

Victorians Decoded: loan objects

All dimensions are height x width x depth.

Star object ★
Non-KCL loan ➡

Entrance Plinth: Room I

A formal case displaying a single iconic item and small descriptive label.

★ **King's College London Archives, (Catalogue number unknown)**

Battery of Daniell Cells.

Battery of ten copper Daniell cells in stand. On display in the glass case in the Staff Common Room, Chapel Corridor, King's Building, Strand.

40 cm x 60 cm x 20 cm (estimated)



Charts: Room I

➡ **The National Archives, Kew. MPG 1/392. (1 item extracted from CO 6/23.)**

Chart showing the intended Telegraphic Communication between Newfoundland and Ireland, tracks of steamers between Europe and America and the Ice Fields in the North Atlantic Ocean (with section of the bottom and of the cable to be used). Scale: 1 inch to about 150 miles. Surveyed by Cyrus W Field. Engraved by Day and Son, Engravers and Publishers. Made for the New York, Newfoundland and London Telegraph Company. 1856.

61 cm x 95.5 cm.

➡ **The National Archives, Kew. MPH 1/454 (former ref WO 78/2172)**

The World. 1 item. 'Coal and Telegraph Chart': showing telegraphs and coaling stations. Admiralty chart 1188: engraved by Edward Weller; published, 8 August 1889.

71.1 cm x 113 cm.

➡ **Cable & Wireless Archive. DOC/ATC/6/11**

Chart of soundings of the section of the bottom of the Atlantic from Valentia to St Johns Newfoundland. 1865. (I can collect by car if this helps.)

Approx. 62 cm x 97 cm

➡ **Institution of Engineering and technology R/P 200/7**

Atlantic Telegraph Company: Chart of Soundings of the bottom of the Atlantic Ocean from Valentia, Ireland to St Johns', Newfoundland. London. 1858.

Foyle Special Collections PAMPH. BOX G9110 ATL

The Atlantic Telegraph Company (1856). *Chart shewing the intended telegraphic communication between Newfoundland and Ireland, track of steamers between Europe and*

America and the ice fields in the North Atlantic Ocean. To which is added, a section of the bottom of the Atlantic, from Valentia Bay, Ireland, to St. John's, Newfoundland, from soundings taken by the U. S. steamer, "Arctic", and sections, full size, of the Atlantic electric cables. London: Day & Son.

60 cm x 93 cm.

Timeline: Room I

★ Guildhall collections

➡ 'Laying the Atlantic cable'. Special edition *Illustrated London News*, 1866 Volume XLIX. Copies to be made from this for timeline on floating wall.



Introductory Area Small Display Case: Room I

The objects are to be positioned so as to resemble items gently strewn across a desk; as if a great scientist had just stepped away. Books are to be carefully displayed open on a pertinent page. Papers can lay casually over one another leaving judicious sections, words or diagrams visible. Objects in the case also feature in the images on the walls. This carefully laid trail of clues will lead the visitor to an intuitive understanding the objects and processes, keeping more formal labelling/explaining to a minimum.

Telegraphic Artefacts

★ King's College London Archives. K/PP107/11/1/18

Charles Wheatstone: Siemens' telegraph cables

Three samples of trans-Atlantic submarine telegraph cable manufactured by Siemens Brothers & Co. Possibly the souvenirs given to John Cutler, (1839-1925) Professor of English Law and Jurisprudence at King's College London, 1865-[1915] by Alexander Siemens in 1898 [see K/PP107/1/4/3 for related correspondence].
13 cm x 1 - 2 cm (diameter estimated. Not using lower one.)



★ Royal Institution Collection, London. (No catalogue number)

➡ *First message sent over trans-Atlantic cable*

Reel of paper tape partially displaying recorded signals and corresponding hand-written decryption of encoded letters. Transcription of same. Currently on display.

Approx. 8 cm x 40 cm (as displayed partially unrolled).



Or if unavailable:

➡ **Porthcurno Telegraph Museum**

Reel of blank ticker-tape.

Approx. 8 cm x any length desired.

King's College London Archives K/PP107/11/2/4

Charles Wheatstone: Micrometer

Nickel silver micrometer made by Elliott Brothers, London, possibly used by Wheatstone.

1.5 cm x 10 cm x 3 cm (height and depth estimated)



Printed Materials



Institution of Engineering and technology UK0108 OPC/1/139

The Atlantic Telegraph poster

Modern copy of an 1866 poster, published by William Stevens, Model Dockyard, 22 Aldgate, showing the Atlantic Cable and other submarine cables in Europe and America together with a picture of the Great Eastern ship laying the cable and a section of the Great Eastern.



Foyle Special Collections PAMPH. BOX GC334 GRE

Meteorological Committee (1872). *Currents and surface temperature of the North Atlantic Ocean, from the Equator to latitude 40 N. for each month of the year. With a general current chart.* London, E. Stanford.

47 pages, 12 leaves of plates, 30 cm.

Foyle Special Collections PAMPH. BOX QC102 WHI

Whitworth, J (1876). *Paper on measurement, read at the conference of the exhibition of scientific instruments, at South Kensington, 17 May 1876, in explanation of the measuring machine and appliances exhibited.* London : printed by Spottiswoode and Co.

4 pages; 25 cm.

Wheatstone Collection, Pamphlet Box, TK5841 HAL

Hall and Wells Prospectus, (1865?). Small, pamphlet with image on front, folded ad image only on top half, text below. Has image of cable with its layers. Display with cable samples.
20.7 cm x 25.5 cm

Loose-leaf Papers

A small selection of loose-leaf papers carefully selected to complement the telegraphic artefacts . These include a letter to Charles Wheatstone from James Clark Maxwell, an electrician's 'shopping list' of technical items, designs for a new kind of battery and notes on the submarine distances between countries.

King's College London Archives. K/PP107/1/3/1-92

Items numbered 4, 8, 22 & 86 in pencil) and an un-numbered envelope with wax seal.

King's College London Archives. K/PP107/1/4/1-60

Items labelled Wheatstone 1/4/7 in pencil.



Transmission Case: Room II

Star objects are to be prominently positioned. Smaller objects, books and note papers are to resemble items gently strewn across a desk; as if a great scientist had just stepped away. Books are to be carefully displayed open on a pertinent page or stacked to reveal the titles on their spines. Papers can lay casually over one another leaving judicious sections, words or diagrams visible. This carefully laid trail of clues will lead the visitor to an intuitive understanding the objects, keeping more formal labelling to a minimum.

