Extracts from the papers of
Sir Charles Wheatstone

WHEATSTONE 3: Series of notes describing experiments
to investigate the nature of electricity, magnetism and
thermodynamics, [1834-1855]

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[1859-1871]

Notes relating to the development of the dynamo including designs with plane
paper models describing armature rotation; list of applications of magneto-electric
devices and summary of the basic principles of their operation; lists of proposed
experiments involving electromagnets; description by Charles Wheatstone of an
experiment into electrical induction outlined by William Robert Grove (1811-
1896), natural philosopher, judge and designer of the Grove Cell, in an article
published in *Philosophical Magazine*, 1868; experiments on electrical attraction
and repulsion, the differential inductometer and note on the theoretical
explanation for induction; description of field experiments involving telegraphic
communication, 1859-1871; experiments designed to test conductivity within
substances; summaries of some basic observations regarding electrical phenomena
including electrical potential, electrical discharge and voltaic batteries.
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Diagram of a four coil telegraph generator, [1859-1871].
Notes and rough diagrams investigating the effects of different size armatures for a four coil generator, [1859-1871]
Diagrammatic model of a four coil generator used for the telegraph with explanatory notes on reverse, by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, [1859-1871], page 1.
Diagrammatic model of a four coil generator used for the telegraph with explanatory notes on reverse, by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, [1859-1871], page 2.
Diagrammatic model of a four coil generator used for the telegraph with explanatory notes on reverse, by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, page 1.
Diagrammatic model of a four coil generator used for the telegraph with explanatory notes on reverse, by John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, page 2.
Notes and rough diagram relating to the development of the four coil telegraph generator, [1859-1871].
List of significant developments relating to the ‘Principles of Magneto-electricity’ from the discovery by Michael Faraday (1791-1867), natural philosopher, to thermoelectricity, [1859-1871], page 1.
List of significant developments relating to the ‘Principles of Magneto-electricity’ from the discovery by Michael Faraday (1791-1867), natural philosopher, to thermoelectricity, [1859-1871], page 2.
Note, marked important, relating to the arrangement of two electromagnetic machines and their circuits, on reverse of a letter from the Meteorological Office, [1871], page 1.
Note, marked important, relating to the arrangement of two electromagnetic machines and their circuits, on reverse of a letter from the Meteorological Office, 1871 Aug 10, page 2.
From the Philosophical Magazine for March 1868.

AN EXPERIMENT

IN

MAGNETO-ELECTRIC INDUCTION.

(W. R. GROVE, F.R.S. ETC.)

Shortly after the publication of Mr. Wilde’s experiments on magneto-electric induction, it occurred to me that some of the ordinary effects of the Ruhmkorff-coil might be produced by applying to it a magneto-electric machine. I tried an ordinary medical machine with a small coil made by Mr. Apps, of 3½ inches length by 2 inches diameter, and having about ½ of a mile of fine secondary wire.

The result was very unexpected. The terminals of the magneto-electric coils being connected with the primary coil of the Ruhmkorff, and the contact-breaker being kept closed so as to make a completed circuit of the primary wire (a condition which would have appeared à priori essential to success), no effect was produced; while if the circuit was interrupted by keeping the contact-breaker open, sparks of 0·3 of an inch passed between the terminals of the secondary coil of the Ruhmkorff, and vacuum-tubes were readily illuminated. Here there was in effect no pri-
Mr. W. R. Grove on Magneto-Electric Induction.

Mary coil, no metallic connexion for the primary current; and yet a notable effect was produced.

I did not at the time publish this experiment further than by communicating it to a few friends, hoping to be able to find a satisfactory explanation of it. All I have observed since is that the effect is dependent upon the condenser; for when that is removed no result is produced.

It would appear, then, to depend on an electrical wave or impulse shot, so to speak, into the uncompleted primary coil, similar to the wave which will deflect in succession magnetic needles placed at different distances on a telegraphic cable, without the current passing through the whole length of wire, as shown in the experiments of Mr. Latimer Clark and others. But why there should be no effect, or an inappreciable one, when the primary circuit is completed, the current being alternated by the rotation of the coils of the magneto-electric machine, I cannot satisfactorily explain.
Notes describing an experiment by William Robert Grove (1811-1896), natural philosopher and judge, [1868].

King's College London Archives
Notes describing the application of a condenser to an inductorium or induction coil, [1859-1871].

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On the effect of condensers on electric currents.

The effect produced by condensers alternately positive and negative currents, and after each current the current is constant. The original currents cannot circulate, because the circuits are interrupted at B, and hence the electricity flows around the plates of the condenser, and when a closed circuit an current takes place is being opposed to the original circuit and the same direction as that which follows it. It can be shown in any way by reversing the plate, to make sure the new circuit always in the same direction. In this case there is now a circuit, the current moving from the two opposed change and discharge the plates.

