Extracts from the papers of Sir Charles Wheatstone

WHEATSTONE 1: Working papers, experimental notes and correspondence relating to the development of the electric telegraph, [1836-1960]

K/PP107/1/1/1-79

[1836-1872]

Papers relating to the development of the electric telegraph, notably including the report of a disputed claim concerning the invention of a version of the voltaic cell developed by John Frederic Daniell (1790-1845), chemist and professor at King’s College London, 1836; descriptions of experimental proposals by Wheatstone including those to determine the angular deviations of the needle of Melloni’s galvanometer [Macedonio Melloni (1798-1854), Italian physicist] by a constant current, 1841; descriptions of Wheatstone’s telegraph, 1844; observations on the phosphorescent effects associated with telegraph cables, 1866; the investigation of the nature of ‘extra current’; experiments to test the veracity of the theory of induction by Michael Faraday (1791-1867), natural philosopher; proposals for the improvement of electric light; suggestions for improvements to electrical measurement devices notably including the galvanometer, the rotary discharger, and a type of battery known as the ‘electrical torpedo’.
To investigate the law of the extra current when coils or magnets were not used. The following experiments were made.

A portion of the circuit was divided into two parts, one of which the galvanometer was placed. In the 1st experiment the current of the two parts was equally divided, in the 2nd the current of No. 1 was reversed while the current of No. 2 that in No. 1 remaining constant.

\[ \begin{array}{c}
\text{No. 1:} & 5^\circ & 10^\circ & 15^\circ & 20^\circ & 25^\circ \\
\text{No. 2:} & 5^\circ & 10^\circ & 15^\circ & 20^\circ & 25^\circ \\
\end{array} \]

When No. 1 was entirely removed, 2 remaining, with the ordinary division of the galvanometer was very strong.

From the division in 2 is not owing to the division of the current in 1, conclusion is the least current as generally supposed; but it remained by a current upon half of the circuit either in the main current or in No. 2, which divided the current in which the galvanometer was placed.

It is quite contrary to a statement of "Faraday" (cited above). It was maintained experimentally that if a silver current was passed through the galvanometer only and the silver wire traversed one entire time, it was also in the natural position, when the current was stopped, no alteration of the needle in the opposite direction took place.

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Notes on how ‘to investigate the law of the extra current’ contrary to a statement by Michael Faraday (1791-1867), natural philosopher, 1868 Nov 25.
June 20th, 1836

A letter 3/4 page 3, R. Daniell,
 cuckold upon me in the last Book, and
 a list which has been received
 from Mr. Raining, and remembered a copy
 of another which Mr. Raining has sent
 to Mr. Clarke. Mt. Raining said that he
 was going to write what he had been told
 the other day. Mrs. Clarke was not. Mt. Millais said he was
 that he was an instrument to do. Daniell and Mrs.
 Mt. Millais had given him five pounds to be
 considered the Inventor.

As he had been at Mr. Daniell's lift,
 Mr. Bell, Stephenson called and asked if Mr.
 Daniell was there. On being asked in he
 asked that he called on the part of Mr.
 Clarke, as he was coming on board, respecting
 a letter which Mr. C. had received from
 Mr. Raining; he was requested to speak to Mr. C.
 as when one was engaged by Mr. C.
 and to give an account of his visit
 with Mr. Raining, C. B. Wall (the one who
 evidently opened that it was false (to whom?))
Report of disputed claim concerning a version of the voltaic cell developed by John Frederic Daniell (1790-1845), chemist and professor at King's College London, 1836 Jun 20, page 2.
Observation of phosphorescent effects associated with telegraph cables, 1866 Nov 20.
Experiment to prove or disprove Faraday's theory of induction.

Equalize the currents in $I$ and $\lambda$.

The ratio of $\lambda$ will therefore be $k:1$.

In the method of a wire in a wire, the ratio will be $k:1$ when it is possible that in the point of equilibrium.

Complete the current $I$.

If there be a counter current, the ratio will be the deflection of $I$. If not, it will remain in the place of equilibrium.

If two wires were differing very much in the motion, the current would employed; the energy of the steel wire according as $I = \lambda$ is spent into the possibility of the difference.