Telegraph Artefacts

- ★ **King's College London Archives. K/PP107/11/1/21**
A Thomson-style reflecting astatic galvanometer made by Elliott Brothers, [1860-1870]. (Picture of similar.)
27 cm x 15 cm x 15 cm



- ★ **King's College London Archives. K/PP107/11/1/5**
Charles Wheatstone: ABC Telegraph transmitter (image of similar)
ABC transmitting telegraphs designed by Wheatstone using a step by step mechanism. The dial is rotated to the required character which operates 'make and break' contacts beneath the dial sending current impulses down the line to the receiver.
21 cm x 16.5 cm x 16.5 cm (depth estimated).



- ★ **King's College London Archives. K/PP107/11/5/1**
Charles Wheatstone: Concertina
Concertina with rosewood fretwork, green leather bellows and thirty two ivory keys, labelled 'By His Majesty's Letters Patent, C Wheatstone, Inventor, 20 Conduit Street, Regent Street London'.
15 cm x 15.8 cm x 15 cm (depth estimated)



King's College London Archives. K/PP107/11/1/7

Charles Wheatstone: Telegraph transmitter

Prototype telegraph transmitter with 30 keys each representing a letter or number and operating a make and break contact sending pulses of current down the line to a receiver. Thirty unmarked ivory concertina style keys on a round mahogany base and octagonal mahogany lid. Display with concertina K/PP107/11/5/1 to which it is so obviously mechanically related.

22 cm diameter x 7-10 cm (height estimated).



★ **King's College London Archives. K/PP107/11/1/8**

An automatic telegraph transmitter developed by Wheatstone, [1858-1867], and based on the Jacquard Loom punched card system using continuous tape. Wheatstone called it his 'Jacquard telegraph'. An original strip of perforated paper tape can still be seen in the top.
20 cm x 20 cm x 14 cm (depth estimated).



King's College London Archives. K/PP107/11/1/13

Charles Wheatstone: Telegraph key

Simple telegraph switch or key possibly for William Fothergill Cooke (1806-1879), inventor, and Wheatstone's double needle telegraph. Consists of a wooden base with brass bars and terminals, and ivory buttons.
10-15 cm x 17 cm x 10 cm (height estimated)



Printed Materials

Foyle Special Collections PAMPH. BOX QC544.G2 THO

Elliott Brothers (1858?). *Sir W. Thomson's patent graded galvanometers*. London (date of publication derived from date of Lord Kelvin's patent). This document is to accompany above galvanometer K/PP107/11/1/21.
8 pages; 23 cm.

Foyle Special Collections

The Universal Private Telegraph Company (1861). *Professor Wheatstone's Patents*.
22 cm x 14.2

Foyle Special Collections PAMPH. BOX T55 SOC (2)

Society of Telegraph Engineers (1873). *Rules and regulations*. London, John King & Co., printers.
15 pages; 21 cm.



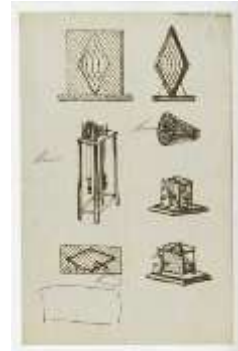
Foyle Special Collections PAMPH BOX TK 5491 SIE 1590771 WHTTSN

Siemens, Halske, and Co. (1860?) *Alphabetical Telegraph: Adapted for Railway and Private Purposes*. Page 2, fig. 1 (dial instrument)
26.4 cm x 20.9 cm (closed)

Loose-leaf Papers

King's College London Archives. K/PP107/1/3/1-92 items numbered 14, 41, 64, 75, 76, 85, 87 & 92 in pencil. Plus un-numbered pen and ink sketch of a transmitter & receiver and a printed patent diagram showing dials. AND K/PP107/1/4/1-60 items labelled Wheatstone 1/4/43 & 1/4/44

A selection of mainly hand-written loose-leaf papers carefully selected to complement and refer to the telegraphic artefacts in the case. These include diagrams and illustrations of equipment as well as papers related to the processes of transmission and invention. Images and further details available in transmission section of appendix.



King's College London Archives. K/PP107/1/3/1-92 (item numbered 48 in pencil)

Single, small piece of paper. Handwritten document trying out various names for a new transmitting device, teletachygraph/ tachytelegraph, etc. This document is to accompany the device to which it refers, the automatic telegraph transmitter K/PP107/11/1/8.

King's College London Archives. K/PP107/1/4/1-60 (item labelled 1/4/42 in pencil)

Document referring to Key Relay for display alongside telegraph key K/PP107/11/1/13.

Coding Case: Room II

The star objects in this case are smaller and more intricate. The case also relies more heavily on loose-leaf handwritten and printed code texts, code books, ciphers and alphabets. The idea of the recently left desk can be very strongly played here, perhaps even with the introduction of period pens, paperweights, blotter, etc. giving the idea of a coding in process. Ideas and methods of coding should be very obvious, again leading the visitor to an intuitive understanding of coding, keeping more formal labelling to a minimum.

Telegraphic Artefacts

★ **King's College London Archives. K/PP107/11/1/22**

Charles Wheatstone: Cryptographs and cipher post

Three cryptographs devised by Wheatstone including one wooden prototype with letters and numerals on circular cards attached to a square wooden base; two in original cases with nickel-silver dials, hands and circular removable cards for assigning the code. The dials are inscribed 'The Cryptograph, C. Wheatstone Invr.'. Cipher post designed by Wheatstone, consisting of a small brass post with rings of letters and numerals on a mahogany base.



Cipher post: 8.6 cm x 2-3 cm diameter (diameter estimated)

Cryptographs 1 & 2: 7-10 cm x 9.8 cm diameter (height estimated)

Cryptograph 3: 7-10 cm x 8.2 cm diameter (height estimated)

Printed Materials

Wheatstone TL694.C6 SLA Wheat.F.4

Robert Slater, (1870). *Slater's Telegraphic Code to Ensure Secresy in the Transmission of Telegrams*. W R Gray, London. (Include photograph of title page, on case label? Two copies at KCL?)