It may be seen why an effect takes place in the secondary coil of the dynamo when the currents passing from a magnet or a battery are follows each other in the same direction.

It is also obvious, why a prejudice should present in the magnetic circuits, for this it may be to the production of the alternate currents.
Notes on the effect of condensers, or capacitors, on electric currents, on reverse of letter from John Matthias Augustus Stroh (1828-1914), telegraph engineer and inventor, regarding a message from William Brettargh, Secretary, Universal Private Telegraph Company about a Mr Kimber [possibly from Kimber & Ellis, solicitors], 1868 Mar 13, page 2.
The Franklinian theory is sufficient to account for the most obvious fact of induction, viz. if the prevention of opposite effects at the two extremities of a conductor in presence of an uncharged body. Rather attract electricity and electricity repel itself, therefore, when the inducing body is uncharged, the electricity repuls the electricity on the conductor by the matter and which possess a sign while the near and shows negative sign, and when it is uncharged its matter attracts the electricity in the conductor leaving the matter and uncharged while conveniently shows negative sign while the near and exhibit positive sign. The theory used to explain the phenomena of the electricity, the Conduct of the Electrophorese, etc. the phenomena of attraction and repulsion and, when an addition to the theory we are to explain, they too, and subsequent writers are obliged to supplement the same by the hypothesis that matter repels itself an operation which is not easy to reconcile with the known fact of the universal attraction of all bodies toward each other.

The experiments above recorded seem to prove that repulsion is not the same as conductivity, though they, and it cannot reconcile in what manner the conductive power can be explained by it.
Notes on the theory of plus and minus electricity proposed by Benjamin Franklin (1706-1790), US President, [1859-1871], pages 2 and 3.
Notes describing the effects on gold leaf of a charged rod, [1859-1871].

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King's College London Archives
A new fact of electrical attraction and repulsion.

A single gold leaf was placed on a short rod connected to a bulb, and after connecting the bulb was placed in a rectangular glass case.

On approaching the leaf an exacted rod of glass or a strip of sealing wax, the leaf was strongly repelled, and on causing it to resolve, it was equally strongly attracted. When the rod was removed at any fixed distance, the leaf hung vertically, but approached or receded as the rod receded or approached.

But when the leaf was touched by the fingers or the form of a communication with the ground, whether the rod approached or receded, the leaf was always strongly attracted; when the rod stood a moment at a certain distance, the leaf in which it approached a little to the rod was brought nearer or removed further off.

Nothing so necessary for the attraction and repulsion as when the rod is stationary, the leaf, however, in the being analogous to dynamic situation.
Notes and diagrams describing 'A Differential Inductometer' or instrument to measure induction, [1859-1871], page 1.
A mechanism must be considered to remove the errors unintensibility.

In this different arrangement the effects of conduction might be entirely eliminated.

Two days different arrangements.

In my different arrangement, I make the dice have a core capability of being moved. The difficult measures distances as in which can have all the changes of one side be equal to another, and the other side. In I confine the dice to be demands.
Notes and diagrams describing 'A Differential Inductometer' or instrument to measure induction, [1859-1871], page 3.
Notes and diagrams describing 'A Differential Inductometer' or instrument to measure induction, [1859-1871], page 4.
Attempts to explain the difference between positive and negative insulating bodies.

Each insulating substance contains a certain quantity either of positive or negative electricity, appropriate to its particular matter and which never leaves it. This arises from the surrounding air, a substance of the opposite electricity either attracting or repelling the insulating action. To reduce its inductive action, conduct it is necessary to remove these substances, which may be done by bringing into contact with its opposite substance in a different electrical state, or still better by rubbing them together; the electric atmospheres had become neutral, and after the substances were separated, if their atmospheres were completely neutral, each substance would exert its peculiar action; but this only occurs in one particular case, viz., when two bodies are rubbed, but the one is dry and the other is moist. When both are positive with respect to earth, a quantity of things thus is established. The primary to conduct the electricity of the interior of the substance, as their atmospheres are in equilibrium, and consequently exhibit no mutual action on objects at a distance, but after contact the electric atmosphere being removed the same condition after no longer withstand the requisite stimulus of the
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Notes describing the difference between positive and negative insulating bodies, [1859-1871], page 2.
Letter from Eugene George Bartholomew ([1827-1880], Government Telegraph Cable Experiments, regarding the results of experiments on battery tension using a Peltier [Jean Charles Athanase Peltier (1785-1845), French physicist] electrometer, 1860 Jan 24, page 1.
Letter from Eugene George Bartholomew ([1827-1880], Government Telegraph Cable Experiments, regarding the results of experiments on battery tension using a Peltier [Jean Charles Athanase Peltier (1785-1845), French physicist] electrometer, 1860 Jan 24, page 2.
Electro-scapal Experiments.

