual
direction, there appeared to be two storms, one in the northwest and the
other in the south. The clouds came together over Princeton and
deluged us with rain. The lightning was almost incessant, but the



thunder was not very loud except on one or two occasions, when it appeared to be very near and then the intensity was not as great as I have heard in Albany. The storm lasted about 3 hours, but not in full force during the whole time. Several places in the vicinity of Princeton were struck and one in the villages nearby Mrs
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

191
July 15th 1841
Effects of Lightning Mrs Hamiltons House struck

Hamiltons house situated on the main street [^][[about]] 30 rods to the south west of the college, on the opposite side of the street. It appears some what strange that this house should have been struck, since it is One of the lowest on that side of the street in the vicinity and on the west of it are a number of high trees. The house is also furnished with a lightning rod but not of very perfect construction or arrangement.

The house stands parallel to the street in a north east and south west direction. It is of brick covered with a shingle roof two stories high - has a door and an ^{[[insert]]} entrance ^{[[insert]]} hall on the on the west, and two rooms, one front and the other rear above, and below with a small room in front over the hall. In the upper story there are three windows in front and two below. The front door being under the 1st window.

^{[[image - house as described in text showing direction of current?]]}

There is a wooden gutter which runs horizontally along the front of the house under the eaves, and at the nor ~~[[strike through]]~~ east side this is furnished with a tin pipe of about 3 inches in diameter, connecting it with the ground. Both the gutter and the pipe must have been filled or nearly filled with water at the time. The lightning rod is attached to the north gable of the house and was probably placed there
[[end page]]

[[start page]]

July 15th 1841 Effects of Lightning 192

rather than on the east, on account of the support which the chimney would give it. It is made of round iron $\frac{3}{8}$ th of an inch in diameter, and in 5 pieces joined by hook and eye joint. It is terminated above by 3 points which are very blunt but do not exhibit signs of fusion, and at the lower end its connection with the earth is very imperfect - it appears to be merely stuck into the ground to the depth of perhaps 2/or three feet. It rises to the height of about -- feet above the roof.

The lightening appears to have come from the south, perhaps a little to the west and first to have struck the s.w end of the horizontal gutter. It then appears to have divided into two parts, the one passing along the gutter which was in all probability filled with water as the rain was falling almost in torrents, and then down the pipe to the ground, the pipe was also probably gorged with water at the time. The other part passed immediately down from the gutter - when the strike was first made - to the casing of the window and then to the jambs of the door beneath to the pavement - traces of it were observed on each side of the window frame, the s.w. upright was split at the top, when the hinge of the window shutter was fastened, and below, also on the opposite upright of the frame near the lower hinge of the shutter, the casing was marked. The gutter was split when the lightning passed down to the window. It made its appearance principally when the nails were inserted. In some case the discharge appeared merely to have touched the ~~[[strike through]]~~ ^{[[paint ?]]} ~~[[strike through]]~~ [^][[wood]] and gouged out a groove of about the 8th of an inch in diameter - the channel appeared rough but

^{[[image in margin beside section above: cut away view of gutter above and separate from a drawing of the window with shutters on either side. Gutter is marked and labeled with a "split" near the left end. The left}



shutter is marked and labeled with two "split"s near top and bottom where the shutter meets the window. Centered between the two splits along the same joint of shutter and window is a spot labeled "touched." A spot near the bottom of the joint between the window and the right shutter is labeled "[[?]]".]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[page start]]

193

July 16th 1841

[[??witten]] 16th

Observations on Thunder storm of the night of July 15th 1841

regular in widths. After passing down from the window, it is next seen on the jams of the door, the casing on each side is marked, that on the SW is split, and ^[[that]] on the opposite side marked in several places. The course of the lightning along the gutter was probably principally through the water; its course however, is shown by a long splinter near the S end of the gutter and also two splinters thrown off from the wash board ^[[or architr--s??]] under the gutter at the other end near the tin pipe. No marks of the discharges were observed along the tin pipe, at the ground where the electricity was probably discharged. The lightning rod was also examined, but no marks about it could be seen, which would lend us to suppose than any part of the discharge had gone down this.

During the storm, there were several females in the house, three of these, old Mrs Hamilton and her two daughters were in the [[insert]] front [[/insert]] room in the second story. The old lady was [[insert]] lying [[/insert]] on [[/insert]] the [[/insert]] ^[[a]] head placed near the partition wall between the two rooms, her daughter Miss Hamilton, was sitting on the bed, and her Daughter Mrs Huntington, was on the floor about 8 feet from the front wall of the house [[insert]] with her face to the same [[/insert]]. A the moment of the discharge, old Mrs Hamilton who was looking toward Mrs Huntington as she stood on the floor, saw her surrounded with light. Mrs H. herself felt a sensation on her right ear which was nearest the point when the lightning first struck, [[end page]]

[[start page]]

July 16th Observations on Thunder storm of the night of July 15th 1841

194

as if it had been touched with a live coal of fire. She also felt a "rushing sensation" down her left side and perceived a brilliant discharge of light at her foot. at the same time a flash or [[/insert]] long [[/insert]] ^[[forked]] spark, 8 inches long, appeared between her body and the nearest window. The other two persons in the room felt nothing unusual, or if any effect was produced, it was merged in the succeeding alarm. No mark on the ear or the foot was perceptible next day. The shoe was also examined, but nothing could be seen. Mrs H at the time was standing on a grass carpet which covered the floor of the room. The window ^[[shutter]] nearest Mrs H. was shut, and also the [[/insert]] windo [[/insert]] shutter of the window over the door was closed. One valve of the window next the pipe was open, the shutters were of the open kind with slanting slats. Three pains of glass were broken in the window over the door, and the glass thrown inward. This window it must be observed was in the little room over the hall and therefore was seperated from the room in which the females were, by a partition wall.

These phenomena do not appear difficult of explanation; the long ^[[horizontal]] gutter and the perpendicular pipe, both filled with water, formed a continuous conductor from the place where the lightning struck, to the ground at the farther corner of the front of the house. This conductor would be acted on by the approaching discharge, and and by induction become lightly charged if the cloud was +, the upper end of the



gutter would be minus, ~~[[the]]~~ its
natural electricity would be repelled towards the earth through the pipe,
and therefore the whole would be in the most favourable condition to
attract
[[page end]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

195

the lightning which came in a direction [[?]] which coinsiding with the direction of the gutter. The effects observed by [[?]] H and her mother in the room, were probably owing to induction. If electricity be suddenly thrown on a pane of glass on one side, electricity will be thrown off on the other by induction, and when a powerful discharge pulses along the front of the house as in this case, the natural electriciy of the [[interer?]] we would suppose would be disturbed and all the effects described by [[?]] H produced. She says that an explosion like that of a pistol took place apparently at her foot, the likes of which appeared like a ball of about an inch and a half in diameter. I am inclined to believe however, that this was the explosion of the [[part?]] of the discharge from the cloud which struck the house since a similar noise was heard at Dr [[?]] (See page ____ x

The discharge came from the south and pulsed over the houses on the opposite side of the street. In one of them, two persons were affected with the discharge. one a servent girl of Mr. [[Marner?]] was thrown into convulsions. Either by the [[?]] effects of the lightning or by the fright produced by the thunder, the other Mrs. Marner fell at the moment a prickling sensation in her limbs [[?]]

[[end page]]

[[begin page]]

196

in her arms, which to use her own expression went out at her fingers. A girl in the room below, with the windows closed, thought she saw the lightning on the floor. Much of these effects may have been produced by immagination, but still there is a sufficient cause in the principle of induction to account for all thses appearances.

On the same day I [[visited?]] Mr. Henry Philip's town, situated about 3 miles from Princeton on the road to Trenton. This was also struck by the same storm. His house has a lightning rod at the end farthest[[?]] from Princeton, but it is in a very bad condition, the [[?]] and [[?]] on five feet of the [[crossed through]] when off, or rather bent down, so that no part of the rod rises above the top of the house. The lightning struck the [[farth?]] gable from the rod on the east end of the house, pulsed down the chimney into the fire of the cellar kitchen, scattered the ashes through the room, and filled all below with smoke.____ a strong odor of sulphure was perceptible, and this was also the case at Mrs Hamiltons. The smell was so strong around the front door, that Mrs. H. thought the house was on fire. But to return to MrsPhilip's case. A large quantity of [[soot?]] was thrown down the chimney, the whole charge however did not go down [[crossed through]] into the fire. a part of it pulsed out through the thick stone wall, which formed the back of the fire place, and came out opposite the upper iron hoop of a [[dry?]] [[?]], which was placed against the



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

197 copied from foot of this page to foot of p. 200. See note on p. 190. N.

wall. It then passed down the cushion which was moistened with the by, and burst off three or four wooden hooks, which alternated with those of iron. The hole in the wall was made between the stone, of a triangular form, the plaster was thrown out, and the angles of the stone broken. No lines of fusion were observed; other cases of a passage through a thick wall were observed in the discharges of the serious storm () -

Induction effects were also noticed in this discharge. Mr P, his wife and little son were seated on the edge of a bed at the distance of about 20 feet from the chimney, where the discharge passed down. They each felt a shock in the legs. Mr P. felt it in his right leg, which was thrown over the other, and did not touch the floor. Mrs P felt the shock in both legs, and said it resembled precisely that which she had felt from an electrical jar. The boy felt it in his knees, also Mr P felt it most in the same joint. The house was about 60 feet long, and from the bad condition of the rod, it is not surprising that the further end of the house should have been struck, particularly given it there was a fire in the chimney

Between Princeton and Mr Philips at Stony brook, we inspected a tree which was struck at nearly the same time. It stood before the door of the house on the left hand as you jump over the bridge going from Princeton.

[written in the left margin: account of this given to and pubd in Proc. Amer. Phil Soc. Vol ii. pp.111-116.]

[image - downward arrow meeting horizontal line under which are the words: copy from this]

[start page] 198

The tree was of the kind called Balm of Gilead, about 50 feet high, it showed signs of the discharge at the distance of about 15 feet from ground, but the principal effect was produced at about 5 feet above this, where the first large branches came out. The splitting and scathing appeared to be confined to a length of 5 or six feet. The upper branches were not affected, and the lower part of the trunk showed no signs of the passage of the discharge. The effect acting however was so intense on the part above the projection of the lower branches, that the tree was nearly severed in two, and was unable to withstand the wind which followed the storm. It fell in the yard and had been cut up, that is all the upper part, before I saw it, the however was standing.

The woman was in the entrance hall almost immediately opposite the tree, and about 25 or 30 feet distance from it. She experienced no effect except fright. Her husband was in the garden immediately below the house and complained of being very sensibly affected by the shock - had a pain in his head all the next day. The tree showed no



indication of ignition, the part struck was much splintered, and the slivers thrown off as if by an explosive power. The tree was green and quite succulent, and this was probably the cause of its not being splintered below, perhaps it was hollow.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[Note in Top Margin:] July 16th 1841 Effects of lightning Barn struck on Rocky Hill Dr [[Macleans?]] House

Visited this morning with Mr George (crossed through) [[Andrew Maclean]] the barn of [[J?]] Leigh of Rocky Hill, which was also struck on the same evening at about 10 o'clock. Lightning struck [[Illustration-barn, with letters a, b, and c referencing different points on the illustration]] at a, the highest peak of the barn, which consists of two parts, one for hay and grain, and the other for a horse stable. It pulsed down each radfter, splintering them in its course, so as to completely destroy the [[continuity?]] of the wood on the north side. It pulsed down along the posts and large [[?]] door, and then through the foundation wall into a kind of [[cellar?]] stable. The barn is on ground which slopes on [[inkblot]] one side so that the entrance to the cellar is [[inkblot]] even with the ground on the lower side. In this cellar, a number of cattle and sheep were collected at this time. 3 of the sheep and a heifer were killed. The lightning made a triangular hole in the wall, with the apex inward as if an explosion from within [[?]] had produced the effect. The same kind of hole was also observed in the wall at Mr Philip's and also at Dr Macleans. A horse in the stable C (underlined) was also much injured by the discharge.

On the same day, or rather evening. Dr Maclean's house. about [[6?]] miles south of Princeton was struck. The lightning pulsed down the rod which had been erected but a few days previous. [[?]] left the rod at or near the ground, and pulsed through the foundation of the chimney, which is $3\frac{1}{2}$ feet thick. making a solid angular hole; as if by a force within out
[end of page]

[begin next page]

[Note in top margin:] Sept 2nd effects of lightning induction at a distance
200

I am informed by Mr [[?-partially circled]] that he has observed that one of Dr [[Haus?]] electrometers is affected by the flash from a cloud at a great distance even miles off.

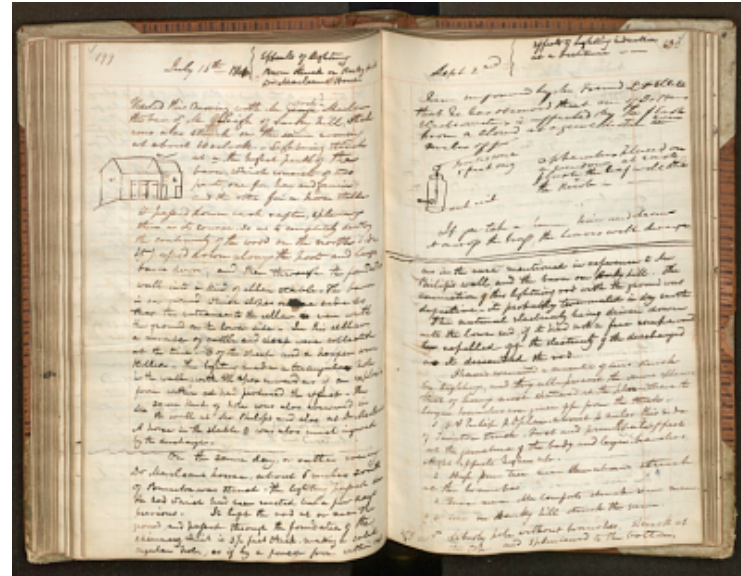
[[illustration with labels, but unable to decipher labeling]] apparatus placed on window at each flash the [[?]] will strike the [[?]]

If you take a [[?]] hair and draw it across the [[?]] the [[leaves?]] will diverge.

[[Double line drawn across page]]

as in the case mentioned in references to Mr Philip's wall and the barn on Rocky Hill. The connection of this lightning rod with the ground was defective. it probably terminated in dry earth. The natural electricity being driven down into the lower end, if it had not a free escape would have repelled off the electricity of the discharged as it descended the rod.

I have examined a number of trees struck by lightning, and they all present the same appearance that being most shattered at the place



[[inkblot]] where the larger branches are given off from the trunk.

1. A tulip poplar. about 4 miles this side of Princeton struck. First and from [[?]] effect at the juncture of the body and larger branches slight effects higher up.
 2. High [[pine?]] tree near [[?]] above struck at the branches.
 3. Tree near Mr Comforts struck same [[?]]
 4. Tree on Rocky hill struck the same.
 5. Liberty hole without branches. Struck at the top and spintered to the bottom.
- [[illustration of a pointing hand? in left margin, with two lines]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

201 Wednesday Oct. 6th 1841

[[image of bar through spool]] Put large bar of iron into large spool. Sent charge from 6 cups through the short thick inner coil. Sound at making and breaking battery contact - nearly of the same intensity.

The sound was observed by means of the microphone, and appeared the same whether [[image]] wires were placed in the same line as able, or at right angles thus [[image]].

Next placed rod of small round iron in the coil of about 2 1/2 feet in length, sound of nearly the same intensity as with the larger, both at beginning and ending of the battery current. Then [[?]] the current through the long wire, found the sound at the ending but not at the beginning. Next joined the ends of the short inner coil. The sound was now intensely imperceptible [[?]], although the magnetism was as strong as before. - Next sent the current through the inner coil and joined the ends of the outer [[?]], the sound was diminished apparently but not intensely [[?]] neutralized [[?]].
[[image]]

The apparatus remaining as before. The microphone was removed and the end of a round rod of wood, about 15 feet long, placed against the end of the iron rod, and the two pressed together. The sound by this arrangement was conveyed to the large room [[?]] and appeared as distinct as with the [[?]] close to the bar The [[?]] [[?]] of [[end page]]

[[start page]] Oct 6th 1841 202

rod of wood was placed in the ear which the other meatus [[?]] was plugged [[?]] with the finger.----

[[image]]

A single wire 18 inches long 1/10 of an inch in diameter, was next placed in the coil, and the sound observed by means of a rod. It was not as clean as with the longer bar but nearly as loud. The wire was stuck into [[image]] the side of the rod, thus the sound was apparently not quite as loud as before. but the difference was very small.

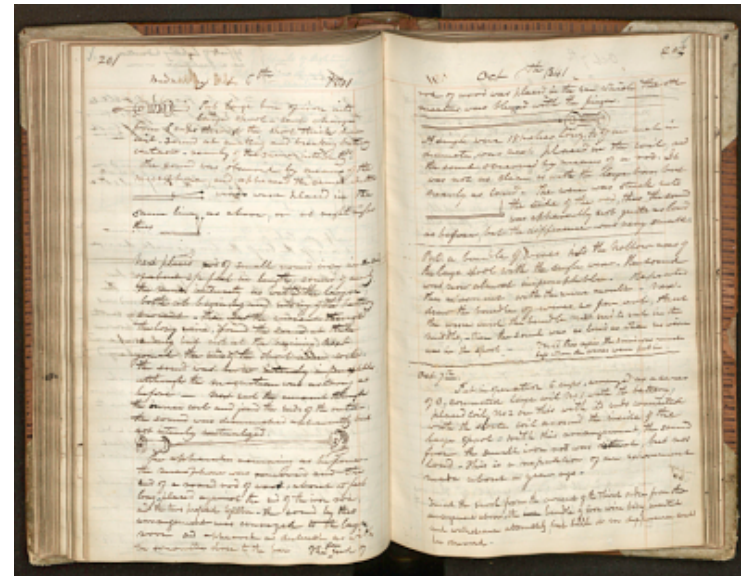
[[horizontal line across page]]

Put a bundle of wires into the hollow axes of the large spool with the single wire. The sound was now almost imperceptible. Repeated this experiment with the same result. Next drew the bundle of wires so far out, that the wire and the bundle met end to end in the middle, then the sound was as loud as when no wire was in the spool. Tried this again, the sound was much less when the wires were put in.

[[wavy line across page]]

Oct 7th

Put in operation 6 cups, arranged as a series of 3 [[?]]. Connected large coil no 1 with the battery, placed coil no 2 on this with its ends



connected with the shorter ~~[[?]]~~ coil around the inside of the large spool. with this arrangement, the sound from the small iron rod was distant, but not loud. This is a repetition of an experiment made about a year ago.

Tried the shock from the current of the third order from the arrangement above, the ~~[[strikethrough]]~~ iron ~~[[/strikethrough]]~~ bundle of iron wire being inserted and withdrawn alternately, but little or no difference could be observed.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

203 Oct 7th 1841

Made exp with magnetizing spirals - placed coil no 2 on no 7 which was connected with the battery arranged as 9 elements, and the circuit of the secondary current closed with four spirals a b c d with a needle in each. The connection with the battery being made by means of a file or rather a sash, the needles were all slightly magnetized except the one in b. They all gave the same direction to the current which was in accordance with my previous determinations. The first coil was a compound one and consisted of more than a hundred turns of fine wires. The second b was a double spiral, the third was a single spiral the spines in contact. The third a single spiral with the spines widely separated.

From this exp (which I have tried before), it would appear that the spiral with a galvan indirect current gives in all cases the same indication of direction. The only circumstance which was unexpected in the result was the non magnetism of the needle in spiral b.

Repeated this exp. again with the alteration of leaving out the lone fine wire spiral a. All other spirals now gave strong magnetism to their needles. I should have mentioned above that the magnetism was weak in all the spirals except a. This was probably due to the diminution of the intensity on account of the long fine wire which composed a.

Oct 7th 1841
204

Made exp on magnetizing Put piece of tin on the outside of small Boston coil, sprinkled filings on the inside - magnetism exhibited - but the tin in the inside of the coil magnets stronger on out side.

Oct 8th

Made an attempt this morning to determine the direction of the current from galvanizing by means of the effect on the nerves, but without any definite effect. Neither myself nor sons gave the same indications in reference to the secondary and tertiary currents. Perhaps we were not sufficiently sensitive galvanometers.

[image - wavy line left to right half way across page]

Took the direction of the ending tertiary current with three spirals - same as those at the top of the page, each gave the same deviation. The result in accordance with all my previous determinations. The tertiary current was of quantity -.

Took the direction of the tertiary current with the galvanometer. noted the first impulse which was in the proper direction as in that which is given by the needle. The long swing however is in the opposite direction and might be mistaken for the true direction were not attention particularly directed to the part. Repeated this with the long coil and by passing the current through water. The effect was not however much increased.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

205 Oct 9th Description of magnetometer also Batteries - Magnetization of needles transverse to conjunctive iron

made arrangements for experimenting with ordinary electricity - constructed an instrument for determining the intensity of the needle. [[illustration of the instrument]] It consisted of a graduated circle within which is suspended a magnetic needle. The needle to be tested is brought at right angles to the magnetic needle and the deflection gives the intensity required.

To measure the quantity of electricity passed into the battery from the machine, the unit measure of Snow Harris was employed. The slide or gages was placed at the 7th mark on the stem.

The batteries used were the in number

First of 7 jars each of 10×18 180 = square inches = in all to $9 \frac{3}{4}$ square feet, afterwards added 5 more jars, the whole surface was then 15 feet.

[[short dividing line]]

2nd of eight jars $13 \times 12 = 156$ inch = in all to $8 \frac{1}{2}$ square feet.

[[short dividing line]]

3rd consists of 23 bottles each $17 \frac{1}{2}$ by $7 \frac{1}{2}$ making 139 inches = in all to 21 square feet nearly. This is the old Dr Franklin battery.

Exp 1-4 Stretched copper silvered wire between the glass posts of the universal discharges 30 inches long.

note in left margin w/ open bracket encompassing paragraph next] needle placed at 1st 10 of the magnet. [[end note in left margin]]

1st with 3 battery charge 50_11 needles in contact mean deflection - $4^{\circ} 5$. [[hind ?]]

2nd same 12 needles in contact mean deflection of the magnetometer 3.16 [[hind ?]]

[[end open bracket at left]]

[[2nd? or 3rd?]] By the same arrangement .25 charge

mean - deflection of 4 needles in contact $2^{\circ} 25$ [[written above]] [[hind ?]] [[/written above]]

-- change .50 4 needles 2.89

[[end page]]

[[start page]]

206

Oct 11th Monday

again same arrangement 4 needles in contact

charge 100 -- deflection $3^{\circ} 12$

again charge 150 mean deflection 3 --

[[short dividing line]]

To determine if the same action is exerted alike on every part of the conjunctive wire. Eleven needles were placed at equal distances from each other [[strikethrough]] [[need ?]] [[strikethrough]] along the wire and in contact with it. With the charge of 50 the following was the result, the battery new and the same as before.

1st 2nd 3rd 4th



3° 3° 4 4 1/2, 5° 5° , 6° 6° . 6 1/4. 5 1/2 6 [[farther ?]] end
 of the wire
 again same arrangement
 $2 \frac{3}{4}$.. 3 .. $2 \frac{1}{2}$.. 4 . $2 \frac{3}{4}$. $2 \frac{1}{2}$. $2 \frac{3}{4}$. $3 \frac{3}{4}$. $3 \frac{3}{4}$ $2 \frac{1}{2}$. 6 $2 \frac{1}{2}$
 [[firthe ?]] end

There appears from the above results to be somewhat of a greater
 tendency to more intense magnetism at the farther end of the wire, ie to
 the end nearer the outside of the battery. This was probably produced
 by the position of the ball of the handles of the universal discharger
 along which the wire was streached.

NB In discharging the battery of 6 jars, part of battery No 2 through the
 thin wire used in the above experiments and about a foot in length, the
 wire observed to produce a sound which continued some seconds after
 the discharge. must examine this.

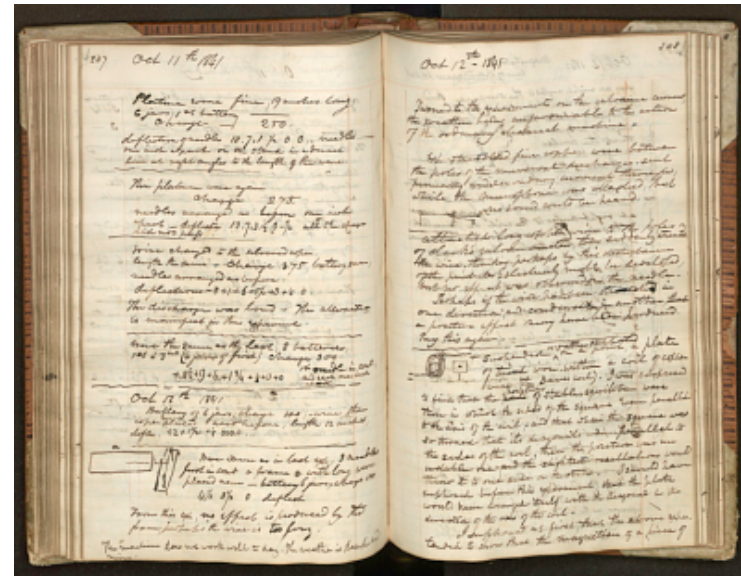
Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

207 Oct 11th 1841

Platina wire fine, 19 inches long, 6 jars, 1st battery ----
charge - 250
deflection of needles 10.7.1 1/2 0 0, needles one inch apart on the stand
in a direct line at right angles to the length of the wire
[[horizontal line half way across page]]
Thin platinum wire again
charge 275
needles arranged as before one inch apart - deflection 13.7.3. 1/2 0 -
1/2 all the charge did not pass
[[horizontal line half way across page]]
wire changed to the silvered copier, length the same - charge 375,
battery same, needles arranged as before.
deflections -8+1+6+5 1/2+3+1/2 0
This discharge was loud - No [[?]] is manifest in this expermnt.
[[dividing line across page]]
Noise the same as the last, 2 batteried, 1st & 3rd (6 jars of first) charge
300
+8 1/2+9+6+1 3/4+ 1/2+0+0 1st needle in cont., and each one inch
apart.
[[dividing line across page]]
Oct 12th 1841
Battery of 6 jars, charge 100, - wire then copier plated used before,
length 12 inches, deflec. +2+1 1/2+1/2+0+0.0. -
[[dividing line across page]]
[[image]] Wire same as in last exp, 3 needles first in cont a frame
[[underlined]] a [[/underlined]] with long wire placed near - battery 6 jars -
charge 100 4 1/2 3 1/2 0 deflect
From this exp, no effect is produced by the frame, perhaps the wire is
too long.
The machine does not work well today. The weather is damp and rainy.
[[end page]]

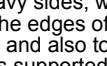
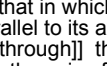
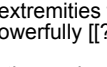
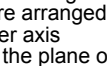
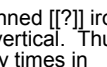
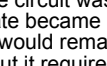
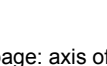
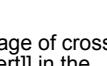
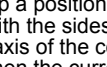
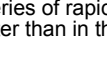
[[start page]]
Oct 12th - 1841 208
Turned to the experiments on the galvanic [[?]] current, the weather
being unfavorable to the action of the ordinary electrical machine.

Exp stretched fine copper wire between the poles of the universal [[?]]
discharge [[?]]. sent primary and secondary current through, while the
microphone was attached, but no sound could be heard.
[[image]]
attached long copper wire to the poles of clark's [[?]] galvanometer, then
suddenly stretched [[?]] the wire, thinking perhaps by this disturbance of
the particles, electricity might be developed, but no effect was observed
on the needle. Perhaps if the wire had been stretched in one direction;
and condensed in another, [[strikethrough]] that [[/strikethrough]] a
positive effect may have been produced. Try this again.
[[dividing line]]
[[image]] Suspended [[insert] or rather supported [[/insert]] on a point, a
plate of turned [[?]] iron, within a coil of copper wire (the Davis coil). I
was surprised to find that the [[strikethrough]] points [[/strikethrough]]
[[insert]] positions [[/insert]] of stable equilibrium were those in which the
sides of the square were parallel to the axis of the coil - and that when
the square was so turned that its diagonals were [[?]] parallel to the
sides of the coil, then the position was an unstable one, and the slightest
oscillations would throw it to one side or the other. I should have
supposed before this experiment, that the plate would have arranged
itself with the diagonal in the direction of the axis of the coil.



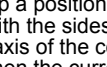
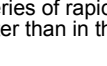
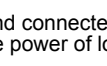
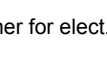
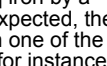
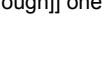
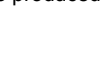
I supposed at first, then that the above exper. tended to show that the magnetism of a piece of

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

209 Oct 12 1842 Magnetism axis of spontaneous polarity was at right angles to the surface, and in order to test this idea I formed a piece of plate thus  cutting the edges of a square so that the circles might be at  to the surface, and also to the diagonal a b, but when this was supported in the coil, the position of stable equilibrium was as before that in which the sides of the square were at right angles to the coil or parallel to its axis [The reason for the phenomenon is probably that ~~the~~ when the one diagonal  is parallel to the axis of the coil the other is perpendicular to the axis and  in the extremities to the surface of the inside of the coil and hence it will be powerfully  on the induction of coil]  When the angles a b were cut off, then the square arranged itself at right angles to the coil in the line SN. {The shorter axis ~~at right angles to the~~ at right angles to the ~~in the plane of the~~ in the plane of the coil}  Next cut a circle of tinned  iron supported this horizontally in the coil which was placed vertical. Thus  the plate spun around on the needle point many times in succession before coming  to rest, but as soon as the circuit was completed with the battery, the whirling ceased. The plate became polar. The polarity was indifferent however as the plate would remain at rest in ~~at~~  any position but it required a slight force to turn it into a new position. [end page]

[written in left margin in direction from bottom to top of page: axis of spontaneous magnetism of soft iron]

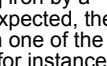
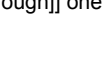
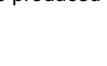
[start page] Oct 12th _ 1841 210
Magnetism {axis of spontaneous polarity

Next cut a piece of iron into the form of a cross thus  with equal arms - supported  this  in the centre of the coil.  It took up a position of stable equilibrium with the axes in the direction NS, or with the sides of the square from which the figure was cut parallel to the axis of the coil. The directive  force  was quite energetic, and when the current was suddenly , the cross came to its position by a series of rapid oscillations. The directive  force  appeared greater than in the case of the square.

The whole of this subject appears to me to be curious and connected with the theory of magnetic distribution, and the retentive power of long bars.----

[dividing line]

Oct 13 Clear day. good weather for elect.

Tried the induction of the different of plates of tinned  iron by a common  straight steel magnet.  As I had expected, the axis of spontaneous magnetism was in all cases through one of the longer axis of the figure . In the case of the square for instance, the polar axis passed through ~~the~~  one of the diagonals.

The idea occurred to me, that perhaps a motion might be produced by



means of the arrangement of the circular [[?]] plates, and the coil. For this purpose, the coil was placed vertically, with the plate supported horizontally on a needle point in the centre of the coil, and a bar magnet brought in a line of the tangent to the circle, but no motion of a rotating kind was produced.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

211 Oct 13th 1841

Made an experiment to determine if a coil transmitting a galvanic current acted like soft iron in increasing the intensity of the secondary current. For this purpose  coil no one was placed on the table, coil no 2 on the last , and helix no 1 on these. The ends of coil no 1 connected with the battery by means of the mercury  ~~cup~~ while a  current was passed through no 2. When the  with the battery was formed with no 1, the needle of the galvanometer was deflected by the secondary current to 15  [deg sign]. The constant current through no 2 was then stopped, and the exp repeated. The deflection was about the same. the experiment was repeated in the same manner, with the exception of changing the direction of the constant current, but no difference was perceptible. It would appear from this experiment that in the reaction of the induction of soft iron, there is no analogy in ~~the~~ ~~the~~ an action of a coil transmitting a galvanic current. And on reflection, I now think there was no reason to expect an action of this kind, since in the case of soft iron, the induction is produced at the beginning and ending of the change of magnetic state of the bar , which only takes place at the beginning and ending of the galvanic current, but in the case of the galvanic current, the action must be instantaneous both ways like a single wave which instantaneously subsides. 

 left margin contains the words: see exp page 153

 start page

Oct 13th 1841 212

Repeated the attempt to reproduce the sound mentioned on page 206, and succeeded  with the battery of six jars and the electronic  (quadrant) at nearly eighty. The sound was quite perceptible. The wire was 15 inches long and of the thin  plated kind. the  effect was produced by a wire of about a foot long of the same spool as the last with a shorter wire the sound was not produced nor with a small discharge of the battery.

 short double line

The sound effect was produced with ~~the~~  a louder sound in using the sonometre, sending the discharge through the iron wire of the instrument which is 3 feet 8 inches long. The battery was still the same as before - next the Franklin battery was added, and a charge considerably greater, but the electrometer  only sood  at about 48 . The wire was  by a wight .

 short dividing line

I found on inspecting  History of Electricity, that he had made experiments on the sound of electricity, and at first sight I was of opinion  that he had hit on the same phenomenon as the one given above, but it appears that the sounds he mentions, (see second vol), were produced by the concussion  of the air by the discharge of the battery.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]] 213 Made no exp on the 14th

Oct 15 1841

Attempted to get sound from the sonometre by means of a galvanic current from the battery of 6 cups arranged as three, but no effect was observed, neither with the sonometre alone, nor by the addition to the circuit of the long coil no 1.

