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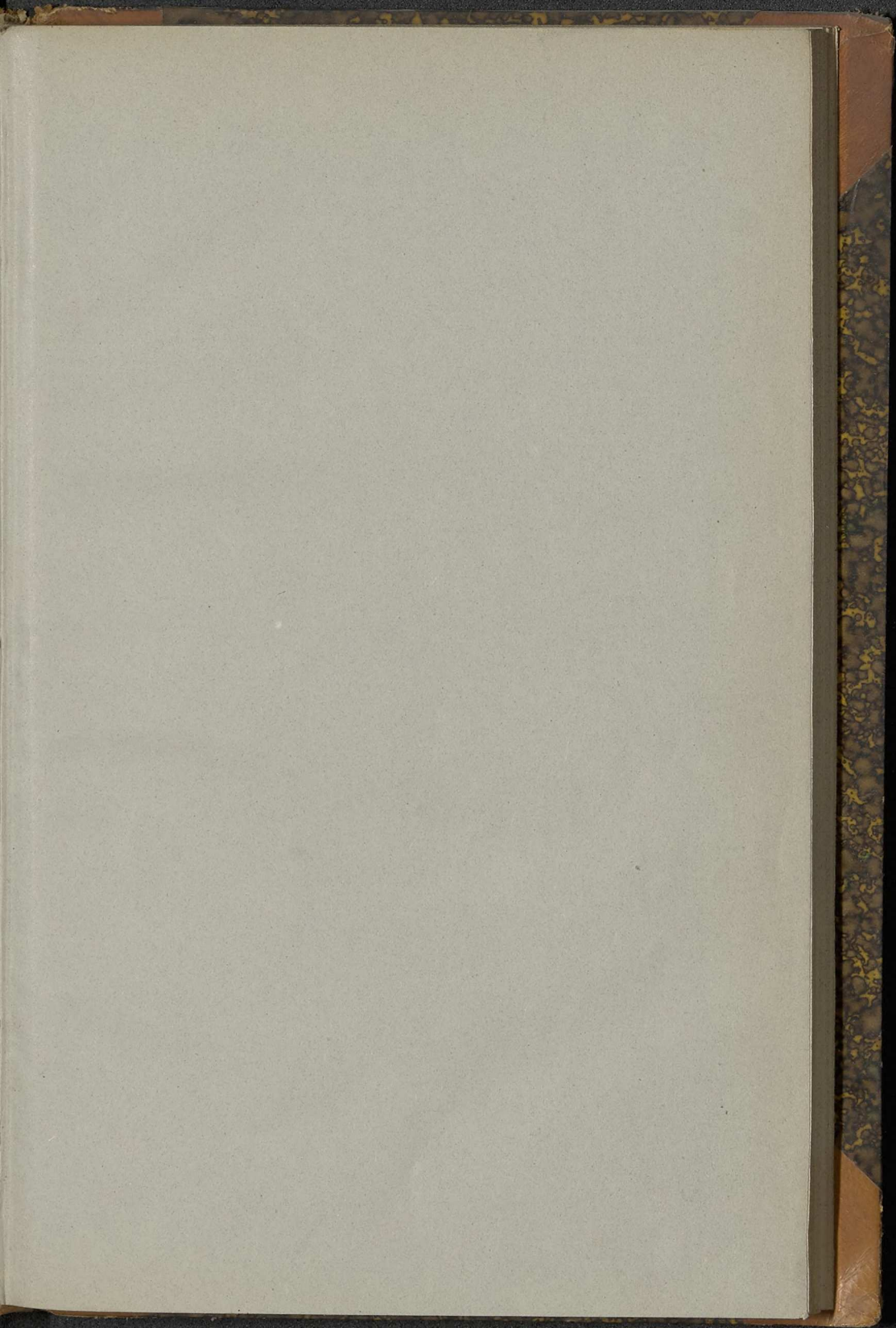
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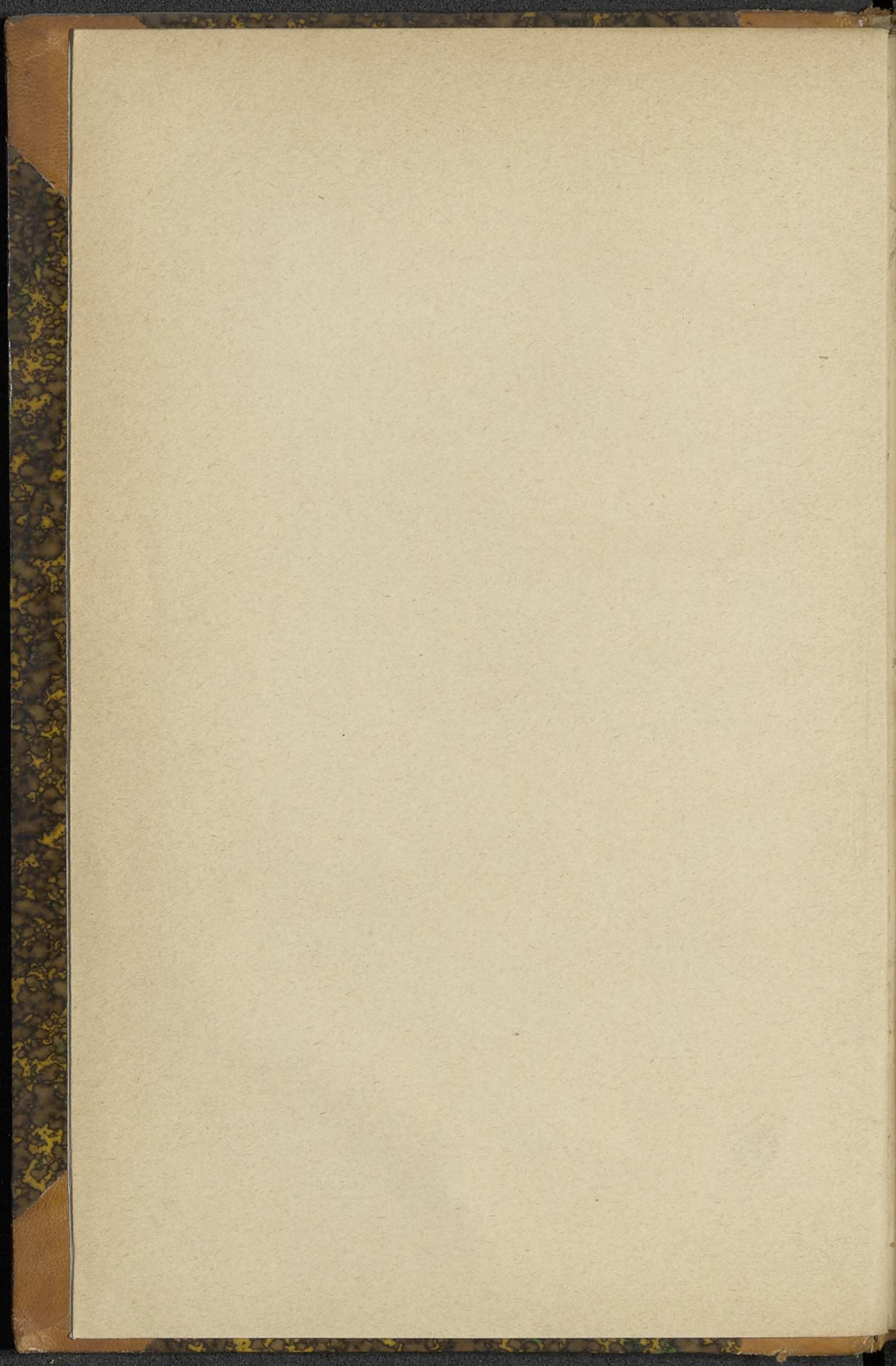


1881-82

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CRYSTAL PALACE.

INTERNATIONAL
ELECTRIC
EXHIBITION,

1881-82.



OFFICIAL CATALOGUE,
EDITED BY W. GRIST
WITH
SPECIALLY PREPARED PLANS,

SHOWING THE POSITION OF EACH EXHIBITOR,

AND

INDICATING THE SPACES LIGHTED BY THE VARIOUS SYSTEMS.

CRYSTAL PALACE

INTERNATIONAL

ELECTRIC

EXHIBITION

1881-82



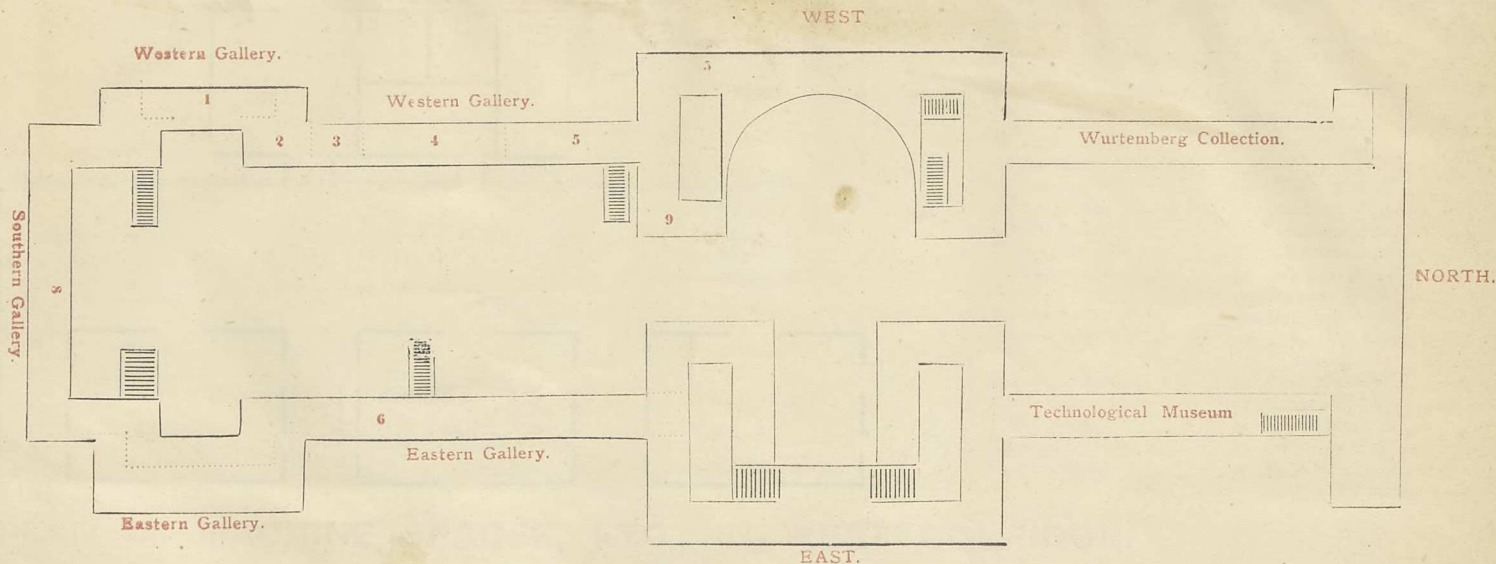
OTTOMAN CATALOGUE

EDITED BY W. CAHILL

SPECIALLY PREPARED FOR

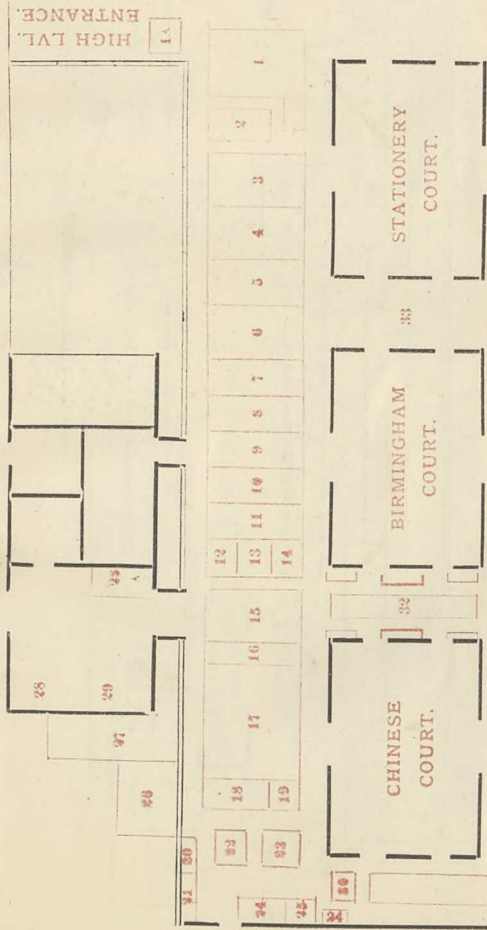
THE OTTOMAN EXHIBITION

INDICATING THE SPACES FOR THE OTTOMAN EXHIBITION

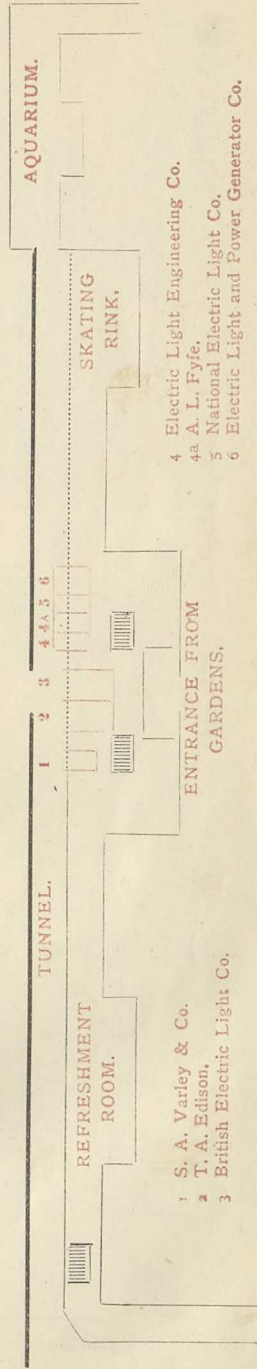


PLAN II.—LIGHTING SPACES IN GALLERY.

- No. 1. G. Hawkes & Co.
 „ 2. Henley & Co.
 „ 3. J. G. Lorrain. Gerard & Co.
 „ 4. Swan's Electric Light Co.
 „ 5. White House Mills Co.
 „ 6. Compagnie Générale d'Electricité.
 „ 8. G. G. André.
 „ 9. Domestic Electric Lighting Co. (Limited).



PLAN III.—MACHINE SPACES, ETC., IN WEST CORRIDOR.

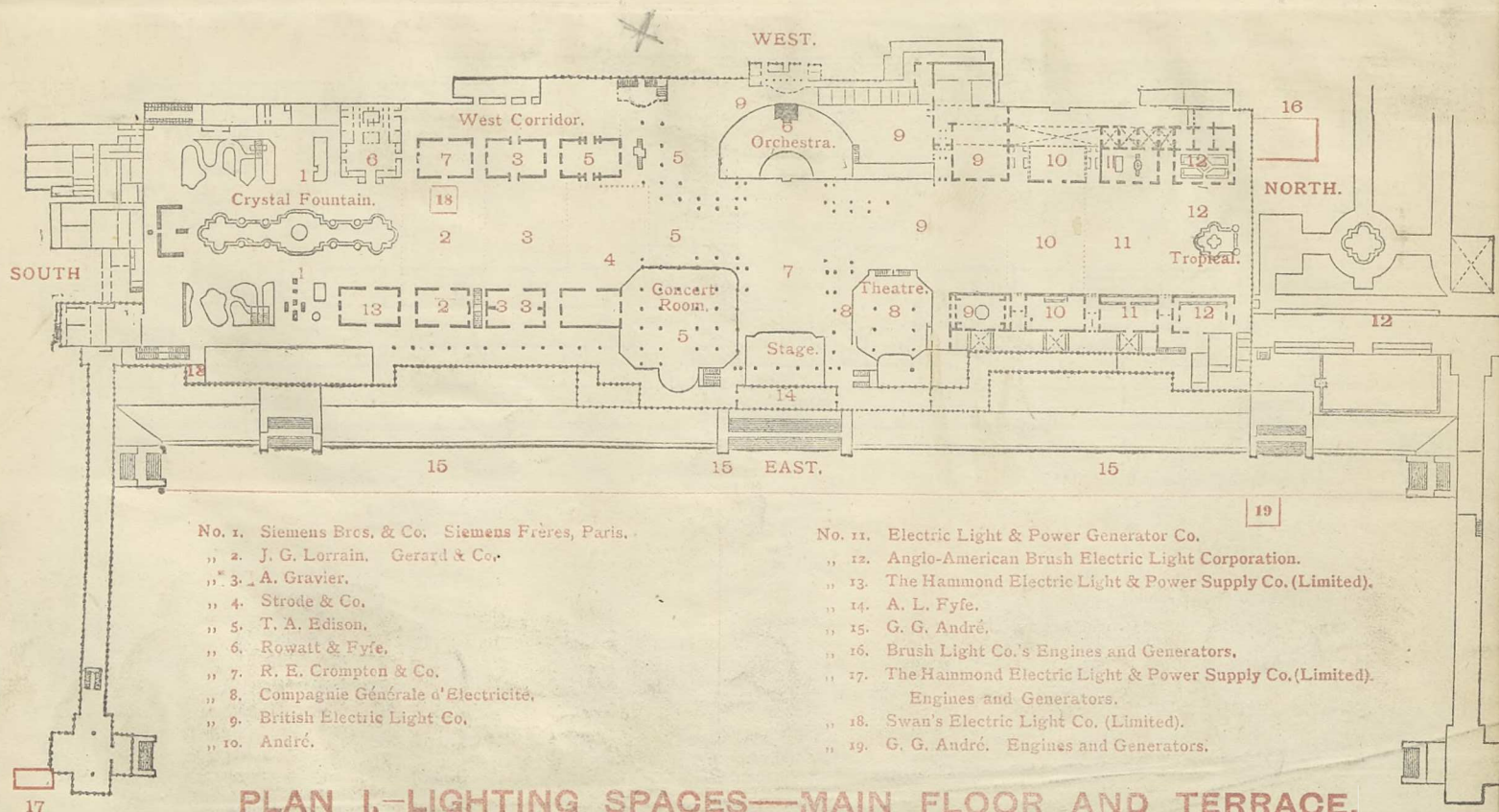


MACHINE SPACES, ETC., ON GROUND FLOOR.

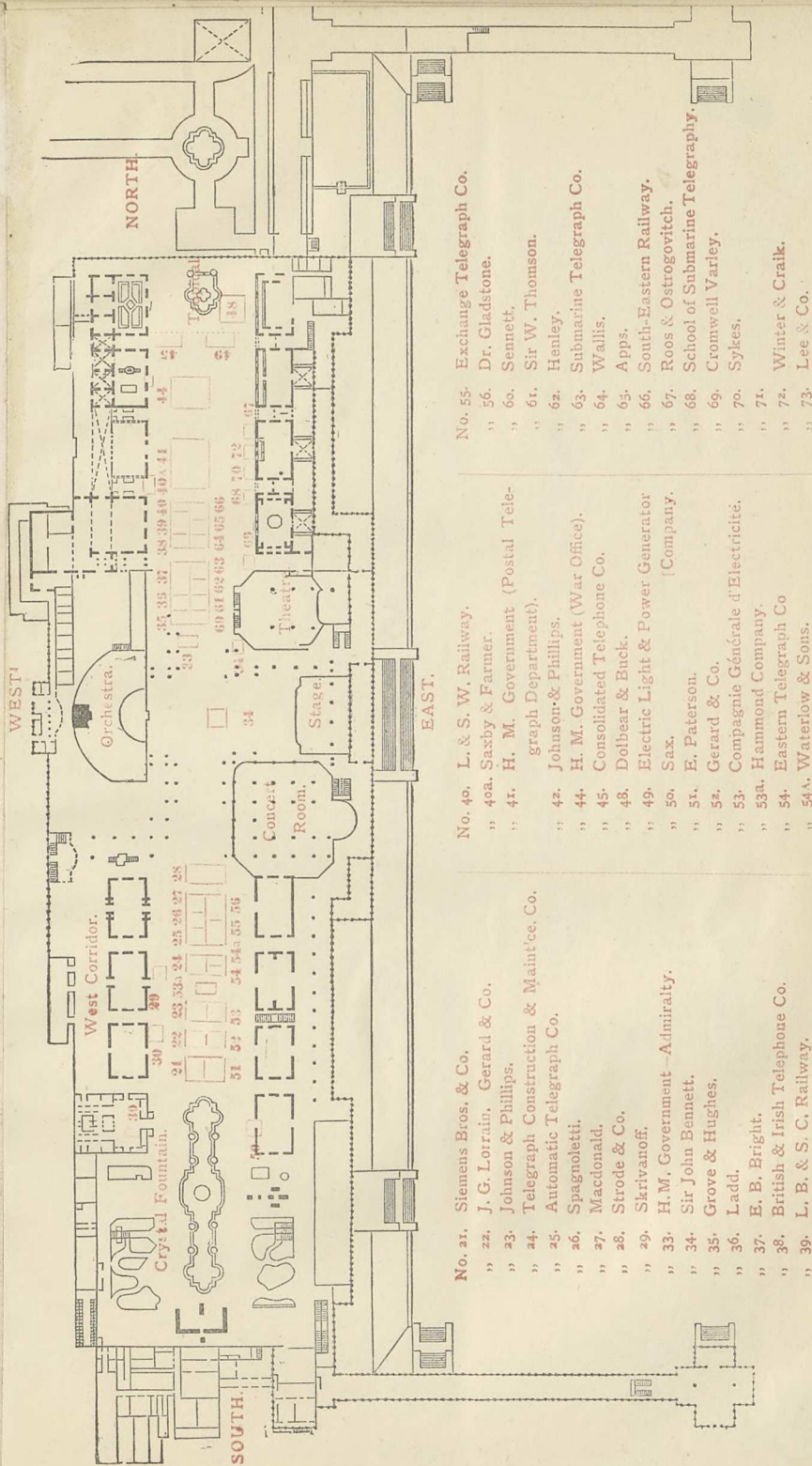
- 1 Elkington & Co.
- 2 R. H. Froude.
- 3 E. Serrell.
- 4 Crompton & Co.
- 5 Rowatt & Fyfe.
- 6 White House Mills Co.
- 7 A. Gravier.
- 8 Storde & Co.
- 9 Compagnie Générale d'Electricité.
- 10
- 11 Henley & Co.
- 12 Electric Lighting Supply Co.
- 13 Mignon & Rouart.
- 14 Faure Accumulator Co.
- 15 J. E. Liardet.
- 16 Siemens Bros. & Co.
- 17 Hawkes & Co.
- 18
- 19 Electric Light Carbon Co
- 20 Zanni & Co.
- 21 Binko & Co.
- 22 L. Amette.
- 23 Thomson & Sterne.
- 24 The Turner Gas Engine Co.
- 25 Chubb & Son.
- 26 Compagnie Générale d'Electricité, Hindley's Engines.
- 27 J. G. Lorrain, Gerard & Co.
- 28 Hawkes & Co. (Boiler).
- 29a Deakin & Parker.
- 29 Siemens Bros. & Co (Boilers).
- 30 C. G. Kelway.
- 31 Elmore & Co.
- 32 Clark, Muirhead, & Co.
- 33 Galloway Engine.
- 34 H. Whiteside Cook.