16.7 cm x 10.2cm x 1.8 cm (When closed)



Caroline Arscott, Private Collection

Bedford McNeill (1899 1st edition). *Mining and General Telegraph Code. Terminal Index - for use with McNeill's Code*. Whitehead, Morris & Co. Ltd., London.



Foyle Special Collections 02 HE7677.P76

Telegraphic Code for the Use of the Police (1885, revised edition), compiled by Chief Superintendent Williamson, London. Eyre and Spottiswoode. Double page spread pp. 40-41. Page with manuscript addition 'Grampus'.

23.1 cm x 16.1 cm x 1.3 cm (when closed).



John Winterburn, Private Collection

Code Book: Great Southern and Western Railway Company, Ireland. 1901

15 cm x 10 cm (when closed)



John Winterburn, Private Collection

Unicode: the Universal Telegraphic Phrase Book. 1894 (ninth edition). Cassell and Company, London, Paris and Melbourne.

21 cm x 15 cm (when closed)



Caroline Arscott, Private Collection

Belgravia, Feb 1875, double- page spread pp. 534-5 wood engraving after George Kirby and poem by H. Savile Clarke, 'Love's Telegraphy' bound volume. Option to include additional volume to show title page.

22 cm x 14 cm (when closed) x 4cm.

Loose-leaf Papers

King's College London Archives. K/PP107/1/3/1-92 (items numbered in pencil 39,40, 42, 44, 45, 46, 48, 49, 50 & 51)

These items comprise a selection of small, handwritten examples of experimental coding including morse, telegraphic and cipher. Most are loose-leaf, single sheet fragments that convey the idea of a Work in Progress. (50 & 51 are to accompany K/PP107/11/1/8.) Please see appendix below for details and images.



Resistance Plinth: Room III

Small case/plinth in room three (if possible). Item K/PP107/11/2/1 can be displayed in any orientation, e.g. vertical. Three simple 'curio' loose-leaf papers to establish theme.

Telegraphic Artefacts



King's College London Archives. K/PP107/11/2/1

Charles Wheatstone: Wheatstone Bridge

Prototype or demonstration model of the 'Wheatstone Bridge' or 'Differential Resistance Measurer' originally devised by Samuel Hunter Christie and further developed and promoted by Wheatstone. An electrical circuit designed to measure unknown resistance by using components with known resistance. Consists of a series of wires and connectors attached to a wooden base in a diamond shape.

2 cm x 43.8 cm x 7.6 cm (height estimated). Can be displayed in any orientation.



King's College London Archives. K/PP107/11/1/19

Charles Wheatstone: Resistance box

Resistance box with for measuring resistance in 1, 2, 4, 8, 16 and 32 mile lengths of telegraph wire. Consists of a wooden box with brass plates and knobs.

14.6 cm x 21.9 cm x 11.7 cm



Loose-leaf Papers

King's College London Archives. K/PP107/1/4/1-60 (item 17 in folder)

Small document referring to Resistance Box.

King's College London Archives. K/PP107/1/3/1-92 (item 17 in folder)

Small document discussing spontaneous charges from unpowered cable.

King's College London Archives. K/PP107/1/1/1-79

Small document on phosphorescent effects of submarine cable.

General Electrical Equipment

Items listed below are relevant to all sections and have accompanying loose-leaf papers to aid understanding. Can be used to balance out distribution of materials in any case if desired.

Telegraphic Artefacts & Accompanying Papers

King's College London Archives. On display in Cabinet in Chapel Corridor

Electrical Equipment (image of similar)

Brass conductor, Leyden jar, rods and other conductors used with the generator (K/PP107/11/3/12) possibly by Wheatstone for teaching, [1834-1837]. On display in glass case, Chapel Corridor, King's Building, Strand. Various sizes.



King's College London Archives K/PP107/2/2/3

John Rymer Jones (1871). *Experimental notes on Standard cells applying an apparently innovatory methodology described by Johann Christian Poggendorf*. Page 1. (To be displayed with Leyden Jar.)



King's College London Archives. K/PP107/11/3/12

A cylindrical electrostatic generator. (Image of similar).

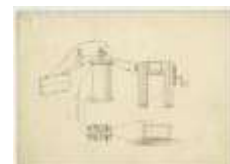
Originally developed by Edward Nairne (1726-1806), optician and scientific instrument maker, and used to demonstrate the properties of electrical charges.

40cm x 42cm x 25 (height and depth estimated)



King's College London Archives K/PP107/2/7/95

Richard William Mellingford Higgs (n.d.). *Mechanical Description of the Magnetic Inductorium*. Includes pencil drawing. Page 3. (To be displayed with electrostatic generator K/PP107/11/3/12.)



King's College London Archives. K/PP107/11/4/1

Charles Wheatstone: Stereoscope (image of similar)

Stereoscope designed by Wheatstone in 1838 using two angled mirrors to reflect two slightly different pictures to each eye through a viewer to create the illusion of a three-dimensional image. Consists of a mahogany frame with adjustable mirrors and viewing lenses.

36.2 cm x 91.3 cm x 25 cm (depth estimated)



King's College London Archives. K/PP107/8/37a, 8/38a

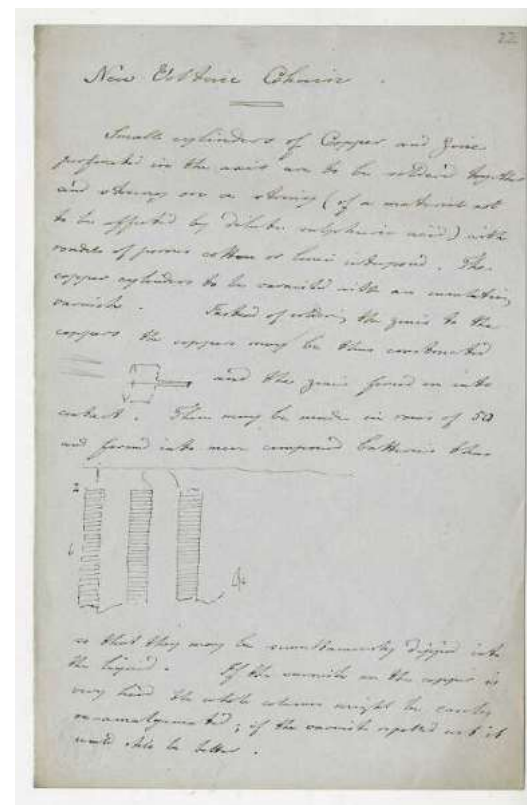
Charles Wheatstone: stereoscopic photograph

Right and left aspects of a mounted stereoscopic photograph showing microscopic enlargement of frond of moss or seaweed. Purple tint.