Day II.

Battery 500 cells, elements C to E.

PE stood at 62°. When the battery was disconnected from E the electrometer stood with hemispherical cone only 52°
with two miles 11°
with four miles 37°
with eight miles 23°
with sixteen miles 17°
When C was again placed at the last known was augmented to 23°,
and when after one of the conductors had been made with 16 miles the hemispherical cone 62°

Four miles of wire, insulated at the opposite ends were placed to each pole of the battery.

C to PE 32. 35. 39
Z to PE 25. 29. 47

The C end of the battery was evidently very perfectly insulated than the Z end.
A circuit of eight miles was completed, & a short wire in contact with the Z pole soon brought the electrometer but without any effect.

A circuit of 18 miles was completed with the same result.

Instead of a short return wire, four miles of wire were employed, with no effect.

In the circuit of 16 miles, the water damper (6½ inches of water) was introduced in the middle, a short wire from the A pole towards PE, which showed

When wire came to Z pole, 27°

When wire came to C pole, 31°

When the water damper was removed, in a short circuit, PE showed 9°.
It is well to be provided with three equal but needles, the first to be charged with positive electricity, the second with negative electricity, and the third be remain uncharged.  

The needles, when subjected to attraction, shall in the best test of the existence of the electric state, for attraction may be produced in a charged needle by a body in the neutral state. The best test of the neutral state is the want of action on an uncharged needle.
Notes describing the use of test needles in experiments, [1859-1871].
List of experiments to be undertaken using Thomson's Quadrant Electrometer [William Thomson (1824-1907), mathematician and physicist], [1859-1871], page 1.
List of experiments to be undertaken using Thomson's Quadrant Electrometer [William Thomson (1824-1907), mathematician and physicist], [1859-1871], page 2.
Notes on 'Electricity' and how different batteries alter the electromotive force, [1859-1871], page 1.
Notes on 'Electricity' and how different batteries alter the electromotive force, [1859-1871], page 2.
Notes describing electricity and effects of return currents for the telegraph, [1859-1871], page 1.
be indicated opposite to each other.

If the wire is charged or discharged not at
the extremity, but at any point of the length,
the instantaneous currents will pass in
opposite directions from the two ends.

If, while the wire is charged at one
extremity, the other extremity communicates
with the earth, a state of permanent
tension is never attained, but a continuous
current is established. If now the contact
with the battery be broken, the current
will only continue after the commencement
of the discharge. But if before
this discharge can be completely effected,
the end, which was in communication with the
earth, is put in communication with the
earth, a portion of the electricity will escape.

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Notes describing electricity and effects of return currents for the telegraph, [1859-1871], page 2.
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Notes describing electricity and effects of return currents for the telegraph, [1859–1871], page 3.
3rd. To construct a relay, made by interlaced insulated conductors, which close and open an inner circuit closed in any when the currents are in the same direction. 4th. Instead of simply discharging the currents to the earth as in 1st. alter the discharging of the battery is effected during the end of the conductors, i.e. in contact with the pole of a battery, by which a current in a circuit is determined in the opposite direction to the return current; the currents from the battery being so regulated as to produce the most perfect neutralization.
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Notes on experiments carried out for the Electric Telegraph Company, 1869 Jan 5.
Results of experiments conducted at Telegraph Street using a Declanche (sic) battery [George Leclanche (1839-1882), French electrical engineer], 1871 Aug 3.

<table>
<thead>
<tr>
<th>Description</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without wire</td>
<td>270</td>
</tr>
<tr>
<td>150 BA units</td>
<td>202.5</td>
</tr>
<tr>
<td>335 BA units</td>
<td>135</td>
</tr>
<tr>
<td>90 BA units</td>
<td>67.5</td>
</tr>
<tr>
<td>33 BA units</td>
<td>33</td>
</tr>
<tr>
<td>50 elements</td>
<td>120</td>
</tr>
<tr>
<td>320 BA units</td>
<td>90</td>
</tr>
<tr>
<td>50 BA units</td>
<td>60</td>
</tr>
<tr>
<td>35 BA units</td>
<td>30</td>
</tr>
<tr>
<td>20 BA units</td>
<td>15</td>
</tr>
</tbody>
</table>

One of the main elements was made of carbon.