NB The idea occurred to me while making this exp. that possibly the conducting power of a wire for electricity might be altered by causing it to vibrate during the passage of the current. Try this.
[[short dividing line]]

I have had made by Mr. [[Rowan ?]], an ingenious watch repairer, now settled in our village, a heliostat on the plan given by Dr Young in his Natural Philosophy - I have put in its position on a board nailed on the window sill of my little study. I find it answers very well. the instrument was adjusted by calculating the point on the wall of the room where the image should strike, and then turning the mirror until it fell on this place. A meridian line was drawn on the board which is on the window, by means of concentric circles, and the [[image?]] of a small [[pole ?]]
[[end page]]

[[start page]]

214 [[checkmark]]

[[underlined]] Oct 15 [[/underlined]]

Made another experiment on the spontaneous axis of polarization. Held the straight magnet [[image: short horizontal bar over and X; bar is labeled N at left end and S at right end.]] over the cross found that the ^[[induced]] polarity was still along the axis and not along the resultant, as in the case of the induction from the coil. --

[[short dividing line]]

[[image: line drawing of a wire starting at left, forming a coil and ending at left; ie. both end of wire forming the coil extend leftward, separately. Top end is labeled +; bottom end is labeled -. To right of coil is an I figure with a \ through where the top cross bar of the I meets the I's vertical line.]] When the coil was placed with its axis in a line with the support of the cross, so as to be at a small distance from the same, and to act like the end of a magnet, then this direction of the spontaneous axis of polarity was the same as in the case of the stright magnet.

[[dividing line across page]]

[[smudged?]] [[image: Circle]] [[/smudged]] Placed a piece of white paper over the face of the small coil / Daves), and passed through a current from the battery of 6 cups arranged as three, then sprinkled filings on the paper, [[image: radially arranged dashes of several concentric levels; dashes are aligned as if emanating from the center of a circle, as of the burst of single fireworks or a dandelion in seed.]] the arrangement was as shown in the margin. The filings around the margin of the circle were arranged in radii, while in the middle they stood perpendicular to the paper.

[[short dividing line]]

[[image: circle containing random arrangement of dots. short dashes are spaced closely around and perpendicular to the circle's circumference and emanate outward; as of the spokes of a wheel.]] Next sent current through coil on the outside of [[tinned ?]] iron cylinder. The arrangement was as shown in the margin, scarcely no magnetism within, while it



was highly magnetic on the outside. The filings were drawn away from the rim on the inside, and then left a white line around.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]] 215
Oct 15th 1841

[[circled]] NB accidentally turned over two pages [[/circled]]
* In order to determine if the sounds described on the ~~12th~~ page were not due, as in the case mentioned by ~~[[?]]~~ to the sympathy of the wire with the agitation of the ~~[[an ?]]~~ by the crack of the battery discharge. I made a number of experiments, using the battery of 6 jars, but although the crack was very loud, the electrometer at 80°, no sound could be observed - unless the discharge was passed through the wire of the sonometre. Also care was taken to prevent any effect from the noise made by ~~^[[the]]~~ striking ~~^[[of]]~~ the different parts of the apparatus together.
[[dividing line across page]]

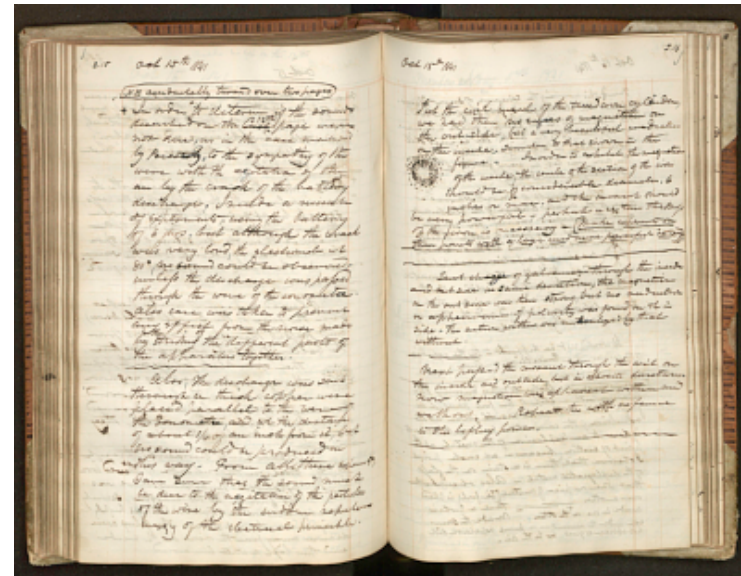
Also, The discharge was sent through a thick copper wire placed parallel to the wire of the sonometre, and at the distance of about 3/4 of an inch from it, but no sound could be produced in this way. From all these experiments I am sure that the sound must be due to the agitation of the particles of the wire by the sudden repulsive energy of the electrical principle.
[[end page]]

[[start page]]
216 [[checkmark]]
Oct 15th 1841

Put the coil inside of the ~~[[tuned ?]]~~ iron cylinder, we had then no signs of magnetism on the outside, but a very beautiful indication on the inside, similar to that shown in the figure - ~~[[image: double concentric radial arrangement of inward facing dashes forming a hollow circle; scattered dots are randomly arranged around the circumference of this circle.]]~~ In order to exhibit the magnetism of the inside, the circle of the section of the iron should be of considerable diameter, 6 inches or more - and the current should be very powerful - perhaps a certain thickness of the iron is necessary -- make experiments on these points with a large and more powerful battery [[/underlined]]
[[dividing line across page]]

Sent charge of a galvanism through the inside and outside in same direction - the magnetism on the outside was then strong, but no radiation or appearance of polarity was found on the inside - The action within was neutralized by that without.
[[short dividing line]]

Next passed the current through the coil on the inside and out side, but in opposite directions. Now magnetism was apparent within and without -- Repeat the with reference to the lifting power.
[[dividing line across page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

217
Oct 16th 1841

Tried this morning the experiment of Snow Harris. Placed an electrometer of gold leaf under the [] of the air pump - made a vacuum of less than $\frac{1}{4}$ of an inch. The leaves still remained in a divergent state. When the air was let in very gently [] the leaves converged immediately.

[horizontal line]

This result of Snow Harris is due to the small charge of the electrometer and the imperfect vacuum for when I suspended two pieces of cotton thread between two balls thus, and the air exhausted, [illustration] no sign of repulsion was exhibited, where the ball on top was connected with the excited machine. But when the air was readmitted, the insulation was produced, and the threads were powerfully repelled. It would not be difficult to try the repulsion of the leaves in a Toricellian vacuum.

[dividing line]

[image] Repeated this morning [] the experiment with a slip of tin foil pasted on glass. Suspect that the result given as the repulsion of the consecutive parts of the current is due to an explosion of the metal at the point of section [] because at each point I observe that there is a stain on the glass of the [] metal-Also observed that when one piece of metal (tin foil) is placed over another [image] that a hole is made in one or the other. Made the same exp. under the recess [] of an an pump, repulsion did not appear as great as in the air. [end page]

[start page]

Monday Nov 4th 1841 218

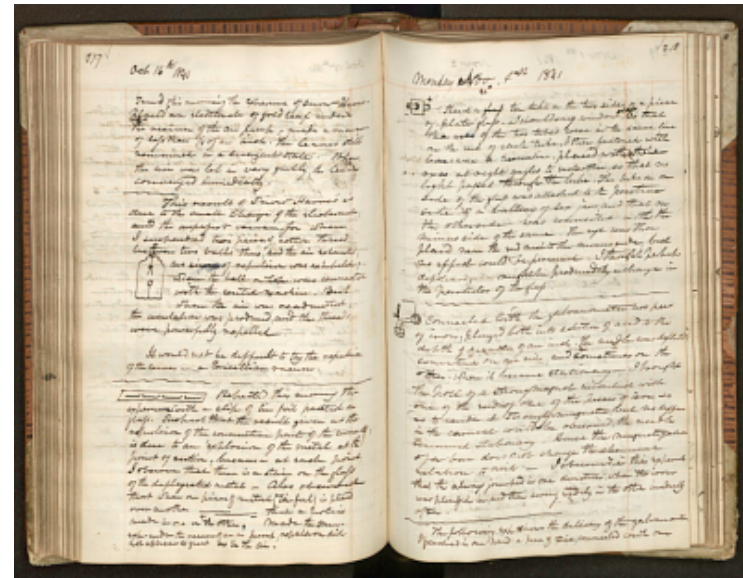
[image] Placed a [] glass [] tin tube on the two sides of a piece of plate glass. I should say window [insert] glass []. [insert] so that the axes of the two tubes were in the same line on the end of each tube. I then fastened with bees wax a tourmaline [], placed with their [] axes at right angles to each other, so that no light passed through the tube. The tube on one [] side of the glass was attached to the positive side of a battery of six jars, and that on the other side was connected with the minus side of the same. The eye was then placed near the end next to the minus side, but no effect could be perceived. I thought perhaps depolarization [] might be produced by a change in the particles [] of the glass.

[dividing line]

[image] Connected with the galvanometer two [] of iron, plunged both into solution of acid to the depth or quarter of an inch. The needle was deflected sometimes on one side, and sometimes on the other. When it became stationary - I bought the pole of a strong magnet in contact with one of the end of one of the pieces of iron so as to render it strongly magnetic but no difference in the current could be observed, the needle remained stationary. Hence the magnetization of a bar does not change the chemical relation to acid - I observed in this experiment that the always jumped [] in one direction when the iron was plunged in and then swing widely in the other immediately after.

[dividing line]

The following exp shows the delicacy [] of the galvanometer. I grasped [] in one hand a piece of zinc [], connected with one



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

219 Nov 1st 1841 Nov 2

of the wires of the galvanometer and with the other I touched to my tongue the other end of the galvanometer wire, the needle was deflected and by timing the touches to the tongue with the swing the deflection was extended to 45° degrees. When the circuit was extended by introducing into it an other person, the same effect was produced. In this experiment one person grasped the zinc, the other the copper, and then the two joined hands, the needle was deflected. In these two last experiments, the small fine wire galvanometer was used.

For several days past, I have been engaged with same the coloured assistant in constructing a Daniell's Battery on a much larger scale than the one I before used. It consists of 12 elements, each formed of a tube of brass shut at the bottom, so as to form a cup twenty inches high and $3\frac{3}{4}$ inches in diameter. The zincs are formed of rods $\frac{3}{4}$ of an inch in diameter and 20 inches long. They were cast by driving into a stove pipe filled with sand a rod of wood of the dimensions of the intended rod, and then withdrawing the same. The metal was poured into the hollow. In this way, the casting was perfect and completely answered the purpose.

Tried 6 jars of the above battery found the magnetic and electrical effect very powerful - The snap was louder than the one with the great battery of plates described in my first paper when arranged as a series of 8 elements.

Nov 2nd 41- 220

Tried the secondary current from the long or rather longer reel, 4 inches of wire were placed on the reel around the nine strands at the axis. The hollow in the axis was filled with a bundle of iron wire. The secondary shock was so powerful that I felt it through the floor. It passed through nearly half an inch of heated air in the flame of a spirit lamp. When iron filings were placed in a tea saucer, and the secondary discharge made through them, the effect was beautiful, the deflagration was like the scations from the jar cooled on the outside with iron filings. With the six jars* a spark was produced at the moment of making contact as well as at breaking. mugs

Nov 3rd Made arrangement this morning to experiment with the Daniell battery, and while the apparatus was preparing, I repeated some experiments on magnetism of soft iron. For this purpose, used first Davis' small coil - iron wire placed on the inside became strongly magnetic, on the outside, also magnet, but much less powerful - Where the end projected considerably below the plane of the coils, the magnetism was quite feeble. This was probably due to the section of the farther side of the coil unscreened.

Tried the decomposing power of the battery, found 5 inches of gas was given off in 20 seconds or 15 cubic inches in a minute, - gas came out in large bubbles from the wire - secondary shock quite powerful, could be felt in the breast and arms, when the feet stood on the damp floor.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

221

Nov 3rd 1841

Illustration of the Electrical fish

Placed the two balls which serve as handles into a basin of water, while they were connected with the ends of the secondary current from the large spool. When the finger and thumb of the hand were placed in the basin, in the [line ?] of the discharge - a shock was felt and also when the finger and thumb were placed a considerable distance aside,

as at a b, but when the fingers were placed cross wise as at c & a, no effect could be perceived.

When a single finger was plunged in the basin, no effect could be noticed provided the body was insulated. This the repetition of the experiment which I have published in my last paper, relative to the hypothesis of the elect[?] [?], but I was probably mistaken in reference to the slight shock in the one finger which is probably due to a lateral current -

When salt and water was substituted for the pure water of the last experiments, no shock could be felt with the finger and thumb in any position. The salt water is a better conductor than the body, and the elect will not leave it to pass into a body.

Attempted to get induction from the water through which a current was passing, but did not succeed, at [least ?] by the method of shocks.

[end page]

[start page]

222

Nov 3rd 1841

Spontaneous axis of polarity --

Sent the secondary shock from the large reel through the wire of the sonometer but could perceive no sound --

[dividing line across page]

Tried to produce sound by sending primary current first through wire around the iron of the large reel, and then through the wire of the sonometer - The iron wire of the sonometer became quite hot, but no sound was produced.

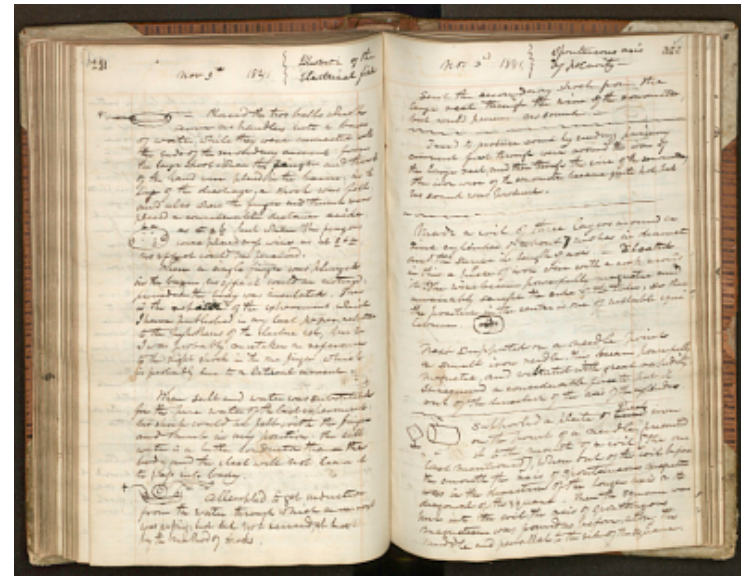
[dividing line across page]

Made a coil of three layers around a zinc cylinder of about 7 inches in diameter and the same in length of axis - Floated in this a piece of iron wire with a cork around it - The wire became powerfully magnetic and invariably sought the side of the tube, so that the positive in the centre is one of instable equilibrium. [image]

Next supported on a needle point a small iron needle. This became powerfully magnetic and vibrated with great rapidity. It required a considerable force to put it out of the direction of the axis of the cylinder.

[dividing line across page]

Supported a plate of ~~tuned~~ sheet iron on the point of a needle, presented it to the mouth of a coil [the one last mentioned], when out of the coil before the mouth, the axis of spontaneous magnetism was in the direction of the longer axis or the diagonal of the square. When the square was put into the coil, the axis of spontaneous magnetism was found as before, along the needle and parallel to the side of the square.

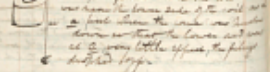


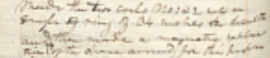
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

223

Nov 3rd 1841

Sent current through long helix described in the old book, - wire placed on the out  side, magnetic when the lower end was near the lower side of the coil as at a, but when the wire was pushed down so that the lower end was at c, very little effect, the filings dropped off. Put wire in inside, it became powerfully magnetic but went to the side.

 Rolled the large ribbon into a - ring 20 inches in diameter - placed piece of soft iron without the coil at the distance of 6 inches - lifted large quantity of filings near by which became less and less as the distance was increased. Placed piece of iron on the out side which became magnetic.

Made the two coils No 1 & 2 into a single ring of 34 inches in diameter and then made a magnetic exploration of the space around, for this purpose I used a slip of sheet iron.

 At a, very little magnetism, at b which was 13 inches off, magnetism very perceptible and increased in strength until the iron was placed against the coil. At c, the magnetism appeared stronger than at d.

In passing across the coil, the magnetism

[[end page]]

[[start page]]

224

Nov 3rd 1841

changed its sign

Repeated last experiment with the apparatus for induction, helix no 1

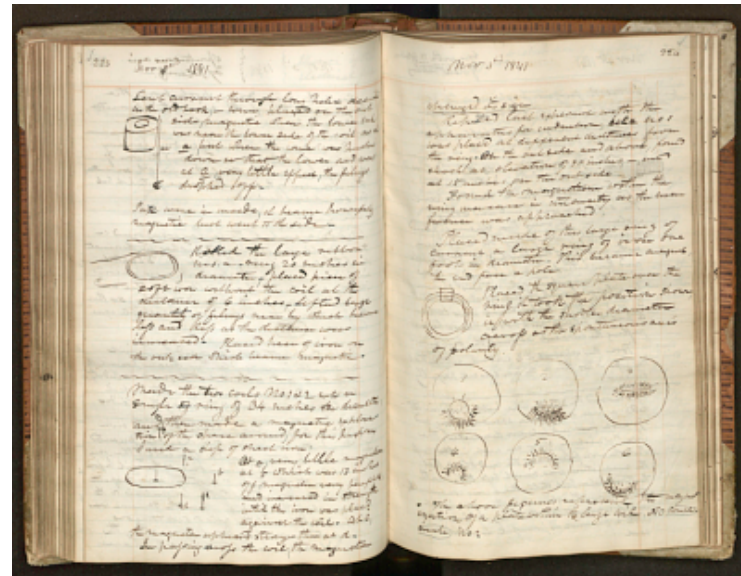
was placed at different distances from the ring. On the out side and above, found shock at elevation of [90? or 10?] inches -- and at 15 inches on the out side.

Found the magnetism within the ring [increases ?] in intensity as the circumference was approached.

Placed inside of this large ring of current, a large ring of iron one foot in diameter. This became magnet, the end [face ?] a pole.

 Placed the square plate over the ring, it took the position shown, ie with the shorter diameter across as the spontaneous axis of polarity.

[[six images, labeled 1, 2, 3, 4, 5, 6. Each image is a circle with a



representation of a circular or arched wire within and dashes or dots representing filings arranged in a particular manner around the wire. The arrangement of the internal items differs in each circle. 1: inner circle near bottom of larger circle; scattered dots inside inner circle; dashes outside the inner circle are arranged perpendicularly to its circumference with more dashes along the bottom half of the inner circle than along its upper half. 2: large circle containing small crescent shape near the bottom of the circle. The arc of the crescent is parallel to the bottom arc of the larger circle. Above the crescent, in the hollow between its points, are many scattered dots; while from the bottom of the crescent, many dashes extend perpendicularly to its circumference. 3: large circle contains a short line (about the length of the radius of the circle) centered and in a horizontal position; dashes surround the line perpendicularly to it (like hairs sticking out from the body of a caterpillar). 4: A downward arcing line (like the top half of a circle) with dashes aligned perpendicularly to it above and below the line; the arched line is placed inside the large circle near the bottom. 5: same arched line and dashes arrangement as in 4 but placed inside the circle nearer its top, just above the large circle's center. 6: a broad U-shaped arched line with dots in the hollow above and perpendicular dashes along the line below; arched line is placed at the bottom inside the larger circle.]]

The above figures represent the magnetization of a plate within the large coil. No [[?]] no 2

Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

[[checkmark]]

225

Nov 4th 1841

Exp with 12 cylinders of new battery

[[note in left margin]] See p 129 bottom [[/note]]

[[open brace at left]] [[?]] [[?]] - the foregoing experiments by means of straps or ribbons of copper. Experiment on the magnetism of hollow bars with soft iron needle. [[/open brace at left]]

[[dividing line across page]]

[[image: cross-hatched horizontal tube with a vertically striped larger tube about its middle (similar to a nut around the middle of a headless, hollow bolt) with two short lines extending above and below from the right end of the larger (outer) tube. The top line labeled +; the bottom line labeled -.]] Put stove pipe into the coil around the zinc, and into this a soft iron needle on a needle point. The soft iron was rendered strongly polar -- To vary this expermnt, placed a quantity of iron filings on a paper in the middle of the length of the stove pipe, and then introduced a short rod of iron wire. The magnetism of the rod was shown by a large bunch of filings which adhered to the end of the wire. Care was taken to put the filings and rod in place before passing the current around the outside.

From this experiment it is evident either that the pipe is too thin or the iron does not perfectly screen.

[[dividing line across page]]

Removed the stove pipe introduced in its [[overwritten or corrected word]] [[stead ?]] [[/overwritten]] a piec of gas pipe - 21 inches long and 1 1/2 inch ~~in~~ interior diameter, the iron of which is 3/16 of an inch in thickness. Put the iron filings into the middle of this, the magnetism was much less than with the stove pipe but still there was considerable attraction. The screening therefore is not perfect even with the this thickness of iron, not with a current as powerful as was ever used.

[[end page]]

[[start page]]

[[checkmark]]

226

Nov 4th 1841

[[Distribution of magnetism]]

Sent the current through a ~~large~~ coil which was close around the iron - so as to produce a more powerful magnetization. Now the quantity of filings was much greater than in the last expermnt, showing that the screening belongs to the intensely of the magnetism. this was also shown by passing a similar current one from a single jar, the screening was now almost perfect.

[[dividing line across page]]

[[image: tall vertical tube with a shorter screen-like or cross-hatched tube around its middle. Arrows indicate a looping action coming out of the top of the tall tube and going to the right side and down the length of the tall tube to enter the bottom.]] Next too the direction of the polarity or the magnetism within and without ~~of~~ the stove pipe. Found the polarity within the stove pipe the same as within the coil, which showed that the magnetism within was due to the action of the coil through the iron which was not sufficiently thick to act as a perfect screen.

[[dividing line across page]]

[[image: long horizontal striped tube with a shorter screen-like or cross-



hatched tube around its middle. Bottom left corner of outer tube labeled +; bottom right corner of outer tube labeled -.] Put stove-pipe into coil and into the pipe put the gas pipe, and into the latter iron filings. With this arrangement, the screening was much more perfect than with the single iron, but still I could perceive a slight attraction of the filings which I put into the rod. The gas pipe was strongly magnetic on the out side. The stove pipe is $\frac{1}{2}$ a 16th thick $\frac{1}{32}$ of an inch, the whole thickness of iron.

Added another stove pipe, making the whole thickness of iron $\frac{3}{16} + \frac{1}{2} \frac{1}{16} + \frac{1}{2} \frac{1}{16} = \frac{4}{16} = \frac{1}{4}$ of an inch, but still magnetism was perceptible in the intercon. the filings were attracted but still very slightly

--

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

227 Nov 4.5h 1841 [Distribution of magnetism]

 Put around the gas pipe another iron cylinder of just sufficient size ~~to admit the gas pip with its surrounding coil~~ Placed glass on the top, and paper over this on which was strewn ~~iron filings~~. The result ~~was~~ rather curious. The polarity within was so strong that it acted through the iron so that the outer cylinder showed a different magnetism from that which it really possessed. The ~~appearances exhibited by the filings was like that shown in the margin.~~ a spaces around was unmagnetized ~~or the filings were drawn away from it.~~ The outer cylinder had the same polarity apparently as the inner, although it ~~should have had a different polarity as is evident from inspecting fig b in the margin.~~

[dividing line]

Removed ~~the iron cylinder and supplied its places by one of paste board, found the same polarity as before but somewhat stronger.~~ The distance at which filings were made to jump on a paper held above the magnet was a little greater with the paste board coating them with the iron one.-

[dividing line]

NB Perhaps the double ring ~~shown in figure a above, was due to the drawing away of the filings from the outer circumference as I have found with the single cylinder~~ [end page]

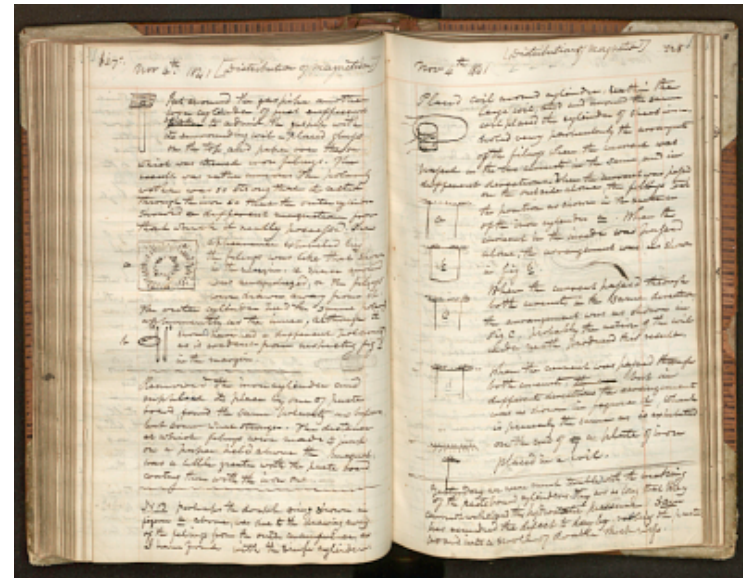
[start page]

Nov 4th 1841 [Distribution of magnetism] 228

Placed coil around cylinder, within the  large coil, and and around the same oil placed the cylinder of ~~the~~. Noted ~~very particularly the arrangement of the filings when the current was passed in the two circuits in the same, and in different directions when the current was passed on the outside alone, the filings took~~ figures marked a, b, c and d] the position as shown in the section ~~of the iron cylinder a~~. When the current in the inside was passed alone, the arrangement was shown in fig ~~b~~. When the current passed through both circuits in the same direction, the arrangement was as shown in Fig c, probably the action of the coil underneath produced this result. When the current was passed through both circuits, ~~the~~ but in different directions the arrangement was shown in figure ~~d~~, which is precisely ~~the same as is exhibited on the end of of~~ a plate of iron placed in a coil.

[double dividing line]

Yesterday we were much troubled with the breaking of the paste board cylinders. The are so long that they cannot withstand the hydrostatic pressure. Sam has remedied ~~the defect~~ today by rolling the paste board into a scroll of double thickness.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

229 Nov 4th 1841 [Distribution of magnetism]

[image 2 figures marked 1 and 2]] These exhibit the magnetism on the in and outside on a larger scale. The arrangement of the particles [?]] was observed with an eye glass-

[dividing line]

[image 2 curved figures marked 1 and 2]] Placed a piece [?] of iron (sheet [?]) but in the form of an S in a strap [?] of copper, so that the strap would be close on each side of the iron, making two complete turns around it. When the current was passed through the strap, the filings arranged themselves as in fig 1. This is an experiment proposed by Prof [?], who did not however try it- since he was sure there would be no magnetism in the concave [?] parts, [[underline]] a [[/underline]] and [[underline]] b [[/underline]]. The results however is entirely different, the magnetism of the concave part is nearly as strong as that of the convex. See Scientific [?]

[dividing line]

Scattered filings over the straps fig 2 without the iron, the same arrangement of the filings took place but they did not stand up as in the case of the iron, the effect was much feebler [?]] [[end page]]

[[start page]]

230

[image]] Make a theoretical magnet of a wire coiled in cylindrical, and these arranged in circles [?]] ~~[?]]~~ ~~[?]]~~ Place paper over the end and strew on this iron filings.

[dividing line]

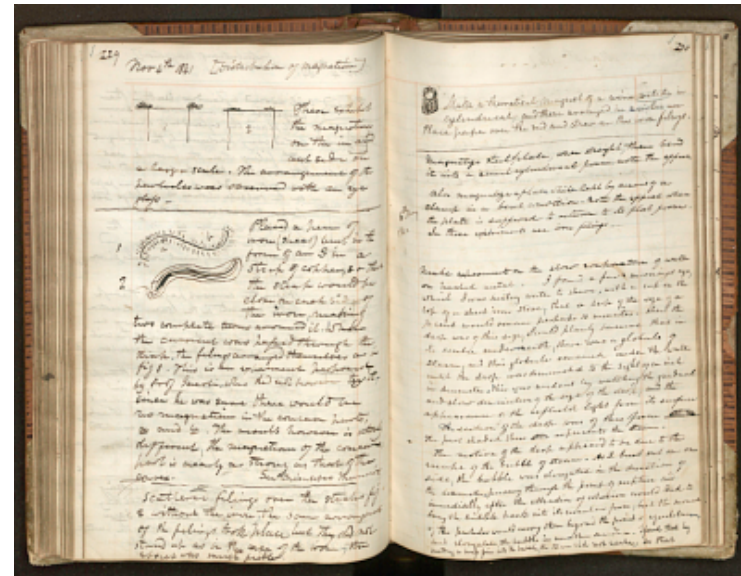
Magnetize steel [?] plate, when straight, then bend it into a small [?] cylindrical form, note the effects.

[[in left margin: 6th May 1841]] Also magnetize a plate while kept by means of a clamp in a bent condition. Note the effect when the plate is suffered [?] to return to its flat form. In these experiments use iron filings.

Make experiments on the slow evaporation of water on heated metal. I found a few mornings ago whilst I was heating water to shave, with a cup on the top of a sheet iron stove, that a drop of the size of a 1/2 cent would remain perhaps 10 minutes. When the drop was of this size, I could plainly perceive that in its centre underneath, there was a globule of steam, and this globule remained under the water until the drop was diminished to the eight of an inch in diameter. This was evident by watching the gradual and slow diminution of the size of the drop, and the appearance of the reflected light from its surface.

A[?] section of the drop was of this form [image]]. The part shaded thus [image]] represents the steam.

The motion of the drop appeared to be due to the escape of the bubble of steam. As it burst out on one side, the bubble was elongated in the direction of the diameter, pushing [?] through the point of rupture and immediately after the attraction of cohesion would tend to bring the bubble back into its circular form, but the movement [?] of the particles would carry them beyond the point of equilibrium, and elongates [?] the bubble in another [?] direction. I found that by putting a brass pin in the bubble, the steam did not escape, so that



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

231 May 6th 1842

the temperature of the bubble may be ascertained by plunging into it the ends of the thermogalvanometer. To determine the effect of letting off the bubble of steam a small tube of glass may be plunged into the bubble --perhaps this would permit the steam to escape as through a chimney -- Also by means of two platinum wires attached to the galvanometer perhaps a current of galvanism might be detected between the stove and the water of the bubble.

[[end page]]

[[start page]]

May 6th 1842 [Induction from ordinary elect.] 232

* [[written within a rectangle box: I have commenced a long series of experiments on the induction from ordinary electricity]]

Charged the Franklin battery of 24 jars with 100 sparks of Haris' [[?]] unit [[?]] measurer [[?]], ball at the 7th ring on the stem. the ribbon coil no 2 was then placed on the coil with its ~~strands~~ spires separated, so as to ensure insulation. ~~with~~ Helix no 1 was placed in this,  and when the discharge was made, sam felt a severe shock up to his shoulders This is the repetition with more precision, of an experiment described in my 3rd series.

[[dividing line]]

Repeated this experiment with the variation of placing two persons in the circuit. The shock was again very severe, the smaller person Mr - felt the shock very severely and both complained of its intensity.

[[dividing line]]

Repeated the same again, with the strand of the spiral farther apart, and also with the circle of greater diameter. The shock was now not as severe as before but still unpleasant.

[[dividing line]]

To be more certain of the insulation, I placed the helix within ~~the~~ a glass cylinder, and the coil around this. The shock was now not as severe as before, but still felt in the arms.-----

[[dividing line]]

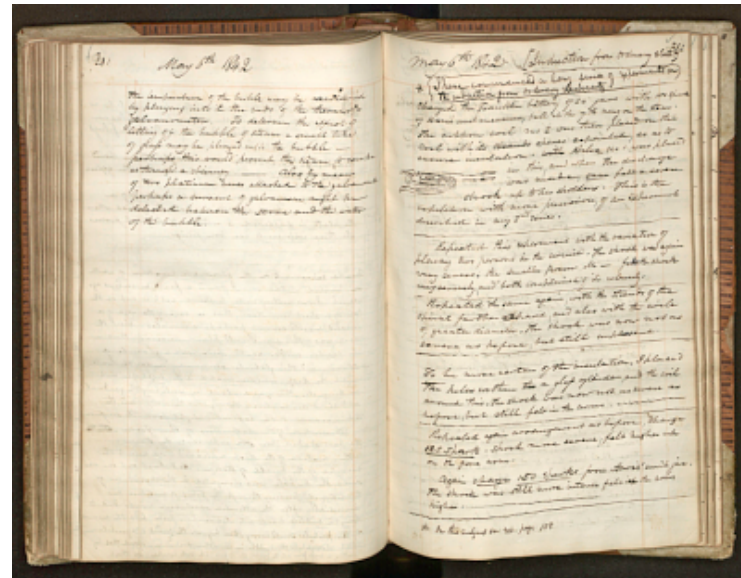
Repeated again arrangement as before, charge 125 spark. Shock more severe-felt higher up on the fore arm.