17.5 cm x 9 cm

Appendix: Loose-leaf Papers

Introduction



Thus for a rod with rounded ends whose
length is five times its breadth the charge
would be $1.736 a = C$

If the breadth were $\frac{1}{5}$ of the length, the
charge would be $\frac{1}{2}$ of the first and so on

$\frac{1}{5}$ of length	Charge
$\frac{1}{5}$	C
$\frac{1}{50}$	$\frac{1}{2} C$
$\frac{1}{500}$	$\frac{1}{3} C$
$\frac{1}{5000}$	$\frac{1}{4} C$

When the length and breadth vary in the
same proportion, the charge varies as the
length simply.

The charge of circular discs varies as the
radius and is independent of the thickness
if the thickness is small

I have no doubt these results are

given in the mathematical treatise
but as the formula for rods illustrates
your remarks to me on the 27th Feb
I have thought it worth while to
send you it.

Yours truly,
J. C. Maxwell

	Nathie Pills		
1	Singor (Calcutta) to Penang	1270	30 Thomson
2	Penang to Malacca	273	31 Moore
3	Malacca to Singapore	144	
4	Singapore to Blingor	255	20 Moore
5	Toboe Ali (Banka) to Batavia	104	
6	Sedans to Macassar	360	20 Moore
7	Macassar to Coquestarin	1514	17 Thomson
		<u>3900</u>	

At 10 words per minute = 80 key-presses per hour

Lt/8 Major was occupying the lower

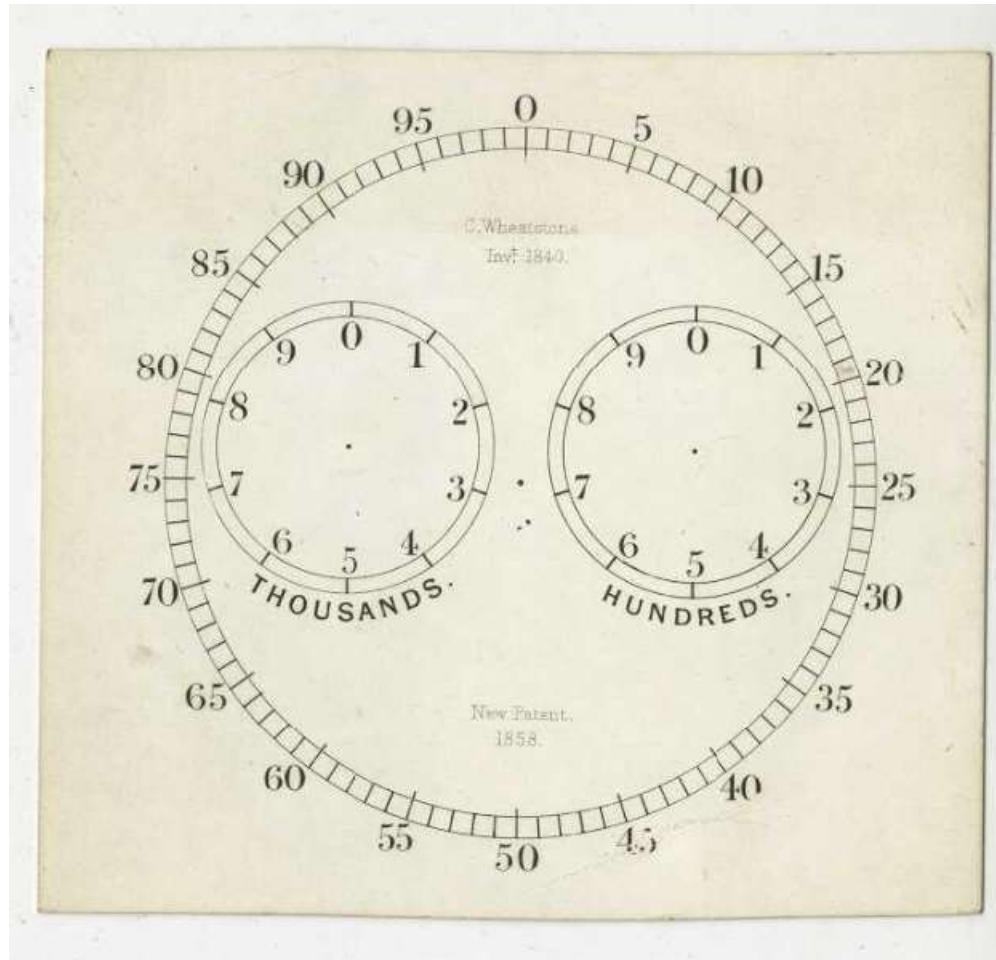
10 per cent at this calculation

Mr. Faraday's method of using
an Electrometer

Recharges the basin to the same amount as the above, the result is thus in equilibrium.

The share is charged with debt in contact with the
 debt, and the share is needed ⁱⁿ the management of
 the debt being its charge, the note shows the
 necessary charge from the relation of the debt
 by the law.

Transmission



March 22. 1859

Specification of Type-printing Telegraphy.
 Description of Automatic Telegraph.
 ———— - alphabetic & type-printing Telegraph.
 ———— - magnetic letters.
 ———— - magnetic capitals.
 ———— - magnetic numbers.
 ———— - magnetic symbols.

Specification of Magnetic Clock.
 Letter to Messrs. Poynter.
 Experiments to be made at the Electric Telegraph Company.
 with Type-printing and magnetic letters, commencing.
 Letter to Mr. Mendenhall, respecting the construction of
 the telegraph to be ordered from Mr. Ladd.
 Note on page for Mr. Ladd.
 Note on page from Mr. Ladd.
 Letter to Mr. Mendenhall and Mr. Poynter.

The Electric & International Telegraph Co.^y

(Incorporated 1856)

Engineers Office.

Telegraph Street, London, E.C.

18 July 1868

Please copy this reference
in your answer.