The induction current (of $I$ to complete) will denote itself between $\lambda$ and $\lambda$.
Notes on ‘Suggestions for the improvement of the Electric Light [arc light]’, [1836-1872], page 1.
5. Instead of the plan (2). The current might be kept continually commencing by means of a main arc on contact with the main terminals of the instrument, the current from the main terminal to the instrument might be conducted separately, and an adjustment be arranged with the fraction of the battery might be evenly arranged.

6. The intensity of the luminous effects from the secondary coil of an transformer would not be materially decreased by adding even a very long thin conductor, because its resistance would cause a comparison with that of the coil. A large transformer with thick wire, or a number of transformers used side by side, might be available for the electric light.
Explanatory text of drawings showing the mode of putting up the lines' possibly for use with patent drawings, [1836-1872], page 1.
17. Section through pole and plan of third form of pole connection.
18. Front view and section of insulating collar used in Figure 16, & 17.
19. Sketch of method of raising the wires very high above the ground and also of maintaining the wires at a proper distance a certain distance between the supports.
20. Porcelain insulation, showing one mode of lashing it to the piece of cane or wood.
21. Form of longs or pieces available in holding holds the wires when being strained.
List of fibres sent to Wheatstone by Joseph Dalton Hooker (1817-1911), Assistant Director of the Royal Botanic Gardens, Kew, 1861 Aug 27.
Thermo-electric Experiments.

1. Deflection of malleable through a large wind.
2. Melting an electric magnet.
3. Induction with a Wire, Battery in a Magnetic wire.
4. Electric in Electric Conduct with rod rubbed.
5. Water decomposed.
6. Galvanometrical operations.
7. Electric Mixture.
8. Spark.
10. Melting an electric magnet with a machine.

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List of thermoelectric experiments and sketch diagrams, [1836-1872], page 1.
List of thermoelectric experiments and sketch diagrams, [1836-1872], page 2.
The magnetic exploder here represented consists of three small magnets, controlled on the same principle as if the same direction as the one to two small electric magnets.

The soft iron wire which makes contact magnet air gap work, in the same direction as the iron, which is the core, the poles of the magnet are made together so as to form when connected with the circuit, main coil, so that the whole produce by each magnet have some momentary.

The instrument when operated is constructed for the purpose of producing a gas by a wire for practice. One horizontal of the wire is connected with a wire to a wire with the end of the wire, and the other end of the wire is connected with the wire of the wire. The wire from the wire to the wire is connected with the wire of the wire. The wire is connected with the wire of the wire.
The instrument employed for these experiments was a very large magnetic dial telegraph. The parts that were to be operated by the instrument were such that the electric part consisted of a magnet having an iron yoke between the poles of the magnet. The machine was so arranged that the iron yoke was inserted in the coil; and the commutator part of the machine was made to connect with the current. When the instrument worked by itself, the finger keys of the commutator being touched, the corresponding letter is drawn on the dial.

But when the commutator keys are pushed over the coil, the current affects the plate. One having a key of the commutator, the letter placed in the coil must always be in advance of the corresponding key. The keys being operated by the push, the commutator effects its operation by the following means: the plate, always drawn in advance of one letter in advance.

To explain this let us take a case where there is a plate at the place where the letter to be touched is at A, the key A is touched, the letter being heard. If the key A is stopped at a given point B, then the commutator in conjunction with the machine, one proceeding from the machine to the other, from the machine to the commutator. If the key B is one letter in advance...
Notes describing a 'keyed magnetic dial telegraph', [1836-1872], page 2.
Notes describing the 'curious condition of a circuit', [1836-1872].
If it is easy to estimate from Gauss's formula the quantity of electricity accumulated in the conductor wire; we have only to multiply these formulas by the unit of length of the wire.

When the wire is so long that the resistance of the battery may be neglected, the quantity of accumulated electricity may be considered as constant, though the length may be varied; only in one case it will be different over a larger scale than in the other. But when the wire is so short that the resistance of the battery is considerable when compared with the resistance of the wire itself, then more importance of the formula must be attached to the quantity of accumulated electricity becomes greater the proportionate to the length of the wire to the difference of height. The current is as the length so as the length.

Thus then of all the electricity accumulated in the wire, we can render variable as to height, the sparks should increase in intensity with the length of the wire rapidly at first, and gradually after a certain stage. But we state an hypothesis that there are other circumstances to be taken into consideration.