Again charge 150 sparks from Haris' unit jar.

The shock was still more intense felt up the arms higher.-----

[[dividing line]]

*on this subject see exp. page 108



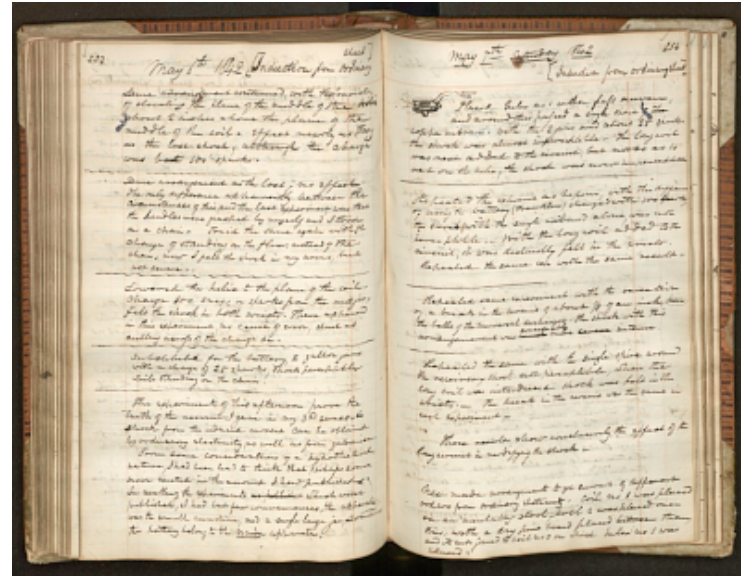
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

May 6th 1842 [Induction from ordinary elect]

[[end page]]

[Induction from ordinary elect]

Repeated the same with the single spine around the receiver - shock not perceptible, when the long coil was introduced shock was felt in the wrist - the break in the current was the same in each experiment -



These results show conclusively the effect of the long current in modifying the shock -

Next - made arrangement to get currents of different orders from ordinary electricity. Coil no 1 was placed on an insulating stool - coil 2 was placed over this, with a dry pine board placed between them, and its ends joined to coil no 3 on which helix no 1 was placed

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

235

[[double underlined]] May 7th 1842 [[/double underlined]]

[[Induction of ordinary electricity]]

The shock was quite perceptible with 100 sparks passed into the battery -- With 150, it was more intense -- With 200, the explosion was very loud, but the shock was not so severe, but scarcely perceptible.

[[dividing line]]

The same arrangement being continued, the small battery no 2 (see page 205) was added to the Franklin battery with this, and 100 sparks, the balls of the unit jar being still at the 7th mark. The shock from the secondary current was apparently more intense than in the case of the last experiment.

[[dividing line]]

The apparatus remaining as in the last exp, the plate of zinc, which has before so often been used, was placed between coil no 1 and no 2. the no of sparks was still 100, not the least effect could be perceived, the plate perfectly screened the action of the primary current from the secondary conduction. Repeated this ex so that no doubt can remain of the screening influence of the plate.

[[dividing line]]

[[in left margin]] [[image: right hand, thumb upward, index finger extended; the whole on a slight upward diagonal left-to-right; pointing to beginning of paragraph.]] [[/in left margin]] Commenced a series of experiments on the direction of the induced currents with needles in spirals and for this purpose, I made 6 spirals all turned from right to left - two were formed of three strata of sphere close to each other - two of one stratum each of wire also in contact, and two of one stratum of ^{each} which the several spines were separated like those of a cork screw.

[[image: line drawing of three horizontal coils (springs), labeled 'No 1' 'No 2' and 'No 3'. Coil No 1 is thicker and shorter in length than No 2 and No 3. No 2 is thinner and longer than No 1, as if stretched. No 3 appears as a series of loops as of a spring stretched to its limit with much space between each loop.]]

[[end page]]

[[start page]]

[[checkmark]]

236

[[underlined]] May 7th 1842 [[/underlined]]

[[Induction from ordinary electricity]]

1st Exp Made an arrangement with coil no 1, 2, 3 & 4 to get the current of the third order. Then united the electrometers into 2 sets as in the figure at the bottom of the last page - and placed one set in the circuit of the secondary current, and the other in that of the tertiary -- Each needle was found to be magnetic, that in No. 1 the stronger, in no 2, less strong, in No 3 feeble, and in an opposite direction to that in the other two spirals [^][[in both sets of spirals.]] The directions of the currents as given by spirals no 1 and No. 2, were as follows.

No 1 & 2 Primary ----- + }
Secondary ----- + } Tolerably
Tertiary ----- - } Strong

The direction of the currents as given by No. 3 are



No. 3 Primary ----- + }
Secondary ----- - } Feeble mag
Tertiary ----- + }

It must be observed in this result, that the needle in spiral no 3 was magnetized in a contrary direction to those in the other spirals in both the circuits. In this expermnt, the two batteries Franklins and No 2, were joined as one and charged with 100 sparks from the unit jar.

Repeated the same with 150 sparks with the same result, the same series was produced.

[[dividing line]]

2nd Exp Changed the batteries with 50 sparks, no 1 and no 2, now gave the same directions of magnetism, and the following series of currents namely:

Primary ----- + }
Secondary ----- - } The magnetism
Tertiary ----- + } stronger

No 2 gave the following

Primary ----- + }
Secondary ----- + } Magnetism
Tertiary ----- - } Weaker

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

237 May 9th 1842 (Monday) Induction of Ordinary Elect.
 The experiments given on the last page are just in accordance with an hypothesis I have formed of the cause of the change in the direction of the mag. of the needle, as given in Contributions [[?]] no.3, and as recorded in the old book. I now suppose that there is in reality no change in the direction of the current and that the phenomenon may be explained on the same [[?]] principles [[?]] I have advanced [[?]] in no 4 relative to the induction from galvanic electricity. The electrical discharge from a Leyden jar [[?]] of necessity give two inductions, one at the beginning of the discharge the other at the ending. The intensity of these may be made to vary by increasing the length of the conductor or by increasing the intensity of the discharge according to the laws I have given in the 1st section of my paper no 4. In this way the shock becomes evident.

The magnetization of the needle in opposite directions, by a change of [[?]], is readily accounted for by an application of the same principle. When the conductors are placed near each other ~~the~~ the ~~inductions~~ both inductions are sufficiently energetic to ~~the~~ more than develop the full [[?]] magnetism [[?]] of the needle, or to magnetize it to saturation. It accordingly is magnetized to saturation by the first induction say - minus, and immediately afterwards in an opposite direction +, by the ending induction. If the magnetic capacity of needle were indefinitely great, then the magnetism induced by the action at the beginning would just neutralize that produced at the ending. The same effect would be produced were [[?]] the two inductions just sufficient to magnetize the needle to saturation without any surplus power ~~the~~ but when the induction action is greater than this, the needle at the end [[?]] of the experiment will show the magnetism of the ending induction.
 [[end page]]

[[start page]]

May 9th 1842 Induction of Ordinary Elect 238

If the magnetic capacity of the needle is greater than the inductive influence of the ~~beginning~~ induction, then the final magnetism of the needle will be that [[?]] of the more energetic induction - with a short conductor [[?]] and intensity current, the beginning induction is more intense (see no4 [[?]]-[[?]]), and hence [[?]] in the cases [[?]] last [[?]] supposed [[?]], the needle will come [[?]] out of the spiral with the magnetism of the beginning induction, but much reduced from its primary strength.

The several experiments given on page 236 are confirmations of this hypothesis.

[[image - hand drawn line separating page]]

To investigate this subject still further, an other ~~left margin - N1~~ spiral was added to each set as described at the bottom of page 235 of two strata of spires. The series [[?]] will therefore [[?]] be as follows. ~~image - diagram of No1 3 strata, No2 2 strata, No3. 1 stratum, No4 spines apart~~

Then spirals [[?]] were placed [[?]] on slips of thin [[?]] in two sets. The ends marked [[?]] at which the needles were to be always put in, and then the direction of the current marked on the wood for the magnetism of the needle which was thrust in.

[[image - hand drawn line separating page]]

The coils were arranged as in the last exp. (bottom of page 236). The ~~two~~ two [[?]] of ~~four~~ four spirals were introduced - the needle in each was magnetized by a discharge from the two batteries ~~left margin - No2~~ of 50 sparks of the unit jar-

The series was as follows, with all the spirals

Primary.....+

Secondary.....-



Tertiary.....-} all the spirals
The only change in the arrangement of this experiment was the
introduction of the additional length of fine wire used in the construction
of the spiral,- also the needles were larger.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

239 May 9th 1842 [Induction from ordinary elect.] Battery no 2 and Franklin battery

The same arrangement as before, the batteries charged with 100 sparks. Needle in spiral No 1 first series south, in No 2 North, in no 3 south, in no 4 north, all feeble.

The needles in ~~no 1 2 3~~ second series or that in the circuit of the tertiary current, were all north.

Arrangement the same as before, charges 175 sparks, needles in no 1 2 strongly mag, in S & 4 feebly, large needles.

The series with spirals No 1 2 & 3 in each was

Primary----- +

Secondary----- +

tertiary----- -} Nos 1. 2. 3 spirals

Primary----- +

Secondary----- -

Tertiary----- -} spiral no 4

x NB The magnetism of the last was feeble

Same arrangement and same charge, 175 sparks, also the same needles with exception of softening them in the flame of a lamp. The following namely

This is the series of the ending induct

{Primary----- +

Secondary----- +

Tertiary----- -} with spirals Nos 1. 2 & 3

irregular series

{Primary----- +

Secondary----- -

Tertiary----- -} very feeble with spiral No 4-

Primary----- +

Secondary----- +

Tertiary----- -} all the spirals

May 9th [Induction from ordinary electricity] 240

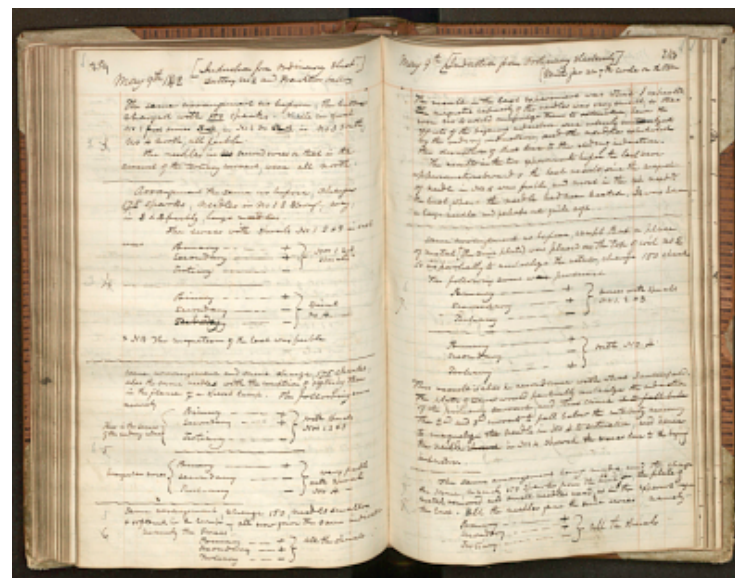
[Unit jar at 7th circle on the stem

The result in the last experiment was what I expected. The magnetic capacity of the needles was very small, so that even no 4 could magnetize them to saturation, the effects of the beginning induction were neutralized by the ending induction, and the needles exhibited the direction of the ending induction.

The results in the two experiments before the last were approximations towards the last result, since the magnetism of needle in No4 was feeble and most in the exp next to the last, where the needle had been heated. It was however a large needle and perhaps not quite soft.

Same arrangement as before, except that a plate of metal (the zinc plate) was placed on the top of coil no 2 so as partially to neutralize the action, charge 150 sparks

The following



series were produced

Primary----- +

Secondary----- +

Tertiary----- -}series with spirals No:1.2 &3

[[dividing line]]

Primary----- +

Secondary----- -

Tertiary----- +}with No. 4

This result is also in accordance with what I anticipated. The plate of zinc would partially neutralize the induction of the primary current, and thus cause ~~it~~ to fall below ~~the~~ the 2nd and 3rd currents to fall below the intensity necessary to magnetize the needle in No 4 to saturation and hence the needle ~~showed~~ in No 4 showed the series due to the beginning induction.

[[short dividing line]]

[[in the margin: 7 ~~8~~]]The same arrangement being made, and the charge the same, namely 150 sparks from the unit jar, the plate of metal removed and small needles used as in the experiment before the last - all the needles gave the same series, namely

Primary----- +

Secondary----- +

Tertiary----- -} all the spirals

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

-241 May 9th 1842 Induction of ordinary electricity
[[left margin]] 8 ~~10~~ [[left margin]]

Same arrangement, used large needles, charge the same as before, 150 sparks, all the needles gave the same series. The needle in no 4 of the secondary current very feeble, or scarcely at all magnetized,
Primary _____ +
Secondary _____ + all the needles
Tertiary _____ -

[[line drawn across page]]

[[left margin]] change of distance in the conductors- 9 ~~11~~ ~~11~~ [[left margin]]

Same arrangement as the last, except that the secondary conductor was separated from the other or elevated above it to the distance of about 6 inches.

The series were now as follows

Primary _____ + From spirals

Secondary _____ + nos 1 2 & 3

Tertiary _____ -
and [[line drawn across page]]

[[left margin]] changes in direction shown by no 4 [[left margin]]

Primary _____ + From

Secondary _____ - spirals

Tertiary _____ + No 4---

[[line drawn across page]]

[[left margin]] 10 ~~12~~ change shown by
no 3 & 4, and partially by no 2 [[left margin]]

Same arrangement, charge 75 sparks -
needles small The following series

N 1

{ Primary _____ + } From

{ Secondary _____ + } Spirals

{ Tertiary _____ - } No 1 alone

and [[line drawn across page]]

Primary _____ + From spirals

Secondary _____ - No 3. & 4

Tertiary _____ +

The needle in spiral No. 2 in the secondary circuit was scarcely perceptibly magnetized in the adverse direction & that in No 1 in the same circuit - While spiral no 2 in the tertiary circuit gave a magnetism the same as no 1. The series from this would be therefore

Primary _____ + } From no 2 but very

Secondary _____ - } feeble

Tertiary _____ - }

[[end page]]

[[start page]]

[[checkmark]]

242

May 10th 1842

Induction of ordinary Elect.

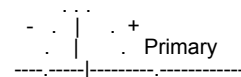
The results of the experiments on the last page are also in accordance



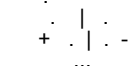
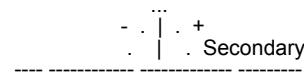
with my anticipations. By increasing the distance, the induction influence is diminished and consequently the needles are not magnetized to saturation by the beginning induction, and hence as the ending induction is allways feebler than the beginning, it cannot destroy all the magnetism of the needles and hence the residue will be that of the beginning induction, therefore a change in the direction of the secondary current will be ap[[hole in page]]t [[best guess: apparent]] in the case of the spirals of a single stratum of spires. The multiplication of the spirals in spirals No 1 & 2 will prevent the result, and still give the current in the same direction as the primary. In the first exp, the intensity of the charge was such as to show the charge only in spiral no 4.

In the 2nd exp, the intensity was less, so that no 3 & 4 exhibited the same -- It should be recollected however, that by diminishing the intensity of the charge, while the quantity remains the same, we will diminish the redundancy of the beginning induction over that of the ending.

I have not yet considered very atntively the nature the induction of the secondary current on the conductor of the current of the third order. If the primary current produces two inductions, one in one direction and the other in the other, then the secondary current must produce 4 inductions, two from the adverse current of the beginning of the primary, and two from the direct current of the ending of the same. The question which arises is how will these four currents act. ~~to give magnet~~ in giving magnetism to the needle. --- There will be two negative currents, and two positive one, these may be represented by curves ~~described~~ in my last paper thus:
 ^[[explained]] in my last paper thus:
 [[Image: approximated below]]

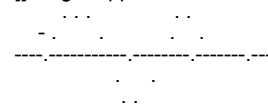


[[note at right of image above]] The minus induction w~~ill~~ prevail in this case with a large needle, and the plus with a small one. [[/note]]



[[note at right of images above and below]] Then will here be a ~~great~~ tendency for the minus induction to prevail with compound ~~helix~~ spiral.
 [[/note]]

[[Image: approximated below]]



[[checkmark]]

243

May 10th 1842 [[in pencil]] V V [[/in pencil]] [[may be associated with the change of "(10)" to "(8)" in pencil below]]

[[underlined]] Induction of Ordinary Elect [[/underlined]]

[[notation in left margin beside next section]] 1 [[/notation in left margin]]

The experiment (~~10~~) of yesterday repeated. The battery charged with ~~150~~ sparks. All the needles gave the same series namely --

Primary ----- + }

Secondary ----- + } all the spirals

Tertiary ----- - }

The ~~hole in page~~ in spiral no 4 of the tertiary circuit was scarcely if at all magnetic. This result is the same as that of yesterday.

[[dividing line across page]]

[[notation in left margin beside next section]] 2 [[/notation in left margin]]

The same arrangement with the same charge with the exception that the coil forming the tertiary circuit was removed. The series was now

Primay ----- + } all the spirals

Secondary --- + } strongly

[[notation in left margin beside this paragraph]] 2 action & reaction
[[/notation in left margin]] The object of this experiment was to note the effect of the ~~effect of the~~ reflex influence of the tertiary current on the secondary - Each needle was strongly magnetized. No 1 drew small needle $12\frac{1}{2}^{\circ}$, no 2 10° , no 3- 6° , No 4- 5° . The apparatus was used described page 205 - [[in pencil]] Oct. 9, 1841. [[/in pencil]]

[[dividing line across page]]

[[notation in left margin beside next section]] 3 [[/notation in left margin]]

Same arrangement same charge. Zinc plate placed on the part of the secondary conductor which was occupied by the tertiary, or on the 3rd coil. The needles were magnetized thus

No 1- 7° No 2- 7° No 3- $2\frac{1}{2}^{\circ}$ No 4- 1°

By comparing the intensity of the needles in the last exp with this, there will be perceived a great reduction in the development of magnetism. The sum of the degrees in the last series is $17\frac{1}{2}^{\circ}$, while the sum of the other series, is $33\frac{1}{2}^{\circ}$

[[dividing line across page]]

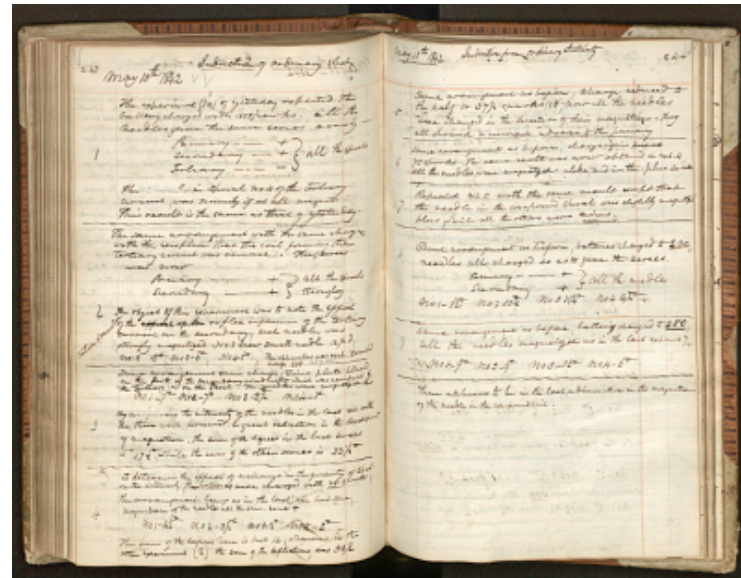
[[notation in left margin beside next section]] 4 [[/notation in left margin]]

To determine the effect of a change in the quantity of elect. on the intensity, the batteries were charged with 7^{sparks} sparks.

The arrangement being as in the last exp but the magnetism of the needles all the same. series +

No 1- $4\frac{1}{2}^{\circ}$ No 2- $3\frac{1}{2}^{\circ}$ No 3- 2° No 4- 2°

The sum of the degrees here is but 12, whereas in the other experiment



(2) the sum of the deflections was $33 \frac{1}{2}$
[[end page]]

[[start page]]
[[checkmark]]
244
[[underlined]] May 10th 1842 [[/underlined]]
Induction from ordinary electricity

[[notation in left margin beside next section]] 5 [[/notation in left margin]]
Same arrangement as before, Charge reduced to the half or $37 \frac{1}{2}$ sparks (38), Now all the needles were charged in the direction of their magnetism - They all showed a current adverse to the primary

[[dividing line across page]]

[[notation in left margin beside next section]] 6 [[/notation in left margin]]
Same arrangement as before, charge again ~~put at~~ 75 sparks. The same result was now obtained in exp. 4 all the needles were magnetized alike and in the plus direction

[[dividing line across page]]

[[notation in left margin beside next section]] 7 [[/notation in left margin]]
Repeated exp 5 with the same result except that the needle in the compound spiral was slightly magnetized plus while the others were minus

[[dividing line across page]]

[[notation in left margin beside next section]] 8 [[/notation in left margin]]
Same arrangement as before, batteries charged to 200
needles all charged so as to give the series
Primary ----- + } all the
Secondary ---- + } needles
No 1-12° No 2-10 $\frac{1}{2}$ ° No 3 11 $\frac{1}{4}$ ° No 4 6 $\frac{1}{2}$ °

[[dividing line across page]]

[[notation in left margin beside next section]] 9 [[/notation in left margin]]
Same arrangement as before, battery charged to 250
All the needles magnetized as in the last expemnt
No 1-9° No 2-9° No 3-12° No 4-6°

[[dividing line across page]]

There appears to be in the last, a diminution in the magnetism of the needle in the compound coil.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
245

[[underlined]] May 11th 1842 [[/underlined]] Wednesday
[[underlined]] Induction from ordinary [[/underlined]] ^[[elect]]

Made arrangements for experimenting on the apparent change of direction in the secondary current by change of distance in the two conductors. For this purpose I put up a rectangle of wire inside of the electrical case against the glass partition - 8 feet high and 6 1/2 feet wide - The wire was insulated from the wood of the window frames by glass tubes.

Also on the large frame, which I used for the screen in experiments on light, I fastened a rectangle of covered wire of the same dimensions as the rectangle on the inside of the glass - The two rectangles were ~~separated~~ separated by the glass partition.

[[dividing line across page]]

[[notation in left margin beside next section]] 1 [[/notation in left margin]]
[[underlined]] Rectangles at the distance of 13 1/2 inches [[/underlined]]
Exp. The three batteries were charged with [[underlined]] 100 sparks [[/underlined]]. The batteries together contain feet of coiled surface - all the needles were magnetized alike and indicating a + current.

[[?]] repelled the [[needle ?]] of the [[inst. ?]] mentioned [[pages ?]] as follows

No 1-1° No 2-1° No 3-1/2° No 4-1/2°

[[dividing line across page]]

[[notation in left margin beside next section]] 2 [[/notation in left margin]]
Distance the same as before, charge [[underlined]] 150 [[/underlined]] - All the needles gave as before a [[underlined]] plus [[/underlined]] current - magnetism as follows.

No 1-2° No 2-1 1/2° No 3-1° No 4-1°

[[dividing line across page]]

[[notation in left margin beside next section]] 3 [[/notation in left margin]]
Distance the same, charge [[underlined]] 250 [[/underlined]], all the needles gave as before a [[underlined]] plus [[/underlined]] current, magnetism as follows -

No 1-2° No 2-1 1/2° No 3-1° No 4-3/4°

[[dividing line across page]]

[[notation in left margin beside next section]] 4 [[/notation in left margin]]
Distance same, charge [[underlined]] 300 [[/underlined]], all the needles magnetized as before -

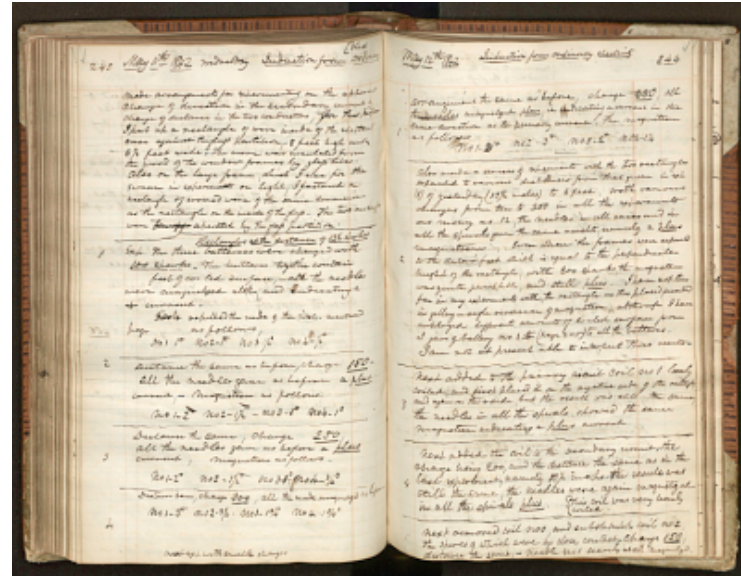
No 1-3° No 2-3 1/2° No 3-1 3/4° No 4-1 3/4°

Next exp with small charges
[[end page]]

[[start page]]

[[checkmark]]

[[underlined]] 246 [[/underlined]]



May 12th 1842 Induction from ordinary electricity

1
Arrangement the same as before, charge 350
all the needles magnetized plus
plus, ie indicating a current in the same direction as the
primary current. The magnetism as follows
No 1- 3° No 2-3° No 3-2° No 4-1 1/4

[[dividing line across page]]

2
Also made a series of experiments with the two rectangles separated
to various distances from that given in exp (1) of yesterday (13 1/2
inches) to 6 feet, with various charges from ten to 350 in all the
experiments as many as 12, the needles in all cases and in all the
spirals gave the same results, namely a plus
magnetism. Even when the frames were separated to the
distance feet which is equal to the perpendicular height of the rectangle,
with 200 sparks, the magnetism was quite perceptible, and still
plus. I have not thus far in my experiments
with the rectangle as this placed succeeded in getting a single reversion
of magnetism, although I have employed different amounts of coiled
surface from 3 jars of battery no 1 ~~to~~ to ~~all the batteries~~
(page 205) to all the batteries.
I am not at present able to interpret these results.

[[dividing line across page]]

3
Next added to the primary circuit coil no 1 loosely coiled, and first placed
it on the negative side of the rectangle, and again on the + side, but the
result was still the same, the needles in all the spirals showed the same
magnetism indicating a plus current.

[[dividing line across page]]

4
Next added the coil to the secondary circuit, the charge being 200, and
the distance the same as in the last experiment - namely 13 1/2 inchs -
the result was still the same, the needles were again magnetized in all
the spirals plus plus. {This coil was very loosely
coiled.

[[dividing line across page]]

5
Next removed coil no 1 and substituted coil no 2 the spires of which
were in close contact - charge 150 distance
the same - needle no 1 scarcely at all magnetized.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[checkmark]

247

May 12th 1842

Induction from ordinary elect

{Experiments with the rectangle on the

{window of the glass case -----

[notation in left margin beside next section] 6 [notation in left margin]

The other three needles gave indications of the preponderance of the minus magnetism - This is the first result of the kind I have had to day - all the other results were in the plus direction.

Magnetism as follows

~~No 1-1 3/4° No 2-2 1/4°~~ That of the needles in no 3 & 4 was stronger than that in Nos - 1 & 2.

[dividing line across page]

[notation in left margin beside next section] 7 [notation in left margin]

Repeated the same experiment with a charge of 200, ~~cur~~ whole ~~of all the~~ conductors the same as 4 on last page - except that coil No 2 with spires close together -

Result same as the last, ~~cur~~ magnetism minus - needle in the first slightly magnetic, in the last the strongest. I do not at present see the rationally of the result of the action of the helix. It probably by its action on itself produces an adverse current which diminishes the intensity of the beginning current, and also that of the ending below the point of saturation of the needle.

[image in left margin: line drawing of a hand with the index finger pointing to the right at the paragraph encompassed by an open bracket] This is an important experiment, as it shows the inductive influence of a part of the secondary current on itself when this part is not affected ~~with~~ by the action of the primary current -----

May 28th. This should be repeated again with the open and closed coil.

[dividing line across page]

[notation in left margin beside next section] 8 [notation in left margin]

Placed the rectangles ~~with~~ at the distance of 2 1/2 inches from each other - charge 20 of two jars all the needles + plus -- magnetism as follows.

No 1-1°+ No 2-1°+ No 3-1/2°+ No 4-1/2°

[dividing line across page]

[notation in left margin beside next section] 9 [notation in left margin]

In charging the jars again, they were filled ~~at a~~ with a little more than 30 sparks - Accidentally the jars were attempted to be discharged when the negative end of the primary circuit was not in contact with the coating of the battery, the needles were magnetized minus

[end page]



[[start page]]

[[checkmark]]

248

May 12th 1842

[[underlined]] continued [[/underlined]]

[[underlined]] [Experiments with the rectangle continued [[/underlined]]

[[notation in left margin beside next section]] 10 [[/notation in left margin]]

Repeated the last experiment with the two batteries charged to 150.

Also with the three batteries charged to 200, all gave the inverse direction to the needle -- Also 2 batteries interrupted current by means of 4 inches of water

[[dividing line across page]]

[[notation in left margin beside next section]] 11 [[/notation in left margin]]

Rectangles at the same distance 2 1/2 inches, charge 50 whole of 1st

battery - All the needles gave [[underlined]] plus [[/underlined]]

magnetism. The intensity as follows

No 1-4° No 2-1 1/2° No 3-1/2° No 4-1/4

[[dividing line across page]]

[[notation in left margin beside next section]] 12 [[/notation in left margin]]

Distance same, charge 75 ~~two~~ 1st

battery -

No 1-4 1/2° No 2-3° No 3-1/2 No 4-1/2°

[[dividing line across page]]

[[notation in left margin beside next section]] 13 [[/notation in left margin]]

Distance same, charge 100, batteries No 1 ~~& 2~~

~~[[/strikethrough]]~~

No 1-4° No 2-2° No 3-1° No 4-3/4°

[[dividing line across page]]

[[notation in left margin beside next section]] 14 [[/notation in left margin]]

Distance same, charge 150, batteries 1&2 -

No 1-4 1/2° No 2-4° No 3-3° No 4-1 1/2°

[[dividing line across page]]

[[notation in left margin beside next section]] 15 [[/notation in left margin]]

Distance same, charge 200, ~~all the~~

[^][[No 1 & 2]] batteries -

- No 1-6 1/2° No 2-5 1/2° No 3-4 1/2° No 4-2°

[[dividing line across page]]

[[notation in left margin beside next section]] 16 [[/notation in left margin]]

- Distance same, all the batteries, charge 200 -

No 1-6 1/2 No 2-6° No 3-6° No 4-4 1/2

[[dividing line across page]]

[[notation in left margin beside next section]] 17 [[/notation in left margin]]

-
Repeated exps 9 & 10 by interrupting the discharge by means of 4 inches of water between the ends of a break in the primary current near the + end. The needles in all the spirals were reversed. Repeated the same with the break and water, at the positive end of the circuit - with the same results -

[[dividing line across page]]

[[notation in left margin beside next section]] 18 [[/notation in left margin]]

Repeated exp. 6, of last page, with the exception adding the coil No 2 to the negative end of the primary current. 2 batter 1 & 2nd. The reversion did not take place, although the needles in the 3 & 4 spirals were scarcely if at all magnetic, while those in the other two were tolerably strong. Tried again with the same result, all the batteries charge 200.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

249

May 12th 1842

[[underlined]] continued [[/underlined]]

Induction from ordinary elect.

[Experiments with the rectangle in the electrical case]

[[notation in left margin beside next section]] 19 [[/notation in left margin]]

[[encompassed by close bracket at right]] Repeated the experiment of introducing the ~~sec~~ coil No 2 into the circuit of the secondary current - The result was as given in 6

[[/encompassed by close bracket at right]] [[note in right margin beside close bracket above]] ~~distance 10 inches 200~~ spa[[trails off page]] [[/note in right margin]]

page 247, needles were again reversed -

[[dividing line across page]]

[[notation in left margin beside next section]] Remarks [[/notation in left margin]]

Made experiment to determine if an induced current could be produced without the jar, for this purpose connected one end of the rectangle with a wire connected with a plate of copper buried in the ground, and the other in connection with the prime conductor, or rather so near that sparks could be drawn. Passed several sparks - needles all magnetic in a minus direction -- This result when compared with the others, appear to be in accordance with the hypothesis - The [^]small quantity of electri[^]ty passed through the primary current, magnetized the needle in the two directions, both below the point of saturation of the needle, and since the first induction is more energetic, particularly in the case of a discharge from the prime conductor, the predominant magnetism is that of the beginning or - minus

[[dividing line across page]]

[[notation in left margin beside next section]] Remarks [[/notation in left margin]]

It also appears from the same expermnt that a small quantity of electricity is sufficient to produce inductive currents of considerable intensity, and that consequently all the discharges which I have passed through the rectangle tended to magnetized the needle beyond its maximum point, and hence the whole series of experiments I have made with the rectangle are in accordance with the hypothesis I have adopted, that is so far as I have studied them. The experments on the retardation of the primary and secondary I have not yet sufficiently considered.