- 4 Electric Light Engineering Co.
- 4a A. L. Fyfe.
- 5 National Electric Light Co.
- 6 Electric Light and Power Generator Co.

- 1 S. A. Varley & Co.
- 2 T. A. Edison.
- 3 British Electric Light Co.



PLAN I.—LIGHTING SPACES—MAIN FLOOR AND TERRACE.



- No. 21. Siemens Bros. & Co.
 " 22. J. G. Lorrain, Gerard & Co.
 " 23. Johnson & Phillips.
 " 24. Telegraph Construction & Maintenance Co.
 " 25. Automatic Telegraph Co.
 " 26. Spagnoletti.
 " 27. Macdonald.
 " 28. Strode & Co.
 " 29. Skrivanoff.
 " 30. H. M. Government—Admiralty.
 " 31. Sir John Bennett.
 " 32. Grove & Hughes.
 " 33. Ladd.
 " 34. E. B. Bright.
 " 35. British & Irish Telephone Co.
 " 36. L. B. & S. C. Railway.

- No. 40. L. & S. W. Railway.
 " 40a. Saxby & Farmer.
 " 41. H. M. Government (Postal Telegraph Department).
 " 42. Johnson & Phillips.
 " 43. H. M. Government (War Office).
 " 44. Consolidated Telephone Co.
 " 45. Dolbear & Buck.
 " 46. Electric Light & Power Generator Company.
 " 47. Sax.
 " 48. E. Paterson.
 " 49. Gerard & Co.
 " 50. Compagnie Générale d'Electricité.
 " 51. Hammond Company.
 " 52. Eastern Telegraph Co.
 " 53. Waterlow & Sons.

- No. 55. Exchange Telegraph Co.
 " 56. Dr. Gladstone.
 " 57. Sennett.
 " 58. Sir W. Thomson.
 " 59. Hanley.
 " 60. Submarine Telegraph Co.
 " 61. Wallis.
 " 62. Apps.
 " 63. South-Eastern Railway.
 " 64. Roos & Ostrogovitch.
 " 65. School of Submarine Telegraphy.
 " 66. Cromwell Varley.
 " 67. Sykes.
 " 68. Winter & Craik.
 " 69. Lee & Co.

PLAN IV.—STANDS ON MAIN FLOOR.

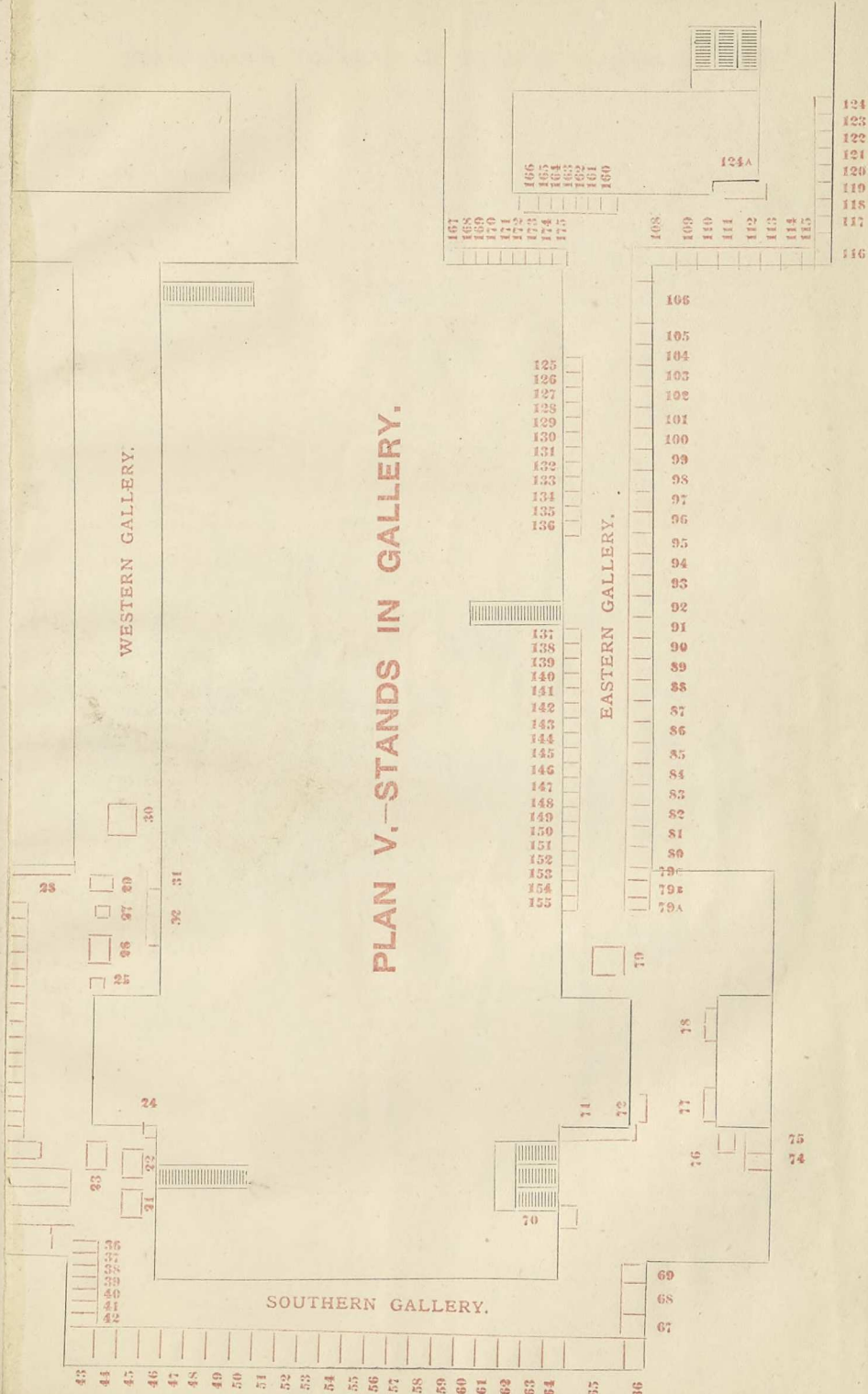
N.B.—For Exhibits in West Corridor see separate Plan.

PLAN V.-STANDS IN GALLERY.

WESTERN GALLERY.

EASTERN GALLERY.

SOUTHERN GALLERY.



REFERENCES TO PLAN OF STANDS IN GALLERY.

- 1 Martin.
- 2 Scriveuer, Gill, & Co.
- 3 Lathoud Belantan.
- 4 Bapty.
- 5 J. F. Pratt.
- 6 J. L. Pulvermacher.
- 7 Witty & Wyatt.
- 8 Copson Garratt.
- 9 George Hawkes & Co.
- 10 Dr. Barda.
- 11 H. C. Whiting.
- 12 Ashworth Bros.
- 13 Darlow & Co.
- 14 Swiss Telephone Co.
- 15 Country Mansions Portable and Economical Electric Light Co.
- 16 Desruelles & Serre.
- 17 Dolbear & Buck.
- 18 Harrison, Cox, Walker, & Co.
- 19 The Gutta-percha Co.
- 20 W. T. Glover & Co.
- 21 Gent & Co.
- 22 Orme & Co.
- 23 J. Collis.
- 24 Telegraph Construction and Maintenance Co.
- 25 Arnold & Sons.
- 26 Coxeter & Sons.
- 27 Poyet.
- 28 Anglo-American Telegraph Co.
- 29 Vian.
- 30 James Davis & Co.
- 31 Blakey & Emmott.
- 32 V. Bartelous.
- 33 Dent & Co.
- 34 Baker & Co.
- 35 E. B. Bernard.
- 36 Consolidated Telephone Co.
- 37 Hutchinson & Co.
- 38 Roth, Schlaefli, & Co.
- 39 G. G. Blackwell.
- 40 F. J. Smith.
- 41 Racagni & Guglielmini.
- 42 Jennings.
- 43 Jonas & Colver.
- 44 Crampton & Co.
- 45 Phillips Bros.
- 46 E. Paterson.
- 47 Johnson & Phillips.
- 48 Brown Wolsey Webb.
- 49 L. Rageot.
- 50 E. E. Fahrig.
- 51 S. Garau.
- 52 Davis & Timmins.
- 53 Somz e.
- 54 J. R. Breckon.
- 55 Tasker, Sons, & Co.
- 56 G. C. Lewis & Son.
- 57 F. M. Rogers.
- 58 Direct United States Cable Co.
- 59 L. Locht Labye.
- 60 J. Sax.
- 61 Woodhouse & Rawson.
- 62 E. Thomas.
- 63 Phosphor Bronze Co.
- 64 Willcox & Gibbs.
- 65 Cohn.
- 66 Exchange Telegraph Co.
- 67 Waterlow & Sons.
- 68 Newall & Co.
- 69 Broughton Copper Co.
- 70 Le Grand & Sutcliffe.
- 71 McWhirter, Roberts, & Co.
- 72 Barraclough.
- 73 Naudin & Schneider.
- 74 E. Blouzon.
- 75 Doulton & Co.
- 76 F. Smith & Co.
- 77 D. Nicoll.
- 78 Exton, Berridge, & Partners.
- 79 Probert & Steljes. W. Rogers. Poulter. Bull. Rodriguez.
- 80 Sauvajan.
- 81 Gray & Son.
- 82 Chapuis.
- 83 J. H. Pring.
- 84 Eastern Telegraph Co.
- 85 E. Webster.
- 86 T. R. Brailsford.
- 87 H. J. Dale & Co.
- 88 The Rustless and General Iron Co.
- 89 Electric Railway Signal Co.
- 90 E. Perrody.
- 91 A. B. Harding.
- 92 Jos. Davis & Co.
- 93 A. Levy.
- 94 Cassell, Petter, & Galpin.
- 95 Moulton & Co.
- 96 Plumbago Crucible Co.
- 97 Moser & Sons.
- 98 C. R. Goodwin.
- 99 Garnham & Co.
- 100 J. Willing & Co.
- 101 Wiggin & Co.
- 102 Britannia Rubber Co.
- 103 J. Stiff & Sons.
- 104 D. Walters & Sons.
- 105 Signal Engineering Co.
- 106 T. T. Powell.
- 107 W. Beanham.
- 108 Compagnie Générale d'Electricité.
- 109 Hart, Son, Peard, & Co.
- 110 London Electric Light Co.
- 111 Neujean & Delaite.
- 112 S. Vyle.
- 113 P. De Villiers.
- 114 Van Stan.
- 115 Scientific Toy Co.
- 116 H. R. Meyer.
- 117 W. Willson Cobbett.
- 118 Alex. Bardillon.
- 119 T. Coad.
- 120 M. Volk.
- 121 J. Gras.
- 122 E. A. Sullivan.
- 123 J. Slater-Lewis.
- 124 J. Storer.
- 125 L. H. Borrell.
- 126 W. Reddall.
- 127 J. Bourne & Son.
- 128 W. F. Stanley.
- 129 R. Webster.
- 130 Dowson Economic Gas Co.
- 131 F. Neill.
- 132 Harrison, Cox Walker & Co.
- 133 G. L. Andris.
- 134 F. W. Pope Cox.
- 135 F. T. Reid.
- 136 G. W. Wigner.
- 137 United Telephone Co.
- 138 Harding & Son.
- 139 Buss, Sombart, & Co.
- 140 J. Darlington.
- 141 R. C. Cutting & Co.
- 142 Sanderson.
- 143 Faulkner.
- 144 Fearn & Co.
- 145 Muller.
- 146 C. Dion.
- 147 United Asbestos Co.
- 148 T. C. Tisley.
- 149 J. G. Lorrain.
- 150 J. Slater-Lewis.
- 151 Laws and Chatterton.
- 152 J. G. Lorrain.
- 153 A. Shippey.
- 154 Fuller.
- 155 Ramsden, Camm, & Co.
- 156 Fynn & Carle.
- 157 Swiss Telephone Co.
- 158 Max Sabel.
- 159 W. B. Woodbury.
- 160 Becker & Co.
- 161 W. M. Foxcroft.
- 162 J. Mackie & Co.
- 163 De Hennaults Fils.
- 164 John Davis & Son.
- 165 Johnson & Nephew.
- 166 A. Tribe.
- 167 F. Hawkins.
- 168
- 169

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 Lieut.-Col. C. E. WEBBER, R.E.
 (President Society Telegraph En-
 gineers, for 1882).

CATALOGUE.

HER MAJESTY'S GOVERNMENT.

Postal Telegraph Department.

The Exhibits of Her Majesty's Government are numbered independently of the rest of the Catalogue; each Catalogue number corresponding to that of the Exhibit.

MODERN APPARATUS AS USED BY THE BRITISH POST OFFICE.

[1.] DOUBLE-CURRENT SOUNDER SET.

This apparatus is used for transmitting messages which are read by sound. The dots and dashes of the Morse Alphabet are given by the falling and rising of the brass lever to which the armature of the electro-magnet is fixed. The key in this instrument sends a current in one direction when depressed, and a current in the reverse direction when raised. These currents actuate a polarised relay, which works the local sounder.

[2.] WHEATSTONE'S AUTOMATIC SET.

The messages are read by the dots and dashes being printed in ink upon a strip or ribbon of paper. It is used chiefly for "press" work, and will transmit at the rate of 200 words a minute and upwards. The message is punched out on a slip of paper in the first instance.

[3.] FAST REPEATER BOARD.

Used in connection with the Wheatstone automatic apparatus for "repeating" over long lines. The repeater set is placed at a point intermediate between the transmitting and receiving stations, and increases the speed of working.

[4.] FAST DUPLEX REPEATER.

This apparatus is used for repeating the signals when working Wheatstone's automatic on the duplex system, and may be also used for ordinary single working.

[5.] UMSCHALTER SWITCH.

This apparatus is used for changing the direction of circuits and for inter-communication purposes.

[6.] MODERN SET OF TESTING APPARATUS.

Used for examining the electrical condition of the wires.

- a. Wheatstone's Bridge and Resistance Coil.
- b. Astatic Galvanometer.
- c. Tangent Galvanometer.
- d. Standard Cell.

[7.] NUMBERING MACHINE FOR NUMBERING MESSAGE FORMS.

This machine is used to number messages consecutively. The change of number is produced automatically.

[8.] TOOL BOX.

[9.] MODERN FORM OF TRAIN SIGNALLING APPARATUS.

Used for carrying out the block system, by which only one train is allowed in one section at one time. Invented by Preece, and used on the South Western and other railways.

[10.] APPARATUS CONNECTED WITH PNEUMATIC TUBES.

- a. Carriers for pneumatic tubes.
- b. Specimens of pneumatic tubes, with outer iron pipe.
- c. Specimens of pneumatic tube after being 25 years in use.
- d. Specimen joint in pneumatic tube.
- e. Double Sluice Pneumatic Valve for continuous working.
- f. Single Sluice Valve for intermittent working.
- g. Block Signalling Apparatus for notifying the departure or arrival of carriers.
- h. Terminal Signaller. Automatic signalling apparatus for notifying the arrival of carriers at the distant station.
- i. Intermediate Signaller. Automatic signalling apparatus, to be fixed intermediate upon a pneumatic tube. The duration of the electric contact can be regulated to any required length by means of the adjusting screw which limits the admission of air to the cylinder.
- j. Mandrel used in making joints in pneumatic tubes.
- k. A Pneumatic Puncher for Wheatstone's automatic apparatus.

[11.] HUGHES' INDUCTION BALANCE.

An extremely delicate apparatus by which impurities in metals and alloys are detected.

[12.] WATER LEVEL INDICATOR.

For indicating the height of the water level in a reservoir. The "transmitter" sends intermittent currents in one direction or the other, according as a float in the reservoir rises or falls. The "receiver" is worked by a polarised armature, with an escapement, which is propelled in one direction or the other, according as positive or negative currents are received from the "transmitter."

INSTRUMENTS, &c., IN OPERATION.

[1.] SET OF WHEATSTONE'S A B C INSTRUMENTS.

[2.] SINGLE NEEDLE INSTRUMENTS, each with Commutators, and one with Tin Sounder.

[3.] DUPLEX DIRECT INKERS.

[4.] DUPLEX DOUBLE-CURRENT SOUNDER SET.

[5.] WHEATSTONE'S AUTOMATIC APPARATUS.

HISTORICAL TELEGRAPHIC APPARATUS.

[1.] 1816. RONALDS' ELECTRIC TELEGRAPH (lent by Mr. Latimer Clark).

This was a Dial Telegraph. Two dials (separated by a wire) were rotated synchronously by clockwork. When a letter which it was desired to transmit appeared at the opening in the dial at the sending end, a charge of statical electricity from a Leyden jar was sent into the wire, which caused two pith balls at both the sending and receiving ends to diverge simultaneously, and thus to indicate the letter. Words were thus spelt out. Sir Francis Ronalds used copper wire insulated in glass tubes protected by a trough of wood well tarred. A portion of this experimental line laid down in his garden in Hammer-smith on the

Thames in 1816, and the original model of the telegraph, is exhibited. His book, published in 1823, the first work on the electric telegraph in the English language, is kindly lent by Mr. Latimer Clark, and exhibited in another part of the exhibition.

- a. Portion of the original telegraph line laid down by Ronalds in 1816.
- b. Original model of Ronalds' Dial Telegraph (1816).
- c. "Fossil" Telegraph.
- d. Insulators used by Morse.
- e. Original type cast in December, 1832, by Morse.
- f. Specimen of first cable between England and France, 1850.

[2.] 1837. THE "FOSSIL" TELEGRAPH.

The first underground practical telegraph laid between Euston and Camden by Cooke & Wheatstone in 1837. It was formed of copper wires covered with cotton and pitch, and laid in grooves in lengths of wood of a triangular section, the grooves being fitted up by strips of the same material. The wood so prepared was buried underground. It was used in connection with Cooke & Wheatstone's Five Needle Telegraph.

- a. "Fossil" Telegraph (1837).
- b. Specimen of first cable between England and France (1850).
- c. Specimen of first Atlantic cable (1858).

[3.] 1837. COOKE & WHEATSTONE'S NEEDLE TELEGRAPH.

Five needles or magnets were employed in conjunction with five Schweigger's multipliers, forming five distinct galvanometers. Each multiplier was connected in the circuit of a separate wire and each needle had two movements, limited by stops, the one movement being to the *right*, and the other to the *left*. The alphabet was formed by the convergence of two needles simultaneously deflected, the letters being engraved on the dial at the points where the projections of the needles met. The currents were transmitted and reversed by depressing simple commutators. Currents from galvanic batteries were used. The five line wires were insulated as shown in the "Fossil" Telegraph. The instrument shown was used between Paddington and West Drayton in 1838. This instrument, from its peculiar shape, is known as the "Hatchment" Telegraph.