To simplify the circumstances we make: As for limit our observation to experiment made within a single part of element. The spark is attributed to the electricity accumulated in the wire, proper to the intrinsic made by the resistance, the smallest being below the current no longer exists. No spark exists in a very short wire because the whole of the electricity is neutralized before a sufficient interval to render the spark visible is obtained; the greater quantity of electricity in a short wire is also another cause for the disappearance or insusceptibility of the spark.
Notes relating to the use of Ohm's formula, [Georg Simon Ohm (1789-1854), German physicist], [1836-1872], page 2.
Notes on the relationship between permanent and instantaneous deflections, 1860.
Note from John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, regarding experiments with different types of insulation, [1852-1872].
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Invitation to ‘private view of Professor Wheatstone’s Improvements in Electric Telegraphs’ [patent with same title dated 1845 but diagram was used in paper published in 1861 On the Circumstances which influence the Inductive Discharges of Submarine Telegraphic Cables], [1845-1861], page 1.

King’s College London Archives
Invitation to ‘private view of Professor Wheatstone’s Improvements in Electric Telegraphs’ [patent with same title dated 1845 but diagram was used in paper published in 1861 On the Circumstances which influence the Inductive Discharges of Submarine Telegraphic Cables], [1845-1861], page 2.
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Letter from George Gabriel Stokes (1819-1903), physicist and Secretary of the Royal Society, regarding a paper by George Biddell Airy (1801-1892), mathematician and Astronomer Royal, 1870 Mar 25, page 1.
Letter from George Gabriel Stokes, (1819-1903), physicist and Secretary of the Royal Society, regarding a paper by George Biddell Airy, (1801-1892), mathematician and Astronomer Royal, 1870 Mar 25, page 2.
Description of an experiment using a thermoelectric element by Claude Servais Mathias Pouillet (1791-1868), French physicist, in a circuit with telescope galvanometer and rheostat, 1868 Nov 13.
The duration of a single contact in the battery line transmitter, going at the rate of 800 letters per minute, is 0.010 second.

A slip of paper with middle perforations only, having a single aperture on one side at a distance of 50 letters, when being passed through the transmitter at the rate of 800 letters per minute gave 26° galvanometer. To produce the same deflection with galvanometer and electric chronoscope it required 0.010 second contact.
Dec 29

Find the experiment in the dining room without a fire, when the door was placed up
the chimney they succeed equally well. These
chimneys were on the table about five from the
fire place. The electricity was at first
uniform, but subsequently was diminution.

Similar effects were produced by changing the
door in different places of the room and outside.

The electric state of this motion is not constant
the room; the more free, the variable, the
motion, and the occasional change of

Perhaps these effects would not take place
the air more dense, and that they can only be
known when the air is a very bad conductor.

With regard to the other door; the change is
more affects the instrument, both is not more
of the door be immersed; an imperfect conductor
in the body seems to be necessary. Even when
placed on the plate of the electrometer, this
conductor appears to be necessary. It was
strange that when the door was shut in the
room, the paper from the fire place to the electrometer
it should not be divided, this looks something like
injustice conductor.

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A metal disc, uninsulated by being held in the hand, placed against any part of the centre of a room, takes a charge and communicates it to an electrometer.

A metal plate, one placed up the chimney of the dining room, as far being as the gallery, and communicated by means of an insulated cord with the plate of the electrometer, no effect was produced.
32 Park Road.
13th May 1865.

My dear Sir,

I enclose you the heads or rather the several particulars of improvements made in the construction, manipulation, and use of the Electrical Torpedo.