The effect of water in the circuit will be to lessen the development of the current, or diminish the length of the ordinales of the curve.

[[end page]]

[[start page]]

[[checkmark]]

250

May 13th 1842

Induction from ordinary electricity



capillarity

Observed this morning a phenomenon which I do not recollect to have seen noticed - namely a bubble of air confined in a small bag of lace, this was in water and the arrangement happened to be such as to confine the bubble. I was surprised to find that it did not escape upwards through the meshes of the lace, although the bag containing it was plunged 5 or six inches under water. Make exp on this Oersted's apparatus for pressure &c.

N:B The rectangle in the upper room was formed of coils no 5 & 6 - In the lower room of a part of wire helix no 3.

Made a rectangle along the floor of the lecture room 41 feet long and 22 wide - then under this in the room below I placed a similar rectangle or parallelogram of the same dimensions the two being separated by a distance of 6/ 10/12 feet, and the floor of one room with the ceiling of the other or two partitions one of wood and the other of lath and plaster *

Charged the three batteries with 350 sparks of the unit jar, then made the discharge through the parallelogram in the upper room, - The sticks with spirals being introduced into the circuit of spirals in the room below, the needles were all found to be magnetic after the discharge in the plus direction, or in such a way as to indicate a current in the direction of the primary current -----

This afternoon I was engaged with a Mr Smith in making some experiments on the photogenic principle in reference to the effect produced by connecting the silvered plate with the prime conductor of the electrical machine while in action according to the later announcement of Daguerre. The result was in favor of the electrical process as far as the experiments were prosecuted but by no means decisive, and therefore we have concluded to repeat them again - The camera was not sufficiently well insulated.

J

The thickness of the floor & ceiling together between the rooms is 1 ft. 2 in.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

251

May 14th 1842

[[underlined]] Induction from ordinary elect [[/underlined]]

[[notation in left margin beside section to follow]] 1 [[/notation in left margin]]

Repeated the [[blot]]xperiment of yesterday with the large parallelogram. The batter ~~y~~ was ~~cha~~ ~~ies~~ were charged both - first 200 ~~turns~~ sparks of the unit jar, the direction of the magnetism was plus. The charge was next diminished to 100 The needles were still all magnetized plus -- next the charge was 50 - the needles were again magnetized plus.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 2 [[/notation in left margin]]

Next the batteries were separated from the circuit of the conductor, and the spark taken on one end of the conductor from the prime conductor, while the other end was connected with a wire leading to the rubber, and also to the ground with which it had a broad connection by means of a plate of metal buried in the soil.

The needle was still magnetized in all the spirals, but the direction was now in all minus.

[[dividing line across page]]

The capacity of the conductor was increased by connecting with it the hollow globe of about 11 inches in diameter. The result was the same, the needles were magnetized in all the spirals, and in all minus.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 3 [[/notation in left margin]]

Next the batteries were attached and charged with 100 sparks. The shock however was not sent immediatly through the conductor, but through 6 inches of water in a basin, the magnetism of the needles was changed by this retardation of the current -

[[dividing line across page]]

The result obtained by exp (3) is surprising. The effect of a single spark from the machine was sufficient to magnetize the needles at the distance of 7 feet in an other room.

[[end page]]

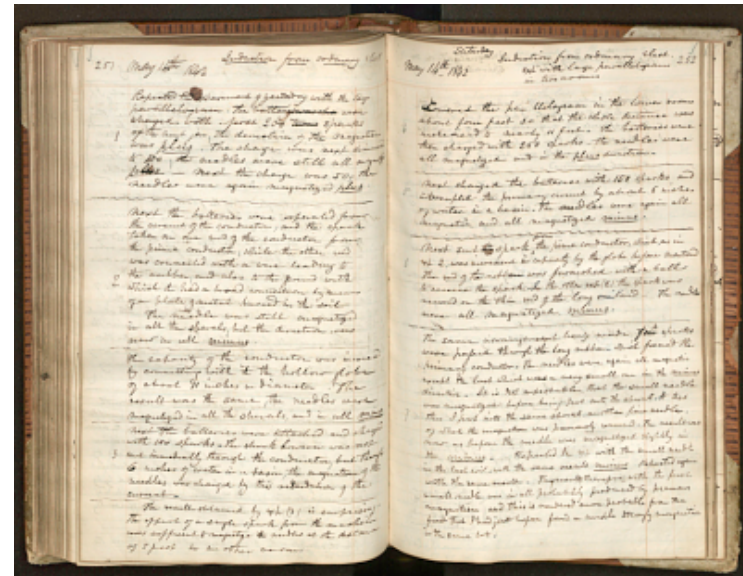
[[start page]]

[[checkmark]]

252

Saturday

May 14th 1842



Induction from ordinary elect.
Exp with large parallelograms in two rooms

4

Lowered the parallelogram in the lower room about four feet so that the whole distance was increased to nearly 11 feet. The batteries were then charged with 250 sparks. The needles were all magnetized and in the plus direction.

[[dividing line across page]]

5

Next charged the batteries with 150 sparks and interrupted the primary circuit by about 6 inches of water in a basin. The needles were again all magnetic and all magnetized minus.

[[dividing line across page]]

6

Next sent ~~the~~ ^a spark ^{from} the prime conductor, which, as in exp 2, was increased in capacity by the globe before mentioned. The end of the ribbon was furnished with a ball to receive the spark - In the other exp (2) the spark was received on the thin end of the long and - The needles were all magnetized minus.

[[dividing line across page]]

7

The same arrangement being made ~~four~~ ⁴ sparks were passed through the long ribbon - which formed the primary conductor. The needles were again all magnetic except the last which was a very small one in the minus direction. It is not improbable that the small needle was magnetized before being put into the spiral. To test this I put into the same spiral, another fine needle, of which the magnetism was previously examined. The result was now as before the needle was magnetized slightly in the minus. Repeated the exp with the small needle in the last coil, with the same result minus. Repeated again with the same result. The result therefore with the first small needle was in all probability produced by previous magnetism and this is rendered more probable from the fact that I had just before found a needle strongly magnetic in the same lot.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
253
May 16th Monday 1842
Magnetization in spiral

[[notation in left margin beside section to follow]] 1 [[/notation in left margin]]
Before making further experiments on the direction of currents, I have concluded to investigate the magnetization of needles in spirals. For this purpose a medicine sized sewing needle was placed in the long spiral mentioned. The one end of the this spiral was connected with the prime conductor of the machine, and the other with a wire leading to the rubber, and also to ~~th~~ a plate of metal buried in the ground. - No magnetism was perceptible in the needle, after 20 turns of the machine. - Next a very small needles was substituted. After 20 turns of the machine, this exhibited magnetic polarity in the plus direction.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 2 [[/notation in left margin]]
Again a larger needle was heated to redness in the flame of a spirit lamp, and although before it was annealed it exhibited no signs of magnetism, yet now it became decidedly magnetic with the plus ~~magn~~ polarity.

[[dividing line across page]]

Again placed a needle in the coil mentioned above (1), gave 20 turns, no signs of magnetism - then passed a very small spark from the prime conductor, needle was now polar in the plus direction. Also sent very small spark through a coarser wire spiral, needle polarized plus.

[[dividing across the page]]

[[image in left margin: clear tube laid horizontally, around which is wrapped or coiled a wire with small even spacing between each turn. The ends of the wire project downward at the left and right ends of the tube.]] [[notation in left margin beside section to follow]] 3 [[/notation in left margin]]

Next used a spiral formed of 13 turns of copper bell wire around a glass tube of about 1/2 inch in diameter - ~~connected~~ with single jar

[[results encompassed by closing bracket followed by note]]

2 sparks ----- needle plus
5 do ----- " plus
10 do ----- " plus
13 do jar charged to saturat. plus

[[/results - close bracket]]

[[note beside results above]] made same expermnts with large & small needles, same result.

[[end page]]

[[start page]]
[[checkmark]]



254

May 16th 1842

Examination of Phenomena of magnetizing spiral - ----- see page 262
[[in pencil]] V V V [[/in pencil]]

[[notation in left margin beside section to follow]] 4 [[/notation in left margin]]

Same experments as the last set, with battery no 3.

[[results encompassed by close bracket]]

[[note beside close bracket]] All made with a loose singe spiral with needles of different sizes [[/note]]

Charge 5 needle mag plus}

10 " " plus}

20 " " plus}

[[above "plus"es underlined]]

40 " " plus}

50 60 70 80 90 100 --- plus}

120 150 200 --- ---- plus}

all the batteres 250 -- plus}

[[["250" above underlined]]

do " " 100 plus}

[[/results - closing bracket]]

Attached the coil no 2 to the circuit, but still the neede was magnetized -
- [[underlined]] plus [[/underlined]]

[[dividing line across page]]

[[notation in left margin beside section to follow]] 5 [[/notation in left margin]]

Used spiral of 2 ~~2~~ turns in 4 inches around tube of about 3/8 of an inch ~~Began~~

~~of wire of an inch in diameter. Began with a charge of 2 sparks in single jar, - then 5 sparks - then 10, then 13. - Then with full set of batteries at 25 sparks, and continued to increase the charge up to 250 sparks, at the rate of 25 sparks at a time, - but in every case the needle was magnetized~~ plus.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 6 [[/notation in left margin]]

Next used a compound spiral which was composed of ~~space~~ turns.

Charge from single jar from 2 sparks to 14 the full charge of the jar. magnetism constantly +, except once which might perhaps been produced by the previous magnetism of the needle. - But about the discharge of 4 or 5, and 9 & 10, there appeared to be a minimum of magnetic development. Next used battery no 3, charge with 25, 50, 75, &c up to 150, but each discharge produced a plus development of magnetism.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 7 [[/notation in left margin]]

Added the coil to the circuit found, the polarity the same.

[[dividing line across page]]

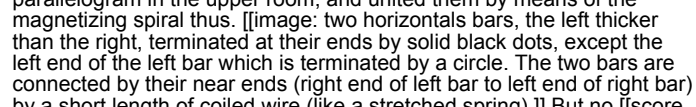
NB I have made to day with single and double spirals upwards of 60
exp. and all except one gave plus results.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
255
May 17th 1842
Induction from ordinary electricity

Returned to the exp ³ with the large rectangles or as I have called them before, parallelograms, and gradually lowered the wire in the museum until it was along the floor, the magnetism was still quite evident, as was shown by the repulsion of the north end of the small compass. The polarity was still plus. This experiment was made yesterday afternoon.

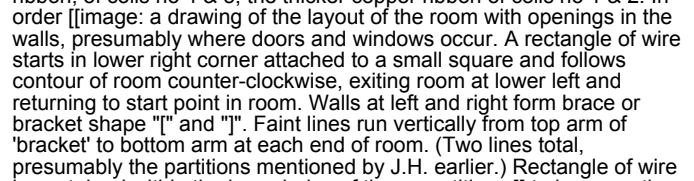
[[dividing line across page]]

Made arrangement to get if possible a secondary current from a conductor which was not closed, for this purpose, I placed two conductors each 12 feet long parallel to the one side of the parallelogram in the upper room, and united them by means of the magnetizing spiral thus.  But no score underlining image above]] effect could be observed, although the experiment was twice repeated. See exp. page 264 & 5

[[dividing line across page]]

Next repeated the experiment of producing induced currents by a single spark of the electrical machine. The conductor in the lower room was placed on the floor, the spirals furnished with needles. The spark being passed from the prime conductor, the needles were found magnetic in the minus direction. [[end page]]

[[start page]]
[[checkmark]]
256
May 18th 1842
Induction from ordinary electricity

This morning I enlarged the parallelogram, and substituted for the thin ribbon, of coils no 4 & 5, the thicker copper ribbon of coils no 1 & 2. In order  to increase the width of the circuit, a part of it was passed out of the southeast window - through the preparation room and in at the NE window.

[[approximation of image described above. a=wall of room; z=wall of 'preparation room'; a=rectangle of wire; #=small box (battery or electrical



machine?); |=partition. "-"=(windows? [[assumed]] N/S/E/W notation added for clarity, not contained in original image.]]

```

xxxxxx---xxxxx---xxxxx---xxxxxx
x | aaaaaaaaaaaaaaaaaa | x
x | a          a | x W
x | a          a | x |
x | a          a | x S--|--N
x | a          a | x |
x | a          aaa|a# x E
x | a          aaa|a# x
xxxxxx-a-xxxxx  xxxxx-a-xxxxxx
  a z          a
  aaaaaaaaaaaaaaaaa
  z
  z
  z
  zzzz

```

The circuit was also removed from the museum, and another formed of bell wire substituted in the [^][[dining room]] below. The length of the two circuits was about the same, and the one in the basement also passed out of the S.E. lower window, then through Mr Clows kitchen and in at the NE window. The wire below, and also the [^][[?]]and above was insulated from the walls and all conductors by means of silk ribb[[blot]] and tubes of glass through which the conductors were passed at points where the electricity might pass off. All the arrangement being complete, battery no 3 was charged with 275 sparks. - a needle being placed in a compound spiral of [^][[space]] turns, was found magnetized so much as to li[[hole in page]] quite a collection of iron filings, and to make the needle of the small compass whirl intirely round. -- Next the a new needle was inserted into the spiral, and while the one end of the long ribbon was in connection with the rubber and the ground, and the [^][[other]] brought to the ball of the prime conductor so as to receive sparks. When a spark of 1 1/2 inches in [^][[strikethrough]] di [^][[/strikethrough]] length was thrown on the end of the ribbon armed with a ball of 2 1/2 inches in diameter, the needle appeared about as strongly magnetized as before, but in the [^][[underlined]] minus [^][[/underlined]] direction.

Again the end of the long ribbon in the upper room was disconnected from the rubber and the wire leading to the ground; the sparks being passed as before, the needle was not affected. the end of the ribbon being again connected with the rubber, the needle was strongly, comparatively speaking, in the [^][[underlined]] minus [^][[/underlined]] direction.

Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

[[checkmark]]

257

May 17th 1842

Induced currents in the basemt story ordinary electricity

~~3~~ With spark from the machine, the magnetism with the arrangement described on the last pages was always minus in all the spirals, and an additional one of these was used.

[[dividing line]]

The circuit of the secondary current was next interrupted by about an inch of water in a tumbler - while the current was induced by means of the snap. Still the current ~~rem~~ or I should say the magnetism, remained unchanged.

[[dividing line]]

Next charge the battery (no 3) with 200 sparks of the unit jar - all the needles direct.

Next introduced into the circuit about an inch of water, now all the needles were minus.

[[dividing line across page]]

Next charged the battery 120 sparks battery (no 3), the magnetism was as follows, circuit complete --

No 1+ No 2+ No 3- No 4-0

Again charge the ~~me~~ 120

No 1+ No 2+ No 3-0 No 4-

Again charge the same 120

No 1+ No 2+ No 3- No 4-

Again charge the same 120°

No 1+ No 2+ No 3-0 No - minus

Charge 150 ~~No 1~~

No 1+ No 2+ No 3-0 No 4-0 This result more +

Charge 175

No 1 No 2 No 3 No 4

Charge 200

No.1+ No.2+ No 3+ No 4.

[[end page]]

[[start page]]

[[checkmark]]

258

May 17th 1842

Induced currents in the basement story - ordinary electricity

Charge 100

No.1+ No.2+ No.3. No.4-

Charge 75

No 1-0 No 2- No 3- No 4-

Charge 50 1+ No 2-0 No 3- No 4 0 very little magnetism.

[[dividing line across page]]

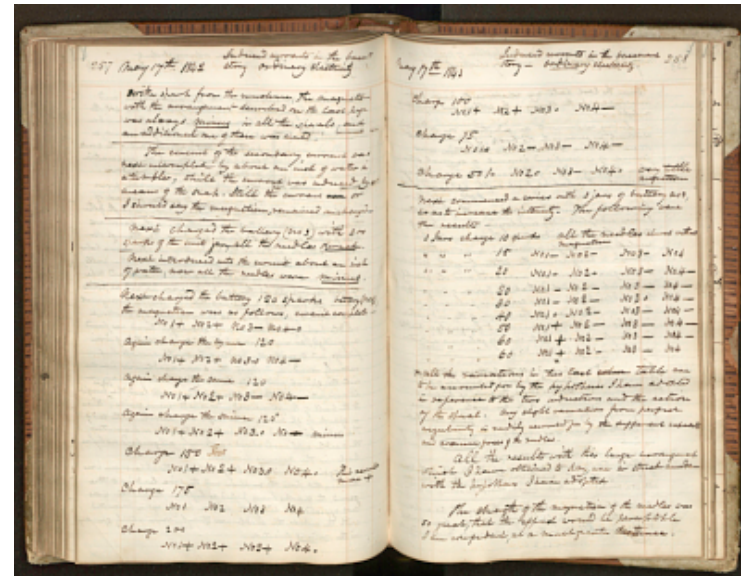
Next commenced a series with 3 jars of battery no 3, so as to increase the intensity. The following were the results --

3 jars charge 10 sparks all the needles

almost without

magnetism

" " " 15 No 1- No 2- No 3- No 4



"	"	"	20	No.1+ No 2+ No 3- No.4-
"	"	"	20	No.1- No 2- No 3- No 4-
"	"	"	40	No.1- No 2- No 3- No 4-
"	"	"	50	No.1+ No 2- No 3- No 4-
"	"	"	60	No.1+ No 2- No 3- No 4-
"	"	"	60	No.1+ No 2- No 3- No.4

x

x all the variations in this last ~~column~~ table are to be accounted for by the hypothesis I have adopted in reference to the two inductions and the action of the spiral. Any slight variations from perfect regularity is readily accounted for by the different capacities and coercive forces of the needles.

All the results with this large arrangement which I have obtained to day, are in strict accordance with the hypothesis I have adopted.

the strength of the magnetism of the needles was so great that the effect would be perceptible I am confident, at a much greater distance.

Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

[checkmark]

259

May 26th (Thursday)

Magnetization of needles by ordinary electricity -

Remarks

Since the last date, my experiments have been interrupted by the opening of the college and my lectures on light. -----

In my experiments on induction on ordinary electricity as given in the old book. I found that when the wire to receive the induction was formed of a compound circuit of several strands, then the magnetism of the needles were always minus. This fact at first sight appeared ~~quite~~ difficult to explain, but on a little reflection, I find it in strict accordance with the hypothesis I have adopted. By employing a number of strands, the same induction which would be exerted on a single wire, is now active through a long wire - The intensity of the disturbance is therefore so much increased, and its quantity so much diminished, that the power of magnetizing the needles to saturation ceases, ie precisely in the same manner as the power of the induction in helix no. 1, is not sufficient to magnetize needles in a single spiral~~s~~, in the case of galvanic induction as shown in my paper No. 3. -----

[dividing line across page]

[image of a device with a flat rectangular base from which stand straight upright two posts, one near each end of the base. Four dots occur in a line along the center of the base between the two posts. Each posts appears to support a short beam. Each beam has a small circle at its center and at each end. The left beam is positioned thus / and the right beam thus \. The circles at the top ends are solid (dots). Between the two dots a wire stretches. Above the wire a series of vertical slashes appears, each perpendicular to the wire.] Charged all the batteries with 390 sparks - placed a number of fine needles above the wire ^[[see fig.]] at different distances from contact up to 1/2 an inch. All were magnetized by the discharge in the plus direction. The length the wire was about 6 inches, its thickness [space] of an inch.

[dividing line across page]

2. Repeated the same, increased the length of the wire to 14 inches, still the result was the same - the needles were all (10 in number) magnetized plus - charge the same in batter 1 & 2.

[dividing line across page]

3. Repeated same exp., lengthened the wire to 20 inches - charge the same, distance of the needles from contact to 1 3/4 inches - All (11) in the same direction, magnetized plus.

Battery 1 & 2.

[end page]

[start page]

[checkmark]

260

May 26th 1842

Magnetization of needles by ordinary electricity

4. Again increased the length of the wire to 40 inches. charge the same - needles from contact to the distance of 3 inches, all ¹² magnetic plus - no change in direction. The needle in contact with the wire appeared more feebly magnetized than any other.

[dividing line across page]

5. Again the same arrangement as before, with the exception of 3 jars

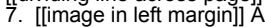


instead of the 2 batteries. The charge was 55 sparks - all the needles except the first [^][[and 3 last,]] were magnetized, and in the plus direction direction. Magnetism much more feeble than when the batteries were used.

[[dividing line across page]]

6. Again Lengthened the wire to about 6 feet. Charge 200 - 2 batteries. All the needles magnetic in the plus distance from contact to 3 inches - distance from contact to 3 inches. --

[[dividing line across page]]

7.  Agan wire of the same length - charge the same, - between three of the needles and the wire a zinc plate was plated - a thin plate of about 8 inches square, so note if any screening took place. - No effect was observed in reference to the plate, all the needles were magnetized plus direction.

[[dividing line across page]]

8.  Placed eleven needles on the edge of a lath and then held the article perpendicular to the wire. The magnetism extended up to the sixth needle. Each was magnetized plus direction. No change of direction could be obtained.

[[dividing line across page]]

9(?) ----- Magnetized needles by a spark from the machine - only however the needles immediately in contact with the wire was - .

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
261
May 26th 1842
Induction from galvanism

Prepared a battery of 10 elements, the battery of quart mugs. Connected this battery with the rectangle on the inside of the electrical case - Next charged the several spirals of one set with needles and connected this with the secondary conductor. The wires being near together, all the needles came out magnetic when the contact was made, the one in the more compound the stronger - When the needles were replaced and the contact broken, all the needles except that in the first spiral came out neutral. The action at the ending just neutralized that at the ~~ending~~ beginning, except in the case of the first needle, this at first was perhaps magnetized to near saturation, and consequently ~~the same magn~~ [^] would more than discharge the magnetism.

The induction with this arrangement is quite feeble, probably the effect would be much greater if a ribbon wire used instead of the thin wire.

[[dividing line]]

Next the same spirals were charged with needles, and then the contact was made and broken with the battery several times in succession - The needles at the end of the operation came out electrified +, or as if by the ending induction.

[[blank space]]

[[double horizontal lines with vertical hashes between them. Continues across both pages. Possibly denoting that the following continues at bottom of next page below the dividing line described here.]]

A part of this afternoon was occupied in distilling mercury for the use of the photographic art -- The mercury was placed in an  iron bottle, and this placed in the  A gun barrel attached at one end to the bottle dipped into water in a wide mouth phial, and this was placed in a wash basin filled with water. The mouth of the phial with a wet towel, and a part of the same was wrapped around the 

[[start page]]
[[checkmark]]
262

May 27th - 1842
Magnetizing spiral common electricity

[[notation in left margin beside section to follow]] 1 [[notation in left margin]]

Placed needle in the axis of the spiral described, bottom page 253 - Sent ~~dis~~charge through the spiral from 3 jars, needle magnetic in the plus direction - Next placed a similar needle in a lead tube of about 1/4 of an inch of external diameter, and 1/20 of an inch thick of metal. The needle with a charge equal in quantity no polarity - The quantity of the charge was next varied, but in no case could I magnetize the needle while it remained in the tube.

[[dividing line across page]]



[[notation in left margin beside section to follow]] 2 [[/notation in left margin]]

Next the tube was cut open along ~~its axis~~ a line on its side parallel to its axis. The needle was now as strongly magnetic as if the ~~wire~~ metal was not present. The two edges of the opening were next purchased together so as to be in contact, but with this I could not succeed in screening, or rather in neutralizing the magnetism.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 3 [[/notation in left margin]]

Next placed a small magnetizing spiral of thin wire with the other one - With the ends open - The needles was strongly magnetized. Next closed the ends of the spiral, now the needle same out very slightly plus; and one not at all magnetized.

[[dividing line across page]]

[[notation in left margin beside section to follow]] 4 [[/notation in left margin]]

important experiment

The spiral used in the last exp was a single one - substituted for this a compound one. The needle placed in this in the first attempt was also magnetized slightly plus [^]when the ends were closed. I then introduced into the circuit a tube of water, so as to pass the charge through about one inch of water. The needle now came out of the inner spiral magnetized - minus. This was repeated 6 or 8 times with the same result.

[[double horizontal lines with vertical hashes between them, continued from left or opposite page.]]

This arrangement was made in order to prevent the regurgitation of the water, and the blowing out of the mercury with the steam. Only about one half of the mouth of the barrel was plunged under the surface of the water in the phial, so as to let the air in to restore the equilibrium.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
263
May 28th 1842 (Saturday)
Current from the return stroke

I consider the last experiment on the last page as an important one in reference to the explanation of the change of magnetism observed by Savary in the case of a spiral - I think it probably that the results obtained by him were due to the cutting across of, or striking across of the electricity from one spire to the other, and thus forming a shut circuit, which in certain cases would have more magnetic power than the primary.

[[dividing line across page]]

[[sideways notation in left margin across next two sections]] current from the return stroke [[/sideways notation]]
[[image: a short horizontal bar suspending a plate by three wires above another plate balanced on a thin vertical column. From the right edge of the balanced plate a wire extends downward, wound immediately into a short coil or spiral with its unwound trailing end arcing downward and to the left beneath the rest of the figure. The right end of the horizontal bar at top is labeled 'b'; the coil or spiral is labeled 'a'; and the free end of the wire extending from the coil or spiral is labeled 'c'.]]

Made an arrangement, such as is shown in the figure, with the plates used for the dancing images - placed the spiral at a, when a spark was drawn from the ball b, the needle became magnetic by the current of the return magnetism. The direction of the current was upwards. The wire c was connected with another which was connected with the earth.

[[dividing line across page]]

[[image: same as above with the short bar supporting a plate suspended by three wires above another plate balanced on a vertical column with a wire attached to plate at the right edge. The wire is wound into a spiral at the end that touches the plate. The remainder of the wire is not wound and runs from the coil to a globe standing on a table to the right of the other pieces.]]

Made an arrangement like that in the margin in which the wire from the lower plate did not form a connection with the earth. ~~the~~ the end was well insulated, by placing it first in the large hollow globe, and the latter on an insulating stool. The needle as before, was strongly magnetized by an ~~ascending~~ ~~current~~ ascending current. The compound spiral was used in this experiment. The compound spiral was used in this experiment. I next substituted a single spiral, but the result was the same. The needle was again magnetized by an ascending current.

[[dividing line across page]]

These experiments give no assurance that I can produce results from the clouds by attaching a wire to the tin roof of my house, and ~~connecting~~ and ~~connecting~~ connecting the lower end of this with the ground, or rather with the well. A part of this wire being formed



into a spiral, will indicate the effect from the flash of a cloud -.
[[end page]]

[[start page]]
[[checkmark]]

264

May 28th 1842

Secondary conductor interrupted

Could not a self-registering electrometer be constructed to be used with clock work which would register the state of the atmosphere at every hour or minute by magnetized needles. Placed in spirals around the periphery of a wheel moved by the clock work, and brought in contact with the end of the exploring wire. The wheel might contain 20 or 30 spirals, and the

exploring rod might be so arranged as to be pushed against the knob of the spiral when it came near, or perhaps better, the spiral might be thrust out when it came opposite the end of the explor rod by means of a clamp and a spring.

I must however first determine whether I can get induction from the heavens by means of the arrangement mentioned at the bottom of the last page.

[[dividing line across page]]

Arranged the rectangle opposite the one in the case with the ends disconnected. Attached on end to the globe, insulated on the stool, and the other to a long ribbon of copper extended along the floor, with this arrangement, and the set of spirals introduced at a a, the needles in the single spirals were unmagnetized, but those in the compound were magnetized in a direction opposite to that of the battery current. From this result, it would appear that a primary ~~current~~ [^]conductor can have a secondary current produced in it, although the two ends are separated by the thickness of the glass in the jar. -----

----- In this expermnt, 2 jars No 1 & 2, were used charged with 150 sparks.

[[dividing line across page]]

With the same arrangement the induction was produced by sparks from the machine, the result was the same, the needle was slightly magnetized again in the minus direction

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
265

[[underlined]] May 28th 1842 [[/underlined]]

[[vertical dividing line between date and page title]]

Induction from ordinary elect. Secondary conductor with circuit interrupted.

[[in pencil]] V V V [[/in pencil]]

[[sideways note in left margin]] In all these experiments, the spiral of 3 turns was used, No 1: page 238. [[/sideways note]]

Repeated the last experiment with the variation of disconnecting the long ~~spiral~~ spiral ribbon which was extended along the floor - now the needles exhibited no signes of magnetism.

I next attached the end of the wire - which before had been joined to the long ribb[smudged], to the wire leading to the ground, now the needle was again magnetic minus minus.

[[dividing line across page]]

Next I insulated the long ribbon, by suspending it from a silk ribband. ~~[[faint and may have been erased]]~~ Also insulated the frame which supported the secondary conductor ~~[[faint and may have been erased]]~~ was separated ~~[[faint and may have been erased]]~~ With a charge of 150, the needle was scarcely magnetized perceptibly. ~~[[faint and may have been erased]]~~ In spiral no 1 - with 200, the magnetism was decided and as before, in the minus minus direction. ----

a large needle appeared to be more affected than a smaller one.

Next the same arrangement being ~~[[faint and may have been erased]]~~, the discharge consisted of sparks from the prime conductor, now the direction of the magnetism was changed, an the needle came out strongly plus plus.

All these results appear to prove the induction of a current in a secondary conductor with the circuit interrupted.

[[dividing line across page]]

Next armed the end of the primary wire with a two inch ball, put needles in all the 4 spirals, sent spark from prime conductor. The arrangement same, otherwise as shown in the above figure - The needles were magnetized as follows

In spiral No 1-0 No 2+ No 3+ No 4+

Repeated the exp with the following result

In spiral No 1- No 2+ No 3+ No 4+

[[end page]]

[[start page]]

[[checkmark]]

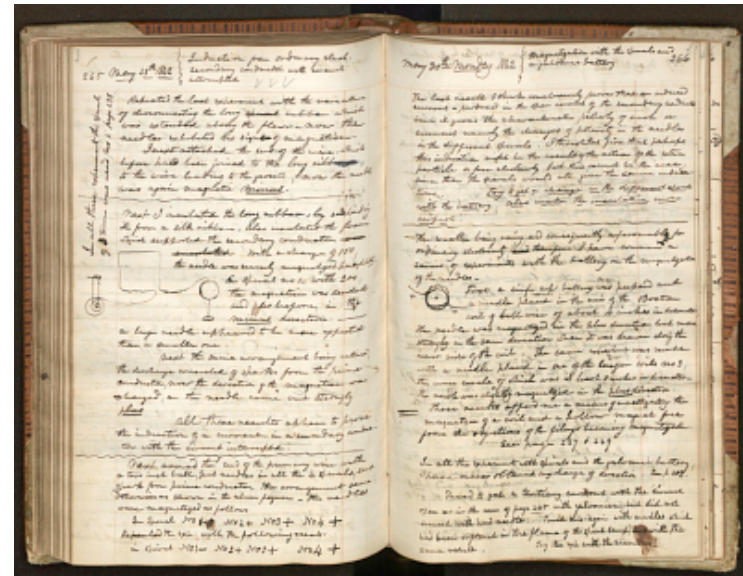
266

May 28th 1842

[[vertical dividing line between date and page title]]

Magnetization with the spirals and a galvanic battery

The last result I think conclusively proves that an induced current is produced in the open circuit of the secondary condutor since it gives the characteristic property of such a current namely the changes of polarity in the needles in the different spirals. I thought at first that perhaps this induction might be the result of the action of the extra particle or free electricity, but this cannot be the case, since then the spirals would all



give the same indications. Try to get a charge in the different spirals with the batter, also make the insulation more perfect.

[[dividing line across page]]

The weather being rainy and consequently unfavorable for ordinary electricity ~~therefore I have~~ and ~~therefore I have~~ commenced a series of experiments with the battery on the magnetization of the needles -

[[image]] First a single cup battery was prepared and a needle placed in the axis of the Boston coil of bell wire of about 4 inches in diameter. The needle was magnetized in the plus direction, but more strongly in the same direction when it was drawn along the inner side of the coil. The same experimnt was made with a needle place in one of the larger coils no 3, the inner circle of which was at least 8 inches in diameter - the needle was slightly magnetized in the plus direction.

[[double dashes like a large = in left margin]] These results afford me a means of investigating magnetism of a coil, and a hollow magnet free from the objections of the filings becoming magnetized.

See page 227 & 229

In all the experiments with spirals and the galvanic battery, I have never obtained any change of direction See p 203.

Tried to get a tertiary current with the circuit open as in the case of page 265 with galvanism but did not succeed with hard needles. Tried this again with needles which had been softened in the flame of the spirit lamp, but with the same result. Try this exp with the secondary!