My dear Sir Charles,

I should be glad if you
would return the two
Condensers in the course
of a week as there are
some experiments for
which I want them,
unless you are using
them just now. as supplied

The "Perforators" are
a weak part of your
apparatus — a great

improvement has been
made in them, and
it is necessary that
all of the old form
be altered.

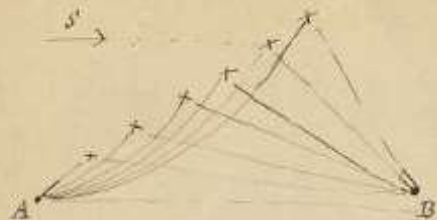
I scarcely think we should
bear this expense entirely
and I have given Mr. Stroh
an order to alter them —
reserving the question of
payment to be settled
between yourself & me.
Mr. Stroh will be able fully
to put you in possession of
the facts

Yours faithfully
R. S. Culver

Prof. Sir Charles Wheatstone

Coast Defences.

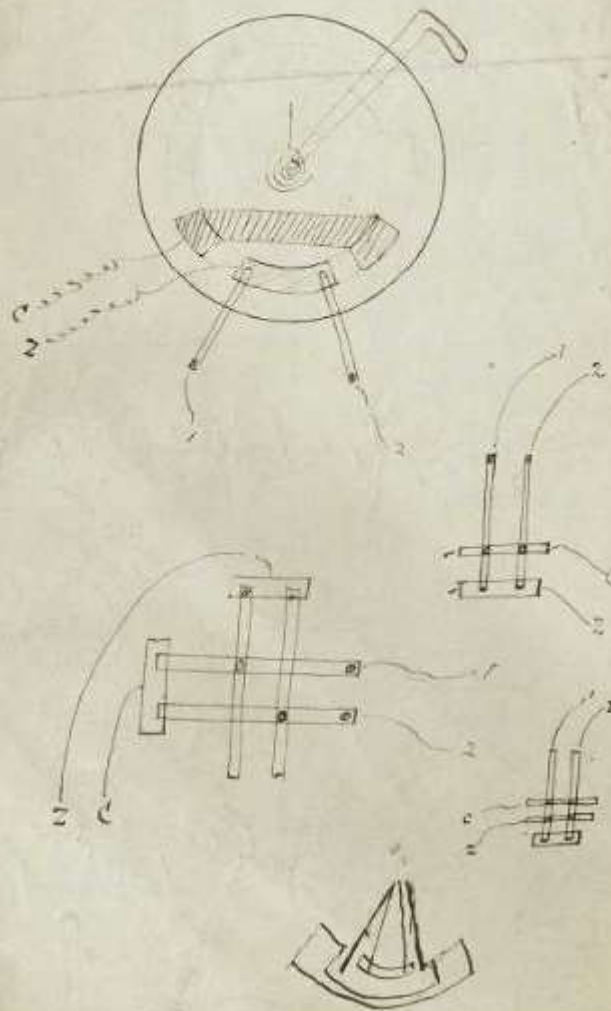
76

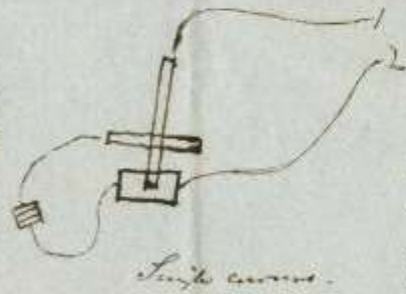
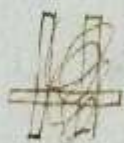
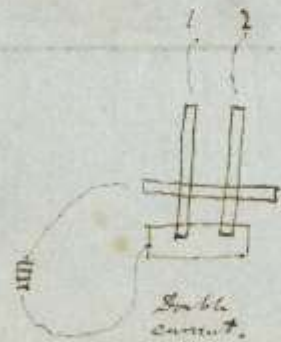
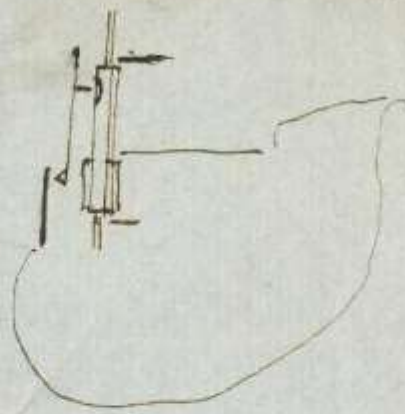
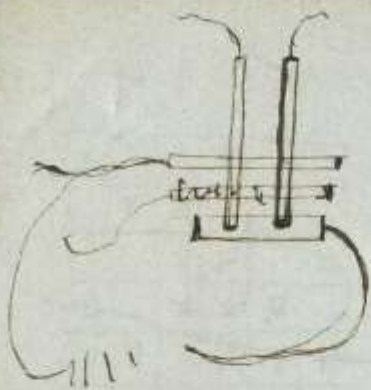


A and B are two heliographic stations on the coast;
between A and C a series of batteries are placed in
the same straight line. A ship approaches in the
direction \rightarrow ; at the moment it is in the line AC,
the observer at A heliographs to B who instantly from the
communication which at the moment is present has line of
sight, and the nearest battery is ordered. Repeat wire
must be placed between each battery and A.
My own largest current indicator should be placed at B.

New Heliographic Telescope.

87





This might serve for
the communication
of the White Telegraph,
which there need be only a
few words.

The following appears to be the most beautiful arrangement of all, the divisions of the dial exactly correspond with the characters.

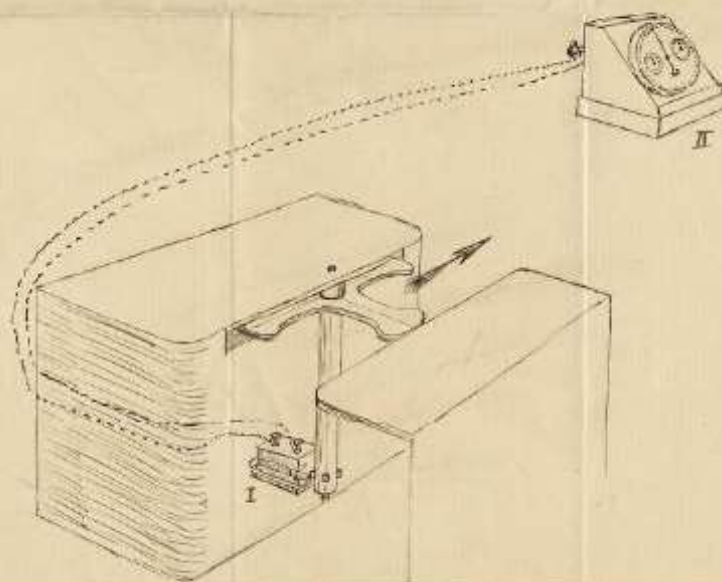
The dial divided into 30 parts.