I have to day had a conversation with Mr. Penleit regarding the question of Patent No. and as the matter is one of great importance I have appointed Monday at 2 o’clock for him to come to consult with you at your house and carefully consider the best course to pursue. I hope that the hour of two o’clock will be convenient for you on Monday as I have one or two...
Description of an unsuccessful trial by Matthias Hipp (1813-1893), German clockmaker, to lay cables under Lake Lucerne from Lucerne to Altdorf in December 1836, [1836-1872], page 1.
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Description of unsuccessful trial by Matthias Hipp (1813-1893), German clockmaker, to lay cables under Lake Lucerne from Lucerne to Altdorf in December 1836, [1836-1872], page 2.
Notes and diagrams relating to resistance, [not in Wheatstone's hand but with his annotations], [1836-1872].
Formula and calculations on measuring resistance on reverse of invoice reminder from Fortnum, Mason & Co, 1872 Sep 24, page 1.
Formula and calculations on measuring resistance on reverse of invoice reminder from Fortnum, Mason & Co, 1872 Sep 24, page 2.
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Sketch diagram of experiment testing intensity, [not in Wheatstone’s hand but with his annotations], [1836-1872].
A manuscript transcription of a newspaper article relating to a storm, *Bombay Times*, April 12, 1848, [1848-1868].
Notes on the advantages of keeping a constant current in a circuit, [1836-1872].
Four or five years ago I accompanied my brother the Astronomer Royal to King's College Crescent House, to see Mr. Wheatstone's Electric Telegraph. I remember perfectly well that, on this occasion, Mr. Wheatstone spoke of a plan founded on some modifications of the principles of the Telegraph, by which the second hand of a clock could be made to commence its motion for any number of hours.

Then were present during some parts of this time, Mr. Francis Baily, Mr. Hartoune the painter, some persons of the Cornish family of Fox, I think, also the Charles London, and other persons whose names I do not know.

Elizabeth Airy.
I have once gone to King's College to see Mr. Wheatstone's telegraph, and on one occasion only I was accompanied by my sister.

Of the date of one of these visits I have no record. The other was in 1860 May 22; it is recorded in the Observatory Journal. I do not know whether it was on this occasion or on the other that I was accompanied by my sister.

At the first of these visits, the indicator used by Mr. Wheatstone consisted of a number of needles, each of which was added upon by a coil of wire through which the galvanic current passed. At the second, there was also an indicator found by causing a piece of wire to make a loop become magnetic and to close.
magneto-electric current through a suit of wires surrounding it and carrying on this current, and causing this magneto-electric iron and an antimony spring to act alternately upon a wheel with escapement.

At one of these visits I heard some conversation on the practical utility of causing an electric current to move the indicating part of many other clocks, by means of a galvanic current. I had heard of this proposal before the visit to King's College at which allowance was made for it. I gave no particular attention to the circumstance, as I considered it to be a mere application of the principles of the telegraph containing no new principle whatever.

G. B. Airy
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Description of the ‘rotary charger and discharger’, [1836-1872].

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King's College London Archives
Outline list of instruments to be made by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, [1852-1872].
Note on telegraph keys with sketch diagram, [1836-1872].

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Note on experiments to be made at 'Mr Reuter's', [Julius (Paul) de Reuter (1816-1899), news agency founder], [1851-1868].
Notes and diagrams of experiments using a Leyden jar, [1836-1872].
Description of an instrument to measure the reciprocal actions of two conducting wires.

The instruments which appear to have employed in his electrodynamic researches are not of the kind that the configuration of the measuring coil can be altered to those. The number of these in the picture which figures to me to be those in question. The instrument is, with its wire, made of copper or other suitable metal; it moves with the coil within the electric dynamic forces, while it is made so as to measure the magnetic forces. It must be observed that in any single instance the two numbers must be equal.

To the year 1840 to this, for the purpose of realizing these relations and having a small number can be made as their modern form, through which a galvanic current is passed, and which is one of the electrodynamic theories. It is a multiple coil, with the coil connected with the coil of the galvanic current to and the other forces. But the whole importance of these arrangements for the purpose of measuring the current may be seen from the figure, while the coil passes through the galvanic current to and the other forces. But the whole importance of these arrangements for the purpose of measuring the current may be seen from the figure, while the coil passes through the galvanic current to and the other forces. But the whole importance of these arrangements for the purpose of measuring the current may be seen from the figure, while the coil passes through the galvanic current to and the other forces. But the whole importance of these arrangements for the purpose of measuring the current may be seen from the figure, while the coil passes through the galvanic current to and the other forces. But the whole importance of these arrangements for the purpose of measuring the current may be seen from the figure, while the coil passes through the galvanic current to and the other forces.
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Manuscript transcription of a translated extract from Wilhelm Eduard Weber (1804-1891), German physicist, *Determinations of Electrodynamic Measure*, 1846, [1846-1868], page 2.
List by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventory, of various pieces of apparatus including galvanometers and a Leyden jar, [1852-1872], page 1.
List by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventory, of various pieces of apparatus including galvanometers and a Leyden jar, [1852-1872], page 2.
Notes and diagrams on various methods of arranging a circuit, [1836-1872].
New instruments to be constructed
the existence of alternating
currents.