[4.] 1838. COOKE & WHEATSTONE'S FOUR-NEEDLE TELEGRAPH.

Since the sounds of C, Q, J, U, and Z need be very little used in the English language, it was found that the remaining letters of the alphabet could be formed by the deflection of four needles, and such an instrument was employed on the London and Blackwall Railway in 1840. In this instrument, the letters H and P are formed by one needle only.

[5.] 1842. COOKE & WHEATSTONE'S DOUBLE-NEEDLE TELEGRAPH.

Owing to the frequent failure of one or two out of the four wires, it was soon found by the operators that an alphabet could be formed by two needles only, if advantage were taken of repeated momentary movements, either separate or combined, instead of prolonged deflections. This identical instrument was fixed at Slough in 1842. Kindly lent by Messrs. Reid Bros.

[6.] 1850. COOKE & WHEATSTONE'S DOUBLE NEEDLE in a Gothic case made specially for the new Houses of Parliament.

[7.] 1852. THE MODERN FORM OF DOUBLE NEEDLE modified by Messrs. Edwin and Latimer Clark, still used to a small extent on some railways in England.

[8.] 1846. THE SINGLE-NEEDLE INSTRUMENT OF COOKE & WHEATSTONE.

It was soon found that an alphabet could be formed by the movements of one needle only, by taking advantage of momentary deflections of the needle to one side or the other. At first an arbitrary alphabet was used, but in the

[9.] 1869. MODERN FORM OF SINGLE NEEDLE,

The German Union Morse Alphabet was adapted, and the form of the instrument much improved. The change of alphabet was made in 1855.

[10.] 1843. BAIN'S I. AND V. TELEGRAPH.

The alphabet is formed by the movements of two pointers, one moving to the right and the other to the left, according to the direction of the current. The pointers are attached to circular magnets moving inside coils. A code similar in principle to that of the single-needle instrument was employed for representing the letters.

[11.] 1846. HIGHTON'S GOLD LEAF TELEGRAPH.

A small strip of gold leaf inserted in a glass tube passes through the field of a permanent magnet and forms part of the line circuit. When a current passes through the gold leaf, it moves the latter to the right or left, according to the direction of the current. The alphabet is made by repetitions and combinations of these movements, as in the Single-Needle Instrument. Batteries and commutators were used as in Cooke and Wheatstone's single-needle system.

[12.] 1848. HIGHTON'S NEEDLE TELEGRAPH.

Used by the British and Irish Magnetic Telegraph Company. A horseshoe or circular magnet within a circular coil, and worked by a reversing key or commutator, is used. The signals are similar in principal to those of Cooke and Wheatstone's single needle.

[13.] 1852. HIGHTON'S NEEDLE TELEGRAPH.

Small form with folding doors. Used by the British and Irish Magnetic Company. Identical in construction with the original form which it superseded.

[14.] 1848. HENLEY'S MAGNETO-ELECTRIC DOUBLE-NEEDLE INSTRUMENT.

Used by the British and Irish Magnetic Company. The needles only move on one side of their vertical position, and the signals are made up of the single and combined movements of the two needles. This instrument requires two line wires, and is worked by the magneto-electric current generated by moving the handle or handles. The interior needles are small straight bar magnets, playing between the semi-circular pole pieces of an electro magnet. The needle remains on the side on which it is left by the last current, which passes through the coils, and does not return to its vertical position by gravity, as in Cooke & Wheatstone's needle instrument.

[15.] 1848. HENLEY'S MAGNETO-ELECTRIC SINGLE-NEEDLE INSTRUMENT.

Used by the British and Irish Magnetic Telegraph Company. Similar in action to the last-named instrument, but only one needle and one line wire were employed. The alphabet was produced by combinations of short and prolonged deviations of the needle, as in the Morse code.

[16.] SERIES OF COILS AND NEEDLES USED IN CONNECTION WITH THE NEEDLE SYSTEM OF COOKE & WHEATSTONE.

a. 1846. The original form, with long coils and permanent magnetic needles.

b. 1848. *Holmes' small Diamond Needle*. This was a great improvement in the original form, as it increased the speed of working considerably by diminishing the arc of vibration of the needle.

c. 1851. *Clark's Needle*.

d. 1866. *Varley's Induced Needle*.

N.B.—This prevented demagnetization by atmospheric electricity—a very frequent source of trouble.

e. 1866. *Brittan's Undemagnetizable Needle*.

f. 1869. *Spagnoletti's Induced Needle*.

[17.] 1878. NEALE'S ACOUSTIC DIAL, employed on a single-needle instrument in the place of the ordinary dial. Is very similar in action to a Siemens' Relay, but the needle is held in the vertical position by a spiral spring behind the dial.

[18.] 1880. TIN PLATE SOUNDER for converting the single-needle instrument from a visual to an aural apparatus. The sounder is fixed to the dial of the ordinary instrument, the ivory pins of which are removed; the needle strikes against the curved surfaces and produces audible sounds.

[19]. 1855. BRIGHT'S BELL WITH RELAY.

Used by the British and Irish Magnetic Telegraph Company. The single-needle alphabet is produced by striking two bells of different tones, the hammers being actuated by electro-magnets worked by a relay and local battery. The relay is double-acting, and consists of two electro-magnetic bobbins placed side by side, their ends being furnished with pole pieces turning inwards. Between these pole pieces at each end of the bobbins, the ends of permanently magnetized needles, pivoted on vertical axes, play; these needles are so placed as regards their polarity that a current in one direction moves the needle which closes the local circuit of the right-hand bell, and a current in the opposite direction moves the other needle, which closes the local circuit of the left-hand bell. The signalling key used with this instrument is similar to that used with Highton's Single Needle. This instrument superseded Henley's magnetic-electric system.

[20.] 1840. COOKE & WHEATSTONE'S A B C INSTRUMENT.

A step by step instrument. The letters of the alphabet are arranged round a paper disc fixed on the axle of an escapement wheel. The letters appear at an opening in the front of the case. The escapement is similar to the "échappement-à-cheville," and is controlled by an electro-magnet. There are as many teeth in the escapement wheel as there are letters on the revolving disc; the latter moves from one letter to the other for each current sent. The train of clockwork is actuated by a main-spring. The communicator is so arranged that a current is sent when its spoked wheel is turned through a distance equal to that dividing the letters engraved upon it. The commutator fixed on the axle of the revolving electro-magnet, is so constructed that the magneto-electric currents are all in the same direction.

[21.] 1840. SIMILAR APPARATUS to No. 20, but a pointer is used instead of a revolving card.

[22.] 1858. MODERN FORM OF WHEATSTONE'S A B C INSTRUMENT.

A magneto-electric instrument. The currents for working the same being generated by the revolution of an armature in front of polarized electro-magnets. The depression of a key opposite a letter arrests the motion of the pointer and cuts off the currents going out to line.

[23.] COLLECTION OF KEYS.

a. 1852. *Simple Spring Key* used with Bain's chemical recording telegraph.

b. 1854. *Key for sending* a short reversal after each signal, two sets of batteries being required. When the key is up, the line wire is connected to the receiving apparatus.

c. 1854. *Varley's Wheel Key*. A constant current is maintained on the line, and signals are made by depressing the key, and thus reversing the current. A switch is used for making the necessary alterations to the connections for sending and receiving.

d. 1870. *Stroh's Key*. Similar in general principle to Varley's key, but the contacts are made by springs, and the switch action is attained by moving the lever of the key to the right or left as required. When the lever is at the "receive" position it cannot be depressed.

e. 1882. *Single Current Key*.

f. 1882. *Double Current Key*.

[24.] COLLECTION OF RELAYS.

a. 1868. *Andrews' Relay* for Hughes' type-printing instrument, used by the United Kingdom Telegraph Company. Its peculiarity consists in the relayed currents being of equal length and independent of the length of the line current.

b. 1858. *Whitehouse's Relay*. In this relay a small permanent horseshoe magnet oscillates between the pole pieces of an electro-magnet. The adjustment is effected by the attraction of another small permanent magnet, instead of the spiral spring generally used.

c. 1856. *Varley's Horizontal Relay*. A horizontal bar of soft iron is pivoted vertically and free to move in the interior of two cylindrical bobbins. The ends of the bar which project beyond the bobbins play between the poles of horseshoe permanent magnets fixed at each end. The relay is adjusted by moving the stops, and consequently the soft iron bar, to one side or the other.

d. 1870. *Stroh's Relay*. Two curved permanent steel magnets are fixed side by side on the opposite sides of a vertical bar, whose ends work in pivots. The poles of these magnets play between the poles of two vertical straight electro-magnets.

e. 1864. *Soft Iron Relay*.

f. 1855. *Varley's Vertical Relay*. The coil is wound on a reel of soft iron, upon each end of which a hollow "casing" or cap of the same material is fitted, almost completely encasing the coil in soft iron. The armature is crescent-shaped, and is magnetized by induction from a compound bar magnet placed behind. The crescent-shaped portion plays between the inner ends of the casings, which for that purpose do not quite meet, but leave the central portion of the coil exposed. An ordinary magnetic needle pivoted below the coil is acted upon by the latter, and serves as an indicator to call attention. The armature is held up against knife-edge bearings by two helical springs, and the adjustment is effected by varying the tension of one of them.

g. 1855. *Preece's Duplex Relay*. Worked on the leakage principle. The outgoing current from either station passes through one coil of the instrument and then divides between the second coil, which is connected to line and a resistance.

h. 1882. *Post Office Standard Relay*.

[25.] 1850. BAIN'S CHEMICAL TELEGRAPH, as used by the Electric Telegraph Company in place of the double needle (No. 7). The paper ribbon was prepared with yellow prussiate of potash and nitrate of ammonia. The style is of iron. The Steinheil code—dots in two parallel lines—was occasionally used, but was entirely superseded by the Morse code of dots and dashes.

[26.] 1846. MAGNETO-ELECTRIC MACHINE, commonly called the "Thunder-pump," employed for releasing the clock-work mechanism of an electric alarum or bell. Used by the Electric Telegraph Company.

[27.] 1846. ALARUM WITH CENTRIFUGAL HAMMER.

Used in connection with Cooke & Wheatstone's first needle instruments. Moved by clockwork; driven by a mainspring; released by an electro-magnet.

[28.] SET OF JOINTS EMPLOYED ON IRON LINE WIRES.

1842. *Cooke & Wheatstone's.*

1844. *Reid's.*

1851. *Clark's "Britannia" Joint.*

[29.] 1843. WHEATSTONE'S ORIGINAL FORM OF RESISTANCE COILS FOR TESTING.

[30.] RAILWAY SIGNALLING INSTRUMENTS.

a. 1845. *Early form of Train Signalling Apparatus*, devised by Cooke, and used on the Norfolk Railway.

b. 1855. *Edwin Clark's Block Signalling Instrument*, fixed on the London and North-Western Railway.

c. 1862. *Preece's Semaphore Signal*, used on the London and South-Western Railway.

[31.] LIGHTNING PROTECTORS.

Selection of Lightning Protectors used at different periods.

a. Latimer Clark's Protector.

b. Henley's Protector.

c. S. A. Varley's Carbon Protector, or Lightning Bridge, with longitudinal section of the same.

d. Varley's Vacuum Tube.

e. Reid's Protector.

f. Twisted Wire Protector.

g. Tube Protector, with outer glass tube.

h. Ordinary Tube Protector used in the Post Office Telegraph Department.

i. Comb Protector (exterior and interior).

- j. Modern Plate Protector, with grooves.
- k. }
- l. } Old forms of Protectors.
- m. }
- n. Varley's Original Vacuum Protector.
- o. Varley's Vacuum Protector (later form).
- p. Cable Lightning Protector, in use by the Post Office Telegraph Department, having in addition to plates a metallic bobbin, electro-nickel plated, in connection with the earth. It is wound with a fine platinum wire covered with silk, and passed through melted paraffine wax, the wire being placed in the line circuit. The metallic bobbin is carefully lacquered to secure insulation in damp situations.
- q. Modern Plate Protector without grooves, in use by the Post Office Telegraph Department.

[32.] INSULATORS.

A Selection of Insulators as used in England at different periods.

- a. Iron wire.
- b. Three-strand copper.
- c. Cook and Wheatstone's original ring insulator (1840).
- d. Cone insulator, original form (1845).
- e. " " later "
- f. " " form for repairing broken insulators.
- g. Walker's double-cone insulator (brown). (1850.)
- h. " " (white).
- i. Physick's insulator (1847), in which the bolt by which the wire is suspended is insulated by mastic cement in the cavity at the top of the insulator.
- j. Edwin Clark's brown earthenware insulator, with zinc cap (1850).
- k. Ditto, with groove for wire.
- l. Ditto, glass instead of earthenware.
- m. (1851) brown earthenware.
- n. " " glass.
- o. Latimer Clark's invert insulator, corrugated (1856).
- p. Varley's double-cup insulator, fitted.
- q. Ditto, in separate parts, 1862.
- r. Varley's No. 11 wire double-cup insulator.
- s. Brown earthenware insulator called (Z).
- t. Jobson's invert white, double shed.
- u. " " single "

- v. South Devon invert insulator (brown).
- w. " " " (white).
- x. Andrew's invert with ebonite inner shed.
- y. " " bolt tube "
- z. " " bolt tube and shed.
- A. Ebonite insulator, single shed.
- B. Old form of shackle.
- C. Bright's shackle.
- D. Modern terminal insulator.
- E. Cordeaux's screw insulator (1877).
- F. " " single insulator.

[33.] Head of Pole, showing mode of leading in and terminating.

[34.] Old Form of Testing Tablet.

[35.] COLLECTION OF BATTERIES.

a. 1844. *Sand Battery in wooden trough*. This battery was in general use in England on the lines of the Electric Telegraph Company from 1844 till 1854.

b. *Sand Battery in Gutta-percha Trough*.

c. 1853. *Trough form of Daniell's Battery*. This superseded the sand battery and was modified and introduced by Mr. John Fuller.

d. *Chamber Daniell Battery*. A modified form of trough battery introduced by Mr. John Muirhead in 1857.

e. Small-size ditto.

f. *Daniell's Battery*. As used by the Postal Telegraph Department.

g. h. *Bichromate Battery (large and medium sizes)*. As used by the Post Office Telegraph Department, introduced by Mr. John Fuller, 1876.

i. *Gravity Leclanché Battery*. As used by the Post Office Telegraph Department.

k. 1862. *Varley's Secondary Battery*. Used for some years in connection with the time signals at the central station. It was charged by an ordinary battery for about half an hour previous to giving the time signal.

[36.] SPECIMENS OF SUBMARINE CABLES IN USE
BY THE P.O. TELEGRAPH DEPARTMENT.

- a. Isle of Man (shore end).
- b. Wexford, old (deep sea).
- c. Reuter's (shore end).
- d. Belfast.
- e. Seven-wire, shore end. Modern type.
- f. One ditto ditto.

- g. Dublin (shore end).
- h. Seven-wire, deep sea. Modern type.
- i. Wexford (deep sea).
- j. One-wire (deep sea). Modern type.
- k. Firth of Tay.
- l. Wexford (deep sea).
- m. North Lowestoft (deep sea).
- n. Wexford, old (shore end).
- o. South Lowestoft (shore end).
- p. Dublin (deep sea).
- q. North Lowestoft (shore end).
- r. Reuter's.
- s. Channel Islands (shore end).
- t. Queen's Ferry.
- u. Channel Islands.

[37.] MODEL OF A CABLE SHIP, by W. R. Culley, of the Sub-marine Department, G. P. O.

[38.] DIAGRAM, showing the growth of the Post Office Telegraphs from the date of the transfer of the Telegraphs to the State up to the present date.

[39.] NORWEGIAN WOODPECKERS, having pierced a telegraph-pole in search of food.

MODEL.—*Showing the Manner in use in Norway to join Sub-marine Cables to Shore Lines.*

A line of the Norwegian telegraph system extends along the coast in the interest of the fisheries and of navigation. This line has branches to the islets which are farthest from the coast, where movable telegraphic stations are established during the fishing season. Along the coast are also found permanent stations for the use of traders and fishermen voyaging to the fisheries.

This system demands the application of many small submarine cables for crossing bays and straits in parts much exposed to the action of a high sea. To protect these submarine cables against this action the cables are covered with cast-iron pipes from the point where they touch the shore to a depth below the action of the sea.

A sample of these pipes will be found in the Exhibition. The construction is principally after the English fashion. As it would be both inconvenient and costly to construct huts for all these small cables,

as is done in order to examine and to protect the shore ends of the great submarine cables near the sea, an insulator with a hole in the centre is fixed to the top of the post nearest the shore, as shown in the model; which, as soon as the wire which connects the submarine cable with the land line is run through, is closed up with a composition of wax and resin.

C. NIELSON, Chief Director.

Christiania, June 15th, 1881.

Some Observations on the Impression Produced on Animals by the Humming Sound and Vibration of Telegraphic Wires.

It is known that the wood-pecker (black or green, *picus martius* and *picus viridis*), specimens of which are in the Exhibition, feeds on worms and insects, which it finds under the bark and in the core of decayed trees, but never in living ones.

As will be seen, the section of wood exhibited is cut from a perfectly sound post, impregnated with sulphate of copper and perforated with a hole, forming a circle of the diameter of 7 centimeters (about $3\frac{1}{2}$ inches) which hole has been pecked out by this bird.

The same phenomenon is frequently found in Norway in certain districts situated near pine woods where this bird is found; the holes are as a rule at the top of the post. According to the opinion of an ornithologist the phenomenon must be attributed to the humming sound produced in the post by the vibration of the wire, which the bird imagines to proceed from worms and insects working inside the post, and that is why he sets to work quite confidently to pick a hole with his beak. Poor bird! after giving himself all this trouble he must find himself bitterly disappointed when, all of a sudden, he finds he has gone right through the post, to see daylight the other side.

It is well known that the greatest delicacy to a bear is honey, and that during his solitary prowls about the mountains, when suddenly the vibration of the telegraphic wire awakens him from his musings, it is very pardonable if the poor beast believes he hears the joyous humming of a swarm of bees, and that he begins to lick his lips at the bare thought of tasting the delicacy; following the delusive sound he at last arrives at the post where it is louder than ever, and as he does not find the expected beehive he very naturally thinks it must be under the heap of stones used to support the post on the bare rock; and then having set to work to scatter these stones in all directions in order to find the dreamt-of treasure, deceived in his first hopes, he finishes, that he may at least have the satisfaction of destroying all the bees he supposes hidden inside the post, by giving the heap a tremendous blow with his paw.

We have at times observed high up in the mountains the scattering of the stones (used in fixing the posts), which seemed a thing quite unaccountable until one found the marks of the claws of the enraged bear in the post.

I would also give some observations on the effect on wolves produced by suspended telegraphic wires; but I must first remark that these phenomena are of the most complicated nature, and appear problematical from a natural science point of view. I will confine myself to stating a few facts and will leave it to everyone to form his own opinion on them. My attention had already been directed to this when there arose a question of placing at the disposal of the Government funds necessary for the main great telegraphic lines. It was then said that a member of the Storthing had declared that, although the part of the country which he represented had no direct interest in the proposed line, he would vote for it all the same because he supposed that by it the wolves would be driven away from those districts where the line would pass. It was a fact that wolves at this time were a great scourge to the country, and that during the winter they used to descend in bands from the mountains into the valleys, where they killed in great numbers the cattle of the peasants; and on this account, in several parts of the country, the precaution had been taken to form a cordon round the cow-houses and farm-buildings by mean of supports connected together with ropes; and it is an established fact that the wolves, starving as they were, dared not pass under the ropes. The same means were made use of to rid an island (really rather a peninsula than an island), from the unwelcome visits of these voracious beasts. After a battue a rope suspended from stakes was stretched across the isthmus, which resulted eventually in freeing the peninsula from the wolves' visits.

The most remarkable thing, however, is that after the great telegraph system was commenced across the mountain plateaux and along the principal valleys of the country (some twenty odd years ago) that wolves have entirely disappeared, and have not since come back; and it is very rarely that one now hears of a solitary specimen being seen.

However, as I have said above, naturalists will deny that in this can be found the true cause of the disappearance of wolves from this country, and will attribute their departure either to the ravages of an epidemic or to the long wanderings of wolves, although it can by no means be proved that any similar thing has happened before in this country, which seems altogether to furnish so many conditions favourable for the harbouring of wolves.

C. NIELSON, Chief Director.

Christiania, June 15th, 1881.

HER MAJESTY'S GOVERNMENT.

War Office.

N.B.—The Exhibits of Her Majesty's Government are numbered independently of the rest of the Catalogue ; each Catalogue Number corresponding to that affixed to the Exhibit.

SPECIAL STORES USED IN SUBMARINE MINING.

[1.] Mine moored to float near surface ; holds 100 lb. of guncotton ; is fired by electric current from the shore when struck by a hostile vessel, the contact of the ship being electrically notified in the firing station on shore.

[2, 3, 4.] Other patterns of the same.

[5.] Wooden Buoy containing circuit-closing arrangement, which acts in the same manner as No. 1, but the charge is contained in a mine moored below.