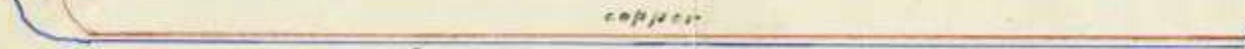
1 2 4 0
2 4 0 16

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

16 30 corresponds with the permanent quadrant position of the dial.

1	---	1	1+2+4+0	---	15	e	
2	---	2	2+2+4+0	---	16	h	
a	1+2	---	3	1+4+4+0	---	17	n
e	2+2	---	4	2+4+4+0	---	18	z
i	1+4	---	5	1+2+0+0	---	19	v
o	2+4	---	6	2+2+0+0	---	20	b
m	1+2+4	---	7	1+4+0+0	---	21	f
t	2+2+4	---	8	2+4+0+0	---	22	g
l	1+4+4	---	9	1+2+4+16	---	23	k
r	2+4+4	---	10	2+2+4+16	---	24	w
u	1+2+0	---	11	1+4+4+16	---	25	2
s	2+2+0	---	12	2+4+4+16	---	26	y
l	1+4+0	---	13	1+2+0+16	---	27	l
n	2+4+0	---	14	2+2+0+16	---	28	x
				1+4+0+16	---	29	
				2+4+0+16	---	30	





copper

iron



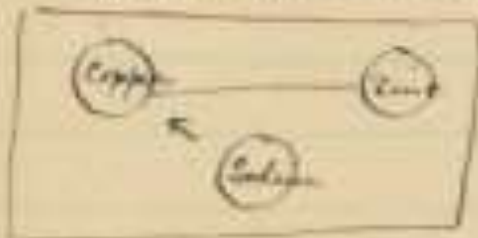
Solenoid
or relay

Electrographite

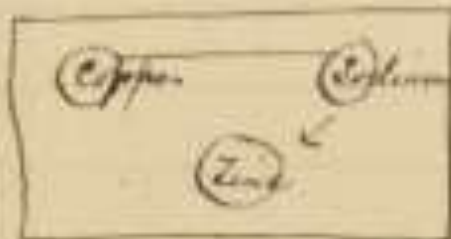
Compound Voltaic

March 11th 1872.

Standard = 28.8 units (45 to 40°)



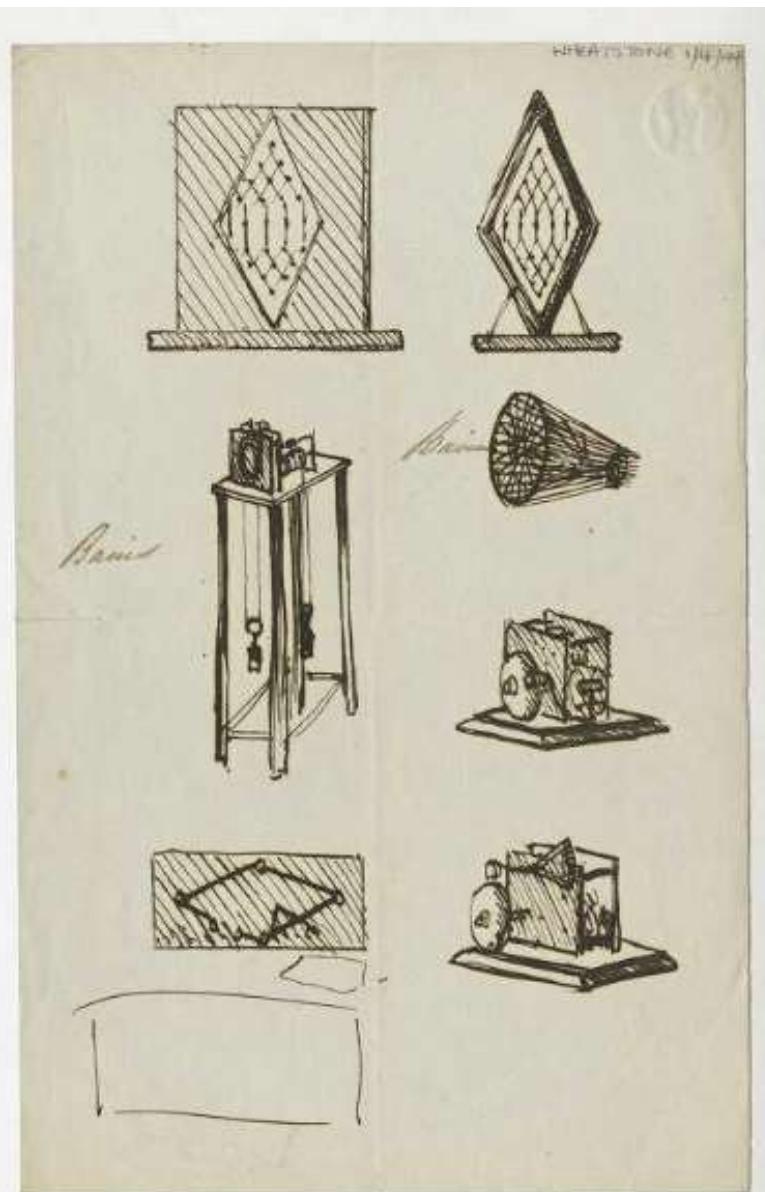
Electro-motive
force = 62.40
units (45 to 40°)
S. 216.6
215.9 etc