Dr Weber has employed for this purpose
two coils one moving within the
other, when the currents are in the same
direction the coils attract each other, when
they are in opposite directions they repel each
other.

My first plan is to have two other
similar magnets, like those of my new disturbers,
placed north to south, and one directly
pointing. Either the currents are in
opposite direction, the magnets will repel each
other.

My second plan is to have one other magnet
and a coil of gold leaf, the current passes
through the leaf and through the leaf gold.
Your instruments might be used to measure the velocity of transmission of the electric current. The instrument being placed at any distance from the electric motor, connected with a shortague, a certain velocity being given to the latter, exactly as the current in the two branches of the instrument, or in the same or in opposite direction, at such or maximum offset would be produced.

The instrument would be preferable to one in which alternate currents are not employed.
The phenomenon was the large circular shape of the tail where the waves of making changes in current are very peculiar.

A system of current fuses across the axis of the coil. On approaching the hand towards the fuse, no matter whether the current system of the fuse-leaned is or not, the streamcript into a curved line. If the might be placed tangentially to the axis, the current stream into not across the axis of the coil, but into opposite much nearer the upper part. The mobility of this system is very great.

Admitting this expression be the effect of the induction, as of the electricity of the luminous phenomena upon the hand, a great difficulty occurs. The effect of such induction from the luminous phenomena would be to produce an opposite effect on that part of the body which is opposed to it, and in consequence through mutual attraction or push, the other place, whereas we have the least immovable attraction. There is then the?
explained? I know of no analogous phenomenon.

If instead of a neutral or charged ligament, some part of the column, could not the column be regarded as a conductor, anode, and as the electricity is positive or negative? Could it not be attracted or repelled according as the electricity of the suspended ligament is the same or contrary to the free electricity of the outer terminal of the induction coil?

Then the hand touches the glass, and the column is attracted while it comes in contact with the glass and sparkles...
In the examination of the curious phenomena of the stratification of the electrical discharge in highly atmopheric spaces, it was found by the way that the experiment had to have almost exclusively confined themselves to the change in the appearance arising from influence in the nature and weight of the vapors employed, in the nature of the current and the form of the vessels. The influence which the peculiar constitution of the electric apparatus, and which presents the phenomena from being exhibited in the manner of these letters, being originated.
A new comparable galvanometer.

Take a compass tube about a foot long; play one of its ends with wood and ﬁber to this play a very ﬁne sheet wire or gold thread, to the other end of this wire attach a small cylinder of iron wire, and ﬁx the tube with mercurial wax to the middle of the magnet, which gives it a motion. Then one hemisphere of the iron is on one end of the tube, and the other is a tube ﬁlled with mercury at the top of the magnet. Fix a second tube to the upper end of the magnet, and a circular scale on the top of the tube.

If the play round the wire be more and move the mercury light, the mercurial might be accurately measured.

This plan might serve as an indicator of a telegraph; invented currents would and it in opposite directions.
Note describing an 'electromagnetic chronoscope', [1836-1872].
Note describing how 'to make an Electric Telegraph act with double the power actually transmitted,' [1836-1872].
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Draft letter to Edwin Clark (1814-1894), civil engineer, Electric and International Telegraph Company, regarding his letter in The Times in which he states that Alexander Bain (1810-1877), Scottish inventor, invented the electro-magnetic clock, 1852 Sep 9, page 1.
draft letter to Edwin Clark (1814-1894), civil engineer, Electric and International Telegraph Company, regarding his letter in *The Times* in which he states that Alexander Bain (1810-1877), Scottish inventor, invented the electro-magnetic clock, 1852 Sep 9, page 2.
Draft letter to Edwin Clark (1814-1894), civil engineer, Electric and International Telegraph Company, regarding his letter in The Times in which he states that Alexander Bain (1810-1877), Scottish inventor, invented the electro-magnetic clock, 1852 Sep 9, page 3.