[6.] Another pattern of the same in iron, in which the buoyancy is obtained in the iron case.

[7.] Mine moored on the bottom of a river or harbour ; holds 250 lb. of guncotton ; is fired by electric current from the shore, either when an enemy's ship strikes the buoy No. 5 or No. 6 over it, or when the ship is observed to be nearly over the mine.

[8, 9.] Larger patterns, to contain 500 lb. of guncotton, for use in deeper water.

[10, 11.] Still larger patterns, giving sufficient buoyancy to float the mines up to the best depth for effect in very deep water. Can be used as ground mines also.

[12, 13, 14, 15, 16.] Sinkers, or mooring weights, for foregoing mines.

[17.] Box, junction, for one multiple 7-cored cable and seven single cables to mines.

[18.] Box, junction, for one single cable and eight single cables to mines, each cable being disconnected automatically in the junction-box when the mine upon that cable is fired. Used with mines Nos. 1, 2, 3, 4.

[19.] Another pattern for a group of four electro-contact mines.

[20.] Box, connecting, for connecting the ends of multiple cables; to avoid splicing.

[21.] Ditto, for single cables.

[23.] Ditto, for shore-end cables.

[24.] Ditto, for connecting mines successively to a single cable. (*See* No. 35.)

[25, 26.] Apparatus, circuit-closing, for mines Nos. 1, 2, 3, 4.

[27, 28.] Ditto, for the circuit-closing buoys Nos. 5, 6.

[29, 30.] Apparatus containing the dry primers and detonators for mines Nos. 7, 8, 9, 10, 11.

[31.] Specimens of Cables employed.

[32.] Specimens of Detonators and Fuzes.

[33.] Wire-rope, steel, for mooring purposes.

[34.] Signalling flags.

[35.] Disconnecter, single, containing a disconnecting fuze, used with No. 24.

[36.]

INSTRUMENTS USED ON SHORE.

[37.] Arc firing for one line of mines.

[38.] Ditto, for several mines.

These arcs are used for firing mines by observation from shore.

[39.] Key, firing.

[40.] Apparatus, containing seven Indicators, to show when a vessel strikes a particular mine or group of mines. This instrument is arranged so that the signal shall be the means whereby the firing current is switched automatically to the cable and the mine fired automatically, if so desired.

[41, 42, 43, 44, 45.] Voltaic Cells used for various purposes.

[46, 47, 48.] Galvanometers used for various purposes.

[49.] Low-resistance Coils and Thermo-Galvanometer.

[50.] High-resistance, one Megohm, for cable-testing.

[51.] Condenser, $\frac{1}{2}$ M.F., for cable-testing.

[52.] Set of Tools for repairing instruments.

[52.] Ditto for making electrical joints, in box complete.

[53.] Dynamo-electric Exploder, worked by hand, for firing low-tension detonators.

[54.] Apparatus, Lime Light, complete.

[55.]

TELEGRAPH EQUIPMENT.

FIELD TELEGRAPH.

[56.] Cable waggon.

[57.] Instrument, Telegraph, Morse, Recording. (Not the latest pattern.)

[58.] Ditto, Sounder.

[59.] Polarised Relay.

[60.] Wheel with Stand for coiling messages.

MOUNTAIN TELEGRAPH.

- [61.] Mule carrying cable.
- [62.] Ditto carrying tools for construction of line.
- [63.] Tent, Telegraph Office, carried by mule.
- [64.] Apparatus for paying out and coiling up cable.
- [65.] Attachment for carriage of single drum of cable on the pack-saddle.
- [66.] Instrument, Telegraph, Sounder, in leather case.
- [67.] Galvanometer, 3-coil.
- [68.]
- [69.]

R. E. FIELD COMPANY EQUIPMENT.

[70, 71.] Dynamo-electric Exploders, quantity and tension, for different kinds of detonators.

[72.] Case of Sections of Detonators, &c.

[73.] Demolition Pack-saddle Equipment. For transporting in such a manner as to keep up with parties of mounted men the necessary materials, tools, and apparatus for effecting the hasty demolition of bridges, railways, &c.

[74.]

[75.]

MISCELLANEOUS.

- [76.] Portable Test Battery, 6 cells, for service in the field.
- [77.] Ratchet for straining telegraph wire.

[78.] Portable Apparatus for testing electrical resistances, with Battery and Galvanoscope complete.

[79.] Earthplates, Leads, and Connectors for use with No. 78, when testing lightning conductors.

[80.] Two Heliostats.

[81.] Telescope and Stand, for Army signalling.

[82.]

HER MAJESTY'S GOVERNMENT.

The Lords of the Admiralty.

Electrical Indicator for showing the position of the helm of
H.M.S. "Inflexible" at last degree. *North Nave.*

English Exhibitors.

Class I.—Static Electricity.

1.—A. APPS, 433, Strand. Educational Apparatus, &c. "Admiral Selwyn's Electrometer, intended to demonstrate the fact that light rays can convey electricity, and that thus the last link in the correlation of forces is completed." *North Nave.*

2.—F. E. BECKER & Co., 34, Maiden Lane, Covent Garden, W.C. Voss's New Self-charging greatly improved and simplified Induction Electrical Machine. (*See FOREIGN SECTION.*)

Concert-Room Gallery.

3.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. Frictional Machines, large Plate Machine, Winter Machine. *Western Gallery and North Nave.*

4.—T. CRAMPTON & Co., 251, High Holborn, W.C. Winter's and Cuthbertson's Frictional Machines. *Southern Gallery.*

5.—H. J. DALE, 4, Little Britain. Frictional Machines and Educational Apparatus. (*See ADVT. p. 123.*) *Eastern Gallery.*

6.—J. ORME & Co., 65, Barbican, E.C. Frictional Apparatus, &c., &c. *Western Gallery.*

7.—E. PATERSON, 76, Little Britain. Frictional Apparatus for class demonstration. (*See ADVT. p. 119.*)

South Nave and Southern Gallery.

7A.—W. F. STANLEY, 13, Railway Approach, London Bridge. Educational Apparatus. *Eastern Gallery.*

Class II.—Batteries and Allied Apparatus.

8.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*)

9.—HER MAJESTY'S GOVERNMENT (War Office). (*See p. 26 et seq.*)

10.—A. APPS, 433, Strand. Batteries (various). *North Nave.*

11.—BINKO & Co., 12, Coleman Street, Bunhill Row, E.C. New kind of Battery. *West Corridor.*

11A.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. Large variety of Leclanché, Bichromate, and other Batteries. *Western Gallery and North Nave.*

12.—GEO. G. BLACKWELL, 26, Chapel Street, Liverpool. Specimen of Crystallised Manganese used in preparation of manganese for Leclanché batteries; Specimen of Crystallised Sal Ammoniac for Leclanché batteries; Specimen of Crystallised Sulphate Copper. Manganese and Sal Ammoniac as supplied for Leclanché batteries; Sulphate Copper as supplied for Daniell's batteries; Bichromate of Potash as supplied for bichromate batteries. Carbon Plates as prepared for Leclanché, bichromate, and Bunsen's (Blackwell's modification) batteries; Carbon Blocks as prepared for Bunsen's battery, clamps attached. Zinc Plates as bent for Grove's cells; Zinc Rods for Leclanché; Glass Jars for Leclanché; Porous Cells for sundry—Bunsen's (Blackwell's modification) and Grove's—batteries. Batteries made from above materials: Leclanché (2 sizes), Grove's, Daniell's, Smie's, Bunsen's, and Bunsen's (Blackwell's modification). Bichromate Bottles (4 sizes). Planté's Secondary Battery (2 sizes). (*See ADVT. p. 126.*)

Southern Gallery.

13.—J. BOURNE & SON, Denby Pottery, near Derby, and 6, St. Pancras Station, Euston Road, N.W. Stoneware Insulators and Battery Cells, possessing a high degree of vitrification, combined with great toughness and strength. The exhibits include several patented shapes, amongst them the well-known Varley's patent double V and the Z patterns, which have established the reputation of these specialities for the possession of all the excellences of the best porcelain, with greater strength and durability, at less cost.

Eastern Gallery.

14.—L. CLARK, MUIRHEAD, & Co., 23, Regency Street, Westminster. Muirhead's Sulphate Battery, with square white porcelain chamber, flat porous cells, and zinc and copper plates; Muirhead's Sulphate Battery, same as above, with square ebonite chambers; Howell's Patent Manganese Battery; De la Rue's Chloride of Silver Battery; Menotti Battery; Various forms of batteries; Parts of batteries. (*See ADVT. p. 131.*)

Between Sheffield Court and Chinese Court.

15.—T. COAD, 78, Blackfriars Road. A Galvanic Generator for electric lighting and motor purposes.

Gallery at back of Concert-Room.

16.—T. CRAMPTON & Co., 251, High Holborn, W.C. Batteries (various), Terminals, &c.

Southern Gallery.

17.—H. J. DALE, 4, Little Britain. Batteries. (*See ADVT. p. 123.*)

Eastern Gallery.

18.—DOULTON & Co., Lambeth, London, S.E. Porous Cells and Battery Jars; Jars for Storage of Acids, Stills, Worms, &c.; Crucibles, Melting Furnaces, &c. &c.

Eastern Gallery.

19.—LA FORCE ET LA LUMIÈRE COMPANY (Faure's Accumulator), 446, Strand, W.C. The Faure Electric Accumulator, or Secondary Battery, illustrating the storage of electro-dynamic energy and its applications to domestic lighting; as also a motive power, and other uses hitherto unattainable by the direct currents.

West Corridor.

20.—DR. J. H. GLADSTONE & MR. A. TRIBE, 17, Pembridge Square, London. Air Battery. The positive element of this galvanic arrangement is sheet-copper; the negative, sheet-silver and crystals of the same metal; the liquid, a solution of copper nitrate. By the intervention of the oxygen of the air, suboxide of copper forms on the silver, and the ordinary voltaic phenomena result.

South Nave.

21.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Higgins' Patent Battery; Menotti Battery; Carbon Battery-plates; Trophy of Patent Insulators. (See ADVT. p. 121.)

South Nave and Southern Gallery.

22.—J. P. KNIGHT, London, Brighton, and South Coast Railway, London Bridge Terminus. Sulphate Batteries (Fuller's improvement); Bichromate of Potash Batteries (Fuller's improvement); Leclanché Batteries.

North Nave.

23.—ARMAND LÉVY, 252, Goswell Road, London. Batteries of all descriptions: Leclanché, Grenets, Bunsen, Daniell, Bichromate, Sodium, &c.; Carbons of all descriptions, all shapes cut and moulded; Glass Jars, all forms and shapes; Zinc in the rod or ready-made; Terminals; Binding Screws; Clamps; Manganese; Salts, &c. &c.

Eastern Gallery.

24.—THE LONDON ELECTRIC LIGHT AGENCY, Broadway Chambers, Broadway, Westminster. (1) New Economical and Constant Battery, patented by Messrs. J. & A. J. Higgin, Manchester. The action of this Battery produces substances having a considerable commercial value, as distinguished from those resulting from the batteries hitherto in use. Samples of various products are shown, and the economic use of the system thereby demonstrated. (2) An Accumulator for the storage of force.

Gallery at back of Concert-Room.

25.—PATENT PLUMBAGO CRUCIBLE COMPANY, Battersea Works, S.W. Porous Battery Cells, red and white, both round and flat, for electrical and other purposes; Morgan's Patent Crucibles for melting metals by Dr. Siemens' process; Plumbago for sealing incandescent lamps, electrotyping, &c.

Eastern Gallery.

26.—E. PATERSON, 77, Little Britain. Leclanché and Manganese Batteries; Bichromate and other Batteries for laboratory purposes; Exploder or Battery for firing mines; &c. &c. (See ADVT. p. 119.)

South Nave and Southern Gallery.

27.—SCIENTIFIC TOY AND GENERAL NOVELTY COMPANY, Sun Works, Kirkwood Road, Peckham. Carbon Porous Pots, Zinc Rods, and Cylinders, and other apparatus for constructing batteries all in cheap form suitable for school-boys and amateurs, with instructions for using same. (See ADVT. p. 139.)

Gallery at back of Concert-Room.

28.—J. STIFF & SONS, London Pottery, Lambeth, S.E. Porous Cells and Cylinders, both red and white. Porous Plates, of all sizes, with and without glazing or upper edges. Vitrified Stoneware Battery Cells, round and square. Shallow Trays and Baths for acids, &c. Insulators, in vitrified Stoneware of all the usual shapes and sizes. Other Apparatus for chemical, electric, and telegraphic purposes; Plumbago and Fireclay Crucibles, &c. J. Stiff & Sons' Telegraph Insulators, Porous Cells and Cylinders, Stoneware Battery Cells, &c., were awarded a prize medal at the Paris Electrical Exhibition, and have been most extensively and satisfactorily used for years past by the best telegraphic engineers and others.

Gallery at back of Concert-Room.

29.—MESSRS. STRODE & Co., 48, Osnaburgh Street, N.W. Planté's Secondary Batteries. (See ADVT. p. 154.)

West Corridor and South Nave.

29A.—SUBMARINE TELEGRAPH COMPANY, 2, Throgmorton Avenue, E.C. The "Chutaux" Battery, mounted as in use at the company's offices.

North Nave.

30.—ZANNI & Co., 47, Holborn Viaduct, E.C. (Agent, Mr. F. Bertram.) Batteries.

West Corridor.

Class III.

Magneto-Electric and Dynamo-Electric Machines.

31.—ANGLO-AMERICAN BRUSH LIGHT CORPORATION, Belvedere Road, Lambeth. Dynamo-Electric Machines, viz.: 1 Machine for working 40 2,000 candle-power lights on a single circuit; 1 Machine for single light of 150,000 candle-power; 1 Machine for 6 2,000 candle-power lights; 2 Machines for 16 2,000 candle-power lights; 4 Machines for incandescent lights; 1 Machine for electroplating; sundry Parts of Machines. All the above are of the Brush type. (See ADVT. p. 122.) *In Annexe at North End.*

32.—BINKO & Co., 12, Coleman Street, Bunhill Row, E.C. Small Dynamo-Electric Models.

West Corridor.

32A.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. A large Magnetic Engine in working order. A small ditto.

Western Gallery and North Nave.

33.—BRITISH ELECTRIC LIGHT COMPANY, LIMITED, Heddon Street, Regent Street. Gramme Machines. (See ADVT. p. 141.)
Ground Floor.

35.—COMPAGNIE GÉNÉRALE D'ELECTRICITÉ (Jablochhoff's), 139, Cannon Street (Mr. Gaudet). Gramme Machines.
Ground Floor and South Nave.

36.—R. E. CROMPTON, Mansion House Buildings, London.
1 Burgin Patent Dynamo-Electric Machine to drive 3 lights; and
3 Burgin Patent Dynamo-Electric Machines to drive 4 lights each.
(See ADVT. p. 144.) *West Corridor.*

37.—MESSRS. R. E. CROMPTON & Co., Mansion House Buildings, London, carry out the lighting of the Transept as follows: 3 Bürgin Machines of the improved form (which received a gold medal at the Paris Exhibition) supply the current to 6 Crompton Arc Lamps, approximately of 3,000 candles each, and one large central lamp of 6,000 candles. For these lamps also they received a gold medal at Paris. Messrs. R. E. Crompton & Co. are prepared to guarantee the economy of their system so far, that, with 1 of their engines driving their own machinery, a light equal to that of these 7 lamps can be produced with a consumption of fuel equal to 40 lb. of Welsh coal per hour. (See ADVT. p. 144.) *West Corridor.*

38.—ELECTRIC LIGHT & POWER GENERATOR COMPANY, LIMITED. Offices, 47, Cannon Street, E.C.; Works, 29, Bankside, S.E.
2 Weston Dynamo Machines; 1 large Maxim Distributor; 1 Maxim Regulator; 1 Maxim Searcher Light Dynamo; 1 Lontin Generator; 1 Lontin Exciter; 1 new (Rapieff) Machine. By this Company's system several machines are driven from one engine. (See ADVT. p. 4 of Wrapper.) *North End of Ground Floor.*

39.—ELECTRIC LIGHT ENGINEERING COMPANY, 35, Queen Victoria Street, E.C. Dynamo-Electric Machine combined with Portable Steam-engine. Siemens and Gramme Dynamo-Electric Machines.
Ground Floor.

40.—THE ELECTRIC LIGHTING SUPPLY COMPANY, 25, Queen Anne's Gate, Westminster. Franklin Dynamo Machine for 3 lights, each of 3,000 candle-power, $4\frac{1}{2}$ horse-power; driven by an Otto gas-engine by means of Hedges' patent belt-frictional gear with strap-tightening apparatus. *West Corridor.*

41.—W. ELMORE, 91, Blackfriars Road, S.E. The Elmore Dynamo-Electric Machine, in use for the double purposes of electro-plating and electro-gilding. (See ADVT. pp. 110 & 111.)
Avenue between Pompeian House and Chinese Court.

42.—A. L. FYFE, 9 & 10, Maidenhead Court, Aldersgate Street, E.C. Engine and Dynamo Machines. *Ground Floor.*

43.—THE HAMMOND ELECTRIC LIGHT & POWER SUPPLY COMPANY, LIMITED (Holders of the Patent Rights of the Brush System for the Northern Counties of England, and for Sussex and Hampshire, and General Agents of the Brush Company), 110, Cannon Street, London; 36, Dale Street, Liverpool; Wharnccliffe Chambers, Sheffield; Post Office Buildings, Middlesborough. Brush Dynamo-Electric Machines. This exhibit is presented to the public at a spot halfway between the entrance to the Palace and the Low Level Station, a spot in the garden having been specially roofed in. (*See ADVT.*, p. 137.)

Railway Corridor leading to Low Level Station.

44.—GEO. HAWKES & Co., 9, Victoria Chambers, Westminster. Several Dynamo-Electric Machines. Messrs. Geo. Hawkes & Co. are using machines of various designs, which may be seen attached to Hodson's Rotary Engines in the Machinery Department. (*See ADVT.* p. 118.)

West Corridor.

45.—W. T. HENLEY (W. T. Henley's Telegraph Works Company), 8, Draper's Gardens, Throgmorton Street, E.C. Dynamo Machines; Magneto Machine for exploding mines, in actual use 38 years, and still retaining its power; Small Magneto-Power Engine, exhibited by Mr. Henley at the London Institution in 1838; Magneto Machine for electric induction, exhibited at the Great Exhibition of 1851, by W. Henley.

West Corridor and North Nave.

46.—E. S. HINDLEY, Bourton, Dorset. Steam-Engine and Dynamo combined, on wheels.

West Corridor.

47.—W. LADD & Co., 11 and 12, Beak Street, Regent Street. Ladd's Dynamo Machine. Invented March, 1867. The first machine with two armatures; one being employed to excite the electro-magnet, the other to produce electric light, heat, &c. Ladd's Magneto Machine—the first machine with circular magnets, 1866.

North Nave.

48.—THE NATIONAL ELECTRIC LIGHT COMPANY, LIMITED, Glasgow. Patent Dynamo Machines for generating, collecting, and distributing electric currents; Sprague's Dynamo-Electric Machines; Experimental Machines in which the rotating armature falls, and is enclosed by the field magnets, and receives from them continuous magnetic influence, while the whole of their wires being parallel, their mutual influence is added to that of the iron.

North Nave.

48A.—THOMAS PENN, Grove House, Lewisham. Magnetic Engine, to illustrate the power of Magnets.

West Corridor, with the Turner Gas Engine Company.

49.—ROWATT & FYFE, 52, Queen Victoria Street, E.C. Schuckert Dynamo, &c. &c.

West Corridor

50.—ALFRED R. SENNETT, C.E., Worthing, Sussex. The Original Machine made by Dr. Antonio Pacinotti in 1860, and described in "Il Nuovo Cimento" in 1864; another, constructed in 1873; another, made in 1875; another, with additional armature for exciting field magnets, for use when the resistance of the external circuit is considerable; Electro-Magnet, Magnetic Rings, and semi-circular Permanent Magnets to explain the action of these machines. *North Nave.*

51.—SIEMENS BROTHERS & Co., 12, Queen Anne's Gate, Westminster. 1 Siemens' Dynamo Machine D², upright, in operation; 1 Siemens' Dynamo Machine S D⁸, in operation; 1 Siemens' Alternate Current Machine W² D⁷, in operation; 1 Siemens' D² Dynamo Machine, upright; 1 Siemens' D⁷ Dynamo Machine, upright; 1 Siemens' D⁶ Dynamo Machine, upright; 1 Siemens' D⁵ Dynamo Machine, upright; 1 Siemens' S D⁵ Dynamo Machine, upright; 1 Siemens' large Dynamo Electric Quantity Exploder; 1 Siemens' small Dynamo-Electric Quantity Exploder; 1 Siemens' Magneto-Electric Quantity Exploder, with 9 magnets; 1 Siemens' Magneto-Electric Quantity Exploder, with 6 magnets; 1 Siemens' Magneto-Electric Quantity Exploder, with 6 magnets, cheaper form. 1 Siemens' large Dynamo-Electric Tension Exploder; 1 Siemens' small Dynamo-Electric Tension Exploder; 1 Siemens' Magneto-Electric Tension Exploder, with 9 magnets; 1 Siemens' Magneto-Electric Tension Exploder, with 6 magnets; 1 Siemens' Magneto-Electric Tension Exploder, with 6 magnets, cheaper form; 9 Battery Cells of various patterns and sizes; 3 Battery Boxes. *West Corridor.*

52.—S. C. TISLEY & Co., 172, Brompton Road, Model Electro-Magnetic and Dynamic Machines. *Eastern Gallery.*

53.—S. ALFRED VARLEY & Co., Hatfield, Herts. Dynamo-Electric Machines, including the original machine provisionally protected in 1866, in which the "action and reaction" principle (discovered by S. Alfred Varley), which forms the basis of electrical transmission of power and the economical production of electricity for light and other purposes, was first introduced. *Ground Floor.*

54.—ZANNI & Co., 47, Hatton Garden, E.C. Zanni's Magneto-Electric and Dymano-Electric Machines. (Agent, Mr. F. Bertram.) *West Corridor.*

Class IV.—Cables, Wires, Conductors, and Allied Apparatus.