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

267 May 31st 1842 Magnetization of needles by the electrical discharge

 Arranged between the balls of the immersed discharger a wire of platinum - of an inch in diameter and 14 inches long connected at its two ends with the plated wire 1/4 of a millimeter in diameter. 1]] Placed needle [^]~~so as to be~~ perpendicular to the wire and - also perpendicular to the magnetic meridian. Made the discharge from 2 sparks. The needles were plus magnetized to the 5th needle, the distance was 1/2 an inch between each needle. 2]] Repeated the same experiment with the same result, the needles were all magnetized plus to the 5th one, after this no magnetism. 3]] Again with a larger charge 275, the platina wire was now deflagrated but the result was the same as the last.

4]] Next substituted for the fine wire of the last arrangement, the plated wire of the same length  The needles were again placed transversely at the distance from each other of 1/2 an inch. The charge being 200 all the needles 10 in number were found magnetic. The 5th needle was magnetized minus, the others all plus. It is not improbable that the fifth needle was slightly magnetized before the experiment. 5]] Repeated the same experiment, charge the same arrangement of needles the same, now all the needles to the 13th were magnetized and plus no change. The magnetism decreased from the 2nd to the last needle. 6]] Repeated the same exp with larger needles no 3. The magnetism now extended only to the 8th needle.

7]] 8]]

May 31st 1842 Magnetization of needles by the electrical discharge 268

9]] ~~It is evident from the foregoing experiments, that the magnetism is perceptible at a greater distance with fine needles than with coarse, and that the second wire gives a greater effect than the first.~~

10]] ~~Repeated the same exp. with fine needles, found all magnetized to the 13th plus~~ plus beyond this magnetism uncertain, - the charge was now 350 -

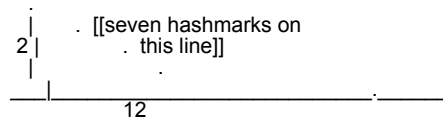
11]] ~~Increased the length of the wire to that of first, procured new needles all of the same size No 10. The needles were all magnetized plus to the 12th needle, - charge 250.~~

12]] ~~Next charged the batteries to the amount of 250 sparks, all the other circumstances remaining the same as in the last experiment. Needles magnetized to the 10th, all plus- discharge not good.~~

13]] ~~Next charged the battery to the extent of 275 sparks, now found that 15 needles were magnetized - the magnetism gradually increasing from the 2nd needle until the 15th, all plus. ---It should be noted in these experiments, that the needle in contact with the wire in all cases was very little magnetized, and that the second needle was the one which received maximum of development.~~



[[image: approximated below. figure is a line drawing of a right triangle, rise labeled 2; length labeled 12; seven hashmarks drawn across the line of the slope perpendicular to the line of the slope.]]



1/6 1/12 [[/image]]

[[left margin: 11 ~~12~~]] Next in order to determine if there were any changes in the magnetism of the needles between the 1st and 2nd needles of the last experiments, I placed the needles along the wire as show in the figure, 11 in number, they were all magnetized alike plus plus. The first was incontact with the wire and each one 1/2 of an inch above the preceding one.

the following are the relative strengths of the magnetism of the needes in exp ~~11~~ 10

No ~~1~~ 2 ~~3~~ 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 {These are the statical deflections see next page}

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

269

May 31st 1842

[[short vertical dividing line]]

Magnetization of needles by the discharge of ordinary electricity

The following are the relative intensities of the needle in the exp 11

[[strikethrough]] 12 [[strikethrough]] last page

No 1-19° No 2 19° No 3-17 1/2 No 4-22 1/2 No 5 21 No 6 26 No 7

24° No 8.23 No 9 25° No 10.25 No 11 26°

[[dividing line across page]]

Exp. 12. Charge 275 wire 7 1/2 feet long

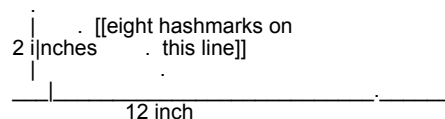
[[results table inside hand-drawn box in two parts side-by-side with four columns to each side. Left side contains results for needles 1-12; right side contains results for needles 13-24. Transcribed as single 4-column table below.]]

No of the needle | dist | deflect | [[untitled]]

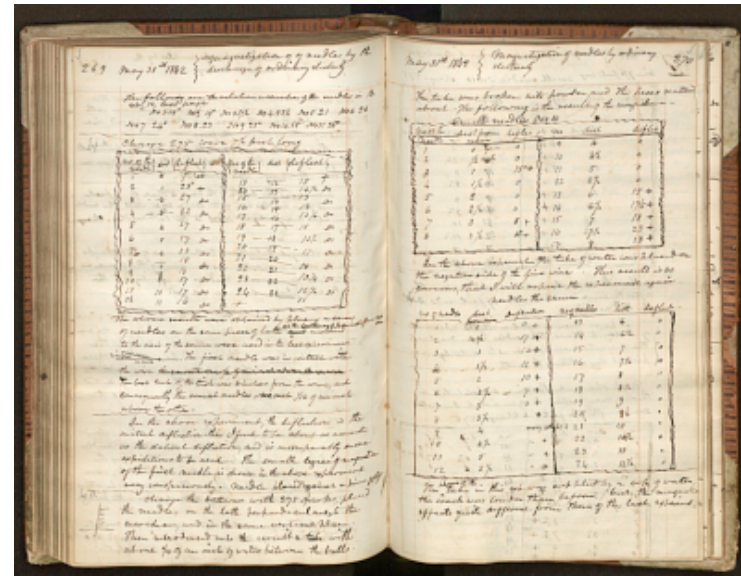
1	0	7	+
2	1	23°	+
3	2	27	Do
4	3	22	Do
5	4	27	Do
6	5	17	Do
7	6	23	Do
8	7	18	Do
9	8	19	Do
10	9	17	Do
11	10	17	Do
12	11	16	Do
13	12	15	Do
14	13	14 1/2	Do
15	14	13	Do
16	15	13	Do
17	16	12 1/2	Do
18	17	15	Do
19	18	12 1/2	Do
20	19	11	Do
21	20	10	Do
22	21	10 1/4	Do
23	22	12 1/2	Do
24	23	11	Do

The above results were obtained by placing a series of needles on the same piece of lath [[strikethrough]] and [[/strikethrough]] ^[[at the distance of 1/2 an inch from each other]] to the axis of the same wire used in the last experiment.

[[image: approximated below. figure is a line drawing of a right triangle, rise labeled '2 inches'; length labeled '12 inch'; eight hashmarks drawn across the line of the slope perpendicular to the line of the slope.]]



[[/image]] The first needle was in contact with the wire [[strikethrough]]



the second was 1/2 of an inch ~~[[? ? ?]].~~ The last end of the stick was 2 inches from the wire, and consequently the several needles were each 1/12 of an inch above the other.

[[dividing line across page]]

In the above experiment, the deflection is the initial deflection. This I find to be about as accurate as the statical deflection, and is incomparably more expeditious to be used. The small degree of magnetism of the first needle, is shown in the above experiment very conspicuously. Needle placed against a piece of glass.

[[dividing line across page]]

Exp. 13.

[[image in left margin]]



[[/image]]

Charge the batteries with 275 sparks, placed the needles on the lath perpendicular to the meridian, and in the same vertical plane. Then introduced into the circuit a tube with almost 1/4 of an inch of water between the balls.

[[end page]]

[[start page]]

[[checkmark]]

270

May 31st 1842

[[short vertical dividing line]]

Magnetization of needles by ordinary electricity

The tube was broken into powder and the peces scattered about. The following is the result of the magnetism -

[[table, in hand-drawn box, in two parts side by side, 3 columns to each part. Transcribed as one table of 3 columns.]]

[[Table header]] Small needles No 10 [[/table header]]

No of the | dist from | deflect

needle	wire	
1	0	0
2	1/2 inch	0
3	1	15° +
4	1 1/2	0
5	2	0
6	2 1/2	0
7	3	5 +
8	3 1/2	10 +
9	4	0
10	4 1/2	0
11	5	0
12	5 1/2	0
13	6	15 +
14	6 1/2	17 1/2 +

15	7	18 +
16	7 1/2	23 +
17	8	28 +

[[/table]]

In the above expermnt, the tube of water was placed on the negative side of the fine wire. This result is so curious that I will repeat the experment again.

Exp. 14. Needles the same.

[[table, in hand-drawn box, in two parts as above. Transcribed as above.]]

no of needles	dist from wire	deflection
------------------	-------------------	------------

1	0	0 +
2	1/2	17 +
3	1	16 +
4	1 1/2	12 +
5	2	10 +
6	2 1/2	7 +
7	3	3 +
8	3 1/2	2 +
9	4	very slight +
10	4 1/2	" +
11	5	" +
12	5 1/2	" +
13	6	0
14	6 1/2	0
15	7	0
16	7 1/2	0
17	8	0
18	8 1/2	0
19	9	0
20	9 1/2	0
21	10	0
22	10 1/2	0
23	11	0
24	11 1/2	0

[[/table]]

The ^[[place of the]] tube in this exp. was supplied by a cup of water the crack was louder than before, but the magnetic effects quite different from those of the last experiment.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
 May 31st 1842
 [[underlined]] 271 [[/underlined]]
 [[short vertical dividing line]]
 Magnetization by electrical discharge

wire 7 1/2 feet long small needles No 10 charge 275
 [[table, in hand-drawn box, in two parts side by side, 3 columns to each part. Transcribed as one table of 3 columns.]]
 no of n | dist | defl

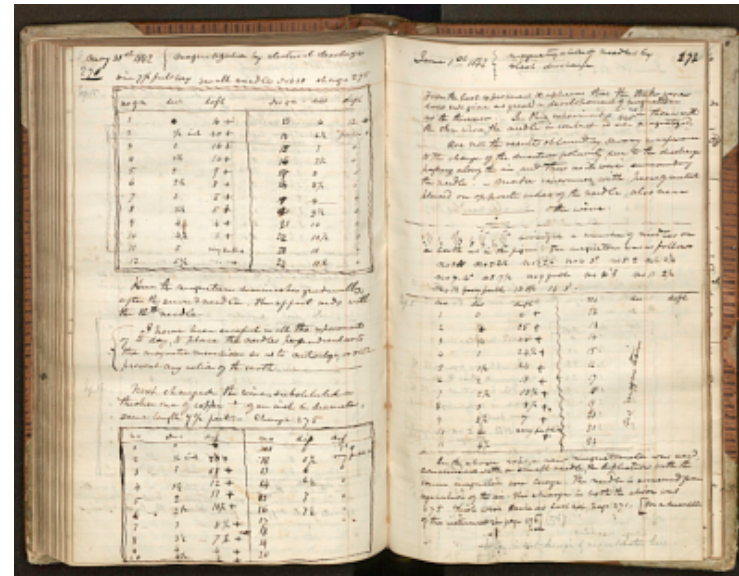
1	0	4 +
2	1/2 inch	20 +
3	1	16 +
4	1 1/2	16 +
5	2	9 +
6	2 1/2	8 +
7	3	6 +
8	3 1/2	5 +
9	4	4 +
10	4 1/2	3 +
11	5	very feeble +
12	5 1/2	" +
13	6	12 +
14	6 1/2	feeble +
15	7	0
16	7 1/2	0
17	8	0
18	8 1/2	0
19	9	0
20	9 1/2	0
21	10	0
22	10 1/2	0
23	11	0
24	11 1/2	0

[[/table]]
 Here the magnetism diminishes gradually, after the second needle.
 The effect end with the 12th needle.

[[open bracket]] I have been careful in all the experiments of to day, to place the needles perpendicular to the magnetic meridian so as to neutralize, or rather prevent any action of the earth. -----

[[/open bracket]]
 Exp. 16. Next changed the wire, substituted a thicker one of copper 1/[[blank]] of an inch in diameter. same length of 1/2 feet. - Charge 275
 [[table, in hand-drawn box, in two parts side by side, 3 columns to each part. Transcribed as one table of 3 columns.]]
 no | dis | defl

1	0	0
2	1/2 inch	20 +
3	1	15 +
4	1 1/2	12 +
5	2	11 +
6	2 1/2	10 1/2 +
7	3	8 1/2 +
8	3 1/2	7 1/2 +
9	4	4 +
10	4 1/2	2 +
11	5	1° +
12	5 1/2	very feeble +
13	6	0



14	6 1/2	0
15	7	0
16	7 1/2	0
17		
18		
19		
20		

[[/table]]
[[end page]]

[[start page]]
[[checkmark]]

272

June 1st 1842

[[short vertical dividing line]]

Magnetization of needles by elect discharge

From the last experiment it appears that the thike wire does not give as great a developement of magnetism as the thinner. In this experiment [[hole in page]] ^[[as]] in those with the thin wire, the needle in contact is [[now? or not? - cut off by hole in page]] magnetized.

Are not the results obtained by Savary in reference to the change of the direction polarity, due to the discharge passing along the air, and thus as it were surrounding the needle. - Make expermes with piece of metal placed on opposite sides of the needle, also near [[image: long horizontal bar with a dot centered beneath it and short horizontal bar centered beneath that.]] the wire.

[[dividing line across page]]

[[image: approximated below, shows 13 needles arranged in three rows: #s 3 - 7 - 11 - 15 in top row; 2 4 6 8 10 - 14 in middle row; and 1 - 5 - 9 12 13 in bottom row. This arrangement creates columns alternating 3 needles and 1 needle. Hyphens above represent empty spaces in the row.]]

	7	11	15				
/	/	/	10	/	14		
3	/	/	6	/	/	/	
2	/	4	/	8	/	/	/
1		5		9	12	13	

[[/image]]

arranged a number of needles on a lath as in the figure. The magnetism was as follows

No 1 4° No 2-2 1/2 No 3 2 1/2 No 4 3° No 5 2 No 6 2 1/4° No 7-4°
N 8 7 1/2 No 9 feeble No 10 3° No 11 2 1/2 No 12 very feeble 13 1
1/2 14 3°.

[[dividing line across page]]

Exp. 1.

[[table, in two parts side by side, 3 columns to each part. Transcribed as one table of 3 columns.]]

no	dis	defl
1	0	0 +
2	1/4	25 +
3	1/2	25 +
4	1	24 1/2 +
5	1 1/2	24 +
6	2	18 +
7	2 1/2	13 1/2 +
8	3	8 1/2 +
9	3 1/2	7 +
10	4	very feeble +

11		4 1/2		+
12				n m
13				o a
14				g
15				n
16				e
17				t
18				i
19				s
20				m

[[/table]]

In the above exp. a new magnetometer was used constructed with a small needle the deflections with the same magnetism are larger. The needle is screened from agitation of the air. The charge in both the above was 275. Thick wire same as last exp page 271. [for description of this instrument see page 176] [[in pencil]] (276) [[L ?]] copy, insert descrp'n of magnetometer here. [[/in pencil]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[checkmark]

273

June 1st 1842

[short vertical dividing line]

Magnetization by ordinary electricity

[in pencil - 3 checkmarks?]

Exp. 2.

[image in left margin: vertical line with 10 short horizontal dashes extending perpendicularly to the right. Below bottom dash on the left is a dot labeled 'a' and to the right is another dot labeled b.] Charge the same as in the last exp. wire also the same and the arrangement of the nee[hole in page] perpendicular on the lath. A brass rod was held on one side of the needles as at [underlined] a b [underlined] being the section of the discharging wire.

[to right of table below] [strikethrough] 5 1/2 [strikethrough] Small needles No 9 [to right of table]

[table]

no. dis. defl.

1	0	5 +
2	1/4	24 +
3	1/2	28 +
4	1	22 +
5	1 1/2	20 +
6	2	18 +
7	2 1/2	12 1/2 +
8	3	5 1/2 +

[/table]

Exp. 3.

[image in left margin: vertical line with 8 horizontal dashes extending to the right. A dot is placed below the bottom dash right of the vertical line. Third dash down has an 'a' to the right.]

Next the brass was held between the 6 & 7th needle -- Charge the same as the last, needles the same.

[to right of chart below]

Small needles No 9

It appears from all the experiments, that the small needles in contact with the wire is magnetized but very feebly.

NB It is not magnetized stronger in its middle.

[table]

no. dis. defl.

1	0	0
2	1/4	23 +
3	1/2	22 +
4	1	24 +
5	1 1/2	19 +
6	2	15 +
7	2 1/2	13 1/2 +
8	3	8 +

[/table]

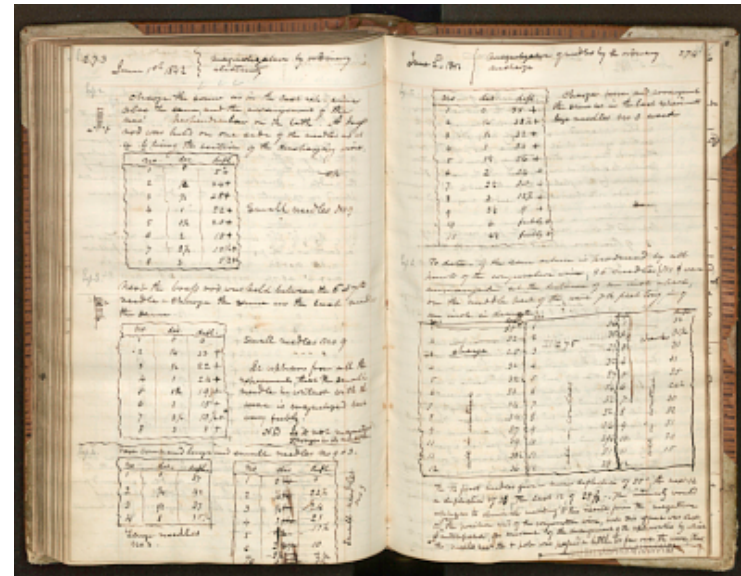
[dividing line across page]

Exp. 4. Next compared large and small needles no 9 & 3.

[table]

no. dis. defl.

1	0	37 +
---	---	------



2		1/4		42 +
3		1/2		37 +
4		1		35 1/2 +

Large needles no 3.

no. dis. defl.				
through				

1		0		0
2		1/4		22 1/2
3		1/2		24
4		1		21
5		1		17 1/2
6		2		10
7		2 1/2		2 1/2
8		3		1 1/2

small needles no 9

274

June 2nd 1842

Magnetization of needles by the ordinary discharge

Exp. 5. Charge wire and arrangement the same as in the last experiment. large needles no 3 used

no. dis. defl.				
----------------	--	--	--	--

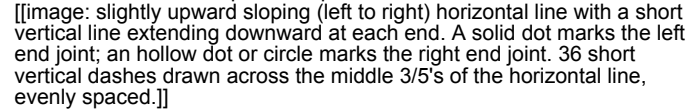
1		0		35 +
2		1/4		38 1/2 +
3		1/2		32 +
4		1		34 +
5		1 1/2		26 +
6		2		24 +
7		2 1/2		20 +
8		3		12 1/2 +
9		3 1/2		9 +
10		4		feeble +
11		4 1/2		feeble +

Exp. 6. To determine if the same action is produced by all parts of the conjunction wire, 36 needles (No 3) were arranged at the distance of an inch apart, on the middle part of the wire 7 1/2 feet long 1/4 of an inch in diameter

Table in three parts, 2 columns each with notation between the columns "all in contact". Table "charge 275 sparks" written within table in middle spaces between the columns on line 3.]

no	defl	no	defl	no	defl
1	30	1	36	1	32
2	32	2	38	2	31 1/2
3	charge 25	3	275	27	3 sparks 33
4	32	4	32	4	31
5	32	5	27	5	25
6	33	6	34	6	24 1/2

7	34	7	32	7	30
8	34	8	32	8	32
9	37	9	26	9	31
11	39	10	29 1/2	10	30
11	38 1/2	11	31	11	15
12	36	12	28	12	

The 12 first needles gave a mean deflection of 35°, the next-12 a deflection of 3°³, the last 12 of 28 7/12 - The intensity would appear to diminish according to this result from the negative to the positive end of the conjunctive wire, but this effect was what I anticipated, on account of the derangement of the apparatus by which the needles next the + pole was passed a little too far over the wire thus:  36 short vertical dashes drawn across the middle 3/5's of the horizontal line, evenly spaced.]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
275
June 2nd 1842
[[short vertical dividing line]]
same subject continued

In the magnetization of the needles of the last expermnt, which were all in contact with the conducting wire, a a very important fact was noted, namely all the needles appeared most strongly magnetized at the section against which the wire was pressed - or in other words, there was a strong tendency to form a coruscation point at the spot which was in contact with the needle - This was shown by the deflection of the small needle, and a comparison was made with observations on needles magnetized at a ~~great~~ distance from the wire.

[[dividing line across page]]

Exp. 7. Repeated the same exp with the fine needles no 9, 13 of these were placed in contact with the wire diagonally, so that it was in contact with the eye of the first, and the point of the last.

[[table in hand-drawn box, 4 rows plus table header row; 13 columns.]]

[[note to right of table]] charge 275 [[/note]] [[table header]] number of needles beginning at the polar end [[/table header]]

[[Row 1]] 1 2 3 4 5 6 7 8 9 10 11 12 13

[[Row 2]] [[centered]] deflections [[/centered]]

[[Row 3]] 12 12 1/2 13 13 15 20 21 8 2 0 feeb feeb

[[Row 4]] + + + + + + + + [[blank]] - - - [[= minus]]

[[table]]

[[image: horizontal line with 23 short evenly-spaced vertical dashes arranged perpendicularly to and across the horizontal line by varying degrees. partial representation below. (unable to place the intervening dashes, but each one is placed a little lower than the one to its left, from left to right.)]]

4 3 2 1

[[/image]] The first needles were magnetized strongly with a north polarity at the ~~north~~ larger end and this diminished as the series advanced towards the other end, and at the 11th needle it became fully negative - showing the effect of a coruscation point. The pole appeared to about one four of the length of the needle poin the larger end in the last needles - This result appears to give me a clue to the phenomenon recorded by M Savary, and which has thus far been a great difficulty in the way of my researches; appearing to vacate the results which I have obtained by means of the polarity of the needle in reference to the direction of the secondary current. [See the paper of M Riess Annals de Chimie et de Physique [?] LXXIV p 158]

[[dividing line across page]]

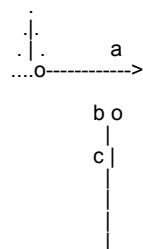
The results given above explain an action which I observed yesterday in testing the strength of magnetism of the small needles, which were in connection with the connecting

[[end page]]

[[start page]]
[[checkmark]]
276
June 2nd 1842
[[short vertical dividing line]]
same continued



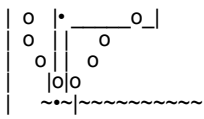
wire. The needle when approached to the magnetometer from a distance, would repel the needle of the instrument which would immediately return, and then adhere to the side of the glass. This effect was produced by the following action



Copy this after last of p. 272.

index needle ^{is} formed of]] a slender sewing needle 2 inches long, and ballanced by a piece of wood at the larger end. (Thus see margin) and suspended





near the end of the index needle. The sides of the figure are enclosed by glass. The oscillations of the needle are stopped by the glass plate which is placed directly across the zero point. The repulsion of the needle drives the index from its point of rest and the extreme dynamic deflection gives the magnetic force required. The force in this case is the vis viva. The operation of this instrument was very satisfactory.

Joseph Henry's Record of Experiments, Book 2
 Transcribed and Reviewed by Digital Volunteers
 Extracted Oct-27-2017 06:40:03

[[checkmark]]
 277
 June 2nd 1842
 [[short vertical dividing line]]

Exp 8. Arranged ~~[[overwritten character]]~~ ~~[[4?]]~~ ~~[[overwritten]]~~ needles
 small no 9 along the wire in contact, arrangement the same as before.
 charge 275
 [[image: hand drawn table or boxes around results below]]

1	2	3	4	5	6	7	
- 30°	-	7°	+	14+	17+	12+	12 1/2

8	9	10	
13+	11+		

It appears that there are here two needles polarized in the regular
 direction, but I am not sure but the wire may have been on the opposite
 of them.

Exp. 9. Repeated the same experiment but was careful to place each
 needle on the middle of the wire, all the series was magnetized
plus plus with the following intensities.

charge 275							
1	2	3	4	5	6	7	
14+	18+	22+	16+	15+	13	1 1/2+	10 1/2+

charge 275		
8	9	
15 1/2+	14+	

It would appear from the last result, that the needles in the last exp
 marked - was on the opposite side of the wire.

Exp. 10. Next tried large needles no 3

charge 275							
1	2	3	4	5	6	7	
35+	27 1/2+	30+	32 1/2+	30+	40+	30+	



8	9
29+	30+

The needles in the above experiment were placed at the distance of about 4 inches apart along the wire.

Arranged 7 half needles no 9 along the wire very nearly in contact.

1 contact 2 not quite 3 cont.

0 contact 3+ 2 +/-

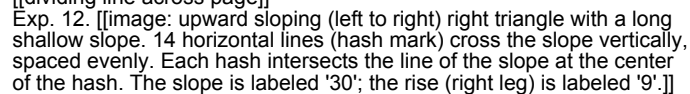
4 no[[]]cont 6 cont 7 non con

5+ 2 +/- 0

8 [[]]

~~0~~ -

[[dividing line across page]]

Exp. 12. 

[[note in left margin]] 30/9.6(.3 [~~--written above-->]] 90~~

Arranged ~~fine?~~ or five? needles each an inch from the other, first in contact, last 9 inches from the wire, whole no 37 3/10 of an inch common [[]].

[[end page]]

[[start page]]

[[checkmark]]

278

June 2nd 1842

[[short vertical dividing line]]

[[three checkmarks in pencil]]

The charge batteries and wire the same as in the last expermnts. needles no 9.

[[table: drawn horizontally in two parts. Transcribed vertically.]]

No.	Dis.	defl.
1	0	13+
2	inches .3	31+
3	.6	25+
4	.9	26+ +
5	1.2	25+
6	1.5	20+
7	1.8	19
8	2.1	15
9	2.4	15
10	2.7	11
11	3.0	8+
12	3.3	7 1/2+
13	3.6	4+
14	3.9	1 1/2+
15	4.2	feeb +
16	4.5	feeb +
17	4.8	0 +
18	5.1	-

19 5.6

[[/table]]

The maximum magnetism is here found at 3 tenths of an inch, and the power extended to the distance of nearly 5 inches.

[[dividing line across page]]

Exp. 13 Large needles no 3.

[[table: drawn horizontally in two parts. Transcribed vertically]]

No	Dis	defl
1	1/4	42
	inches	
2	1/2	41
3	1	38
4	1 1/4	36 1/2
5	1 1/2	36 1/2
6	1 3/4	32 1/2
7	2	29
8	2 1/4	27
9	2 1/2	20
10	2 3/4	16 1/2
11	3	15
12	3 1/4	11
13	3 1/2	10
14	3 3/4	6
15	4	4
16	4 1/4	feeb
17	4 1/2	feeb
18	4 3/4	fee
19	5	0

[[/table]]

[[image: upward sloping (left to right) right triangle with a long shallow slope. 10 horizontal lines (hash mark) cross the slope vertically, spaced evenly. Each hash intersects the line of the slope at the center of the hash. The slope is labeled '36'; the rise (right leg) is labeled '9'. Left end of slope labeled 'a'; right end of slope labeled 'b'.]]

Each needle one inch from the other along the line a b. The first needle was not quite in contact, the maximum is at 1/4 of an inch. All the needles after the 15 and this also exhibited some effects like that of conuculive ? points.

I find on subsequent examination, that the action mentioned here is due to the soft eye of the needle, and the induction of the needle of the index. The magnetizing power appears to stop at about the same distance in both cases, ie with fine and coarse needles.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]
 279
 June 3rd 1842
 [[short vertical dividing line]]

Exp 1. The copper plated wire used was $\frac{1}{110}$ th of an inch.

[[table: drawn horizontally in two parts; transcribed vertically]]

No	dist	Defl
1	[[2 blots]] 0	16 1/2+
2	.2 1/4	34
3	.5 1/4	36 +
4	.8	32
5	1.0 3/4	29
6	1.3 3/4	24 1/2
7	1.6 1/2	23
8	1.9 1/4	21
9	2.2	17 1/2
10	2.4 3/4	18+
11	2.7 1/4	17 1/2+
12	3.0 1/4	9+
13	3.3 [[blot]]	feeb +
14	3.5 3/4 +	very feeble +
15	[[blank]]	[[blank]]
16	[[blank]]	[[blank]]

[[/table]]

The above table gives the result with a series of fine (9) needles arranged on a lath. The maximum is here  at the 3rd needle, and the magnetic effect does not extend up as high as in the other cases with the fine wire. This was rather an unsatisfactory exp.

[[dividing line across page]]

Exp.2 
 Repeated the same exp., small needles no 9

[[table: drawn horizontally in two parts; transcribed vertically]]

No	dist	Defl
1	0	16 1/2+
2	1/4 inch	37 1/2+
3	1/2	37+
4	1	34+
5	1 1/4	32+
6	1 1/2	30+
7	1 3/4	26+
8	2	24+
9	2 1/4	21+
10	2 1/2	19+
11	2 3/4	15+
12	3	12+
13	3 1/4	10+
14	3 1/2	5+
15	3 3/4	2+
16	4	feeble +
17	4 1/4	do +
18	4 1/2	16+



Charge 275. Here the magnetism ends at 4 1/2 inches. The maximum is at the 2nd needle. The magnetism stopped at precisely the same distance as it did in the exp which stands 1st on the last page.

Shortened the fine wire to 3 feet, also used needles 15 mill long wire

1/110th of an inch.

Exp. 3

[[table: drawn horizontally; transcribed vertically]]

No	dist	Defl
1	0	7
2	.1	26
tenths		
3	.2	30
4	.3	32
5	.4	31
6	.5	29 1/2
7	.6	20
8	.7	18
9	.8	21
10	.9	25

[[/table]]

[[end page]]

[[start page]]

[[checkmark]]

280

June 3rd

[[short vertical dividing line]]

The needles in the last experiment were of the same length as those used by Savary but the thickness was just double that of those used by the same.

[[dividing line across page]]

Exp. 4. Repeated the expemnt with the needles transverse to the wire but projecting more and more over..

[[image: right-triangle with slope below the long leg; short-leg at left; point at right. 12 numbered vertical hash marks (needles) evenly spaced along the triangle with their points touching the line of the slope and crossing the long leg; number left to right.]] Wire the same 1/110 of an inch 3 feet long.

[[table header]] Large needles no 3 [[/table header]]

[[table: drawn horizontally with 2 rows, 10 columns, each cell boxed; transcribed vertically]]

No defl

[[notation across columns 2-5 between the rows]] all in contact

[[/notation]]

1	22+
2	38+
3	50+
4	48+
5	32+
6	29+
7	30+
8	12+
9	feeble+

[[/end table]]

In this exp there are no changes in the direction of the magnetism. The ninth needle was scarcely at all magnetized at the larger end which projected over the wire but was strongly at the south end.

[[dividing line across page]]

Exp. 5 Repeated same experiment with the small needles no 9.

[[table: hand-drawn with boxed cells, 11 columns, 2 rows; transcribed vertically.]]

No def

1 15+

2 8+

[[notation between rows across columns 4-7]] no change of sign

[[/notation]]

3 18+

4 22+

5 18+

6 22+

7 18+

8 9+

9 4+

10 3+

[[/end table]]

Change not quite as great as before

[[dividing line across page]]

Exp. 6.

[[table: hand-drawn with boxed cells, 12 columns, 2 rows]]

No defl

1 19+

[[notation between rows across columns 3-6]]

2 26+

3 38+

4 32+

5 [[possibly written across this and next column]]23+

6

7 32+

8 28+

9 22+

10 9+

11 0

[[/end table]]

Repeated the same exp. same charge, same arrangent needles fine, No

9, and softened in the lamp. no change of sign.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

281 June 6th (Monday) 1842 [short wavy vertical dividing line] Attempt to get static induction through the floor

I have been prevented from repeating the experiments of M Savary in the manner described by him in the *Annales de Chimie*, on account of the want of platinum wire of the proper thickness.

Made arrangements to determine at which distance I could get inductive effects by ordinary static induction--used for this purpose Dr Hares single leaf electrometer, The one which he presented me, ~~with~~ with

 suspended the plate for dancing images from a ~~of~~ of wood by a silk ribbon, placed the electrometer under this.

Found that the ~~of~~ was perceptible at the distance of 10 feet horizontally, and quite strong at the distance of five feet perpendicularly. I next carried the electrometer into the room below to determine the fact if the induction could be felt through the floor, but I was unable to get any [^][[positive]] results, although the electrometer was armed with a spirit lamp which very much increased its sensibility.

The day was not perhaps very good, although the ~~of~~ machine gave a long spark, but as far as this experiment can be depended on, it shows that ordinary induction is by no means as energetic as the current or dynamic induction.

[dividing line]

Savary states that he found by filings sprinkled over the needles, that they had no consecutive points. I tried that experiment with some of the fine needles, I had previously magnetized by contact, but I was unable to determine the polarity by this means even by the aid of the microscope. I begin to doubt the accuracy of Savary's results.

[dividing line]

 In the arrangement shown in the figure above, I placed at a spiral, and then drew sparks from the machine, found the needle magnetic in a direction indicating a current towards the machine.

Next removed the plate ~~of~~ a ~~of~~, and insulated the wire

[end page]

[start page]

June 6th 1842

[short wavy vertical dividing line]

Lateral discharge 282

of the spiral, still the needle was magnetized in the same direction, but not as strongly- next put a piece of tin foil in contact with the end of the wire so as to increase the surface on the other side of the needle, now the magnetism was considerably stronger than in the last experiment.