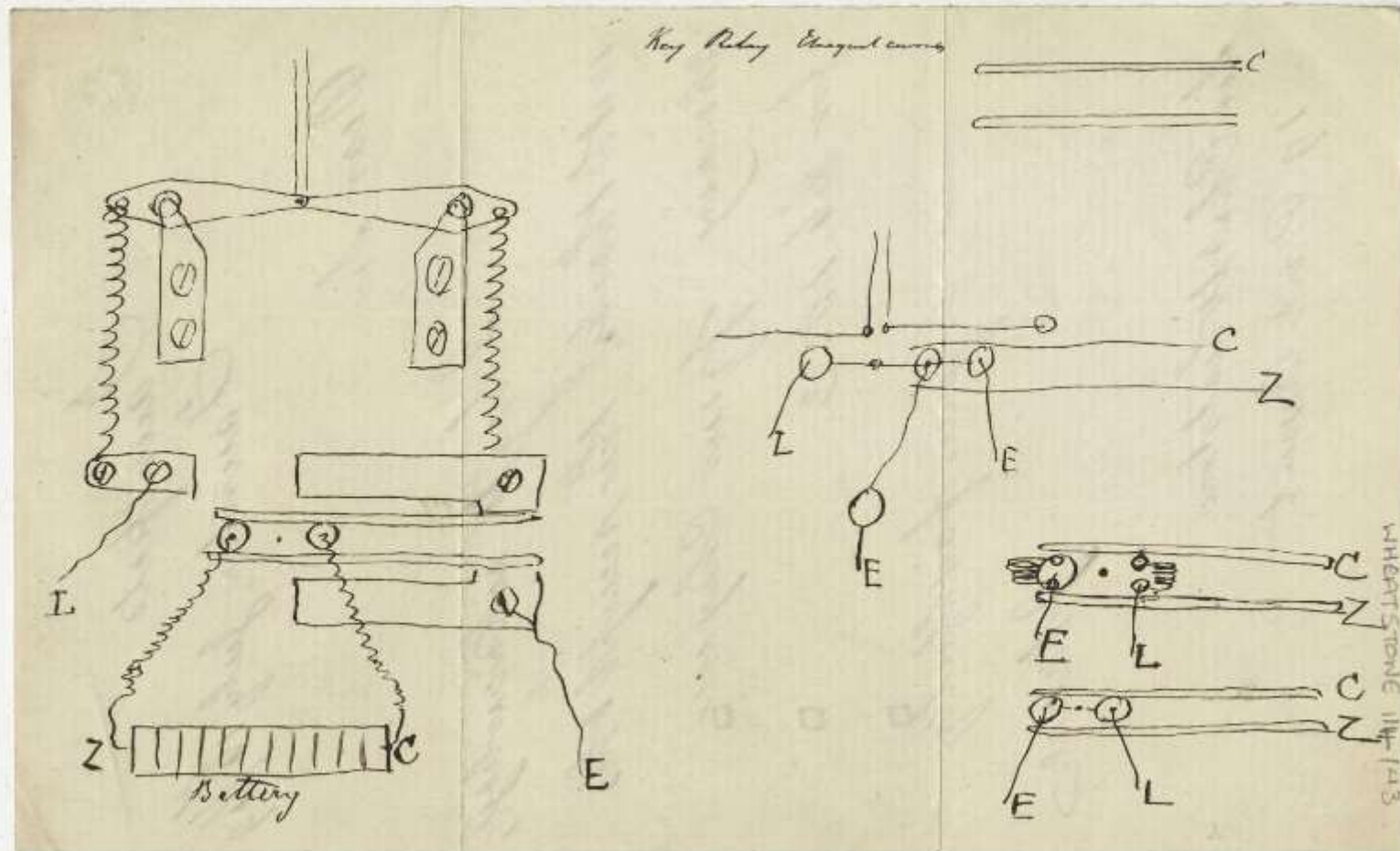


Electro-motive
force = 33.6
units (45 to 40°)
S. 116.6

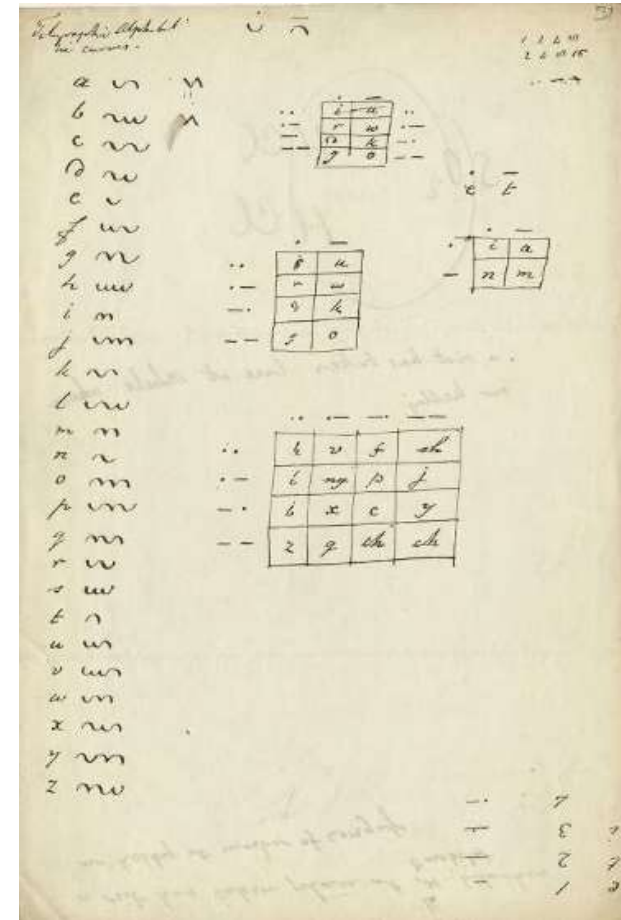
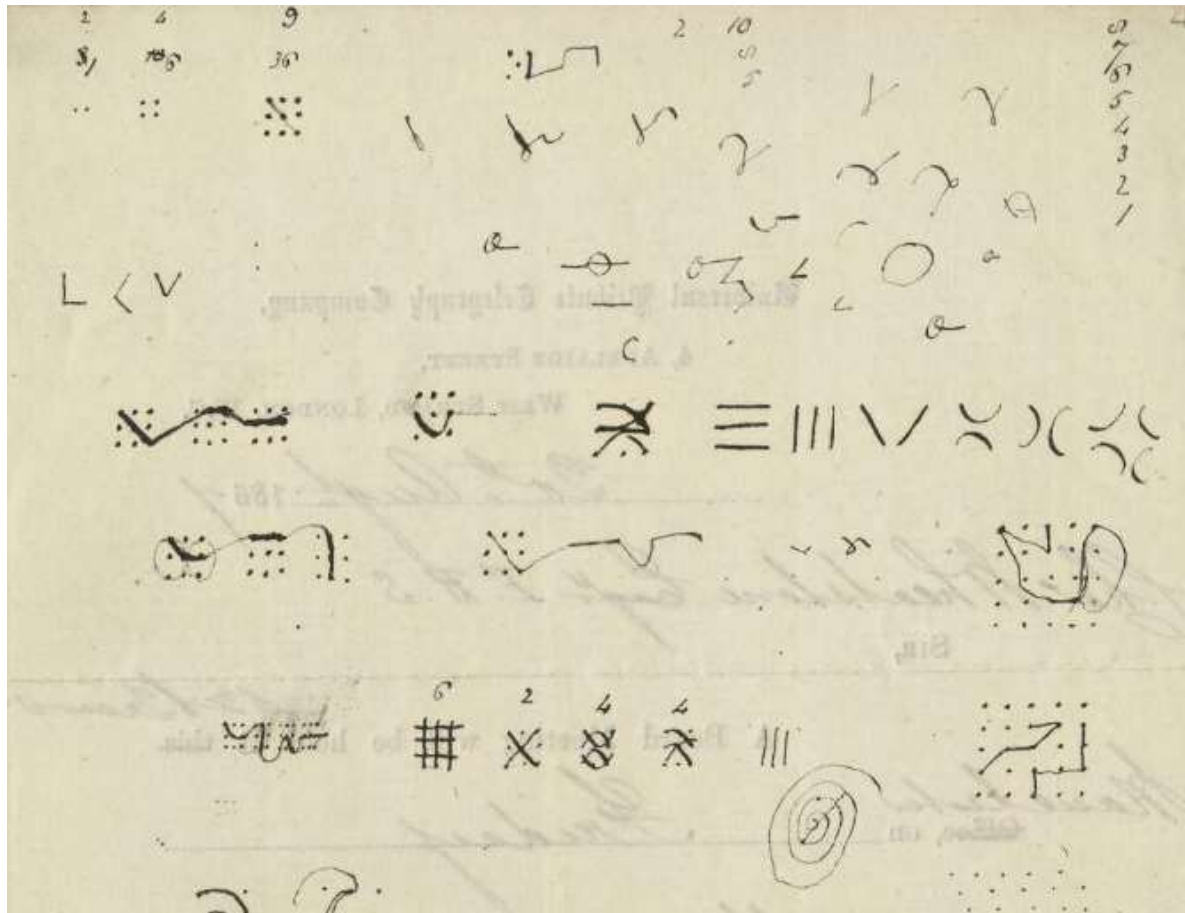