55.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*) *North Nave.*

55A.—HER MAJESTY'S GOVERNMENT (War Office). (*See p. 26 et seq.*) *North Nave.*

56.—ANGLO-AMERICAN TELEGRAPH COMPANY, LIMITED. (1) Map showing the Company's Submarine Telegraph Lines between Great Britain, France, Canada, and the United States of America also the Connecting Lines throughout the world; (2) Specimens of the Company's Cables laid. (*See* ADVT. p. 126.) *Western Gallery.*

57.—W. BEANHAM, 31, London Street, Paddington. A case containing Specimens and showing Sections of the British Indian Submarine Telegraph Company's Cables, 1870; also, a small portion of the first Submarine Cable laid between England and America.
Gallery at back of Concert Room.

58.—BRITANNIA RUBBER & KAMPTULICON COMPANY, 32, Cannon Street, E.C. Submarine Cables; Indiarubber-covered Copper Wire for telegraphic and military purposes; Vulcanite Telephone Cases; Tubing, Rods, Sheets, &c.
Eastern Gallery.

59.—L. CLARK, MUIRHEAD & Co., 23, Regency Street, Westminster. Field's Patent Nigrite Core and Covered Wires for Cables; Copper Wires insulated with gutta-percha, silk, cotton, and tape; Braided Wires for telephones; Electric Light Leads; Copper Rope Lightning Protectors; Muirhead's Patent Metallic-covered Wire to eliminate induction. (*See* ADVT. p. 131.)
Between Sheffield Court and Chinese Court.

60.—T. CRAMPTON & Co., 251, High Holborn. Covered Wires, &c. &c.
Southern Gallery.

61.—R. C. CUTTING & Co., 147, Queen Victoria Street, E.C. Solid Copper Tape Lightning Conductors in continuous lengths, with Cutting's patent coupling, and Colson's inductive earth-bed, as approved by the Secretary of the Meteorological Society. (*See* ADVT. p. 138.)
Eastern Gallery.

62.—J. DAVIS & Co., Tyrrel Street, Bradford, Yorkshire. Model Chimney, with the following Lightning Conductors fixed: Top rod and points, with copper tape conductor fixed with clips; top rod and points, with copper rope and patent connector, fitted with clips or glass insulators to prevent the oxide of copper marking stonework of good buildings.
Western Gallery.

63.—J. DAVIS & SON, 118, Newgate Street, E.C. Lightning Conductors.
Concert-Room Gallery.

64.—THE DIRECT UNITED STATES CABLE COMPANY, LIMITED, 52, Old Broad Street, E.C. Sundry Apparatus, same as is used for working the Transatlantic Telegraph Cables and Land Line connections of this Company; several pieces of Cable picked up in repairing operations; Chart showing the system of the Company between London and New York. (*See* ADVT. p. 125.)
Southern Gallery.

65.—DOULTON & Co., Lambeth, London, S.E. Insulators in Stoneware and Porcelain; Preservation Pipes with patent joint for underground Cables, with manholes for inspection; Pipes made in two pieces, for similar purpose, in Terra Cotta and Brown Stoneware; Telegraph Pole Caps; Knobs for top of Street Lamps; Every description of Salt Glazed and other Stoneware, and in Porcelain. *Eastern Gallery.*

66.—EASTERN TELEGRAPH COMPANY, LIMITED, 66, Old Broad Street, E.C. Specimens of Cables recovered, &c. &c. (See p. 51). Maps, &c. &c. *Eastern Gallery and South Nave.*

67.—THE ELECTRIC LIGHTING SUPPLY COMPANY, 25, Queen Anne's Gate, Westminster. Samples of Electric Cables, Insulators, and Carbons, as used in the Liverpool Docks. *West Corridor.*

68.—EXTON, BERRIDGE, & PARTNERS, Westminster Works, 127, Page Street, S.W. Light, strong, rigid Steel Pipes, for conveyance and protection of electric wires, &c.; made by patented machinery from homogeneous metal (those made in sections patented); durable and as cheap as iron, and unbreakable. Fitted with the firm's special joint, which a labourer can readily detach and fix, they are specially adapted for this purpose, as any fault in the wire can be quickly got at. They are being freely used for steam, water, and gas. (See ADVT. p. 113.) *Eastern Gallery.*

69.—J. FAULKNER, 13, Great Ducie Street, Strangeways, Manchester. Lightning Conductors (various kinds); Photographs of Expedients for applying Lightning Conductors to high spires and factory chimneys. *Eastern Gallery.*

70.—WALTER T. GLOVER & Co., 25, Booth Street, Manchester. Works, Salford. Patent Covered Gutta-percha Wire, for leading in tunnel and underground work, served with Stockholm tar, ozokerit, and paraffin. Specially Covered Iron Wire for aerial lines. Sample of covered iron wire, which was up in the worst district in Manchester for seven to eight years. Fancy Single and Double Telephone Wires (paraffined), and Terminal Cords. Woven Silk Covered Wires. Specimen of the finest Woven Covered Wire which has ever been produced. Patent Covered Electric Light Leads and Cables for the various systems, served with Stockholm tar, ozokerit, and paraffin. (The patent covering more thoroughly protects the wire, and has the advantage of not being able to ravel or come loose, even if cut.) Silk and Cotton Covered Copper Wires. Covered Gutta-percha Wires for bell-work. Non-combustible Wires for Electric Lighting. Various classes of Aerial and Underground Cables, and special Anti-induction Cables for the Telephone. Sample of Nineteen-Wire Cable, made in one process by W. T. Glover and G. F. James' Patent Wire Twisting and Cabling Machine. (See ADVT. p. 142.) *Western Gallery.*

71.—J. W. GRAY & SON, 58, Fenchurch Street, E. Lightning Conductors. Model of Ship, showing inboard and outboard systems of Gray's patent lightning conductors, as fitted in Her Majesty's Navy. Model of Church, showing Gray's patent system of lightning conductors as applied to buildings. Drawing of private residence, showing Gray's patent system of lightning conductors as fitted thereto. Samples of Copper Terminal Points as fitted to Government buildings. Copper Band Conductors in long lengths, and all fastenings connected therewith, both for ships and buildings. Copper Tube Conductors as fitted to buildings and ships. Patent Slide for allowing for expansion and contraction on high shafts and buildings. *Eastern Gallery.*

72.—THE GUTTA-PERCHA COMPANY, 18, Wharf Road, City Road. Copper Conductors (strand and solid) covered with gutta percha, as used for submarine telegraph cables, underground lines, both telegraphic and telephonic, electric lights leads, battery, bell, and house connecting wires, &c. &c.; Sheet Gutta Percha for making joints, and other Materials used in the manufacture and working of insulated wires; Willoughby Smith's patent Joints for subterranean and telegraph wires; Specimens of Cores and Cables recovered during repairs after long submersion. *Western Gallery.*

73.—HARRISON, COX, WALKER, & CO., Darlington. Vyle's Patent easily-tested Lightning Conductor. *Eastern Gallery.*

74.—HART, SON, PEARD, & CO., 53—58, Wych Street, Strand (Contractors to Her Majesty's War Department). Lightning Conductors, Points, and Attachments of Solid Copper Band, as devised by the late Sir W. Snow-Harris; also of Copper Wire Rope and Woven Copper Wire Band. Price lists on application. *Gallery at Back of Concert-Room.*

75.—W. T. HENLEY (W. T. Henley's Telegraph Works Company), 8, Draper's Gardens, Thogmorton Street. Submarine and Torpedo Cables; W. T. Henley's Patent Core and Cables; Telephone Wires; Underground Wires; &c. &c. *North Nave.*

76.—RICHARD JOHNSON & NEPHEW, Bradford Ironworks, Manchester. Telegraph, Submarine Cable Armour Wire, No. 00, B.W.G. Submarine Cable Armour Wire, galvanised; No. 8, B.W.G. Galvanised Telegraph Wire of low electrical resistance, to meet the requirements of the British Post Office specification; No. 16 \times 3 ply Galvanised Telegraph

Wire Strand, to British Post Office specification ; No. 11, B.W.G. Galvanised Special Telephone Wire ; No. 15, B.W.G. Galvanised.

Concert-Room Gallery.

77.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Brass and Lead Covered Cables; Taped Iron Wire; Indiarubber-covered Wire; Lightning Conductors; Vyle's Patent Lightning Conductor; Mance's Lightning Guard; Grapnels; Ordinary Cutting, and Cutting and Holding Grapnels; Mushrooms; Steel Centipedes; Steel Buoys; Patent Self-mooring Mark Buoy; Steam Hauling Gears; Insulators and Fittings; Patent Fluid Insulators. (*See ADVT., p. 127.*)

South Nave, Southern Gallery, and North Nave.

78.—ARMAND LÉVY, 252, Goswell Road, London. Gutta-percha and India-rubber Cores; Leads to any specification; Silk Cotton Wires; Telephone Transmitters; Rubber in the Raw, in Unvulcanised Sheet and Taping Cloth; Fine Cut Sheet Rubber Tape for covering wire; Gutta-percha, raw and manufactured.

Eastern Gallery.

79.—MCWHIRTER, ROBERTS, & Co., 249 to 251, East India Road, London. Manufacturers of Grapnels, Buoys (steel and iron), Mushrooms, Centipedes, Swivels and Links, Buoy-lamps and Frames of improved construction; Makers of the Imperial Cable-tank Lamp for burning non-explosive mineral oil; Portable Forges, Cable Sheaves, Wood Hearts, Tricolor Lamps, Splicing and Sleeking Tongs, and all other Specialties for Telegraph Cable Ships.

Eastern Gallery.

79A.—HENRY ROBERT MEYER, B 12, Exchange Buildings, Liverpool. Samples of Earthenware Troughs (Patent Electric Permanent Way), and Wires or Metal Ribbons for conducting large numbers of Wires, &c., underground.

Concert-Room Gallery.

80.—MOSER & SONS, Southwark, London. Telegraph Wire, made from Anglo-Swedish iron. Various tests (hot and cold) of the Anglo-Swedish iron. Planished and toughened Metal Sheets tested cold. Moser & Sons' high-class Tool, Steel, and Tests of same. Telegraph Engineers' tools.

Eastern Gallery.

81.—R. S. NEWALL & Co., Gateshead-on-Tyne. Specimens of Submarine Cables, made by R. S. Newall & Co. Lightning Conductors and Fittings.

Eastern Gallery.

82.—E. PATERSON, 76, Little Britain. Solid Copper-tape Lightning Conductors. (*See ADVT., p. 119.*)

South Nave and Southern Gallery.

83.—PHILLIPS BROTHERS, Macintosh Lane, Homerton. Electric Light Leads and all Wires used for electrical purposes. (*See ADVT., p. 123.*)

Southern Gallery.

84.—PHOSPHOR BRONZE COMPANY, 87, Sumner Street. Phosphor Bronze Wire for Telephones and Land Telegraphs; Springs and Rods for electric purposes; Bearings and other Wearing Parts of Machinery used for electric lighting, &c. *Eastern Gallery.*

85.—DR. DAVID S. PRICE, Technological Museum, Crystal Palace. Specimens of Cooke and Wheatstone's first Telegraph laid between Camden Town and Euston; the first Submarine Cable laid between Calais and Dover; the first Atlantic Cable, &c. &c.; Various Samples of Submarine Cables by different makers; and a series of five large Maps showing the leading submarine telegraphic communications in the world. *Technological Museum.*

85A.—RAMSDEN, CAMM, & Co., Brighouse, Yorkshire. Wires for Telegraphs and Telephones. *Concert Room Gallery.*

86.—W. REDDALL, 10, South Street, Finsbury. The Patent Box Street Curb, for the conveyance of electric wires through the streets of cities and towns and elsewhere. Its proposed position as a curb to the footways provides for the ready insertion, inspection, or removal of any length of wires, the effectual covering of same; and communication with every house; at a cost a little beyond that of the ordinary granite curb.

Eastern Gallery.

87.—THE RUSTLESS AND GENERAL IRON COMPANY, 3, Queen Street Place, Cannon Street, E.C. Wrought-iron Tubes, Insulators, Cast-iron Pipes, Wire, &c. (See SPENCER, next page.)

Eastern Gallery.

88.—SANDERSON & Co., 44, Essex Street, Strand, W.C. Sanderson & Co.'s Solid Copper-tape Lightning Conductors in continuous lengths without joints, of high conductivity, as supplied to Her Majesty's and other Governments, and now being fitted to the Royal Courts of Justice, Strand, and exported to all parts of the world. Prices from 1s. per foot, all complete for fixing. Invented by the Exhibitors. Prize medals Brussels and Philadelphia International Exhibitions, 1876. Samples of Sanderson & Co.'s Points or Terminals for above, showing method of fixing.

Eastern Gallery.

89.—SCHOOL OF SUBMARINE TELEGRAPHY, TELEPHONY, AND ELECTRIC LIGHT, 12, Princes Street, Hanover Square (removed from 4, George Street, Hanover Square). Long Artificial Cables, with Mirror Galvanometers and Siphon Recorder for demonstrating the retardation of signals on long submarine cables, such as England to India and Australia; and, secondly, in sections comprising the following: (1) England to Gibraltar; (2) Gibraltar—Malta; (3) Malta—Alexandria; (4) Suez—Aden; (5) Aden—Bombay; (6) Madras—Singapore; (7) Singapore—Java; and (8) Java—Australia. Apparatus used for translation on land lines and cables. (See ADVT., p. 3 of Wrapper.)

North Nave.

90.—SIEMENS BROTHERS & Co., 12, Queen Anne's Gate, Westminster. 1 Siemens' No. 10 Iron Tubular Telegraph Pole, with 4 stretching insulators; 1 Siemens' No. 5 Iron Tubular Telegraph Pole, with buckled plate and 4 intermediate insulators; 1 Siemens' No. 105 Iron Tubular Telegraph Pole, with Le Grand and Sutcliff's patent base pile; 1 Siemens' No. 110 Iron Tubular Telegraph Pole, with Le Grand and Sutcliff's patent base pile; 2 Rammers for driving piles; 1 Short Wooden Pole, with 17 insulators of various patterns; 1 Short Wooden Pole, with 22 insulators of various patterns; 1 Short Wrought Iron Pole, with 11 insulators of various patterns; 1 Short Wrought Iron Pole, with 10 insulators of various patterns; 1 small box, with samples of Siemens' Compound Wire; 4 Small Coils of Siemens' Compound Wire; 3 Insulators for electric light leading wire; Samples of Leading Wire for electric light use; Samples of Underground Cable for electric light use; Specimens illustrating manufacture of Gutta-percha and Gutta-percha Core; Specimens illustrating manufacture of India-rubber and India-rubber Core; Cases containing specimens of Submarine, Subterranean, Military, and Torpedo Cables; Platino Brazilian Cable, 1873; Direct United States Cable, 1874; French Atlantic Cable, 1879; new American Atlantic Cables. (*See also CLASS VI.*) *South Nave.*

91.—F. SMITH & Co., Caledonia Works, Halifax. Galvanised Telegraph and Telephone Wire with Samples, showing tests applied under the Post Office specifications. *Eastern Gallery.*

92.—JAMES E. & SAMUEL SPENCER (Rustless and General Iron Company), 3, Queen Street Place, Cannon Street, E.C. Works, West Bromwich, Staffordshire. All kinds of Black Galvanised Enamelled and Anti-corrode (coated by Barff's rustless process) Wrought Iron Tubes and Fittings; Cast Iron Pipes, plain and coated by Dr. Angus Smith's Solution; Telegraph Wire, Insulators, and the various accessories of telegraph, telephone, and electric light companies. *Eastern Gallery.*

93.—SUBMARINE TELEGRAPH COMPANY, 2, Throgmorton Avenue, E.C. (1) Specimens of Cables laid down and worked by the Submarine Telegraph Company between Great Britain and the Continent of Europe. (2) Specimens of Cables injured by ships' anchors, fishing trawls, and chemical action of soil at bottom of the sea upon the iron wires, which have been picked up after a submersion of many years. (3) Specimen of the Experimental Submarine Wire (the first ever laid in the world) between Dover and Cape Grisnez in August, 1850, under the superintendence of

Mr. Charlton Wollaston, C.E., electric communication between the two places having lasted only a few hours; this piece was picked up in the Channel in a fisherman's trawl 25 years after it had been laid down. (4) Specimens of the first Cable laid between Dover and Sandgatte (near Calais) in September, 1851, for the Submarine Telegraph Company, by their engineer, Mr. T. R. Crampton, C.E., which is still in good working condition.

North Nave.

94.—TELEGRAPH CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED, 38, Old Broad Street, London; Manufactories, Wharf Road, City Road, and Morden and Enderby's Wharves, East Greenwich. Submarine Telegraph Cables, &c. (This Company was formed in 1864 by the amalgamation of Messrs. Glass, Elliot, & Co., and the Gutta-percha Company. The latter were the first manufacturers of core for cables, and of land lines insulated with gutta-percha.)

No. 1. Submarine Telegraph Cables: a case of specimens of submarine telegraph cables, illustrating the progress and development of submarine telegraphy up to the present time.

(Note.) The cables from Europe to North America, Brazil, Egypt, India, South Africa, China, Australia, New Zealand, and other parts of the world, 65,400 nautical (or 75,400 statute) miles in length, have been laid by the Company across seas and oceans, varying from shoal water to 3,000 fathoms in depth. Some of these cables have been grappled and brought to the surface from great depths, in one instance 2,400 fathoms ($2\frac{3}{4}$ statute miles), and have been found in good condition after many years' submersion.

No. 2. Proposed System for establishing communication between lightships and the shore by means of submarine telegraph cables, showing double-linked mooring chain designed for the protection of the cable, and the swivels to prevent it fouling or twisting the moorings of the lightship as she swings to the tide.

No. 3. Map showing the Submarine Telegraph Cables manufactured and laid by this Company between the years 1854 and 1881.

South Nave.

95.—UNITED ASBESTOS COMPANY, 161, Queen Victoria Street, E.C. Asbestos was known to the ancients as indestructible by fire. This property is utilised, as here shown, for insulators, for cables, wires, &c. &c. (See ADVT., p., 124.)

Eastern Gallery.

95A.—MAGNUS VOLK, Telegraph Works, Ditchling Rise, Brighton, Manufacturing Electrical and Telephonic Engineer. Various Wires used in telephony, &c.

Eastern Gallery.

96.—S. VYLE, 22, Borough Road, Middlesborough. Vyle's Patent (easily-tested) Lightning Conductor. This lightning conductor carries an insulated testing-wire up the interior of the copper rope, serving for the conductor, both being connected together at the top and bottom. About 4 ft. from the ground the testing-wire is brought out, divided, and attached to the top and bottom, terminating in a tiny test-box, through which the cable passes. A third terminal has connection with an earth-plate some distance from the plate attached to the conductor. In its normal condition the first and second terminals are strapped across, so that the testing-wire then becomes part of the conductor.
Gallery at back of Concert-Room.

97.—ZANNI & Co., 47, Holborn Viaduct, E.C. (Agent, Mr. F. Bertram.) Wires, Insulators, &c. *West Corridor.*

Class V.—Apparatus for Measuring Electricity.