[dividing line]

 Made the arrangement shown in the figure - placed needle in the spiral at a, found it indicated a current in the direction towards the jar.

[dividing line]

Next repeated same experiment with a set of of spirals (see page 238)- all gave current in the same direction as the last, but I took a spark from the prime conductor accidentally, which perhaps interfered with the result - for when the experiment was again tried with a heavy charge, all the needles were reversed [^][[except the last which gave ~~of~~]]. In this experiment a spark was seen at ~~of~~ c ~~of~~. Next repeated the experiment ~~of~~ by ~~of~~ separated conductor from jar, so that no spark was perceived at c, still the magnetism as the last, ~~of~~ adverse ~~of~~. The needle in no 4 was again not magnetic.

Next Repeated the experiment with the difference of making the



conductor a part of the circuit. The spirals in  [[writing in left margin: see vol 3 p59]] this and the last two experiments were attached to the ~~insulated~~ insulated metal plate. The result was now different from the last, the needles in spiral no 1 was magnetized [^]~~strongly~~ indicating a current towards the jar, also that in no 2 the same, while those in nos 3 & 4 were oppositely magnetized. This effect would indicate what I suspected, the action of two currents, and it would also appear that the current ~~towards~~ ~~from the jar~~ was the more intense of the two because it prevails in the ~~current~~ ~~single spirals~~.
Tried the spirals by a spark from the machine, found all the needles magnetized in the plus direction. Sent a heavy shock from the single jar through spirals, found all the needles powerfully magnetic plus direction

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

283

June 6th 1842

[[squiggly line]] Investigation relative to the spiral

Repeated the last exp sent shock through all the spirals, same result.

[[line across page]]

[[image]]

Next mated the two sets of spirals together, so that they formed 8 consecutive spirals. needles no 5

[[written on left margin]] one jar [[written on left margin]]

[[table of results drawn horizontally; transcribed vertically.]]

1st set

No - Defl
1 41 1/2+
2 42+
3 35+
4 29+

2nd set

1 41+
2 41 1/4+
3 33 1/2+
4 30 1/2+

[[notation sideways in end of table]] static deflection [[/notation]]

[[/table]]

In both sets of spirals in this experiment the 2nd spiral gives the stronger magnetism. This is probably owing to the imperfect insulation which suffers more electricity to pass between the spires of the compound than the more simple spiral.

[[dividing line across page]]

Exp. 8.

[[table of results drawn horizontally; transcribed vertically.]]

needles No 5

1st set

No. Dif.
1 35 1/2°+
2 37 1/2°+
3 28°+
4 27°+

2nd set

1 32 1/2°+
2 31°+
3 29 1/2°+
4 27°+

[[/end table]]

[[notation sideways beside end of table]] static deflection [[/notation]]

In the above experiment the discharge was somewhat less than the last.

The first and second as a mean will give about the same.

[[dividing line across page]]

Repeated the same exp with much stronger charge.

[[table of results drawn horizontally; transcribed vertically.]]

needles 5

1st set

No Defl
1 38°+
2 35°+[[overwritten to: 38°?]]
3 30°+
4 30°+



2nd set
 1 38°+
 2 38 1/4°+
 3 29 1/2°+
 4 31°+
 [[/end table]]
 [[notation sideways beside end of table]] statical def [[/notation]]
 [[dividing line across page]]
 Exp. 9.
 [[table of results drawn horizontally; transcribed vertically.]]
 needles 5
 1st set
 No Defl
 1 38°+
 2 38°+
 3 35°+
 4 31 1/2°+

2nd set
 1 36 1/2°+
 2 38 1/2°+
 3 33 1/2°+
 4 31 1/2°+
 [[/end table]]
 This result was obtained by two jars.

NB The above experims must be repeated with needles of different sizes in the two sets of spirals.
 [[end page]]

[[start page]]
 [[checkmark]]
 284
 June 7th 1842
 [[vertical squiggly line]] spiral continued

To test by direct experiment the hypothesis I have formed I passed through the two sets of spirals a spark from the machine and then a smaller one in the opposite direction

[[image in left margin: cut-away drawing of hand with index finger pointing to the paragraph to follow]]
 The result was as follows --
 needle in spiral ~~[[strikethrough]]~~ No 1+ No 2+ No 3-0 No 4 -
~~[[/strikethrough]]~~
 1st set No 1- No 2- No 3. No 4+
 2nd set No 1- No 2- No 3. No 4+

This is a beautiful confirmation of the theory.
 [[dividing line across page]]
 Next sent a very small charge from two jars through both sets of spirals. The following was the result
 [[table of results drawn horizontally; transcribed vertically.]]
 1st set
 No Defl
 1 28 1/2°+
 2 28°+

3 22 1/2+
4 20+

2nd set

1 30
2 27
3 23
4 20

[/end table]

[[dividing line across page]]

Sent a very small charge from one jar through both sets of spirals.

[[table of results drawn horizontally; transcribed vertically.]]

needles 5

1st set

No Defl

1 28°+
2 25°+
3 20°+
4 17 1/2°+

2nd set

1 28°+
2 25°+
3 20°+
4 18°+

[/end table]

[[dividing line across page]]

Next sent single spark from Prime conductor through both sets of spirals. The following is the results

[[table of results drawn horizontally; transcribed vertically.]]

needles 5

1st set

No Defl

1 13°+
2 12°+
3 feeble+
4 0

2nd set

1 12 1/2°
2 11°
3 feeble+
4 0

[/end table]

[[notation sideways along right edge of page beside all three tables of results]] all by statical defl and needles No 5 [[/notation]]

In this case the magnetism of the needles in spirals No 3 and 4 was so feeble that the softness ^[[so to speak]] which I have found at the end of the needle was attracted by the index needle

[[dividing line across page]]

[[notation sideways in left margin]]

[[Number ?]] of 2 38 1/3

Do of 1 36

[[Niss??]] of 1[[? or superscript 1?]] 23 1/3

" [[ditto for: [[Niss??]]]] of 2[[superscript 3?]] 21 1/3

[[/notation]]

In all these results it appears ^[[that]] with a heavy charge the magnetism developed in spiral no 2 [[overwritten by 3?]] is greater than that in No 1 and the contrary when the charge is small. This I think is due to the striking across of the discharge from spire to spire the

tendency being of course greater in the more compound spiral [and the
reason reflexiv[[ness?]] June 9th 1842

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

2

285

June 7th 1842

[[vertical squiggly dividing line]]

Investigation of the spiral continued

[[notation sideways along left edge of page]] N. B. all the experiments on this page were made with needles of no 5. [[/notation]]

Next made a new spiral of three strata put in the circuit with spiral no one of one of the sets passed shock of intensity through both from two jars. The new spiral was insulated between the layers by gold

[[bealers?]] skin still I perceived at each discharge a flash between the ends of the different strata and this appeared to materialize a considerable part of the magnetic power.

new spiral 23°

spiral No 1 35°

again

new spir 24 1/2°

spiral no 1 36°

In the last experiment, the spark appeared at the lower extremity of the spiral and in the fist at the upper - no spark was seen between the spires of the old spiral and it is probable that it passed along from spire to spire throughout the two surfaces of spires which were in contact.

[[two short dividing lines]]

Next used a spiral the several spires of which were insulated by coating of cement, but a spark appeared between the ends of the layers in this, as in the last and the result was the same

[[dividing line across page]]

Sent a smaller spark from 2 jars through the two coils of the above expermnts. The result was about the same.

Large coil 27. Smaller 33.

It is not improbable that the larger coil was injured by the discharge from the two jars of the previous experments.

[[dividing line across page]]

Passed a small spark from the Prime conductor through the

[[/strikethrough]] machine [[/strikethrough]] two spirals. The one consisted of 6 spirals with 45 spires in each, the other - 3 strata of spirals.

Larger spiral gave deflec 16 1/2°

Smaller do " " 13°

From this it appears that when there is no cutting across from spire to spire, the greater the number of spires the greater ^[[is [[its?]]]] magnetic development.

[[end page]]

[[start page]]

[[checkmark]]

286

June 7th 1842

[[vertical squiggly dividing line]]

Investigations of the spiral continued [[underlined separately]] needles magnetized minus [[/underlined]]

Commenced a series of experments similar to those seen in the last three pages with small needles no 12

[[results presented horizontally; transcribed vertically]]



1st set

No	Def.
1	15 1/2+
2	14 1/2+
3	12+
4	7 3/4+

2nd set

1	15 1/2+
2	13 3/4+
3	12 1/4+
4	6+

[[/end results]]

The current here was a very small spark the prime conductor

[[dividing line across page]]

Small charge from two jars

[[results presented horizontally; transcribed vertically]]

1	10
2	13 1/2
3	15
4	15 1/2

1 9 1/2

2 14

3 15

4 15 1/2

[[/end results]]

[[dividing line across page]]

Little large charge from 2 jars

[[results presented horizontally; transcribed vertically]]

1st set

1	6 1/4
2	5 1/2
3	16°
4	17

2nd set

1 21 1/4

2 2

3 15

4 17 1/2

[[/end results]]

needles no 9

[[dividing line across page]]

Litt larger charge from 2 jars quantity not great

[[image in left margin: large asterisk]]

[[results presented horizontally; transcribed vertically]]

1st set

No	Defl
1	15 1/2+
2	26 1/2+
3	10-
4	13+

2nd set

1 26+

2 26+

3 10-

4 7 [[3/4?]]

[[/end results]]

needles no 9

The result of last experiment completely over throws my supposition that the change of direction is accidental. It can scarcely be possible that the needles in the two spirals 3 & 3 should both accidentally and by cutting across of the electricity magnetize just these two needles while all the others are plus. This is the first unequivocal example I have yet found of the change of sign with a direct current ~~as in the case of electricity.~~

I must follow out this result with great care.

[[short dividing line]]

[[vertical squiggly line at left side of paragraph to follow]] I thought that perhaps the last effect might have been produced by a spark passing to my fingers but on repeating the experiment with precaution in this respect I found the same result. see top next page.

[[short dividing line]]

After reflection on the cause of this phenomenon I am disposed to attribute it to a series of inductions backward~~s~~ and forward in the primary conductor.

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

287

June 8th 1842 Monday

[[vertical squiggly dividing line]]

Investigations of the spiral continued

[[all results on these pages written in hand-drawn horizontal tables;
transcribed vertically.]]

The following are the results of the exp. at the bottom of the last page.

[[note in left margin]] 2 jars tolerably charged [[/note]]

[[table]]

needles 11 & 12

1st set

No Defl

1 26 1/2+

2 26 1/2+

3 6 1/4+

4 12+

2nd set

1 27+

2 27 1/4+

3 2-

4 7+

[[/end table]]

Next commenced a series of experiments with the battery (French) 9 jars

[[dividing line across page]]

[[note in left margin]] charge 2 sparks needles no 11 & 12 [[/note]]

[[table]]

1 5⁺

2 8+

3 14 3/4+

4 16+

1 13⁺

2 4+

3 16+

4 16 1/2+

[[/end table]]

[[note in left margin]] ch 4 sparks needles 11 [[/note]]

[[table]]

1 7+

2 11 1/4+

3 17 1/2

4 15 1/2

1 10

2 10

3 18

4 16 1/4

[[/end table]]

[[note in left margin]] charge 6 sp³ needles

11 [[/note]]

[[table]]

1 17+

2 12+

3 14+

4 16 1/2+



1	18+
2	13+
3	13 3/4+
4	17+

[[/end table]]
[[note in left margin]] ch 8 sparks needles no 11 [[/note]]
[[table]]

1	19+
2	26 1/2+
3	11 1/2+
4	15+

1	20+
2	18+
3	12 1/2+
4	14+

[[/end table]]
[[note in left margin]] charge 10 sp needles 11 [[/note]]
[[table]]

1	18+
2	16 1/2+
3	1+
4	18

1	18
2	17 1/2
3	9+
4	11

[[/end table]]
[[note in left margin]] charge 12 needles 11 [[large *]] [[/note]]
[[table]]

1	9+ [[+ overwrites 1/2]]
2	8 1/2+
3	X *
4	feeble+

1	feeb-
2	8+
3	14-
4	feeb-

[[/end table]]
[[note in left margin]] ch 14 [[/note]]
[[table]]

1	18+
2	16+
3	10 1/2+
4	10 1/4+

1	19+
2	16+
3	11 1/2+
4	9+

[[/end table]]
...* The needle dropped out of the spiral
[[end page]]

[[start page]]

[[checkmark]]

288

June 8th 1842 Monday

[[vertical squiggly dividing line]]

Investigation of the spiral continued

[[note in left margin]] ch 16 needles no 10 [[/note]]

[[table]]

1 22+

2 22+

3 22+

4 19 1/2+

1 22 1/2+

2 22 1/2+

3 21 1/4+

4 21+

[[/end table]]

[[note in left margin]] ch 20 needles no 10 [[/note]]

[[table]]

1 12 1/2+

2 15+

3 18 3/4+

4 22

1 17 1/2+

2 15+

3 18 1/4+

4 23+

[[/end table]]

[[note in left margin]] ch 25 needles no 10 *[[/note]]

[[table]]

1 13+

2 8 1/2+

3 13 1/2-

4 16 3/4

1 19+

2 10+

3 13-

4 14+

[[/end table]]

[[note in left margin]] " [[ditto for: ch]] 30 " [[ditto for: needles]] no 9

[[/note]]

[[table]]

1 17 1/2+

2 13 1/2+

3 8 3/4+

4 14 1/2+

1 21+

2 17+

3 10+

4 15+

[[/end table]]

[[note in left margin]] " [[ditto for: ch]] 35 no 9 * [[/note]]

[[table]]

1 22 1/2+

2 20+

3 17+
4 9-

1 23+
2 22 1/2+
3 16+
4 feeble+

[[/end table]]

[[note in left margin]] " [[ditto for: ch]] 40 no 9 * [[/note]]

[[table]]

1 22 1/2+
2 21 1/2+
3 14+
4 11-

1 24+
2 22 1/2+
3 14 1/4+
4 8-

[[/end table]]

[[note in left margin]] 50 - no 9 [[/note]]

[[table]]

1 22 1/2+
2 23+
3 18 1/2+
4 12+

1 22+
2 22+
3 19+
4 12 1/2+

[[/end table]]

[[note in left margin]] 55 no 9 [[/note]]

[[table]]

1 19 1/2+
2 20 1/2+
3 18+
4 13+

1 20 1/2+
2 18 1/2+
3 18+
4

[[/end table]]

[[note in left margin]] 60 no 9 [[/note]]

[[table]]

1 21+
2 20+
3 16+
4 16 1/2+

1 23+
2 18 1/2+
3 16 3/4+
4 16 1/2+

[[/end table]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

289

June 8th 1842

[[vertical squiggly dividing line]]

Investigation of the spiral continued

[[all results on these pages written in hand-drawn horizontal tables;
transcribed vertically.]]

[[note in left margin]] ch 65 [[/note]]

[[table]]

1	23 1/2+
2	25+
3	20+
4	13+

1	25 1/2+
2	23 1/2+
3	28 1/2+
4	27 1/2+

[[/end table]]

[[note in left margin]] charge 70 no 9 * [[/note]]

[[table]]

1	18-
2	15-
3	0-/+
4	13 1/2+

1	18-
2	18 1/2-
3	0
4	13+

[[/end table]]

Repeated the same with the same charge except that needles no 10
were used. The general result as it regards the sings was the same.

[[note in left margin]] ch 80 needles 10 [[/note]]

[[table]]

1	17 1/2+
2	16 1/2+
3	18 1/2+
4	18+

1	18+
2	18+
3	20+
4	18 1/2+

[[/end table]]

[[note in left margin]] ch 90 n 10 [[/note]]

[[table]]

1	29 1/2+
2	29 1/2+
3	26 1/2+
4	22+

1	31+
2	29 1/2+
3	26+



4 23+

[[/end table]]

[[note in left margin]] ch 100 [[/note]]

[[table]]

1	30+
2	25+
3	22
4	15

1	30
2	30
3	27 1/2
4	15 1/4

[[/end table]]

[[dividing line across page]]

In all these experimts the French battery of 9 jars was used
 Commenced a series of experiments with the battery and the larger
 needles no 5

[[note in left margin]] ch 5 ne^d no 5 [[/note]]

[[table]]

1	32+
2	27+
3	23 1/2+
4	23 1/2+

1	32+
2	28+
3	23 1/2+
4	23 3/4+

[[/end table]]

[[note in left margin]] ch 10 no 5 [[/note]]

[[table]]

1	33 1/2+
2	35 1/2+
3	32+
4	24+

1	36+
2	35 1/2+
3	32
4	35 1/2

[[/end table]]

[[note in left margin]] ch 15 no 5 [[/note]]

[[table]]

1	30+
2	34+
3	33 1/2+
4	29 1/2+

1	34+
2	36+
3	33+
4	29 1/2+

[[/end table]]

[[end page]]

[[start page]]

[[checkmark]]

290

June 8th 1842

[[vertical squiggly dividing line]]

Investigations of the spiral continued

[[note in left margin]] charge 20 same needles [[/note]]

[[table]]
1 25 1/2+
2 24+
3 27 1/2+
4 28+

1 21 1/2+
2 14+
3 28+
4 30+

[[/end table]]

[[note in left margin]] ch 25 no 5 [[/note]]

[[table]]
1 20 1/2+
2 19+
3 26+
4 26+

1 22 1/2+
2 22 1/2+
3 21+
4 26+

[[/end table]]

[[note in left margin]] ch 30 [[/note]]

[[table]]
1 27+
2 19+
3 18+
4 24+

1 28+
2 22+
3 21+
4 24 1/2+

[[/end table]]

[[note in left margin]] 40 [[/note]]

[[table]]
1 29 1/2+
2 28+
3 23 1/2+
4 30+

1 28 1/2+
2 28 1/2+
3 30 1/2+
4 29 1/2+

[[/end table]]

[[note in left margin]] 50 [[/note]]

[[table]]
1 [[overwritten]] 33 [[or]] 34 [[/overwritten]]+
2 34+
3 31+
4 31+

1	36+
2	32 1/2+
3	31+
4	31 3/4+

[[/end table]]
 [[note in left margin]] ch 60 [[/note]]
 [[table]]

1	33 1/2+
2	33+
3	27+
4	30+

1	34+
2	32+
3	26+
4	30+

[[/end table]]
 [[note in left margin]] ch 70 [[/note]]
 [[table]]

1	31+
2	32+
3	28+
4	30+ spark

1	33+
2	29+
3	26 1/2+
4	22+

[[/end table]]
 [[note in left margin]] ch 80 [[/note]]
 [[table]]

1	
2	
3	
4	

1	34+
2	31+
3	27+
4	26 1/2+

[[/end table]]
 [[note in left margin]] ch 90 [[/note]]
 [[table]]

1	
2	
3	
4	

1	38
2	21
3	15 1/2
4	3

[[/end table]] *
 [[note in left margin]] ch 95 [[/note]]
 [[table]]

1	33 1/2+
2	28+
3	27+

4 22+

1 40+

2 29 1/2+

3 26+

4 26+

[[/end table]]

[[note sideways beside tables for ch. 25 to 95]] all the needles used in these experiments were of No 5 [[/note]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

291

June 9th 1842

[[vertical squiggly dividing line]]

Investigation of the spiral continued Larger
needle no 5

[[all results on these pages written in hand-drawn horizontal tables;
transcribed vertically.]]

[[note in left margin]] Charge in spark of unit jar 100 [[/note]]

[[table]]

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	41+
2	31+
3	34 1/2+
4	22+

[[/end table]]

[[note in left margin]] 110 [[/note]]

[[table]]

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	32+
2	29+
3	21+
4	24+

[[/end table]]

This was the first exp of to day and as the weather is dark and rainy the
charge was not as great as the unit would represent

[[note in left margin]] Charge in spark of unit jar 120 [[/note]]

[[table]]

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	29+
2	27 1/2+
3	22+
4	25+

[[/end table]]

[[note in left margin]] Charge in spark of unit jar 140 [[/note]]

[[table]]

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]



1	31+
2	30 1/2+
3	19+
4	27+

Charge in spark of unit jar 160

1	
2	
3	
4	

1	29+
2	29+
3	23+
4	29+

Battery warmed spark more intense

Charge in spark of unit jar 180

1	
2	
3	
4	

1	36 1/2+
2	38+
3	26+
4	20+

French batter 9 jars

Charge in spark of unit jar 190

1	
2	
3	
4	

1	36 1/2+
2	37+
3	21+
4	28 1/2+

Battery cold

Charge in spark of unit jar 200

1	
2	
3	
4	

1	37+
2	37+
3	[[29 ?]]+
4	27 1/2+

Charge in spark of unit jar 225

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	34 1/2+
2	35+
3	31 1/2+
4	26+

Charge in spark of unit jar 250

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	37+
2	37+
3	37+
4	32+

Charge in spark of unit jar 275 full charge

1	[[blank]]
2	[[blank]]
3	[[blank]]
4	[[blank]]

1	32+
2	33 1/2+
3	22+
4	19+

292

June 9th 1842

Investigations relative to the spiral continued

The last series of experiments on needles of the larger size, but such as I have been in the habit of using in my previous researches, at least with few exciptions, give no change in direction from the smallest charge of

the battery to the full capacity of the apparatus.

Next compared needles no 12 & no 5 - one placed in one set of spirals and the other in the other.

Charge in sparks of unit machine 25

1	26+
2	23+
3	22+
4	18+

needles no 5

1	34+
2	29+
3	31+
4	32+

30

1	23+
2	24+
3	21 1/2+
4	27+

n no 5

1	32+
2	26 1/2+
3	32+
4	32+

35

1	
2	26+
3	20+
4	22+

no 5

1	33+
2	28+
3	26+
4	31+

40 asterisk drawn as an x with a dot above and below

1	21 1/2
2	23+
3	16+
4	3+

needles no 5

1	26 1/2
2	25
3	17
4	27 1/2

[[/end table]]

[[note in left margin]] 45 [[large asterisk]] [[/note]]

[[table]]

[[underlined]] needles no 12 [[/underlined]]

1	21 1/2
2	23+
3	16+
4	3+

[[underlined]] needles no 5 [[/underlined]]

1	26 1/2
2	25
3	17
4	27 1/2

[[/end table]]

[[note in left margin]] 50 [[/note]]

[[table]]

[[underlined]] needles no 12 [[/underlined]]

1	26 1/2+
2	26+
3	18+
4	21+

[[underlined]] needles no 5 [[/underlined]]

1	31+
2	28 1/2+
3	23+
4	30+

[[/end table]]

[[note in left margin]] 43 [[/note]]

[[table]]

[[underlined]] needles no 5 [[/underlined]]

1	26+
2	21+
3	18 1/2+
4	16+

[[underlined]] needles no 5 [[/underlined]]

1	34+
2	26 1/2+
3	26+
4	33+

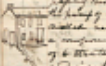
[[/end table]]

The above comparative experments agree on the whole remarkably well with those given at page 288 with about the same charge of the battery -
 - On account of the moisture of the atmosphere it is difficult to charge the battery to precisely the same amount as in the other experiments.

[[note written sideways along right edge of page, beside results tables for charges 50, 45, 40, 35]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

293 June 10th 1842 First
Induction from a thunder cloud

agreeably to the suggestion given at the bottom of page 263, I connected by soldering a copper wire (bell size) to the tin roof of our house, and passed the lower extremity into the water of the well. This was effected by ~~fastening~~ a ~~fastening~~ cylinder of lead to the end of the wire, and passing this through a hole in the cover near the pump of the well.  The wire was then divided near the window of the study, and a compound spiral inserted. This was formed of 6 strata of wire, each consisting of 40 spires and insulated by cement. After this arrangement was completed (on Monday last), I waited with some anxiety for the appearance of a thunder cloud, but none appeared until last evening, when I observed before going to bed a few very distant and faint flashes of light, but too distant to produce any effect: they must have been from a cloud at the distance of 100 miles. I placed a needle [^]in the ~~helix~~ spiral, and then went to bed; at a little before three o'clock, I was awakened by a storm of rain, and heard several distant discharges of lightning. I did not rise, but ~~the~~ in the morning I found the needle strongly magnetic in the direction which indicated a current upwards. This result is precisely in accordance with my anticipations, and perfectly analogous to the experiment described page 263. The deflection of the needle magnetized by the flash was $23 \frac{1}{2}^\circ$ minus.

June 10th & 11th 1842 Experiments with the spiral 294

Commenced a series of experiments with needles No 5, and a fine wire spiral (plated) containing about 200 spires, I commenced with 5 spark and increased the charge to 30, when I obtained a minus polarity strongly developed. I however could get this but once, although I experimented several times with the same charge. The weather however is so unfavorable for experiments of this kind, that the battery will not hold its charge, and therefore there is some uncertainty relative to the exact quantity of electricity which produced the above result

June 11th Saturday

Repeated the experiments on the magnetization with the fine wire spiral. Commenced at 30 and went up to ^{150? or 160? middle digit overwritten}, the full jar of the jar. The weather is very fine to day for electrical experiments, and the battery holds the charge well. In the whole series of the experiments I have not obtained a single negative result. Repeated the experiment with the lower charges, and also took the lower series found a charge at 29 & 30, the same as in the first exp on this page.

The following is the series of deflections obtained

2	4	6	8	10	12	
27	26	25	1/2	33	25	26
15	20	25	19	30		
24	27					25
35	40	45	50	55		



16 31 35 18° 24°

60 65 70 75 80
29 27 34 23° 23 1/2°

90 100
36 1/2 19 1/2

[[dividing line]]

My experiments are interrupted on account of the illness of the colored
servant of the Laboratory, Sam Parker

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

295 June 13th Monday 1842 Second Induction from a thunder cloud
A thunder storm occurred again to day [^]at about 7 o'clock p.m.] but as is usual in this village, the lightning was at a distance. There were two reports; at the time of the first, no needle happened to be in the spiral. Before the next one came, the rain was falling in great quantity; but notwithstanding this, the needle was magnetized by the second flash. The distance of the thunder must have been between 3 and four miles, as indicated by the interval between the flash and the report. The induction effect was the same in this case as in that of the morning of the 10th, the needle was magnetized with the end in the spiral, a south pole indicating a discharge upwards.

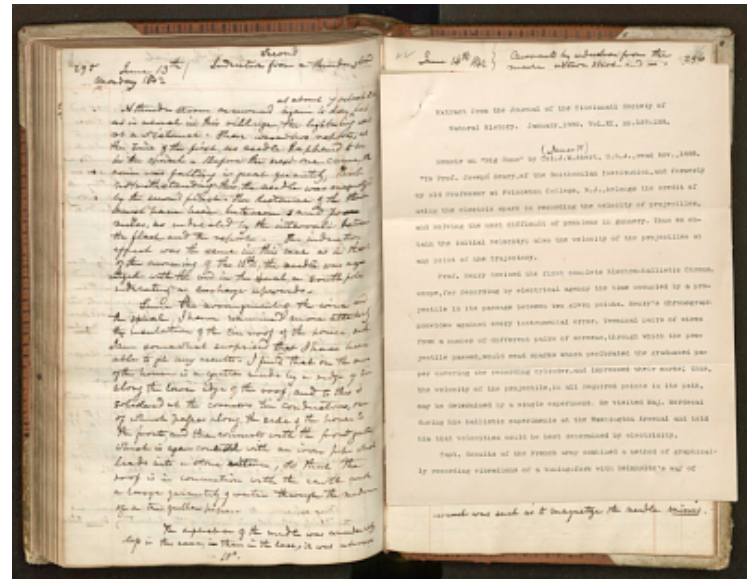
Since the arrangement of the wire and the spiral, I have examined more attentively the insulation of the tin roof of the house, and I am somewhat surprised that I have been able to get any results. I find that on the rear of the house is a gutter made by a ridge of tin along the lower edge of the roof, and to this is soldered at the corners tin conductors, one of which passes along the side of the house to the front, and then connects with the front gutter, which is again connected with an iron pipe which leads into a stone cistern, so that the roof is in connection with the earth and a large quantity of water through the medium of a tin gutter pipe. The deflection of the needle was considerably less in this case, in than in the last, it was about 10 °.
[end page]

[start page]
296

[checkmark]
[two checkmarks] June 14th 1842
[vertical squiggly divider line] Currents by induction from the machin return strokes [remainder covered by top portion of a typewritten sheet of paper laid over the page.]

[text from typewritten sheet of paper laid over the journal page]
Extract from the Journal of the Cincinnati Society of Natural History. January, 1889. Vol. XI, pp. 127-128.

Memoir on "Big Guns" by Co. J. W. [^][[James W]] Albert, U. S. A., read Nov., 1888. "To Prof. Joseph Henry, of the Smithsonian Institution, and formerly my old Professor at Princeton College, N. J., belongs the credit of using the electric spark in recording the velocity of projectiles, and solving the most difficult of problems in gunnery. Thus we obtain the initial velocity; also the velocity of the projectiles at any point of the trajectory. Prof. Henry devised the first complete Electro-ballistic Chronoscope, for recording by electrical agency the time occupied by a projectile in its passage between two given points. Henry's chronograph provides against every instrumental error. Terminal pairs of wires from a number of different pairs of screens, through which the projectile passed, would send sparks which perforated the graduated paper covering the recording cylinder, and impressed their marks; thus, the velocity of the projectile, in all required points in its path, may be determined by a single experiment. He visited Maj. Mordecai during his ballistic experiments at the Washington Arsenal and told him that velocities could be best determined by electricity. Capt. Schultz of the French army combined a method of graphically recording vibrations of a turning-fork with Helmholtz's way of [typewritten sheet]



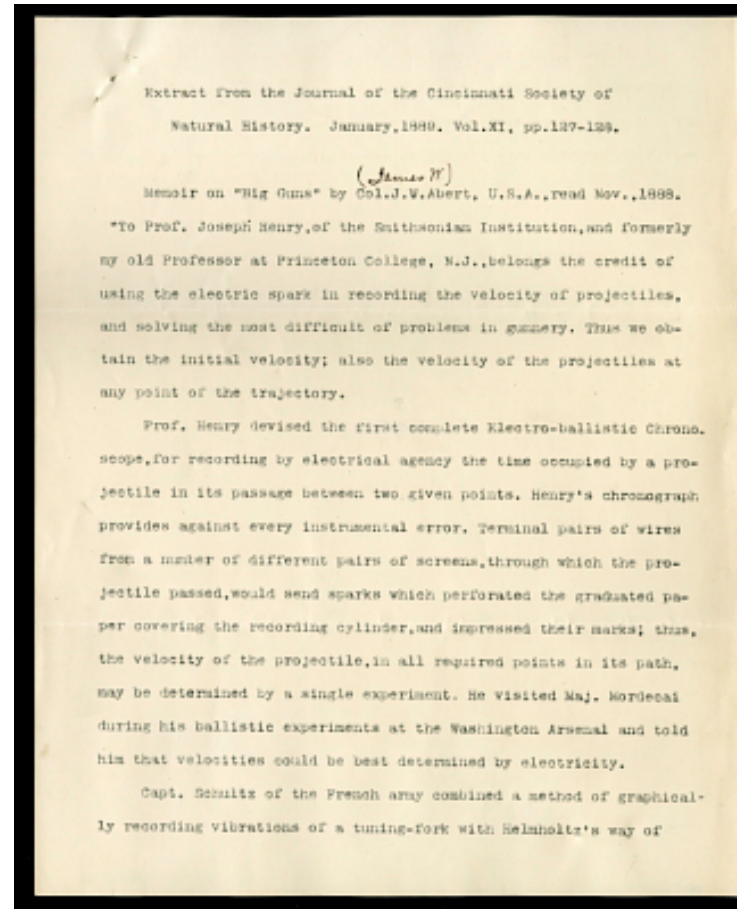
circuit was such as to magnetize the needle minus

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

Extract from the Journal of the Cincinnati Society of Natural History.
January, 1889. Vol. XI, pp.127-128.

Memoir on "Big Guns" by ^[[James W.]] Col.J.W.Abert, U.S.A., read Nov., 1888.