Electro-motive
force = 62.40
units (45 to 40°)
S. 216.6
215.9 etc





Coding



The alphabet may be so arranged that the class of most frequent occurrences shall be indicated by the first letter.

Printed

W. Folke
Rev. St. Augustine

Morse Alphabet.

1 A	..	c	II
2 B	...	s	---
3 C	----	h	----
4 D	----	t	----
5 E	----	m	----
6 F	----	o	----
7 G	----	ch	----
8 H	----	a	----
9 I	----	n	----
10 K	----	r	----
11 L	----	l	----
12 M	----	h	----
13 N	----	c	----
14 O	----	y	----
15 P	----	u	----
16 Q	----	f	----
17 R	----	b	----
18 S	----	x	----
19 T	----	z	----
20 U	----	p	----
21 V	----	L	----
22 W	----		----
23 X	----		----
24 Y	----		----
25 Z	----		----

Alphabet.

a	u	n
b	w	x
c	v	y
d	r	z
e	m	
f	l	
g	k	
h	j	
i	q	
j	o	
k	p	
l	s	
m	t	
n	u	
o	v	
p	w	
q	x	
r	y	
s	z	
t		
u		
v		
w		
x		
y		
z		

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Morse Alphabet.

1 A	..	c	II
2 B	...	s	---
3 C	----	h	----
4 D	----	t	----
5 E	----	m	----
6 F	----	o	----
7 G	----	ch	----
8 H	----	a	----
9 I	----	n	----
10 K	----	r	----
11 L	----	l	----
12 M	----	h	----
13 N	----	c	----
14 O	----	y	----
15 P	----	u	----
16 Q	----	f	----
17 R	----	b	----
18 S	----	x	----
19 T	----	z	----
20 U	----	p	----
21 V	----	L	----
22 W	----		----
23 X	----		----
24 Y	----		----
25 Z	----		----

... ..
... ..
... ..
... ..

Resistance

Spontaneous charge of a Submarine Cable
Mr. Lumsden of the Electric Telegraph Company
says that a submarine cable was from the factory
placed and while he was being laid no any current
passed through it, when placed in a bath became after
a time charged, but always positively. The discharges
when once and is placed in the water. It is instantaneous
but continues for several minutes. When completely
discharged and allowed to rest for some time it becomes
again charged and so on indefinitely. He says that
a current is sufficient to show this.

Insulating Materials

Bitumen, Copal and Shell lac materials are

By the application of heat shell lac is
separated into a very hard substance very difficult
to melt, and one soft. The hard substance is as
brittle as timber than shell lac. It cannot
easily be laid on the wires, but when the lac, and the
soft shell is laid on the wires the soft one has
acted by paper it through a plane.

When the insulating material is laid on a wire coated
with wire, the material is very much diminished;
probably in consequence of the cohesion of wire fibres

5 16
14
7.7
8.10
2.10
66.3
3

Planchon coils from $\frac{1}{10}$ to 10000 units
with L240 8.28 with L25
13.59 BA units = 1 unit per $\frac{1}{10}$ in 70-

Shannon galvanometer reflecting - L100
Shunt $\frac{1}{9}$ $\frac{1}{99}$ $\frac{1}{999}$ - - - - - 2.10

Pitt's electrometer - - - - - 3.3

Condenser - - - - - 6.10

Key - - - - - from 24 to 60 Hz

2 Apparatus for conductivity of wires

7

A set of Rheostatic coils with
Duffenbach's Rheostatic measure.

A very delicate Galvanometer with long scale.

A Thomson's Electrometer.

~~One section~~

A voltmeter battery as used by the Submarine Cable

A do (substitute of above) as used by the Submarine

A variety of methods for testing.

2 Pitt's Electrometers.

Apparatus for testing faults.

An apparatus for testing the strength of cables