98.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*) *North Nave.*

99.—A. APPS, 433, Strand. Portable Set of Resistance Coils attached to bridge or balance, in cabinet complete. Post Office Pattern Set of Resistance Coils; Shunt for use with Sir W. Thompson's Galvanometer. *North Nave.*

100.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. Thompson's Reflecting Galvanometer; Graduated Wire Bridge, with low resistance galvanometer, got up especially for the use of wire manufacturers in testing the percentage conductivity of their wires. *Western Gallery and North Nave.*

101.—CLARK, MUIRHEAD, & Co., 20, Regency Street, Westminster. Sir William Thomson's Reflecting Astatic Galvanometer, with ebonite coil frames, to prevent cross-leakage between the wires; Sir William Thomson's Astatic Reflecting Galvanometer on tripod stand; Schwendler's Tangent Galvanometer, as used by the Indian Government; Latimer Clark's Patent Double Shunt, Differential Galvanometer and Set of Resistance Coils; Set of Resistance Coils, with bridge and three pairs proportional coils; Set of Resistance Coils, rectangular pattern, arranged in units, tens, hundreds, and thousands, with bridge of four pairs of proportional coils; British Association Units, 1, 10, 100, 1000 Ohms; Set of Resistance Coils, Post Office pattern with, bridge, battery key, and galvanometer key; Jacobi's Rheostat; Muirhead's

Improved Form of Thomson and Varley's Slide Resistance Coils, registered design; Lambert's Discharging Key; Battery Reversing Key; Simple Contact Key; Plug Keys, various; Short's Circuiting Key; Hopkinson's Key, useful for Thomson's method of comparing capacities; Graham's Bridge Key; Battery Reversing Key on ebonite pillars; Clark's Standard Cell Electromotive force 1.457 Volts; Standard Condenser $\frac{1}{3}$ Microfarad; Standard Condenser $\frac{1}{2}$ Microfarad; Standard Condenser 1 Microfarad; Standard Condenser 1 Microfarad subdivided, $\cdot 1 \cdot 2 \cdot 3 \cdot 4 = 1$ Microfarad; 20 Microfarad Condenser; 5 Microfarad Condenser, subdivided, $\cdot 2 \cdot 1 \cdot 1 \cdot 4 \cdot 2 \cdot 2 \cdot 1 \cdot 04 \cdot 03 \cdot 02 \cdot 01 = 5$ Microfarad. (See ADVT., p. 131.) *Between Sheffield and Chinese Courts.*

102.—T. CRAMPTON & Co., 251, High Holborn, W.C. Galvanometers; Resistance Coils, &c. *Southern Gallery.*

103.—THE ELECTRIC LIGHTING SUPPLY COMPANY, 25, Queen Anne's Gate, Westminster, S.W. Electric Light Indicator and Current Meter. The Indicator shows if a light on any particular current becomes accidentally extinguished, and draws attention by striking a bell. Andrews' Patent Meter registers at a glance the amount of current in Amperes. *West Corridor.*

104.—J. W. GRAY & SON, 58, Fenchurch Street. Galvanometers for testing lightning conductors and buildings. *Eastern Gallery.*

105.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Resistance Box—Vyle's patent system of testing lightning conductors. (See ADVT., p. 127.) *South Nave and Southern Gallery.*

106.—ELECTRICAL TRADING Co., 9, Victoria Chambers, Westminster. C. Vernon Boys' Patent Meters, comprising: (1) Patent Engine Power Meter; (2) Patent Integrating Dynamometer for shafting; (3) Patent Integrating Dynamometer for belting; (4) Patent Electric Current Meter, No. 1; (5) Patent Electric Current Meter, No. 2; (6) Patent Electric Current Meter, No. 3; (7) Patent Electric Energy Meter. *South Nave.*

107.—F. MURRAY ROGERS, 21, Finsbury Pavement, E.C. Galvanometers. *Southern Gallery.*

108.—THE NATIONAL ELECTRIC LIGHT COMPANY, LIMITED, Glasgow. Sprague's Patent Amperometer for measuring and recording

electrical work applicable to electro-plating, to show the work done or doing in a vat; will call attention or cut off the current when any desired quantity of work is done. For lighting or machines acts as the ordinary meter does for gas. Sprague's Patent Galvanometer, showing current in Weber's from 10' to '0005, and resistance in ohms from '01 to 1000. *North Nave.*

109.—E. PATERSON, 76, Little Britain. Ayrton and Perry's Am. Meter, a portable electric light current galvanometer, measures directly in ampères the strongest electric light currents. Ayrton and Perry's Volt Meter; Ayrton and Perry's Arc Horse-power Measurer; Ayrton and Perry's Ohm Meter; Ayrton and Perry's Dispersion Photometer; Ayrton and Perry's Dynamometer Coupling; Galvanometers of various descriptions. (*See ADVT., p. 119.*) *South Nave and Southern Gallery.*

110.—SANDERSON & Co., 44, Essex Street, Strand, W.C. Galvanometers. *Eastern Gallery.*

111.—SCHOOL OF SUBMARINE TELEGRAPHY, TELEPHONY, AND ELECTRIC LIGHT, 12, Princes Street, Hanover Square (removed from 4, George Street, Hanover Square). Mirror Galvanometers and Siphon Recorder, for demonstrating the retardation of signals on the long submarine cables. (*See same Exhibitor in CLASS IV.*) (*See ADVT., page 3 of Wrapper.*) *North Nave.*

113.—SIEMENS BROTHERS & Co., 12, Queen Anne's Gate, Westminster. 1 Dial-pattern Testing Bridge; 1 Portable Testing Bridge; 1 Set of Testing Apparatus on ebonite pillars; 1 Thomson's Reflecting Galvanometer; 1 Portable Folding Lamp and Scale-stand for same; 1 Jacob's Transparent Lamp and Scale-stand for same; 1 Siemens' Universal Galvanometer; 1 Obachs' Galvanometer, for measuring powerful currents; 1 Siemens' Electro Dynamometer, for measuring powerful currents; 1 Siemens' Electro Dynamometer, for measuring small currents; 1 Duplex Condenser, from $\frac{1}{4}$ to 2 Microfarad capacity; 1 Condenser of 0.37 Microfarad capacity; 1 Siemens' Electrical Pyrometer, complete; 1 Box of Comparison Resistance Coils, 10,000 Ohms; 1 Box of Branch Resistance Coils, from 2 to 1,000 Ohms; 1 Carbon Resistance Frame, 3 units; 1 Hoop-iron Resistance Frame, 0.1 to 1 unit. Firing Keys; Test Battery and Galvanometer combined, B.N. pattern; Clark's Double-shunt Galvanometer; 3-Coil Galvanometer, as supplied to War Office;

Multiple Junction Box; Single Junction Box; T Junction Box; Coil of Bessemer Steel Wire Mooring Rope; Firing Arc; Converging Arc; Low Resistance Cells (latest War Office pattern) with porus cell; High Resistance Cells; Post Office pattern large size Resistance Bridge; Chatham Sounder; Testing Table for 7 mines; Shutter Box for 7 mines. *South Nave.*

114.—S. VYLE, 22, Borough Road, Middlesborough. By means of the delicate Differential Galvanometer exhibited, two tests are taken indicating the resistance of the metallic circuit, and also when the conductor is connected to the earth. Should the latter very greatly exceed the former it is evidence of its faulty condition, and, beyond a certain margin, would need seeing to. This conductor is spoken of by high authorities as being the only really scientific one yet invented. The galvanometer is also specially suited for testing electric light, conducting wires, and apparatus. *Gallery at back of Concert-Room.*

Class VI.—Telegraphs, Signals, and allied Apparatus.

115.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*) *North Nave.*

115A.—HER MAJESTY'S GOVERNMENT (War Office). (*See p. 26 et seq.*) *North Nave.*

116.—A. APPS, 433, Strand. Bagot's Patent Colliery Signals, and Vinery or Hothouse Safety Apparatus; applicable also as a Fire-alarm Apparatus; increase or decrease of temperature being instantly telegraphed to the central station. Pair of Morse Sounders for ordinary telegraphic purposes. Series of Contact Pushes and Electric Bells, as employed in mansions, club-houses, and ordinary houses. Wheatstone's Bridge, Resistance Coils, &c. &c. *North Nave.*

117.—AUTOMATIC TELEGRAPH COMPANY, LIMITED, 4, Ludgate Circus, E.C. Automatic Type Printing Instruments, worked on a single line wire, for distributing general, parliamentary, and sporting news, and Stock Exchange quotations. The exhibit comprises a complete system of apparatus at work: *i.e.* Central Station Transmitting Instrument, and a number of Receiving Instruments, which print automatically on paper-slip in bold Roman-type characters. *South Nave.*

118.—E. BARBER BERNARD, 122, Junction Road, N. Railway Passengers' Safety Signal. Five operations are performed by one pull of the handle, which opens the communication with the next compartment, exhibits the "disc" indicating the carriage, rings the bells in the driver's and guard's van, and in the carriage.

Western Gallery.

119.—BINKO & Co., 12, Coleman Street, Bunhill Row, E.C. Bells and Indicators.

West Corridor.

120.—GEO. G. BLACKWELL, 26, Chapel Street, Liverpool. Electric Bells and Pushes in working order (various sizes). (See ADVT., p. 126.)

Southern Gallery.

121.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. Large collection of Switches; Morse Keys, mounted on ebonite; Warburton and Crossley's Patent Bell Instrument; Warburton and Crossley's Relays; Warburton's Special Arms for Telegraph Poles; Warburton's Signal Repeater, as used by the Lancashire and Yorkshire Railway Company; Warburton's Transfer Switch; Trembling Bells; Battery Reversers and Terminals, with battery clamps of special form; Single Needle Block Instrument, as used on the Great Northern Railway; Railway and Colliery Bells; Press Buttons; Thief Detectors.

Western Gallery and North Nave.

122.—EDWARD B. BRIGHT, C.E., 45, Gerrard Street, London. Street Fire Alarm (adopted in London by the Metropolitan Board of Works), consisting of a set of street-posts and wall-boxes fixed at various points throughout the Palace, and connected by a wire with a set of alarm apparatus at the brigade station established at the Palace by the Metropolitan Fire Brigade. This system of fire alarm works on the principle of the electrical balance, and dispenses with all clockwork and intricate mechanism. A small electro-magnetic coil of definite resistance is placed in each street-post or wall-box, and is brought into circuit by pulling the handle. This increases the electrical resistance of the wire along the streets, which had been previously balanced by a corresponding resistance in a rheostat at the fire brigade station and the needle of a galvanometer relay is deflected, ringing an alarm until the commutator-handle on being turned inserts an additional electrical resistance, equivalent to that of the alarm-post, whence the call has emanated. The locality of the post is shown on the dial of the commutator. If the conducting-wire is out of order, attention is immediately called to it by the station apparatus ringing, on the electrical balance being disturbed. Self-acting Fire Alarm for buildings, illustrated by a working model, heat detectors, localisers, and commutators. In applying this apparatus the small heat detecting boxes (about 1 in. square) are placed on the cornice or ceiling of each room protected. A bi-metallic spring in each box is expanded on any undue heat

arising, and makes contact with a screw, which can be adjusted to any required degree of heat in excess of the normal temperature. A small resistance-coil in each room enables the locality of the fire to be ascertained, on a commutator placed at the point to which the alarm is to be communicated, and the disturbance of the electric balance at the same time, rings one or more alarm-bells, as in the street fire alarm apparatus already described. Direct Acting Sounder for telegraph purposes: this telegraph instrument can be worked without any relay, by means of ten Leclanchè cells, through 10,000 B.A. units of resistance; Combined Needle Instrument and Sounder—in this apparatus the movements of the indicating needle, so largely used for railway purposes in England, are supplemented by distinct sounds. *North Nave.*

123.—L. CLARK, MUIRHEAD, & Co., Regency Street, Westminster, S.W. Single-needle Dial Instrument, with drop-handle and Spagnoletti's dial; Single-needle Dial Instrument, with Highton's keys and Spagnoletti's dial; Spagnoletti's Induced Coils for single-needle instrument; Varley's Induced Coils for single-needle instrument; Morse Ink-recording Instrument, or Direct Ink-writer, for terminal or intermediate station correspondence; Post Office Standard-pattern Relay; Pocket Relay in ebonite case; Quadruplex Relay, Muirhead and Winter's patent; Henley's Soft Iron Relay; Pony Sounder, Post Office pattern; Sounder, Post Office pattern, with galvanoscope; Pocket Sounder, with key and switch complete; Sir William Thomson's Speaking Galvanometer, with Judd's soft iron core adjustment; Lamp, Scale, and Stand for speaking galvanometer; Winter's Block Instrument, with plunger, switch, and two indicating-dials and bell complete in one instrument; Winter and Craik's Interlocking Semaphore, used in connection with above; Electrical Alarm-Bell, with clockwork arrangement for calling attention at stations; Belgian Pattern Lightning Protector; Indian Pattern Lightning Protector; Maye's Pattern Lightning Protector; Post Office Pattern Lightning Protector; Siemens' Pattern Lightning Protector; Saunders' Pattern Lightning Protector, for cables; Jamieson's Pattern Lightning Protector, for cables; Eggington's Pattern Lightning Protector, for cables; Smith's Double Switch, for through working on submarine cables; Plug Switches, various; Saunders' Translation Switch; Single-current Transmitting Key; Highton's Double-current Key; Saunders' Improved Signalling Key, for submarine cables; Muirhead's Patent Inductive Resistance, for use in Muirhead's system of duplex telegraphy; $\frac{1}{4}$ Unit Rheostat, for use with above; High-resistance Rheostat, for use with above; Subdivided Condenser, for use with Muirhead's system of duplex telegraphy; Sounder, designed for use with Muirhead's and Winter's quadruplex relay; Pole Changers. (See ADVT., p. 131.) *Between Sheffield Court and Chinese Court.*

124.—BRITISH & IRISH TELEPHONE & ELECTRIC WORKS COMPANY, 20, Regent Street, S.W., and 28, Queen Street, Cheapside, E.C. Improved Railway Signalling Apparatus; Radcliffe's Improved Railway Locking-Gear; Bright's Improved System of Fire-Alarm, Electric, and other Signals. *North Nave.*

125.—F. W. POPE COX, Bedford Chambers, Plymouth. Magneto Call Bells, to ring 200 miles (no battery required); Magneto Call Bells to ring 20 miles; Various Electric Bells; Switch Bells; Bell Pushes, &c. (*See ADVT.*, p. 132.) *Eastern Gallery.*

126.—R. C. CUTTING & Co., 147, Queen Victoria Street, E.C. Electric Bells and Indicators for domestic and other purposes; Burglar Alarms; Colliery Signals. (*See ADVT.*, p. 138.) *Eastern Gallery.*

127.—H. J. DALE, 4, Little Britain. Electric House Bells. (*See ADVT.*, p. 123.) *Eastern Gallery.*

128.—J. DAVIS & Co., Tyrrel Street, Bradford, Yorkshire. Electric Bells, with indicator, press buttons, and door pulls; Electric Bell, with speaking tubes; Single Stroke Bell, Burglar Alarm, Fire Alarm, &c. *Western Gallery.*

129.—DOULTON & Co., Lambeth. Stoneware Caps for Telegraph Posts. *Eastern Gallery.*

130.—EASTERN TELEGRAPH COMPANY, 66, Old Broad Street. Telegraph and Instruments. 1. Maps showing Telegraph Systems of Eastern, Eastern Extension, Eastern and South African, and Black Sea Telegraph Companies. 2. Tables showing various sections, mileage, &c., of above, tonnage of ships, &c. 3. Specimens of Cables recovered. 4. Electrical Apparatus for submarine telegraphy as follows: (*a*) Sir William Thomson's Siphon Recorder; (*b*) Brown and Allan and other Relays, showing retardation in submarine cables by means of an artificial line; (*c*) Keys, Switches, and Commutators; (*d*) Telephone Signal Apparatus, for intercommunication between several persons on one line. 5. Marine Boring Worm. 6. Sea Adders, taken off cable during repairs. 7. Soundings at various depths of the sea, shown through microscopes. *Eastern Gallery and South Nave.*

131.—THE ELECTRIC RAILWAY SIGNAL COMPANY, Stone Cross, Mansfield, Notts. King's Patent Electric Railway Signal. In this automatic system (King's Patent, No. 2,308) signal posts are placed along a line of railway, and a train passing the first puts the signal, by mechanical means, at danger, simultaneously sig-

nalling forward by electricity to any distant junction. On passing the next post it puts this signal at danger, at the same time, by electricity, putting the signal at the previously passed post at line clear. In certain of the signal boxes an arrangement of clockwork is placed which shows how long the previous train has passed, and also indicates the number of trains passing the box in a day and the exact time each does so. At junctions the signals are connected with the points which, when opened, show danger to the driver coming on the main line and clear on to the branch, and remains so until the points are closed. *Eastern Gallery.*

132.—THE EXCHANGE TELEGRAPH COMPANY, 17 and 18, Cornhill, E.C.

Type Printing Instruments in various positions throughout the building connected by wires with the head office of the Company, 17 and 18, Cornhill, and employed daily in the delivery of the Company's financial intelligence.

Type Printing Instruments similarly placed and connected with the transmitting office at 27, Regent Street, employed by MacMahon's Telegraphic News Company, Limited, for the delivery of general and sporting news, and, during the session, of parliamentary intelligence.

Type Printing Instruments similar to the above, with transmitting apparatus complete, to show the manner of working. (The transmitter exhibited, which is driven by an electrical motor, is capable of working 1,500 instruments simultaneously.)

Domestic Signalling Apparatus, showing the method of calling for messengers, cabs, police, or giving the alarm of fire, &c., and the manner in which burglarious attempts upon premises are made to automatically summon assistance from the outside. There are now 6,496 of these instruments in use in the city of New York by the American District Telegraph Company, and 2,938,321 calls were made thereby in twelve months.

Automatic Fire Signalling Apparatus, in connection with the latter exhibit, or otherwise, for automatically indicating the outbreak and exact locality of fire.

Street Fire Alarm System; the locality from which the alarm is sent being indicated by a needle upon a dial, or in an aperture of the receiving apparatus by the name coming into sight. (This apparatus requires but one wire for any number of alarm-posts, a return metallic circuit being unnecessary, and but one manipulation at either sending or receiving station.)

The whole being patented by the Exchange Telegraph Company, Limited. (See ADVT., p. 114.) *South Nave, Eastern Gallery, and Library and Reading-Room, &c.*

133.—J. FAULKNER, 13, Great Ducie Street, Strangeways, Manchester. Altandæ Electro-Magnetic Semaphor, Stop or Brake Actuators and Indicators. Altandæ Electric Telegraph, sounder and key on one board. Altandæ Electric Telegraph, sounder and key separate. Altandæ Electric Cricket Sounder. Altandæ Electric Sphinx Sounder. Altandæ Electric Telegraph Sounder, with movable regulating cover. Altandæ Electric Telegraph Monkey Sounder, with movable regulating cover. Altandæ Electric Pony Sounder, with movable regulating cover. In these instruments the iron covers are movable, and made to partially or totally slide on the coil and core within, the instrument being set so as to give the maximum results with a minimum battery-power, and, in case of failure of power, can be made to give increased effects by simply putting on more iron cover. Altandæ Electric Telegraph Sounder, with movable regulating core. Altandæ Electric Telegraph Sounder, with movable regulating coil. Altandæ Electric Telegraph Sounder, with inner movable regulating cover, within a fixed cover, for expanding or contracting the field of magnetism. Altandæ Electric Bells, for domestic use. Altandæ Electric Bells, for railway-trains and works. *Eastern Gallery.*

133A.—T. FULLER, 23, Grand Parade, Eastbourne, Sussex. Fire Alarm. Electric Call for Firemen residing at a distance from a fire station, and at different parts of a town, to summon them by electric bell from a common bell-pull, as usual at a fire station; as also by telephone if desired. Also Call for Turn-cock; from the one pull, any number can be called by this system. Simple and sure in action. *Concert-Room Gallery.*

134.—GARNHAM & Co., Sash Court, Wilson Street, Finsbury. Stroudley's Patent Train Communicators, as in use on the London, Brighton, & South Coast Railway. Harper's Patent Interlocking Instruments for the signalling of trains, as in use on the following railways: London, Brighton, & South Coast, London & North Western, Lancashire & Yorkshire, Midland, Great Western, and Dublin, Wicklow, & Wexford, Ireland. Harper's Patent Clockwork Apparatus for recording the signals given or received in signalling on railways; also an instrument to record the signals, as from six different stations. *Eastern Gallery.*

135.—J. W. GRAY & SON, 58, Fenchurch Street. Electric Bells (various) in work, with different kinds of indicators and samples of pushes in wood, metal, porcelain, ivory, onyx, and marble. *Eastern Gallery.*

136.—HARRISON, COX, WALKER, & Co., Darlington. Mining and ordinary Electric Bells with single coils; Indicator for showing rise and fall of water; Semaphore Arms, &c.

Eastern Gallery and Western Gallery.

136A.—G. JENNINGS, Palace Wharf, Stangate, Lambeth, S.E. Automatic Electric Speaking Tubes; Indicators; Patent Bells; Improved Contacts for windows; and General Fittings.

Southern Gallery.

137.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Large and small Iron Telegraph Poles. (See ADVT., p. 127.)

South Nave and Southern Gallery.