"To Prof. Joseph Henry, of the Smithsonian Institution, and formerly my old Professor at Princeton College, N.J., belongs the credit of using the electric spark in recording the velocity of projectiles, and solving the most difficult of problems in gunnery. Thus we obtain the initial velocity; also the velocity of the projectiles at any point of the trajectory. Prof. Henry devised the first complete Electro-ballistic Chronoscope, for recording by electrical agency the time occupied by a projectile in its passage between two given points. Henry's chronograph provides against every instrumental error. Terminal pairs of wires from a number of different pairs of screens, through which the projectile passed, would send sparks which perforated the graduated paper covering the recording cylinder, and impressed their marks; thus, the velocity of the projectile, in all required points in its path, may be determined by a single experiment. He visited Maj. Mordecai during his ballistic experiments at the Washington Arsenal and told him that velocities could be best determined by electricity. Capt. Schultz of the French army combined a method of graphically recording vibrations of a tuning-fork with Helmholtz's way of
[[end of page]]



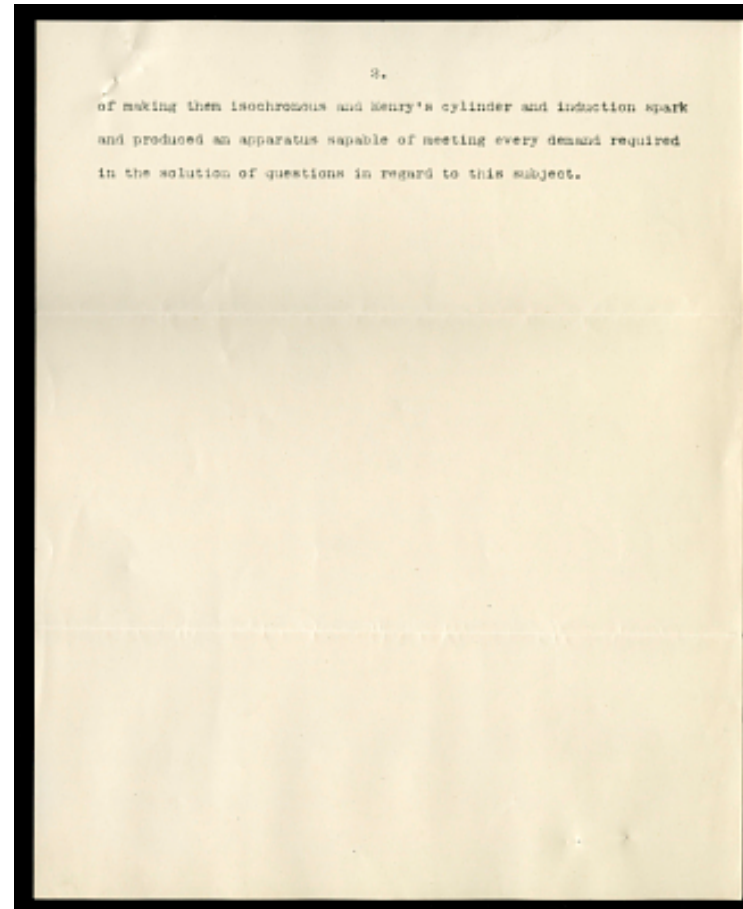
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[start of page]]

[[top margin]] 2. [[/top margin]]

of making them isochronous and Henry's cylinder and induction spark
and produced an apparatus sapable of meeting every demand required
in the solution of questions in regard to this subject.

[[end of page]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[top of page, right side]]Weather Bureau,
Washington, June 15, 1893.

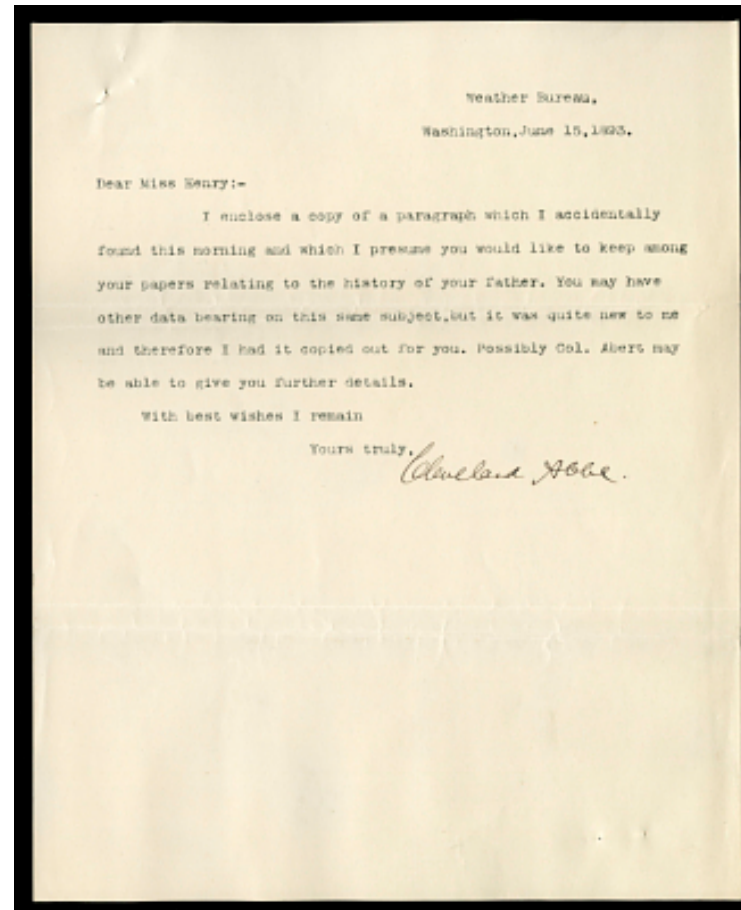
Dear Miss Henry:-

I enclose a copy of a paragraph which I accidentally found this morning and which I presume you would like to keep among your papers relating to the history of your father. You may have other data bearing on this same subject, but it was quite new to me and therefore I had it copied out for you. Possibly Col. Albert may be able to give you further details.

With best wishes I remain

Yours truly,

[[signature]]Cleveland Abbe



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

295 June 13th Monday 1842 / Second Induction from a thunder cloud

A thunder storm occurred again today ^ [at about 7 oclock P.M.] but at a distance. There were two reports; at the time of the first, no needle happened to be in the spiral. Before the next one came, the rain was falling in great quantity; but notwithstanding this, the needle was magnetized by the second flash. The distance of the thunder [?] have been between 3 and [?] miles, as indicated by the intervals between the flash and the report. The induction effect was the same in this case as in that of the morning of the 10th, the needle was magnetized with the end in the spiral, a south pole indicating a discharge upwards. Since the arrangement of the wire and the spiral, I have examined more attentively the insulation of the tin roof of the house, and I am somewhat surprised that I have been able to get any results. I find that on the [?] of the house is a gutter made by a ridge of tin along the lower edge of the roof, and to this is soldered at the corners tin conductors, one of which passes along the side of the house to the front, and then connects with the front gate, which is again connected with an iron pipe which leads into a stone cistern, so that the roof is in connection with the earth and a large quantity of water through the medium of a tin gutter pipe. The deflection of the needle was considerably less in this case, [?] in [?] than in the last; it was about -10 [degree symbol].

June 14th 1842 Tuesday -

Currents by induction from the [?] return stroke and [?] unfavorable weather for electrical experms 296

1 [Image of Leyden jar and wires] Attached a wire to the outside of a jar connected with the rectangle [page?]. Found an induced current which magnetized all the needles as if by a current in the [underline] plus [underline] direction.

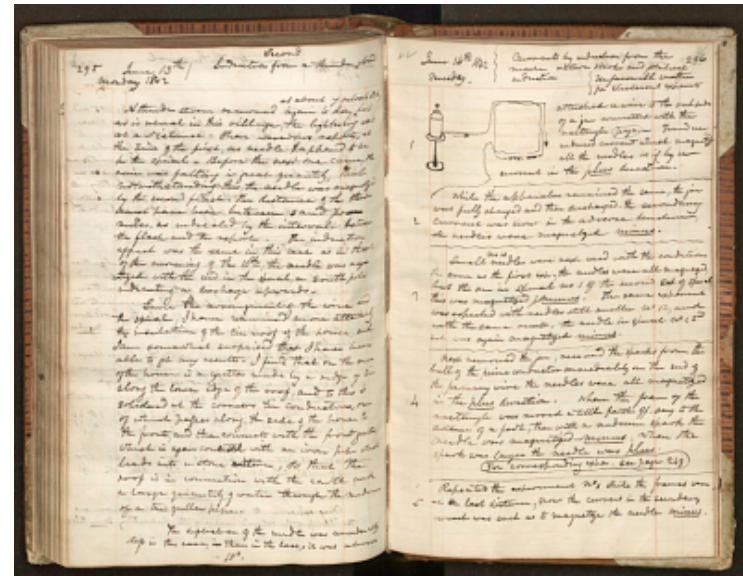
2 While the apparatus remained the same, the jar was fully charged and then discharged. The secondary current was now in the adverse direction, the needles were magnetized [underline] minus [underline].

3 Small no 10 needles were next used with the conditions the same as the first exp., the needles were all magnetized but the one in spiral no 1 of the second set of spirals, this was magnetized [underline] minus [underline]. The same experiment was repeated with needles still smaller no 12, and with the same result, the needle in spiral no 1, 2nd set was again magnetized [underline] minus [underline].

4 Next removed the jar, received the sparks from the ball of the prime conduction immediately on the end of the primary wire the needles were all magnetized in the [underline] plus [underline] direction. When the [frame?] of the rectangle was moved a little farther off, say to the distance of a foot, then with a medium spark the needle was magnetized [underline] minus [underline], when the spark was larger the needle was [underline] plus [underline].

For corresponding exper. see page 249

5 Repeated the experiment no 1 while the frames were at the last distance, now the current in the secondary circuit was such as to magnetize the needle [underline] minus [underline].



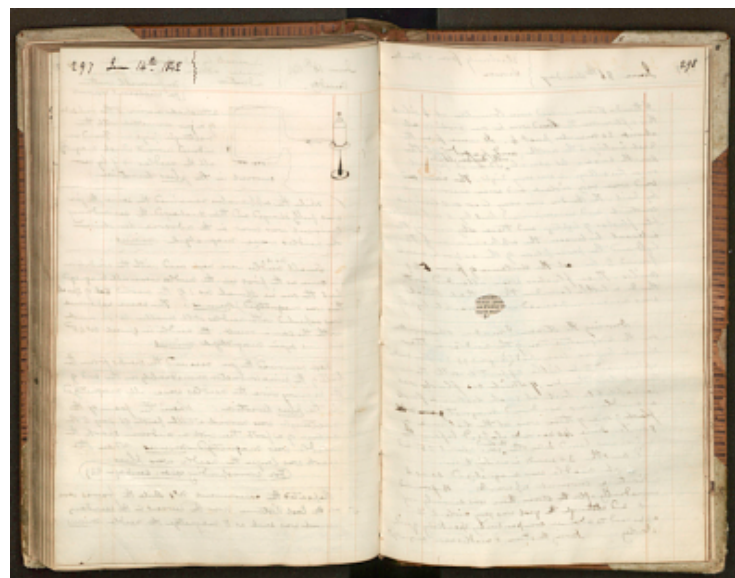
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

297 June 14th 1842 [[vertical line]]

[[end page]]
[[start page]]

298

persons.
storm pass
on Friday ev
there was
Ju



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

299 June 26th Sunday Electricity from a thunder shower

A thunder storm passed over [[Princeton?]] at 4 o'clock this afternoon, the cloud was in our [[?]] at about 20 minutes past 4. It came from the west [[inching?]] to the north, and passed [[?]] the south east. As usual ^ [[with thunder clouds,]] where it passed over this village, it was very high. The rain and wind were very violent, and were accompanied by hail. The thunder was very low [[not?]] loud, but constant, and accompanied but by 5 or 6 perceptible flashes of lightning, and these by counting the interval between the appearance of the light, and the perception of the report, were found to be at the distance of from 5 to 8 miles. These flashes were attended with thunder a little louder than that which was not accompanied [[? visible?]] lightning. During the storm, I made observations on the magnetization of the needles in the spiral before described (page 293). The needle appeared to be little affected with the [[?]] low thunder of which no flash was perceptible, but at each distinct flash, a needle was rendered magnetic [[strikethrough]] [[zed ? flash]] [[/strikethrough]] of one of these was at a distance of 8 miles, since 40 seconds elapsed before the report was heard. In another ^ [[the sound]] was about 25, and another 30 seconds in reaching the ear. Each needle was magnetized so as to indicate a current upwards. Before and immediately after the storm, there was scarcely any wind, and although the gust was very violent, it appeared to advance comparatively speaking quite slowly. During the storm, 5 needles were magnetized.

[[end page]]
[[start page]]

300

[[newspaper clipping]]

^[[?1842?]]

WOODSTOCK, COMBAREE, (S.C.) July 20.

Thunder Storm - Nine Persons Killed.

A dreadful thunder storm passed over this section of country, on Friday evening, the 17th inst., in which there was an awful destruction of human life. Just previous to its bursting upon them, twenty of the negroes belonging to the Hon. Henry Middleton being crowded into a house, whither they had repaired as a place of refuge, were struck down by a vivid flash of lightning, and the following is the result of the stroke. Four of them escaped entirely--two were severely shocked--five were stunned, and horrible to relate, nine were killed upon the spot. The electric fluid entered the house at the door, carrying part of the side of the house and gable, and after doing some other damage seemed to separate into different fragments, as each alternate individual was killed or wounded--it then left the house at the back door and in its passage killed two of the people five faces from the house, into which they were hastening. The nine who were killed never moved nor manifested any signs of animation, but presented a heap of mangled corpses. The five who were stunned recovered their senses only after the expiration of an hour, and two who were only severely shocked, did not lose their recollection. The visible and external marks were different according to the intensity of the stroke upon each. Those who were stunned were and are very much swollen and puffed up, especially in the extremities; but how shall I describe the appearance of those who were killed! Nine inanimate beings, who but a few hours before stood up in all the vigor of life, now lay riven and blasted by the dreadful thunderbolt. Their features and bodies bloated and swollen to the full extent of the skin, were so disfigured as nearly to obliterate the identity of the individual, the blood uncoagulated poured from their noses and ears, the muscles, as is usual, so entirely relaxed as to permit the body to be fixed in any



direction. In two only of these was there any abrasion of the skin, and that slight, extending mealy to the cuticle. Charleston Mercury.

[[/newspaper clipping]]

[[newspaper clipping]]

[[image of hand pointing]] ELECTRIC PHENOMENA AT TRENTON.--

The great lightning storm of 19th June, when extended 700 miles in length, presented at Trenton, N.J., some facts that are deserving of particular record. The extensive iron works at that place, belonging to Peter Cooper, Esq, of New York, became charged with electric energies from the storm. The iron damper connected with iron chains, was attempted to be lowered during the storm. The first person that laid hold of the chain was knocked down: a second made the attempt and shared the same fate, and a third received a severe shock. A fireman stirring the melted iron in the furnace, received a shock when he touched the molten metal with his iron stirrer. A tin dripping pan under the bellows was bruised as if a 56 lb. weight had fallen in its centre from a great height. There were in the works at the time between two and three hundred men, and about 2000 tons of iron, some in a state of fusion, some in a heated state, and the residue cold.

Peter Townsend, Esq, who has been an extensive manufacturer of iron forty years, informs me that he has noticed, during an extensive lightning storm, a tinkling sound among the pigs of iron lying upon the ground, while the lightning was active in the clouds. --Jour. of Conn.

[[/newspaper clipping]]

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[newspaper clipping]]

The

[[line across clipping]]

[[blank space]]

[[line across clipping]]

TRAVELLING LINES.

[[line across clipping]]

24 Hours in Advance of any other Line.

[[images: steam locomotive & carriage at left. Steamship at right]]

GREAT SOUTHERN UNITED STATES MAIL LINE.

The only Line Carrying the Great Mail.

TRAVELLERS, be on your guard, or you will be deceived by misrepresentations made by the steamboat and bay lines, as to speed or safety. Passengers for the South, taking the Steamboat and Bay Line which leaves Philadelphia every morning, via Norfolk and Portsmouth, CANNOT CONNECT at Weldon N. C. with the cars for Wilmington, consequently are detained in Weldon from 1 o'clock, P. M. until 7 o'clock, A. M. next day, when the train leaves Weldon, daily for Wilmington N. C.

Passengers bound to Charleston, by the Philadelphia Steamboat Line, are respectfully informed that there is as much despatch by remaining in Baltimore or Washington city all night, and taken this Line the following morning, as there would be by taking the Bay Line, via Norfolk to Weldon, where they would, of necessity, be detained in one of the most unhealthy places in the whole southern country, from 17 to 20 hours, until the arrival of the Mail Line.

The only Line which gives certain connection is the Mail Line that leaves Philadelphia at 1 o'clock, A. M. by the Railroad. The Railroad from Weldon to Wilmington, (N. C.) being finished, and the whole line in complete order, the Postmaster General has ordered the following fast schedule to take place from this date:

[[two columns, separated by vertical line]]

[[column one]]

LEAVES

Philadelphia 1 A.M.

Baltimore, 9 A.M.

Washington, 11 1/2 A.M.

Fredericksburg, 6 1/2 P.M.

Richmond, 12 P.M.

Petersburg [[cut off]]

[[/column one]]

[[column two]]

REACH

Baltimore, 8 A.M.

Washington, 11 A.M.

Fredericksburg, 6 P.M.

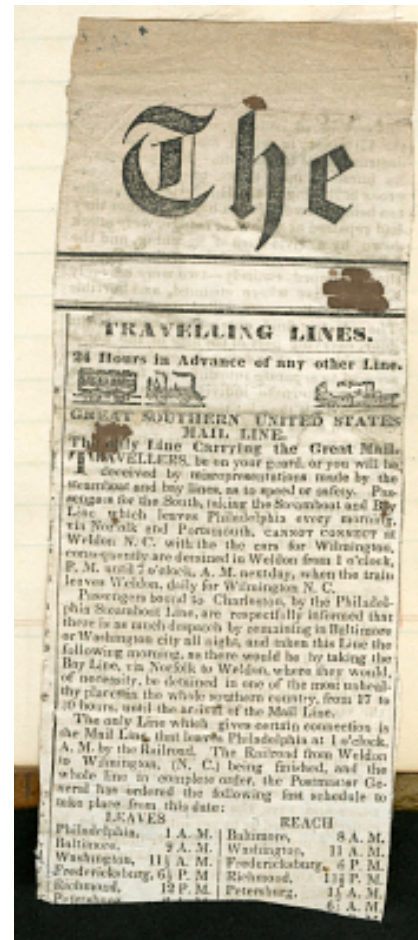
Richmond, 11 1/2 P.M.

Petersburg, 1 1/2 A.M.

[[cut off]] 6 1/2 A.M.

[[column two]]

[[/two columns]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[newspaper clipping]]
disturbances, growing out of that complaint, and we do recommend its use to others.

[[text in two columns]]

[[column one]]

F. W. Ricord
Wm. Douglass,
Robt. Crawford
Flavel Ross,
Amos S. Marvin
Thomas B. Cone,
Joseph Burroughs
Wm. H. Watkins,
Wm. Bradford,
O. W. Searing,
Wm. Whitty
S. S. Young,
Isaac Little,
David Thomas,

[[/column one]]

[[column two]]

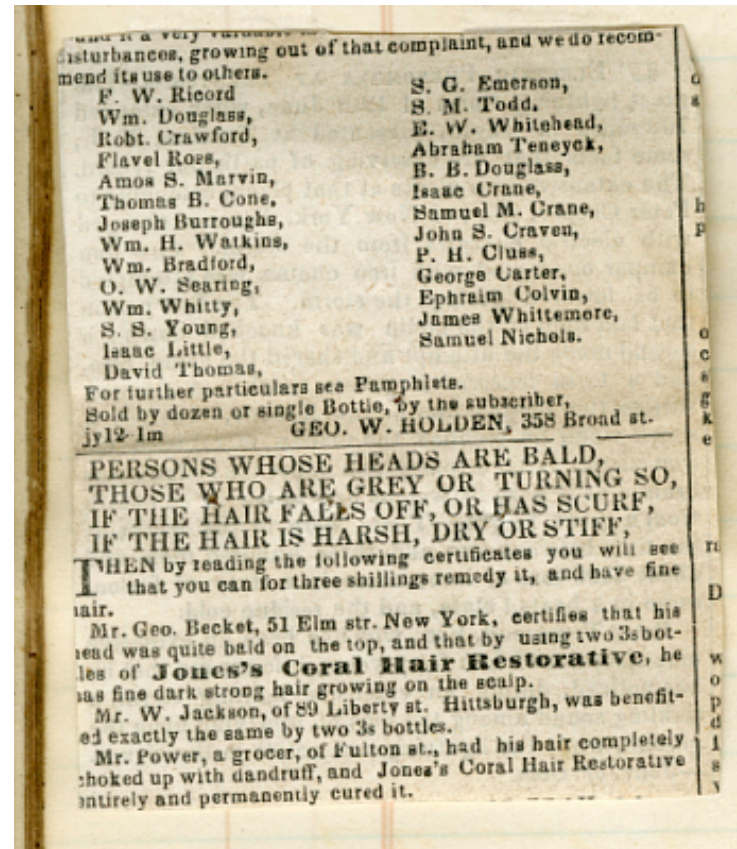
S. G. Emerson,
S. M. Todd,
E. W. Whitehead,
Abraham Teneyck,
B. B. Douglass,
Isaac Crane,
Samuel M. Crane,
John S. Craven,
P. H. Cluss,
George Carter,
Ephraim Colvin,
James Whittemore,
Samuel Nichols.

[[/column two]]

[[/text in two columns]]

For further particulars see Pamphlets.
Sold by dozen or single Bottle, by the subscriber,
jy12-1m GEO. W. HOLDEN, 358 Broad st.
[[line across clipping]]

PERSONS WHOSE HEADS ARE BALD, THOSE WHO ARE GREY OR TURNING SO, IF THE HAIR FALLS OFF, OR HAS SCURF, IF THE HAIR IS HARSH, DRY OR STIFF,
Then by reading the following certificates you will see that you can for three shillings remedy it, and have fine hair.
Mr. Geo. Becket, 51 Elm str. New York, certifies that his head was quite bald on the top, and that by using two 3s bottles of **Jones's Coral Hair Restorative**, he has fine dark strong hair growing on the scalp.
Mr. W. Jackson, of 89 Liberty st. Hittsburgh, was benefited exactly the same by two 3s bottles.
Mr. Power, a grocer, of Fulton st., had his hair completely choked up with dandruff, and Jones's Coral Hair Restorative entirely and permanently cured it.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

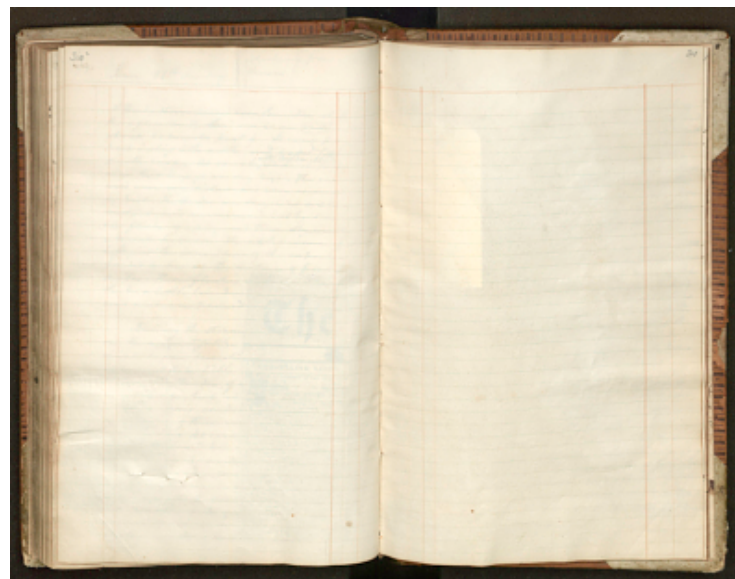
300 ²

[[page blank]]

[[end page]]

[[start page]]
301

[[page blank]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[left page blank]]

[[end page]]

[[start page]]

303

[[checkmark]]

July 19th Tuesday 1842

... [[binocular-shaped blot]] Since the last date, I have given an account of my expermnts to the american Phil society, and have informed some of my Friends abroad of the most prominent results. But my time has been so much occupied in college duties, writing letters, drawing up a report for an examination of a school, and examining old papers in the Transactions of the Royal society relative to electricity, that I have done nothing in the way of experment, except to make some observations on the electricty of the thunder cloud.

The first expermt this morning was made with the mug sustaining battery. 19 pots or mugs were arranged by Sam, the action was quite energetic.

[[tall rectangular scrap of blue-lined paper occludes the left two inches or so of the next 10 lines of text.]]

[[on scrap of paper]] House Struck by Lightning
July 9, 1842

Was a/c of this ever published?

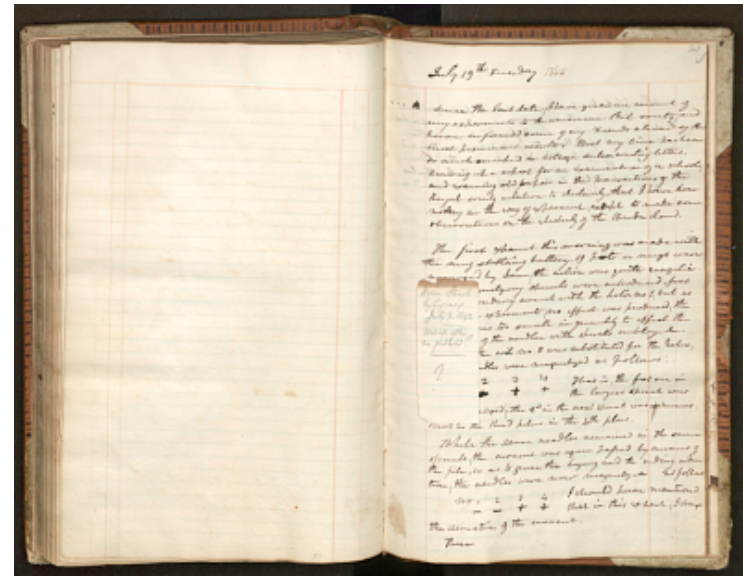
?[[/on scrap of paper]]

[[netizing spirals were introduced, first
[[ndary current with the helix no 1, but as
[[experiments, no effect was produced, the
[[as too small in quantity to effect the
[[of the needles with spirals employed.
[[the coil no 2 was substituted for the helix,
[[edles were magnetized as follows:
[[2 3 4 That is, the first one in
[[- + + the largest spiral was
[[etized - the 2nd in the next spiral was - minus, that in the third pilus, in
the 4th plus.

While the same needles remained in the same spirals, the current was again passed by means of the file, is as to give the beginning and the ending in direction, the needles were now magnetized as follows.

[[+ and - signs are indicated below each number in journal: transcribed on same line for clarity]]

No 1 - 2 - 3 + 4 + I should have mentioned that in this expent, I changed the direction of the current.
These



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[left page blank]]

[[end page]]

[[start page]]
303
[[checkmark]]

July 19th Tuesday 1842

... [[binocular-shaped blot]] Since the last date, I have given an account of my expermnts to the american Phil society, and have informed some of my Friends abroad of the most prominent results. But my time has been so much occupied in college duties, writing letters, drawing up a report for an examination of a school, and examining old papers in the Transactions of the Royal society relative to electricity, that I have done nothing in the way of experment, except to make some observations on the electricty of the thunder cloud.

The first expermt this morning was made with the mug sustaining battery. 19 pots or mugs were arranged by Sam, the action was quite energetic.

The magnetizing spirals were introduced, first into the secondary current with the helix no 1, but as in the old experiments, no effect was produced, the electricity was too small in quantity to effect the magnetism of the needles with spirals employed.

Next the coil no 2 was substituted for the helix, then the needles were magnetized as follows:

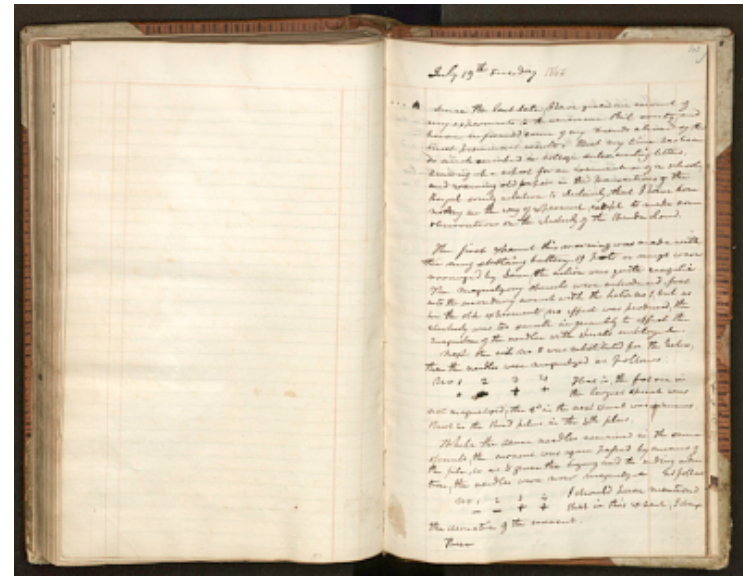
[[0, + and - signs indicated below the numbers in journal: transcribed on one for clarity; commas added]] No 1, 0 2,- 3,+ 4,+ That is, the first one in the largest spiral was not magnetized - the 2nd in the next spiral was - minus, that in the third pilus, in the 4th plus.

While the same needles remained in the same spirals, the current was again passed by means of the file, is as to give the beginning and the ending in direction, the needles were now magnetized as follows.

[[+ and - signs are indicated below each number in journal: transcribed on same line for clarity; commas added]]

No 1,- 2,- 3,+ 4,+ I should have mentioned that in this expent, I changed the direction of the current.

These



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

304 [[checkmark]]

attempted to get induced current from galvanic current when the secondary circuit was open, but did not succeed. Used for this purpose the coil no 1 for the battery, coil no.2 on this, and coil no.3. under, the spirals were then placed between the [^][[two]] ends of no 2 and 3, while the other two were separated, but no effect was observed on the fine needles.

[[end page]]

[[start page]]

305

[[checkmark]]

July 22nd 1842

Visited this afternoon in company Arch.^d Alexander [^][[MD.]], a house struck with lightning near the plain Tavern about 4 miles south east, or perhaps nearly east of Princeton, on the morning of July the 9th at about 10 o'clock - I regret that I did not go sooner to inspect the building ~~since~~ [^][[because]] the house has been since partially repaired, although the [^][[greater]] effects are still visible:

[[image of a two-story house with an attached single story at left, chimneys at each end, three windows and a door on the face of the two story wing and a window and a door on the face of the one-story wing. A well is indicated in the front 'yard' in front of the one-story wing and a hog pen is indicated off to the right and rear of the two-story wing. Various lines are drawn to indicate the lightning strike and path the electricity traveled. Farther to the right of the hog pen is a notation indicating the location of "another house."]]

The house is a tall narrow two story one, with a kitchen on the west side. It stands on the road with a small court yard in front, nearly east and west. The lightning struck the chimney of the house, part of the lightning passed into the chimney and down it about 8 feet, and then burst through to the front ~~corner~~ [^][[edge]], down which was a tin water conductor.

The principal part of the discharge passed down the corner post of the frame of the building and almost completely destroyed it, throwing some parts of it into the yard to the east to the distance of 20 yards, and even pieces of the clap boards were thrown off with such force as to fall on the house to the east at the distance of 35 yards. The principal part of the discharge passed down the corner post and perhaps along the gutter, and then appears to have scattered in every direction along the surface ~~which~~ [^][[of the ground]] which was flooded with water at the time - Around the house, in every direction, to the distance of 20 yards, marks on the vegetation of its passage were visible. At the distance of about 22 yards to the NE of the house, two pigs were killed out of seven in a pen. A part of the discharge passed along the ~~of~~ [^][[the]] garret, or rather of the floor of the garret of the main building, and then through



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[checkmark]]

[[underlined]] July 22nd 1842 [[/strickethrough]]

Account of House struck by lightning July [[underlined]] 9th
[[/underlined]] 1842

the garret of the kitchen - in which some pieces of stove-pipe were placed at the time - to the chimney of the kitchen - In its passage, it threw off [[underlined]] all the [[/underlined]] a great part of the plaster from the ceiling of the upper room.

Either the explosion of the main discharge, or the part which passed to the kitchen, exerted such an expansive influence on the air in the small garret, that the whole roof was lifted from its place, and all the rafters unloosened, the shingles were torn up and the whole effect resembled the operation of a quantity of confined gun-powder - nearly all the ^[[panes]] of glass in the house were broken.