138.—J. P. KNIGHT, Esq., General Manager London, Brighton, and South Coast Railway, London Bridge. Double and Single Train Signalling Telegraphs as used in 1855, 1866, and 1881; early form of Alphabetical Telegraph; Double Needle and Single Needle Speaking Telegraphs, dates 1849, 1851, 1870, and 1881; Electrical Repeaters; Hearing Bells for gatehouses at level crossings, &c.; Perry and Houghton's Electrical Alarm for tunnels, &c., Bell Commutator, Repeater Contacts, Train Describer; Saxby and Farmer's Union of Lock and Block Train Signalling Apparatus; Stroudley and Rusbridge's Passenger and Guard Communication; Sunshine Recorder.

North Nave.

139.—LEGRAND & SUTCLIFF, Magdala Works, 100, Bunhill Row, London. Patent Dwarf Pile or Foundation for electric lamp-posts and telegraph poles. Advantages: Rapidity, immediate and permanent stability, economy of labour, simplicity of appliances. This patent foundation is driven forcibly into the earth by an internal rammer, without digging or boring. The operation occupies but a few minutes, and takes but one-fourth of the labour usually expended in the erection of poles and posts. This system compresses the earth (instead of loosening it as is the case in digging for a foundation), and the pole can be put into immediate use as soon as erected.

Eastern Gallery.

140.—G. C. LEWIS & SON, 1, Lowndes Terrace, Knightsbridge, S.W. Electric Bells for domestic use. Improved Portable Electric Bells for invalids and travellers; Electric Alarms in case of thieves or fire; Electric Bell Wires and Fittings; Electric Signals as applied to letter-boxes, jewel-cases, cash-boxes, &c.

Southern Gallery.

141.—LONDON & SOUTH-WESTERN RAILWAY COMPANY, Waterloo Station. 2 Sets of Preece's Block Signalling Instruments complete in working order as joined up for a block section—the bells indicate automatically the position of the signal-arm in the distant signal-box; 3 Signal "Repeaters," showing the various positions of the outdoor signal-arms as indicated to the signalman. In trying the working of the block instrument the public are requested to leave the switch handles to "on." *North Nave.*

142.—J. HAY ATHOLE MACDONALD, 15, Abercromby Place, Edinburgh. Automatic Fire Alarm. A strip of thin gutta-percha sheet is fastened as a bridge between two uprights; a metal bar rests on the gutta-percha. When the temperature rises the gutta-percha gives way under the weight of the bar, which falls between two metal springs and completes an electric circuit. *South Nave.*

143.—MCWHIRTER, ROBERTS, & Co., 249 to 251, East India Road, London. Makers of Telegraph Fittings, Signalling Lamps and Apparatus, Cutters, Lapping-wire, Fitters' and Jointers' Tools, &c. &c. *Eastern Gallery.*

144.—DONALD NICOLL, 19, Devereux Court, Temple. Secret Communication Effectuator. A new system of secret correspondence by electric telegraph (Post Office or Postal Cards) intended to supersede ordinary cipher or code systems. Changes in the new system may be made daily by arrangement with correspondents, curiosity or treachery at the same time being defeated. Special education is not required as in the case of ancient cipher or code systems. European languages are alone used; the bewilderment of telegraph employés is avoided, and the meaning of the messages cannot be made out without the possession of duplicate instruments, registered 6 & 7 Vic. cap. 65, under the title of "Secret Communication Effectuator," by the inventor, holder of "une mention honorable pour telegraphie electrique, Exposition Universelle, Paris, 1867." The new system is brought within reach of the million, the price being 1s. for each set of 6 plates: such may be ordered of every stationer in the kingdom or colonies, or will be forwarded by post, plus only cost of stamps, 19, Devereux Court, Strand, London. *Eastern Gallery.*

145.—J. ORME & Co., 65, Barbican, E.C. Electric Bells, Button Pushes, &c. &c. (See ADVT., p. 119.) *Western Gallery.*

146.—JAMES M. ORMES, HORACE H. ELDRED, G. L. ANDREIS, 31, Queen Victoria Street, E.C. Hanning's Transmitter; Automatic Sub-Offices. *Eastern Gallery.*

147.—E. PATERSON, 76, Little Britain. Electric Signals for hotels, houses, mines, yachts, &c., with all accessories. (See ADVT., p. 119.) *South Nave and Southern Gallery.*

148.—T. TEALE POWELL, James Street, Harrogate, Yorkshire. Powell's Electric Signalling on Railways, securing direct and interchangeable communication between passengers, guards,

drivers, and signalmen, and the localisation of trains whilst at full speed.

Gallery at back of Concert Room.

149.—I. PROBERT & J. STELJES (School of Telegraphy), Moorgate Street Buildings, E.C.—A Single or Reversing Current Key. Small play and one set of batteries were the special features aimed at when this key was devised, in 1874. It consists of two brass bars insulated longitudinally and representing line and earth. The bar on the right of the insulator is the same as that of an ordinary S. C. key; but the one on the left has a parallel steel spring secured to its lower surface, whose relative contacts on the base, front, and rear are adjacent to those of the first bar. Vertical screws regulate the space between the ends of spring and contact studs; these, in conjunction with the adjusting screw on the other side, admit of $\frac{1}{32}$ of an inch play being obtained. A switch enables the operator to send reverse currents as in the double-current system, and, when in the usual *receive* position, is also right for single-current working. An Automatic Gumming Apparatus, for use with the Hughes type printer, 1871. An endless cord connects a power of the printer with a friction pulley on the same axis as a boxwood roller, whose half section turns in a reservoir containing gum. The reservoir can be raised or lowered at will. A scraper frees the roller of superfluous gum. The *slip* is guided between, and, when released by the printing lever, moved by two rollers, after which it slides over a curved plate with rounded edge. The gumming system is easily attached to the printer; and a simple adjustment is provided to regulate the tension of the driving-cord. With tweezers and scissors the gummed slip is affixed to the message form. *Eastern Gallery.*

150.—F. MURRAY ROGERS, 21, Finsbury Pavement, E.C. Needle Sounder, for calling attention at will, or audibly reproducing the deflection of the needle. Railway Station Indicator for local lines (the indicator is worked automatically by the train on entering station, and shows the station arrived at in each compartment). Rotating Carbon Relay, contact sticking of the tongue being entirely overcome by fresh surface exposed at each contact; Electric Bells, Pushes, Switches. *Southern Gallery.*

151.—RUSTLESS AND GENERAL IRON COMPANY, 3, Queen Street Place, Cannon Street, E.C. Telegraph Poles and Fittings. *Eastern Gallery.*

152.—MAX SABEL, 2, Coleman Street Buildings, Moorgate Street, E.C. Agent for C. Milchsack & Co., Gladbach, Rhenish

Prussia. (a) Rolls of Telegraph Tape for Wheatstone machine, rapid writer; for Sir W. Thomson's recording machine, submarine cable; for Cowper's Telegraph writer; for the Morse, Hughes, and Meyer systems, &c. &c.; for automatic machines. (b) Rolls of Ribbon-paper, or winding-tapes. (c) Rolls of Tape for railway metals testing machines, train velocity gauges, and all other technical purposes, according to instructions.

Concert-Room Gallery.

153.—SANDERSON & Co., 44, Essex Street, Strand. Samples of Sanderson & Co.'s Telegraph Instruments, Electric Bells, Indicators, Burglar Alarms, Pulls, Pushes, Batteries, Electric Wire, &c., for commercial and domestic purposes. *Eastern Gallery.*

154.—JULIUS SAX, 108, Great Russell Street, Bloomsbury. Electric Bells for private houses, hotels, offices, ships, &c. Electric Burglar and Fire Alarms. System of Electric Calls, as fitted at the Metropolitan Fire Brigade Station.

Eastern Gallery and South Nave.

154A.—SAXBY & FARMER. (See J. P. Knight, L.B. & S.C. Railway Co., No. 138.) *North Nave.*

155.—SCHOOL OF SUBMARINE TELEGRAPHY, TELEPHONY, AND ELECTRIC LIGHT, 12, Princes Street, Hanover Square, W. (removed from 4, George Street, Hanover Square). Wheatstone's fast Automatic System. A Collection of Electrical Testing and Signalling Apparatus. (See ADVT., p. 3 of Wrapper.) *North Nave.*

156.—SIEMENS BROTHERS & Co., 12, Queen Anne's Gate, Westminster. 1 Set of Portable Field Outpost Telegraph Apparatus, including Inker, Battery, Drum of Cable in knapsack, Drum of Cable in transport box; Bag containing Jointers and Connection Wire; Case containing Tools, &c.; Various Field Telegraph Instruments, Inkers, and Sounders; 2 Intermediate Morse Double-Current Duplex Translation Instruments; 2 Morse Double-Current Self-starting End Local Instruments; 1 Model A B C Instrument, with finger-key; 1 Round A B C Instrument, with handle; 1 Square A B C Instrument, with handle. (See also CLASS IV.) *South Nave.*

157.—SIGNAL ENGINEERING COMPANY, 181, High Holborn, W.C. Electric and Pneumatic Bells and Indicators, Fire and Thief Alarms, Electric Signals, &c. (See ADVT., p. 123.)

Gallery at back of Concert-Room.

158.—C. E. SPAGNOLETTI, Great Western Railway Telegraph Department, Paddington. Electric Locking of Railway Signal Levers; Electric Signals; Electric Signal Repeaters; Electric Signal Light Indicator, showing if lamp is "in" or "out"; Electric Train Describers; Electric Induced Coil. *South Nave.*

158A.—SUBMARINE TELEGRAPH COMPANY, 2, Throgmorton Avenue, E.C. Instruments used by the Company—the

"Hughes" Type Printing and the "Morse"—for their service between England and the Continent of Europe. *North Nave.*

159.—E. A. SULLIVAN, 20, Mawbey Road, Old Kent Road, S.E. Patent Electric Fog and Night Signals, for preventing accidents on railways. This signal is entirely under the control of the signalman. When it is required to indicate danger the tire of the wheels of a passing train runs on a bar which is made to project slightly above the metals. By this means a powerful gong is sounded. When the signal is at "clear," the bar is drawn below the metal by an electro magnet, in which case the gong becomes inoperative. *Eastern Gallery.*

160.—W. R. SYKES, Nunhead, London, S.E. Sykes' Combined Electric Lock and Block System of Signalling on Railways. Prize medal, Paris, 1881; patents 1875-1880. This invention was the first introduced and worked upon any railway, forming the mechanical union between the lock and block, and the connection between three signalling points. The repeated failures and disastrous accidents caused by what is known as the "block system," showed the necessity of the improvement such as that illustrated by the working of the model, whereby no signalman can let two trains following each other into any given section of a line at one and the same time, nor can he pass a train while the points are open for the performance of a shunt, nor can a shunt be made if line clear has been given for a train to advance until that train has passed clear out of the section. The signals have been working for several years on the London, Chatham, & Dover, and the Metropolitan District Railways. The Great Western Railway have recently placed it on a section of their line, and the Glasgow & South-Western Railway are now having it fitted at one of their most important junctions. No accident has taken place where these signals have been in use. *Railway Corridor.*

161.—S. ALFRED VARLEY & Co., Hatfield, Herts. Unmagnetizable Needle Telegraph Coil, invented by S. Alfred Varley in 1866, and adopted by the Postal Telegraph Department.

Ground Floor.

161A.—MAGNUS VOLK, Telegraph Works, Ditchling Rise, Brighton. Case containing Electrical Instruments, Street Fire Alarms, Service, and Specimens of Rough and Finished Parts. Street Fire Alarm, two Call Boxes, and one small Receiving Station Apparatus. *Eastern Gallery.*

162.—C. V. WALKER, F.R.S., Tunbridge Telegraph Works, South-Eastern Railway. Electric Telegraph Specialties, introduced and in use on the South Eastern Railway. Exhibited in chronological order, by Charles V. Walker, F.R.S., &c.,

telegraph engineer to the Company from October, 1845. Essential parts of Mr. T. Forster's *Original Wire-covering Machine*. Original Specimens of the first Wire covered in England with gutta-percha; of Grooved Board for protecting same in tunnels; of the first Submarine Wire made and used under the sea itself; Movable Studs and Coils for use in time of earth-currents; Lightning Protector; Compound Needle; Platinised Graphite Battery; Brown Stone and White Porcelain Insulators; Single-strokes and One-stroke Bells; Original Commutator for time signals; Original Galvanometer and Electro-Magnetic Semaphores, and the actual Semaphore established and now in use for train signals on the block system; Time-table; Single Needle Instrument and Book of Message Forms for the Princess Alexandra royal train; pair of Train-describers complete; Original Distant-signals Repeater; Original System of Inter-communication between passengers, guards, and drivers. *North Nave.*

163.—WATERLOW & SONS, LIMITED, 25, 26, 27, Great Winchester Street, London Wall, and Finsbury Stationery Works, London, E.C. Every description of Endless Telegraph Printing Papers as used for the Morse and other telegraphic instruments. Morse Paper, in reels, 8-in. diameter and 2-in. spindle, various widths, as supplied to Her Majesty's Post Office, and to the principal telegraph companies of the world. Paper for the Wheatstone Instrument, plain and oiled. Recorder Printing Paper for the electric automatic printing instruments. The Exchange Telegraph Company's Instrument, printing in plain type, can be seen in operation. *Eastern Gallery and South Nave.*

164.—MESSRS. WINTER & CRAIK, Madras Railway Company, 61, New Broad Street, London. Single-wire Block Telegraph Instruments, with connected outdoor signals for working single or double lines on the block system. The combined action of two signalmen is required to alter the indications of the instruments and signals. The instruments indicate whether the line is "clear" or "blocked," and, if "blocked," show in what direction the train is travelling. The outdoor signals being connected with the instruments, the condition of the line, "clear" or "blocked," is made plain to enginemen. A train leaving A for B station, itself puts the outdoor signal at A to danger, and this signal remains unalterable by either signalman himself, until the arrival of the train has been signalled from B to A, and "line clear" has again been asked for and obtained. Makers, Messrs. L. Clark, Muirhead, & Co., 23, Regency Street, London. *Railway Corridor.*

165.—ZANNI & Co., 47, Holborn Viaduct, E.C. (Agent, Mr. F. Bertram.) Electric Bells, Magneto-Electric Telegraph Apparatus, Switches, &c. &c. *West Corridor.*

*Class VII.***Telephones, Microphones, and Photophones.**

166.—G. L. ANDRIS, JAMES M. ORMES, AND HORACE N. ELDERED, 31, Queen Victoria Street, E.C. Dolbear Telephone; Direct Working Telephones and Telephone System; Hotel Telephone and Telephone System. *Eastern Gallery.*

167.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. The well-known Crossley Transmitter, elaborately got up, in glass case, brasswork being electroplated; Blake Transmitter; Warburton and Crossley's Relays, in single and double form, for telephone circuits, where a number of stations are worked in circuit on one line; Large 50-line Switch, as manufactured by this firm for most of the Telephone Exchanges in England, Australia, &c. &c. *Western Gallery and North Nave.*

168.—BRITISH & IRISH TELEPHONE & ELECTRIC WORKS COMPANY, LIMITED, 20, Regent Street, S.W., and 28, Queen Street, Cheapside, E.C. Improved Gower Bell Telephones, connected between two points in the building, and at work with other telephonic apparatus. *North Nave.*

169.—CONSOLIDATED TELEPHONE CONSTRUCTION AND MAINTENANCE COMPANY, LIMITED, 6, Lombard Street, E.C. Telephones and Telephonic Apparatus and Materials. Telephones of various descriptions and forms are manufactured by the Company, including the "Gower-Bell," or "Loud-speaking Telephone," as used by the Post Office and various Government departments at home and abroad. The Military or Portable Telephone, the Bell-Telephone and Blake Transmitters, as used for exchange purposes. The Magneto-Bell Telephone, Exchange Switch Boards, Indicators, and various Articles used for communicating by telephone. Any further particulars or information can be had by applying to the Company. (*See ADVT., p. 133.*)

North Nave and Southern Gallery.

170.—F. W. POPE COX, Bedford Chambers, Plymouth. (1) Telephonic Combination (first prize silver medal), consisting of Magneto Call Bell, Cox's Transmitter, and Ader's Receiver, Base Board, and Battery Box; (2) Switch Board for 8 lines; (3) Cox's Transmitter for electric call bells; (4) Ader Telephones; (5) Telephone Ebonite Cases; (6) Telephones (various); (7) Transmitters (various); (8) Microphones (simple). (*See ADVT., p. 132.*)

Eastern Gallery.

171.—R. C. CUTTING & Co., 147, Queen Victoria Street, E.C. Telephones. (*See ADVT., p. 138.*)

Eastern Gallery.

172.—J. DAVIS & Co., Tyrrel Street, Bradford, Yorkshire. Crossley's Electro Magnetic Telephone Receiver; Crossley's Transmitter, with magnetic bell and generator.

Western Gallery.

173.—EASTERN TELEGRAPH COMPANY, 66, Old Broad Street. Telephone Signal Apparatus for submarine intercommunication between several persons at one time. (See same Exhibitor in CLASS VI.)

South Nave and Eastern Gallery.

174.—EDISON-GOWER-BELL TELEPHONE COMPANY OF EUROPE, LIMITED, 6, Lombard Street, E.C. Telephones of various descriptions, and Telephonic Apparatus, jointly with the Consolidated Telephone Construction and Maintenance Company, Limited. (See also UNITED TELEPHONE COMPANY.)

175.—J. FAULKNER, 13, Great Ducie Street, Strangeways, Manchester. Double Bell, showing that residuum magnetism does not interfere with the quickest action required for telephonic or holophonic purposes. Instrument, showing the change of central magnetism, caused by differences in the thickness or quality of iron used for an armature, to a four-sided altandæ or exalted electro magnet, one side of the four being open. (A common compass-needle is used to show the change of central magnetism.) The Altandæ Electro-Magnetic Holophone, consisting of an altandæ electro magnet of the cricket-sounder type, with a fixed perforated armature, between which and the open end of the altandæ magnet a thin iron plate is at liberty to vibrate sounds. A Holophone, with iron-covered coil and core, a magnet being screwed to one end, the open end as before, with a fixed perforated armature, having a thin plate to vibrate between them. A Holophone, with magnetical poles of one kind placed around the coil, the centre iron core being connected to the other pole.

Eastern Gallery.

176.—J. T. GENT & Co., Faraday Works, Leicester. Gent & Co.'s Patent Telephone Transmitters, with receivers and batteries complete. These transmitters are marvellously clear and distinct, and will work with any form of receiver.

Western Gallery.

177.—J. W. GRAY & SON, 58, Fenchurch Street. Telephonic Apparatus in work.

Eastern Gallery

178.—HARRISON, COX WALKER, & Co., Darlington. Telephonic Apparatus, &c. Hunnings' Patent Micro-Telephone Transmitters; Cox-Walker's Receivers or Electrophones; Call Boards, &c., in various forms; Indicator Bells for showing when the line is occupied; Individual Bell (Ander's Patent) and Vibrating Keys for "calling up" any one of a number of stations on one line.

Eastern Gallery and Western Gallery.

179.—A. HUTCHINSON & Co., 3 and 4, Great Winchester Street, E.C., Telephone No. 265. (Telegraphic address, "Hutchinson, London.") Ebonite Telephone Receivers; India-rubber Tubing for insulators; "International" Tubing. This black tubing is the best known for gas, chemical, and telephonic use; it may be covered with braid of various materials and colours.

Southern Gallery.

180.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Carbon Blocks for Microphones. (*See* ADVT., p. 127.)

South Nave and Southern Gallery.

181.—ARMAND LÉVY, 252, Goswell Road, London. Telephone Receivers in Vulcanite and Celluloid; Magnets; Vulcanite Rod, sheet and moulded to any shape; Silk, Worsted, and Braided Transmitters.

Eastern Gallery.

182.—J. SLATER LEWIS, 28, Hamilton Street, Birkenhead. Telephonic Transmitter, Receivers, and Bell. Manufactured by Exhibitor. Price 20 Guineas per set of 2, including batteries. These instruments are not only of substantial character, but are free from the complications usually found in others. All the working contacts are of riveted platinum, and the coils are wound in the most careful manner with specially prepared silk-covered copper wire. The transmitter is enclosed in a stout polished teak case, of quite a new design in telephony, with a small sloping desk attached for taking notes &c., and will stand, without an inch of wire being seen, upon a counter, table, chimney-piece, or wall-bracket. There are two receivers of special design with each transmitter, *i.e.* one for each ear.

Eastern Gallery.

183.—J. G. LORRAIN, C.E., 9, Victoria Chambers, Westminster.
1. New Patent Loud-speaking non-Magnetic Telephone, not susceptible to disturbances from induction or leakage on lines.
2. Patent Call-Signal for magnetic telephones.

Eastern Gallery and Concert-Room Gallery.

184.—J. ORME & Co., 65, Barbican, E.C. Telephones and Transmitters as used throughout the country and abroad for lines of from 1 to 250 miles. (*See ADVT., p. 119.*) *Western Gallery.*

185.—E. PATERSON, 76, Little Britain, Aldersgate Street, E.C. Gower-Bell Loud-speaking Telephones; Johnson's Patent Carbon Transmitter; Exchange Boards of various descriptions; and Complete Outfits for telephone exchanges. (*See ADVT., p. 119.*)

South Nave and Southern Gallery.