At the same time of the stroke, the house was occupied by a man and his wife and two children. The woman was in the lower room, standing near the door which was closed, or nearly closed. The man was in the corner of the kitchen in the rear, and next to the house part, on his bench making shoes. The two children were at the kitchen point door, one had climbed up on a chair and was looking over the half door. The other was climbing up at the time. The woman heard nothing of the report, and must have been stunned at the moment. The man says that his head fell on his breast as if he had suddenly lost the power of sustaining it. He thinks that he raised it immediately, but cannot be certain - When he looked up, the children were both jumping up and down on the floor, but did not exhibit any signs of having been affected by the lightning. The woman did not complain of any effect, and the man was affected so slightly as to suffer but little inconvenience, although he thinks his head has not been as sturdy since the time of the accident.

a small part of the discharge passed down the wall since a ^[[small]] hole was observed on the crib,
[[end page]]

[[start page]]

307

[[checkmark]]

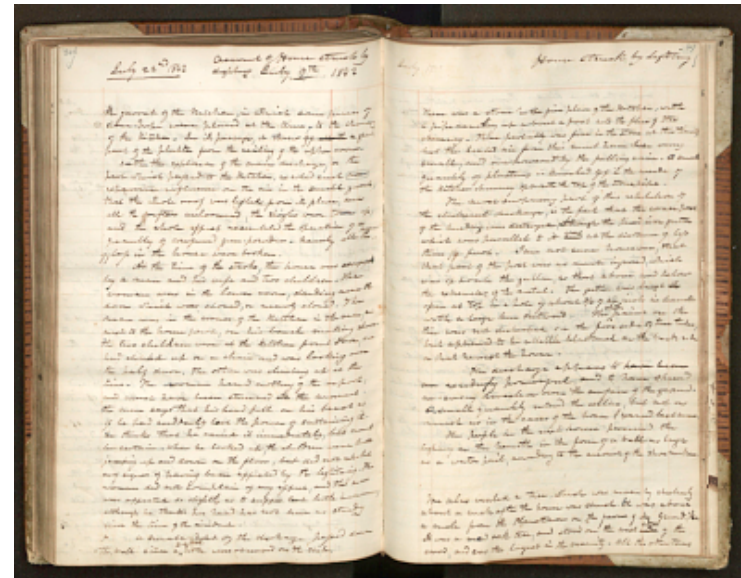
July 18[[faded]]

House struck by Lightning

There was a stove in the fire place of the kitchen, with a pipe reaching up about a foot into the flue of the chimney. There probably was fire in the stove at the time, but the heated air from this must have been very small, and overpowered by the falling rain. A small quantity of plastering is knocked off in the inside of the kitchen chimney opposite the top of the stove pipe -

The most surprising part of this exhibition of the electrical discharge, is the fact that the corner post of the building was destroyed, although the tinned iron gutter which was parallel to it [[/strickethrough]] and [[/strickethrough]] was at the distance of less than 1/[[?]] foot. I am not sure however, that that part of the post was as much ignored, which was opposite the gutter, as that above and below the extremities of the metal. The gutter was burst [[/strickethrough]] the [[/strickethrough]] open at top in a hole of about 3/4 of an inch in diameter with a [[?]] bin outward. The ^[[white]] paint on the tin was not disturbed ie the fore side of the tube, but appeared to be allittle blackened on the back side or that nearest the house.

The discharge appears to have been [[/strickethrough]] an
[[/strickethrough]] exceedingly powerful, and to have spread in every



direction over the surface of the ground. A small quantity entered the cellar, but not as much as in the case of the house I examined last summer.

The people in the next house perceived the lightning on the hearth in the form of a ball as large as a water pail, according to the account of the shoe maker.

We also visited a tree, which was riven by electricity about a week after the house was struck. It was about a mile from the Plain Tavern on the farm of Mr Grundiker. It was a red oak tree, and stood on the east ~~side~~ ^{edge} of the wood, and was the largest in the vicinity. All the other trees

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

308

[[checkmark]]

were of the same kind. There was nothing very particular in this case, the branches as in the trees I have before examined, were but little scathed, and the ~~which~~ ^{principal} zone of this discharge was on the main trunk, at about 12 feet from the ground. It was broken off at this point, although nearly 18 inches thick. The splinters were thrown to the distance of 75 yards.

For an account struck with lightning, see Edinburgh Phil ~~[[?]]~~ vol VI 379.

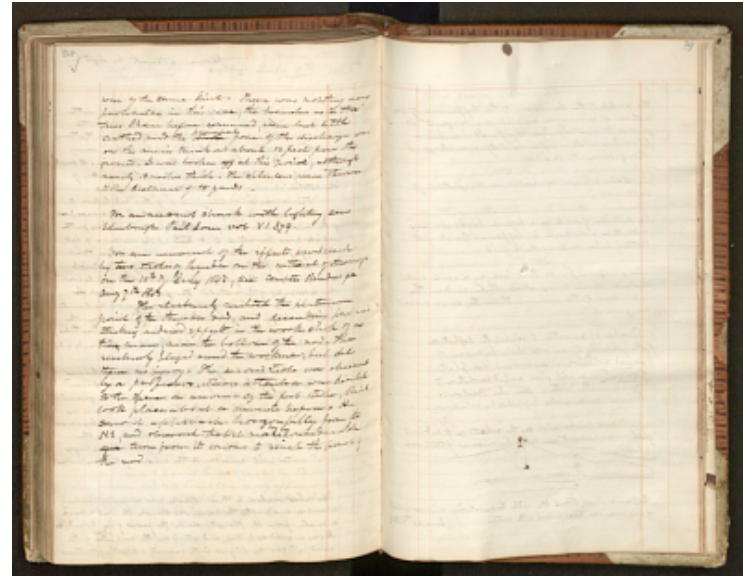
For an account of the effects produced by two strokes of thunder on the cathedral of strasbourg on the 10th of July 1843, see Comptes Rendus for Aug 7th 1845.

The electricity melted the platinum point of the thunder rod, and descending produced ~~[[striking ?]]~~ induced effect in the work shop of a tin man, near the bottom of the rod. The electricity played around the workmen but did them no injury. The secondary stroke was observed by a professor, whose attention was directed to the spire on account of the first stroke, which took place about a minute before. He saw it approach horizontally from the NE, and observed that it made ^{an} considerable ~~arc~~ turn from its course to reach the point of the rod -
[[end page]]

[[start page]]

309

[[page blank]]



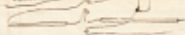
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

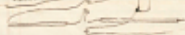
The credit of the discovery of the difference of the action of common and electro-magnets is given to me by [[loggundorf ?]]. It has been placed in a clear light by Professor Magnus
Pog g ann 37 p 436.

See sturgeons paper on magnetism of soft iron.

To determine if and or a liquid [[?]]roduces [[an ?]] induction, interpose in different parts of the battery tubes containing the liquid.

Mr Sturgeon finds that iron in a coil will retain more magnetism while under the influence of the current than the same current can give it.

Make apparatus to exhibit the deflection of the polarity of an iron plate by means of rapid rotation - surround iron plate  a coil give rapid revolution to the plate. See Mr. Barlows paper on magnetic deflection rotation.

Next make exper on the retention of induced galvanic current -- ab by means of statical elect. 

Repeat Wheat stones exp with the revolving mirror instead of the long wire use tubes filled with water. June 24th 1842
[[end page]]

[[start page]]
311

Send shock through a vacuum see if the light will produce phosphorescence

Cause a needle to oscillate in the [[?]] say in a vacuum transversely and otherwise.

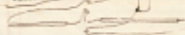
See if palpitation such as is produced in mercury can be produced in water acidulated

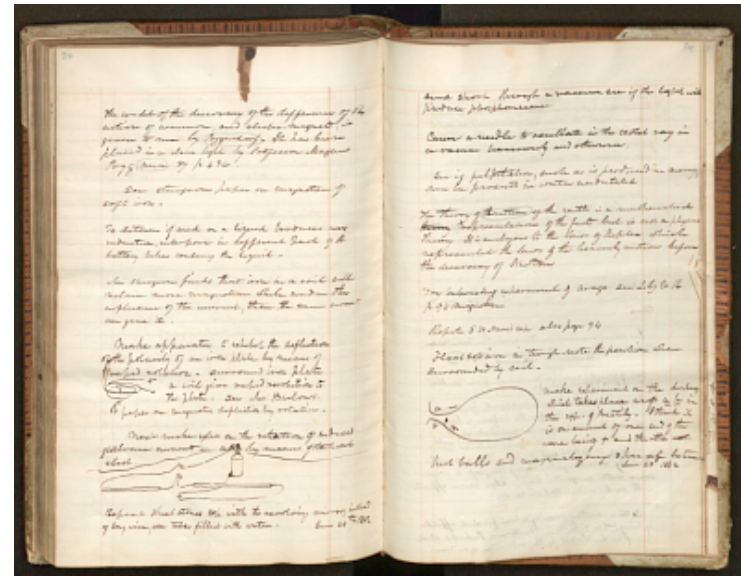
The theory of [[?]] of the earth is a mathematical ~~theory~~ representation of the facts but is not a physical theory. It is analogous to the laws of Kepler which represented the laws of the heavenly motions before the discovery of Newton

Try interesting experiment of [[Arago ?]] see [[Liby ?]] [[?]] 12 p 94 magnetism

Repete S W Har[[i? or e?]]'s exp also page 94

Float soft iron in trough - note the position when surrounded by coil.

 Make experiment on the discharge which takes place across a b in the exp. of Prestely -



I think it is on account of one end of the wire being + and the other -
[[minus sign]]
put balls and magnetizing spiral between
June 23^d 1842

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

Suppose a spiral were placed near the beging and ending of a very long wire would the current of induced elect be the same from the two -- Try this with galvanism and the long coil of Mr. Morse not necessary to [[?]] it.

Try experiment on the sound produced in a long iron rod by friction first without magnetism 2ndly after being magnetized by the action of the coil. Note any difference in the electricity.

Can a continued sound be produced in a bar of iron by the action of the electro [[toms ?]].

In experimenting on the sound in iron, use the microphone thus
[[image: horizontal bar; two lines extend right-ward from the bar's right end, with a ball between the spread ends of the two lines. the two lines form a cone lying on its side.]]
[[short separating score]]
Have done this with success.

See if sound can be produced from Nickle [[spc. ?]] [[gravity of pine ?]] neele 8+

[[short separating score]]

Try if induction can be produced from a conduction of acid use for the purpose a long piece of the intestine of some animal -- did not succed well

Dr Young states that a glass plate charged with electricity is discharged by causing the glass to sound. same with magnetic bar - also same effect with heat. - see [[?]] on heat.

Is the conducting power of a bar from elect affected by being put in a state of vibration. Perhaps elect may be developed by the vibration of a bar.

[[end page]]

[[start page]]

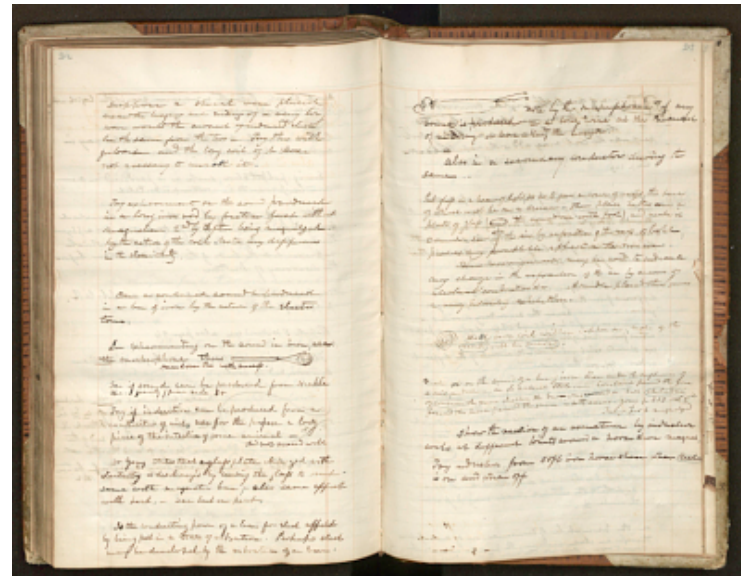
[[image]] note by the microphone if any sound is produced in a long wire at the moment of making or breaking circuit.

Also in a secondary conductor during the same. .

Put glass in a beam of light, so as to give a [[cover ?]] of [[rays ?]] the base of which will be on a screen - Then place in this [[cover ?]] a plate of glass ([[image]] the round one with foot), and make it sound. See if the air by refraction of the rays of light, produes any perceptible effect on the screen.

Same arrangement may be used to indicate any change in the refraction of the an by means of electrical conductor &- if candle placed thus gives a very interesting exhibition.

[[image: spiral]] Roll iron coil within copper one, note if the [[nap ?]] will



be [[wired ?]]

Make exp on the sound of a bar of iron when under the influence of a coil and when in its natural state. --- Coulomb found the fire of coisive the same whether the bar was [[?]] or not Mr Calvi found the pitch of sound the same in both cases. Young p 403 vol 2nd Tuning Fork magnetized

Show the reaction of an armature by induction coils at different points around a horse shoe magnet

Try induction from soft iron horse shoe when [[keeper ?]] is on and when off

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[image]] See if my little wigglers cannot be made to move faster by introducing into the circuit a [[?]] coil. perhaps the coil may add to the repul~~[[strikethrough]]~~ [[?]] ~~[[strikethrough]]~~sion
(Tried the exp, but the effect was less with the coil see p 149)

Nov 11 Mr Saxton and myself tried to discover pulsations in the discharge of a galvanic current from a [[?]] shank trough, but did not succeed, we used the revolving mirror - try the same with the introduction of the long was 4 miles - in this case the affect should be produced.

the induction of an electrical discharge is some what different from that of the induction at the rupture of a galvanic current, hence the secondary current in the one case might be supposed to have different properties from that of the other - But no such differences should exist relative to the currents of the different orders. Exp. on this point.
[[notation in left margin]] 11 [[/notation]]

Perhaps in case of the induction with the ends of a spiral open the fact there no influence is perceived is that there is a reflex wave, which neutralizes the direct action. This may be tested perhaps by a wire, a a long wire b a wire connected with the battery. the spiral is placed at d to catch as it were, a little of the current which may pass around the cd.

on the principle of transmission of an [[impulse ?]] through an [[elastic ?]] medium, the particles [[immedially ?]] come to rest. Does not this refer to the induct at beg and end.
[[end page]]

[[start page]]
315

The galvanometer only indicates the current of some duration, perhaps then a current might be detected in a second wire by a [[frog ?]] by interrupting the second wire, while the first transmits a constant current, or by a magnet for the first condition.

[[dividing line across page]]

Amalgam of zinc. If we throw on an amalgam of zinc, a solution of the [[mureate ?]] the [[insertion]] of protoxide of iron, and then place on the surface a crystal of sullfitic, there is soon around the crystal a black circle and this covers the intire surface of the mercury - when a large crystal is used. If on the contrary a small crystal is used the surface of mercury is raised so as to produce a hollow and the spot diminishes little by litte until it is absorbed by the mercury - It forms in this case an amalgam of mercury which is attributable by the mercury. All the nitrates and nitric acid act as salt petre. The other salts even the chlorate of potassen produce no similar effects so that the phenominon is a means of detecting nitric acid.

It is important that the salt of the proton of iron without any trace of the peroxide.

Annals d Phisiqu d - 1827 No 3

Archives des [[dacower ?]] vol 1829 p 154

The above is important in reference to my experiments on the motion of mercury.

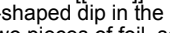
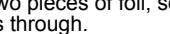


Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

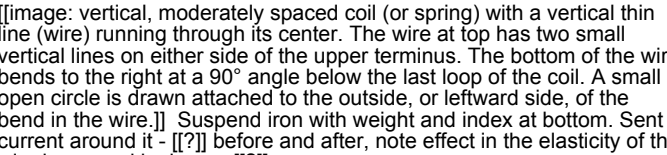
Exp to be made

Revolve a piece of soft iron or a magnet on its own axis, while surrounded with a coil connected with a galvanometer - see if elect. is produced. June 1[[6 ?]], 1840

Stretched a thick conductor - move coil or helix  near it, so that the center of the same may describe a line parallel to the wire or conductor. Do. [[Ditto for: June 16[[?]], 1840 ?]]

Make experimnts on the holes observed in the end of the . See bottom of page 134.  Suspend two pieces of foil, so that the ends touch - send shock from several jars through.

Arrange for currents of the different orders - see if any reflex effect is produced by putting coil between 3 & 4th on the 2nd

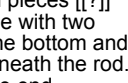
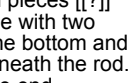
 Suspend iron with weight and index at bottom. Sent current around it -  before and after, note effect in the elasticity of the wire increased by image .

 Attempt to produce a current of elect by suddenly stretching a wire - See Masson p 273 Aug 3rd 1840 - Try by vibrating a van. No effect tried oct 12th 184

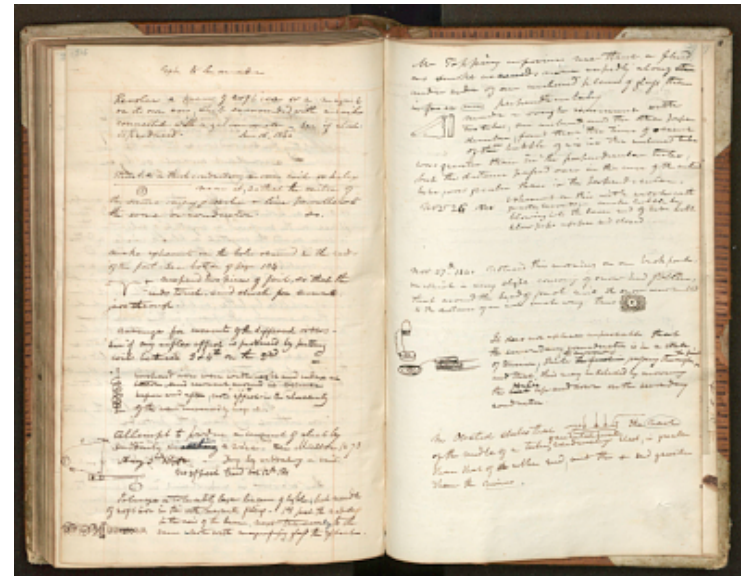
Polarize a tolerably large beam of light - put needle of soft iron in this with magnetic filings - 1st put the needle in the axis of the beam, next transversely to the same - note with magnifying glass the effect.


[[end page]]

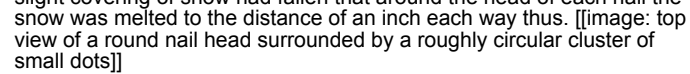
[[start page]]
317

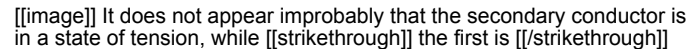
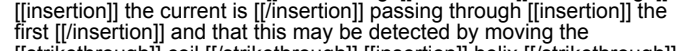
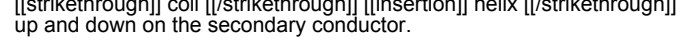
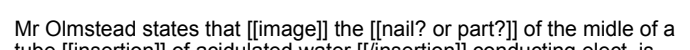
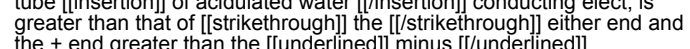
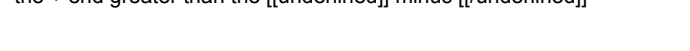
Mr Topping informs me that a fluid as smoke ascends more rapidly along the under side of an inclined plane of glass than in pieces  perpendicularly.  Made a rough experiment with two tubes one inclined and the other perpendicular found that the time of ascent of ~~the~~ a bubble of air in the inclined tube was greater than in the perpendicular tube but the distance passed over in the case of the inclined tube was greater than in the perpendicular.

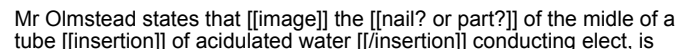
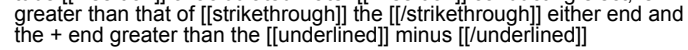
Nov 26, 1840 Experiment on this with watch with quarter seconds -- make bubble by blowing into the lower end of tube with blow pipe upper



end closed ---

Nov 27th 1840 Noticed this morning on a back porch on which a very slight covering of snow had fallen that around the head of each nail the snow was melted to the distance of an inch each way thus. 

 It does not appear improbably that the secondary conductor is in a state of tension, while ~~the first is~~  the current is  passing through  the first  and that this may be detected by moving the ~~coil~~  helix ~~coil~~ up and down on the secondary conductor.

Mr Olmstead states that  the  of the midle of a tube  of acidulated water  conducting elect, is greater than that of ~~the~~  the ~~either end and~~  the + end greater than the minus

Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

Make experiments on the heat produced in the compressibility of water. For this purpose make two holes in the cylinder  of the compressing apparatus of Oersted through which introduce two wires, one of platinum and the other of truned iron. Connect these with each other at the ends in water, and by means of the wire of galvanometer without.

Care must be taken in this exp that the heat of the  does not by the condensation of the air affect the result. Note the compression by the water apparatus, ie by the compression of the water.

 Fasten in a vise an iron or steel plate and a graduated ark then after noting the degree at which the end stands, then magnetize the bar by a current through the coil. The bar will probably rise a little if it be  by a weight previous to the magnetization. Probably a motion of some magnitude may be produced.



 (unlined, unfolded sheet of paper laid over journal page)
319

Mr E Becquerelle has made experments on the increase of the diameter of a small wire, by discharges of electricity. The diameter  of the wire  0mm, 072 dix-huit boxes  to 60°

The wire became waved when a number of discharges were passed

The effect was not produced when the wire was made  by a lamb of alcohol.

The increase of the diameter of the wire can be readily explained, but the corugation would appear to indicate a vibration of the particles at right angles to the axis.



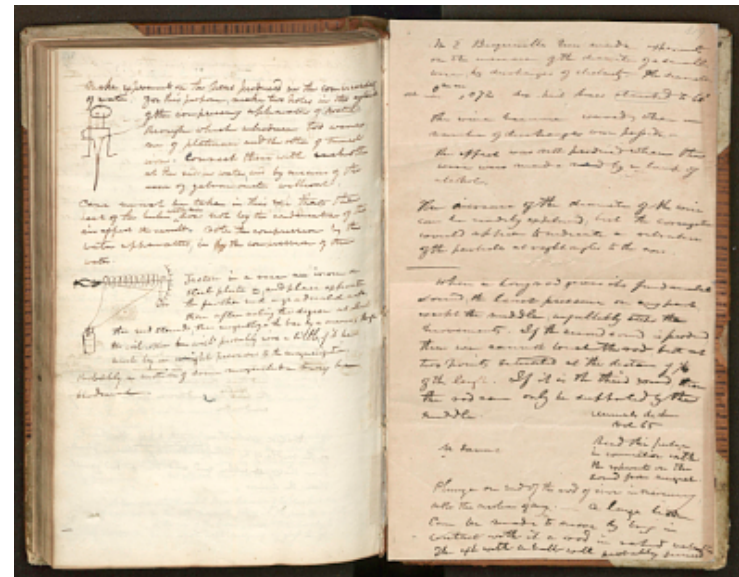
When a long rod gives its fundamental sound, the least pressure on any part except the middle infallibly stops the movement. If the second sound is produced then we cannot touch the rod, but at two points situated at the distance of 1/6 of the length. If it is the third sound, then of the length. If it is the third sound then the rod can only be supported by the middle.

Annals de chem
vol 65

 M Savant 

Read this paper in connection with the experents on the sound from magnet.

Plunge on end of the rod of iron in mercury, note the motion if any -- a large  can be made to move by bring in contact with it a rod in rapid  The exp with a ball will probably succeed.



Mr E Becquerelle has made expermnts on the increase of the diameter of a small wire, by discharges of Electricity. The diameter of the wire 0^{mm}, 072 dix-huit boxes ^{circled} charched ^{circled} to 60°

The wire became waved when a number of discharges were passed. The effect was not produced when the wire was made red by a lamp of alcohol.

The increase of the diameter of the wire can be readily explained, but the corr^u ^{insertion} gation would appear to indicate a vibration of the particles at right angles to the axis.

When a long rod gives its fundamental sound, the least pressure on any part except the middle, infallibly stops the movement. If the second sound is produced then we cannot touch the rod, but at two points situated at the distance of 1/6 of the length. If it is the third sound, then the rod can only be supported by the middle.

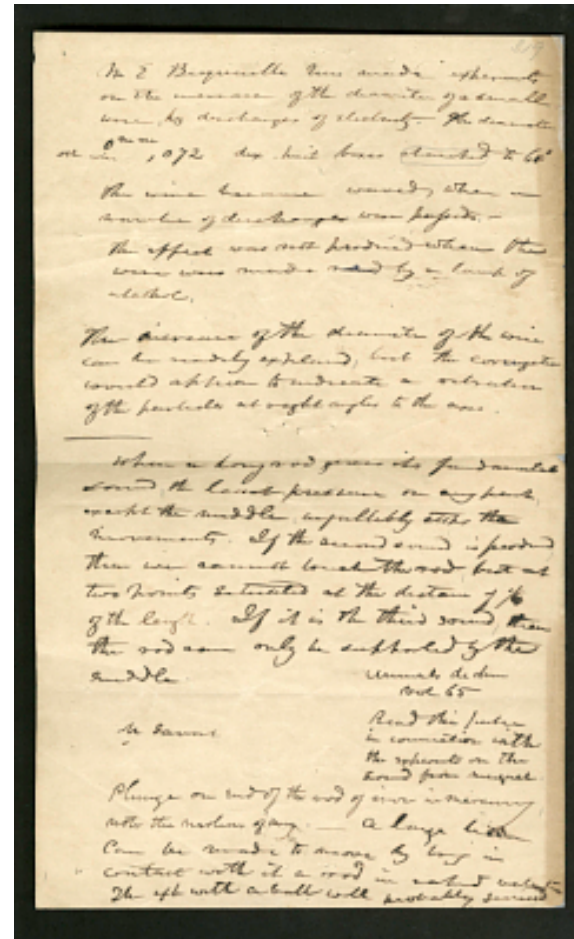
M Savat.

Annals de dum
vol 65

Read this paper
in connection with
the expermts on the
sound from magnet

Plunge on end of the rod of iron in mercury, note the motion if any - a large ^{beam?} can be made to move by bring in contact with it a rod in rapid ^{velocity?}

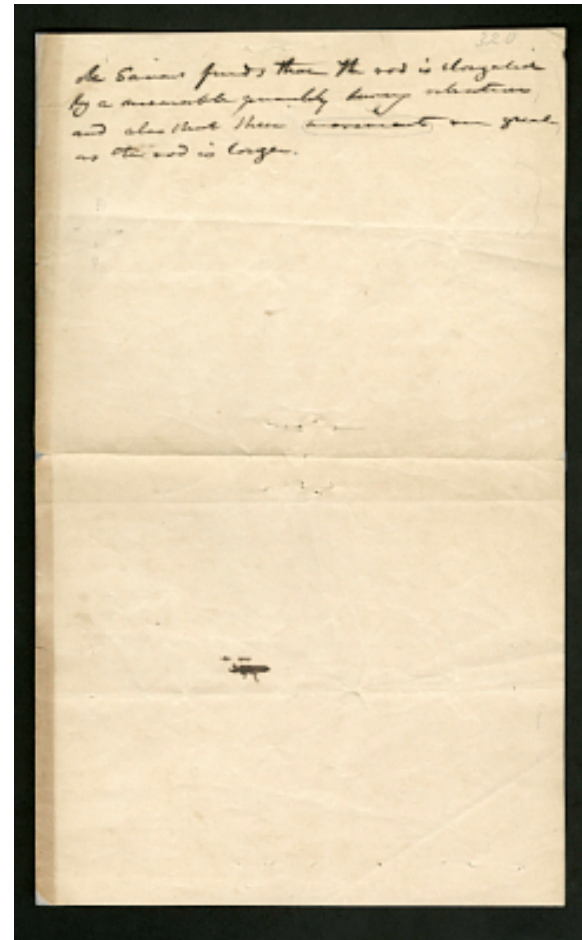
The exp with a ball will probably succeed.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

320

Mr Savant finds that the rod is elongated by a measurable quantity during vibration, and also that these increments are greater as the rod is larger.



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[duplicate scan of page 318 with a different sheet of paper laid over opposite page from previous scan.]]

318

Make experiments on the heat produced in the compressibility of water. For this purpose make two holes in the cylinder  of the compressing apparatus of Oersted through which introduce two wires, one of platinum and the other of truned iron. Connect these with each other at the ends in water, and by means of the wire of galvanometer without.

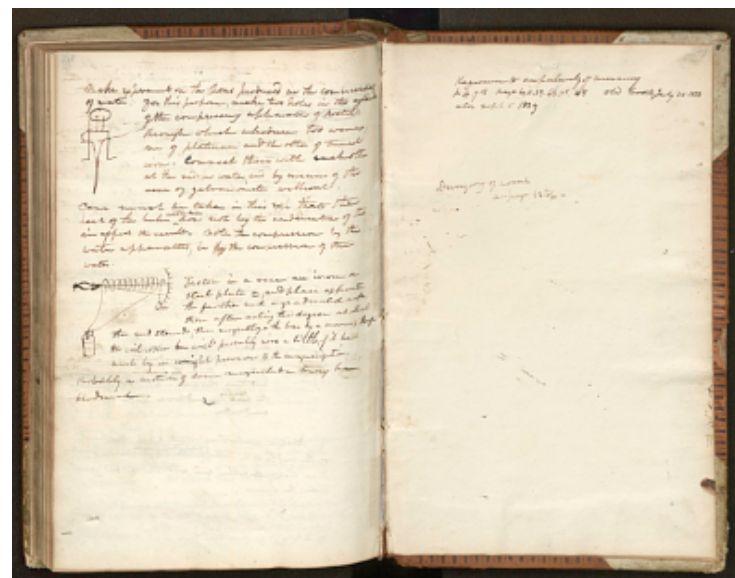
Care must be taken in this exp that the heat of the  does not by the condensation of the air affect the result. Note the compression by the water apparatus, ie by the compression of the water.

 Fasten in a vise an iron or steel plate fasten a fasten, and place opposite the farther end a graduated ark then after noting the degree at which the end stands, then magnetize the bar by a current through the coil. The bar will probably rise a little if it be  by a weight previous to the magnetization. Probably a motion of some magnitude may be produced.

[[start page]]
319

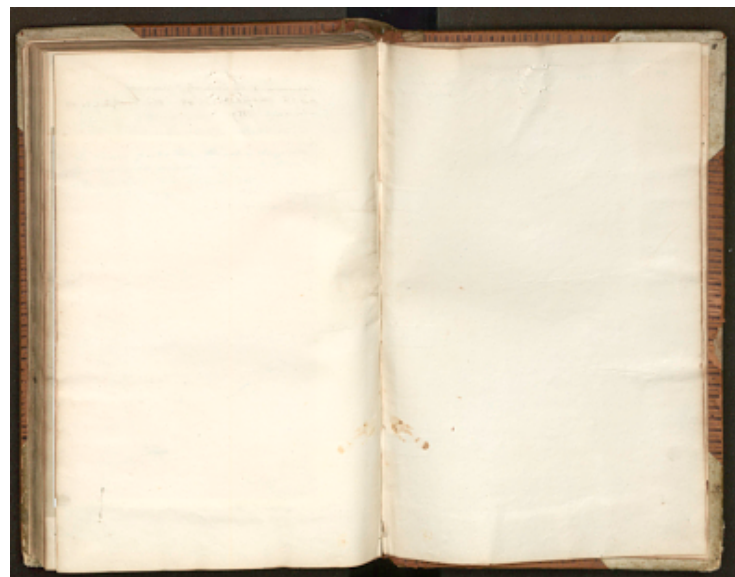
Reference to capalarity of mercury p 4.7¹²¹²
page 40.39.43.45.48 old book July 25 1838 also Sept 5 1839

Divergency of current
see page 42 top -



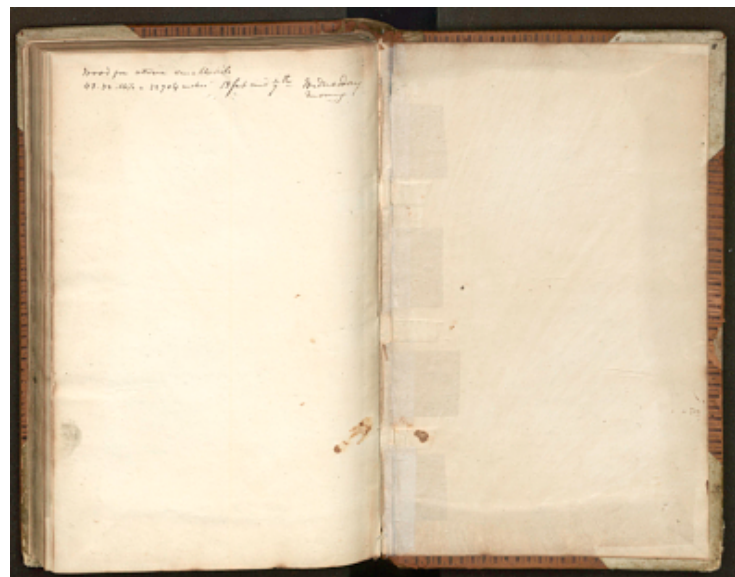
Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[two blank pages]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

wood for stove small pile
 $43 \times 32 \times 16 \frac{1}{2} = 22704$ [[inches?]] 13 feet and 1/7th Wednesday
[[money?]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03

[[back cover]]



Joseph Henry's Record of Experiments, Book 2
Transcribed and Reviewed by Digital Volunteers
Extracted Oct-27-2017 06:40:03



Smithsonian Institution

Smithsonian Institution Archives

The mission of the Smithsonian is the increase and diffusion of knowledge - shaping the future by preserving our heritage, discovering new knowledge, and sharing our resources with the world. Founded in 1846, the Smithsonian is the world's largest museum and research complex, consisting of 19 museums and galleries, the National Zoological Park, and nine research facilities. Become an active part of our mission through the Transcription Center. Together, we are discovering secrets hidden deep inside our collections that illuminate our history and our world.

Join us!

The Transcription Center: <https://transcription.si.edu>

On Facebook: <https://www.facebook.com/SmithsonianTranscriptionCenter>

On Twitter: [@TranscribeSI](https://twitter.com/TranscribeSI)

Connect with the Smithsonian

Smithsonian Institution: www.si.edu

On Facebook: <https://www.facebook.com/Smithsonian>

On Twitter: [@smithsonian](https://twitter.com/smithsonian)