186.—JULIUS SAX, 108, Great Russell Street, Bloomsbury. Telephone Transmitters and Indicators.

Eastern Gallery and South Nave.

187.—SCIENTIFIC TOY COMPANY, Sun Works, Kirkwood Road Peckham. The Musical Ghost or Electric Songster. A small transmitter conveys vocal and other musical sounds any distance by secreted wire to the musical ghost, another small instrument which reproduces same greatly increased in volume and effect; thus a song hummed gently at one end is magnified and literally roared out at the other, causing either great amusement or consternation as desired.

Gallery at back of Concert-Room.

188.—F. J. SMITH, Taunton, Somerset. 2 Sets of Transmitters and Telephones. (*See ADVT., p. 139.*) *Southern Gallery.*

189.—TASKER, SONS, & Co., Sheffield. Johnson's Transmitter has been devised to overcome the deteriorating influences constantly at work in microphonic transmitters, and thereby to secure absolute permanency of adjustment; to clear the circuit of noises in the receiving telephone; to increase the clearness and distinctness of articulation; and to reduce the battery power. In combination with a special arrangement of carbon contacts is a branch-circuit of proper resistance, which, working together, prevent an undue rise or fall of the electric undulations on line. (*See ADVT., p. 130.*)

Southern Gallery.

190.—UNITED TELEPHONE COMPANY, LIMITED, 36, Coleman Street, E.C. Telephones and Telephone Exchange.

Eastern Gallery.

190A.—MAGNUS VOLK, Telegraph Works, Ditchling Rise, Brighton. 50-line Telephone Exchange Switch-board, complete, with reversed slipper springs to avoid accumulation of dust; Table Keys for switch-room; Table and other Jacks; Switch-bell for use with battery; Switch-bell Magnets, new pattern; Annunciator Drops for exchange switch-board, requiring no connections beyond screwing up on the board; various Switches 2, 3, and 4 drop Annunciators, complete.

Eastern Gallery.

191.—WOODHOUSE & RAWSON, 11, Queen Victoria Street, E.C. A new Telephone; a Microphone upon a new principle.

Eastern Gallery.

Class VIII.—Electric Lighting.

192.—G. G. ANDRÉ, Havelock Cottage, Dorking. Electric Light (André System). Arc Lamps specially designed for street lighting. These lamps, provided with a single pair of carbons, burn 36 hours without change. The carbons are fed up as they are consumed by means of mechanism in the engine-room, the action of which is controlled by the length of the arc in each individual lamp.

The Terrace, part of North Nave, Renaissance and Greek Courts.

193.—G. G. ANDRÉ, Havelock Cottage, Dorking. Incandescent Lamps of 20 and 50 candle-power for street lighting. Provision is made for preventing extinction of light. Lamps for lighting works and warehouses where colours have to be distinguished. Lamps for domestic and general use. A characteristic feature of these incandescent lamps is their durability.

Technological Museum and Southern Gallery.

194.—ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION, Belvedere Road, Lambeth. 1 single Arc Light of 150,000 candle-power; 40 Arc Lights of 2,000 candle-power, for illuminating Tropical Section and Byzantine Courts; 20 Arc Lights, assorted; 6 Arc Lights for illuminating engine house; Sundry Parts of Arc Lights. All the above of the Brush type. (See ADVT., p. 122.)

Tropical End and Byzantine Court.

195.—ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION, Belvedere Road, Lambeth. 600 Incandescent Lamps from 10 to 100 candle-power, of the Lane-Fox type.

Alhambra Court.

196.—BINKO & Co., 12, Coleman Street, Bunhill Row, E.C. Carbons in flèches, cylinders, and sticks.

West Corridor.

197.—GEO. G. BLACKWELL, 26, Chapel Street, Liverpool. Swan's Incandescent Lamp, worked by Blackwell's modification of Bunsen's battery. (See ADVT., p. 126.)

Southern Gallery.

198.—EDWARD B. BRIGHT, 45, Gerrard Street, London. Improved Powers of Electric Light.

North Nave.

199.—BRITISH ELECTRIC LIGHT COMPANY, LIMITED, Heddon Street, Regent Street, W. Arc and Incandescent Lamps. (See ADVT., p. 141.)

Italian and Egyptian Courts, North Nave, &c.

201.—COMPAGNIE GÉNÉRALE D'ELECTRICITÉ (JABLOCHKOFF'S), 139, Cannon Street (M. J. Gaudet). Example of Lighting the auditorium and stage of a theatre by Jablochkoff's electric light. Example of Street Lighting; Patterns of Lamps for streets, shops and warehouses, workshops, &c.; Illustration of Railway Station Lighting. (The Crystal Palace Station of the London, Brighton, and South Coast Railway is entirely lighted by Jablochkoff.) *Opera Theatre and Eastern Gallery.*

202.—COUNTRY MANSIONS PORTABLE AND ECONOMICAL ELECTRIC LIGHT COMPANY, 50, Trafalgar Road, S.E. Portable Incandescent Drawing-room, Study, Pulpit, and Shop Lamps of great variety. In a charmingly furnished boudoir—bronzed statues standing amidst flowers and ferns—other artistic and useful lamps are shown, with a special battery for the supply of electricity self-contained, or in an adjoining box or cupboard. No acids are used, and the batteries give off no kind of smell. The object is to provide one or any small number of incandescent electric lamps at an insignificant first cost. (*Vide* ADVT.) Walls and a ceiling shut out the daylight from this room, causing it to be one of the few points in the Palace where electric lights can be advantageously seen *at all hours of the day.*

Western Gallery.

203.—R. E. CROMPTON, Mansion House Buildings, London. 12 Crompton Lamps in Transept; 2 in Chinese Court; 6 Crompton's Pattern Miners' Lanterns, for use with incandescent lamps in mines; Specimen Length of Crompton's Patent Electric Main Conductor. (*See* ADVT., p. 144.) *Centre Transept.*

204.—The Lighting of the Chinese Court is carried out by Messrs. R. E. CROMPTON & Co. on the same system as that adopted in the Centre Transept. the distribution of the light and the general illumination being effected by means of the arrangement of the peculiar lanterns and reflecting screens adopted by Mr. Jas. N. Shoolbred, C.E., of Westminster, in his patent double-reflection system of illumination for interiors *Chinese Court.*

204A.—THE DOMESTIC ELECTRIC LIGHTING COMPANY, LIMITED, 6, Lombard Street, E.C. Exhibition of a Modern Mansion fitted with Electric Light and Electrical Apparatus. Entrance Room, Smoking Room, Dining Room, Drawing Room, and Boudoir—decorated, fitted, and embellished in the highest style of modern art. (*See* ADVTS. pp. 121 & 140). *Victoria Cross Gallery.*

205.—ELECTRIC LIGHT AND POWER GENERATOR COMPANY. Offices : 47, Cannon Street, London, E.C. Works : 29, Bankside, S.E. Rapieff Lamps, as used in *Times* printing office for nearly three years ; Incandescent Lights for domestic purposes, for mines, collieries, and general use ; Maxim Incandescent Lamps for street lighting, singly and in clusters ; Weston Indoor Arc Lamps ; Weston Arc Lamps ; Maxim Arc Lamps ; Maxim Incandescent Light ; Rapieff and Lontin Lamps ; Maxim Searcher Lights for torpedo warfare. By this Company's system a large number of arc and incandescent lamps are worked from one point. (Machinery below, near the scene painters' room.) (*See ADVT.*, back of Wrapper.)

North Nave, Roman Court, and Mediæval Court.

206.—THE ELECTRIC LIGHT CARBON COMPANY, 133, Great Suffolk Street, Borough. A Collection of Solid Carbon Rods of various diameters and lengths for electric lighting, with Lamps ; a Collection of Patent Carbon Rods made hollow ; a Collection of Patent Carbon Rods, with wire in centre for greater conductivity.

West Corridor.

207.—ELECTRIC LIGHT ENGINEERING COMPANY, 35, Queen Victoria Street, E.C. Common & Joel's Patent Electric Light Arc Lamps.

Ground Floor.

208.—ELECTRIC LIGHTING SUPPLY COMPANY, 25, Queen Anne's Gate, Westminster. Hedges' Patent "Gravity" Electric Lamp, with magnesia block ; Hedges' Focussing Gravity Lamp, workshop pattern, without clockwork or parts liable to injury, the separation at the points being effected by an electro magnet ; same Lamps, with differential action to work in series, taking carbons 3 ft. 3 in. in length, to burn 16 hours. The Company's standard form of Patent Switch, for instantaneously substituting one light for another, as supplied to nearly all the leading electric lighting companies ; the same, with duplex contacts for currents of high electro-motive force ; Deviator and Electric Light Indicator, as designed for use in the Liverpool Docks ; Differential Clutch Lamp, arranged for street lighting. By these less light is absorbed than in the ordinary opal glass, and the colour harmonises with gaslight. Ornamental Bronze Lantern with tinted glass. Drawing showing arrangement of lights in the Liverpool Docks.

West Corridor.

209.—WM. ELMORE, 91, Blackfriars Road, S.E. The "Hallett" Arc and Incandescent Lamps. Complete System of Lighting as applied to public streets, gardens, open spaces, theatres, factories, workshops, hotels, houses, &c. (*See ADVTs.*, pp. 110 and 111.)

Avenue between Pompeian House and Chinese Court.

210.—F. L. FAHRIG, Southampton. Arc Lamps.

South Gallery.

211.—A. L. FYFE, 9 and 10, Maidenhead Court, Aldersgate Street, E.C. Arc Electric Lamps, to light up a completely-furnished tent.

Queen's Corridor.

212.—THE HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY, LIMITED (Holders of the Patent Rights of the Brush System for the Northern Counties of England, and for Sussex and Hampshire, and General Agents of the Brush Company), 110, Cannon Street, London; 36, Dale Street, Liverpool; Wharnccliffe Chambers, Sheffield; Post Office Buildings, Middlesborough. 64 Brush Electric Lamps and Incandescent Lamps. These lights provide the whole of the illumination of all the corridors and staircases from the Low Level Station to the entrance to the Palace from the corridor; also for the avenue between Pompeian House and Chinese Court, the end of the West Corridor, the avenue between the Chinese and Birmingham Courts, the avenue in front of the Chinese Court, the pathway leading from the Upper Terrace to the Panorama of the Siege of Paris; also an office in the Nave between the Jablochhoff Stand and the Electric Lightship, in which is shown a Printing Press worked by power transmitted from a Brush Dynamo.

Railway Corridors, leading to L. B. & S. C. Railway, and Costume Court.

213.—G. HAWKES & Co., 9, Victoria Chambers, Westminster. 6 Electric Arc Lights of 6,000 candle-power each. A simple, neat, and self-regulating electric light, thoroughly free in its working from cogs, wheels, pulleys, strings, clockwork, or such like mechanism. The arc is established by the passage of the current operating upon two magnets, and is controlled and sustained at its proper dimensions by a regulator which allows the carbons properly to approach each other at an infinitesimally slow rate. The light can be maintained for any period required, varying from 6 to 20 hours, or longer, in a single lamp, and from 12 to 40 hours, or longer, in a double lamp. In the double lamp the current is automatically switched from one pair of carbons to the other at the proper time. (See Advt., p. 118.)

Western Gallery, under Gymnasium.

214.—W. T. HENLEY (W. T. Henley's Telegraph Works Company), 8, Draper's Gardens, Throgmorton Street, E.C. Lamps for Electric Light.

North Nave, Western Gallery, and West Corridor.

215.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.; and Charlton, S.E. Brookie's Patent Electric Lamp; Carbon Rods

(black and coppered); Patent System (underground) of Pipes for electric light circuits. (*See ADVT.*, p. 127.)

South Nave and Southern Gallery.

216.—GERARD & Co., 9, Victoria Chambers, Westminster, S.W. Gérard's Patent Electric Lamps for factories and warehouses; Gérard's Patent Electric Lamps for streets, docks, harbours, &c.; Gerard's Patent Electric Lamps for theatres, halls, and public buildings; Gérard's Patent "Veilleur" or Automatic Cut-off for using where a large number of lamps are placed on one circuit, so that, should an accident occur to any one lamp, the others will not be affected. (*See ADVT.*, p. 128.)

South Nave and Western Gallery, also lighting the China Court.

217.—J. HAY ATHOLE MACDONALD, 15, Abercromby Place, Edinburgh. Model of a Holophote Course Indicator, for preventing collisions at sea—an electric light with a movable reflector. While the vessel's helm is amidships, the reflector is held fast projecting the light straight ahead. On the helm being put to port, the reflector is set free to sweep from straight ahead to starboard. When the light has been moved round to starboard, it is automatically shut out from view, until it is brought back to straight ahead. The sweep from ahead to starboard can then be repeated, and this can be done again and again, as long as the helm is ported. The converse action, sweeping from ahead to port, is obtained when the helm is put to starboard.

South Nave.

218.—E. MULLER, 94, Kennington Road. Glasses for Incandescent Lamps; Air Pumps for Lamps.

Eastern Gallery.

219.—THE NATIONAL ELECTRIC LIGHT COMPANY, Glasgow. Patent Incandescent Lamps.

North Nave.

220.—ROWATT & FYFE, 52, Queen Victoria Street, E.C. 6 Pilsen Lamps, 10 Joel Lamps.

Handel Orchestra, and Pompeian House.

221.—SCIENTIFIC TOY COMPANY, Sun Works, Kirkwood Road, Peckham. The One Shilling Electric Lamp burns two hours without attention, consumes Renier carbons, automatic action, brass works, &c. With each lamp a book of instructions is supplied, enabling any person to construct powerful batteries for working same at trifling cost. (*See ADVT.*, p. 139.)

Gallery at back of Concert Room.

222.—SCHOOL OF SUBMARINE TELEGRAPHY, TELEPHONY, AND ELECTRIC LIGHT, 12, Princes Street, Hanover Square W. (removed from 4, George Street, Hanover Square). A new Incandescent Lamp. (*See ADVT.*, p. 3 of Wrapper.)

North Nave.

223.—SIEMENS BROTHERS & Co., 12, Queen Anne's Gate, Westminster. 1 Siemens' Hanging Pendulum Lamp, burning in connection with the D² Upright Machine, mentioned in CLASS III.; 6 Siemens' Differential Lamps in large chandelier, exhibited by Messrs. Siemens' Frères; 2 Siemens' Differential Lamps on iron poles for street lighting; 50 to 60 Swan Incandescent Lamps, lighting Messrs. Bertram & Co.'s saloon dining-room. The above 8 differential and 60 Swan lamps are maintained by the W² D⁷ machine mentioned in Class III.; 6 Siemens' Differential Lamps, maintained by the S D⁸ machine mentioned in Class III.; 1 Siemens' Hanging Pendulum Lamp, with abutment pole, City of London pattern, with reflector; 1 Siemens' Hanging Pendulum Lamp, enclosed in square lantern with reflector; 1 Siemens' Hanging Pendulum Lamp, with cover removed; 1 Siemens' large Pendulum Lamp, upright; 1 Siemens' large Pendulum Lamp, with abutment pole, in reflector, upon cast-iron stand, with universal motion; 1 Siemens' Duplex Hanging Pendulum Lamp, on stand; 2 Siemens' Differential Lamp, with abutment poles on lamp-posts, City of London pattern; 1 Siemens' Differential Lamp, with cover removed; 1 Siemens' Differential Lamp, for ship's use; 1 Siemens' Lamp, with horizontal carbons; 1 Globular Lantern, with pendant, ash tray, counterweight, and 20-inch alabaster globe; 1 Globular Lantern, with reflector, City of London pattern; 1 Square Lantern, with inverted umbrella-shaped reflector and weather covers.

South End of Palace.

224.—MESSRS. STRODE & Co., 48, Osnaburgh Street, N.W. 4 Electric Arc Lamps (Mackenzie's Patent), suspended to light 3 bays; each lamp will be supplied with electric current from separate dynamo machines. Electric Lights (Mackenzie's Patent) on Standards; Incandescent Electric Lamps on Ornamental Standards. Mackenzie's Patent Electric Apparatus for lighting Gas; Art Metal Work for Electric lamps. (See ADVT., p. 154.)

West Corridor and South Nave.

225.—SWAN'S ELECTRIC LIGHT COMPANY, LIMITED, 13, Mosley Street, Newcastle-on-Tyne. Swan's Patent Incandescent Lamps, fitted to chandeliers specially designed to suit them. These lamps were awarded the only gold medal which was given at Paris specially for incandescent lamps. They are supplied with electricity from one of Messrs. Siemens' Alternate Current Generators, described under CLASS III. (See ADVT., p. 135.)

Picture Gallery.

226.—SWAN'S ELECTRIC LIGHT COMPANY, LIMITED. Swan's Patent Incandescent Lamps, fitted to brackets; Table Lamps; Miners' and Divers' Lanterns; also accessories used in connection

with the Swan Lamps. Swan Lamps, with accessories, may be seen in Office in South Nave. Swan Lamps are also shown at Messrs. Elkington's Stand, West Corridor; at Messrs. Bertram & Roberts' Saloon Dining Rooms, at the south end of the Building. Current for these is also supplied from Messrs. Siemens Brothers' machines. They are also in operation at Messrs. W. Elmore's Stand between Pompeian House and Chinese Court; at Messrs. Hindley's Annexe in West Corridor; and at the Turner Gas-Engine Company's Stand, West Corridor; also in Furniture Court, which is lighted by a large Electrolier fitted with Swan Lamps. (For further particulars, see ADVT. p. 135.) *South Nave.*

227.—G. W. WIGNER, F.C.S., F.I.C., &c., 79, Great Tower Street, E.C. Automatic Regulators for the Electric Light. The regulators are actuated solely by water pressure, which may be obtained from the mains or from a cistern. The quantity of water used is from $\frac{1}{2}$ gallon to 1 gallon per day. Two forms are exhibited, one as a street lamp, in which the carbons are above the regulator; one for factory and general use, in which they are below the regulator. *Eastern Gallery.*

228.—WOODHOUSE & RAWSON (Agents to the Anglo-American Brush and Lane-Fox Incandescent Electric Light System), 11, Queen Victoria Street, E.C. Improved Lamps (Incandescent and Arc); Electrical Lighting of Trains; Patent Electrical Couplings, Fittings, Brackets, Standards, &c., for incandescent lighting. *Eastern Gallery.*

Class IX.

Electric Motors and Transmission of Energy.

229.—A. APPS, 433, Strand. Electro-Magnetic Model Engine, giving the maximum effect of the attraction and repulsion of electro-magnets. *North Nave.*

230.—EDWARD B. BRIGHT, C.E., 45, Gerrard Street. An improved Electro-motor. *North Nave.*

231.—T. CRAMPTON & Co., 251, High Holborn, W.C. Small Motors (stationary and locomotive). *Southern Gallery.*

232.—F. E. FAHRIG, Electrician, Southampton. F. E. Fahrig's Patent; Dr. Hemsted's, M.D., Patent Motor. This Patent is called the Eclipse Motor. Fahrig & Hemsted—Patent taken out in these two names. *Southern Gallery.*

233.—LAWS & CHATTERTON, 46, Queen Anne's Gate, Westminster. Plan and longitudinal and transverse sections of the proposed Charing Cross and Waterloo Electric Railway; with sectional models, showing the mode of constructing the subway in the bed of the river, and working model of carriage.

Concert-Room Gallery.

234.—E. PATERSON, 76, Little Britain. Electric Motors. (See ADVT., p. 119.)

South Nave and Southern Gallery.

235.—MESSRS. STRODE & Co., 48, Osnaburgh Street, N.W. Electric Motor. (See ADVT., p. 154.)

West Corridor and South Nave.

Class X.—Electro-Medical Apparatus.

236.—A. APPS, 433, Strand. New Constant Medical Battery, with closed cells; very portable.

North Nave.

237.—ARNOLD & SONS (by appointment to Her Majesty's Government), 35 & 36, West Smithfield, E.C. Medical Galvanic Batteries. Arnold & Sons' Patent Continuous Current Battery; Arnold & Sons' Portable Bichromate Battery; Arnold & Sons' Improved Galvanic Caustery Battery; Tibbitt's Continuous Current Batteries; Stöhrer's Continuous Current Batteries; Guiffe's Chloride of Silver Batteries; Arnold & Sons' Modified Smees' Battery; Arnold & Sons' Continuous Current Battery, with improved regulating dial, &c., &c.

Western Gallery.

238.—ASHWORTH BROTHERS, Moss Brook Works, Collyhurst, Manchester. Conveying electricity from a battery to the head or any part of the body, through the numerous ends of the wires (1500 points) of "Metallic Comb-Brushes." For toilet and bath use; also for horses, cattle, dogs, &c. (See ADVT., p. 124.)

Western Gallery.

239.—F. BARTY, Greenwich and Leeds. A collection of Magnetic Curative Appliances, comprising Belts, Lung and Nerve Invigorators, Chest Protectors, Knee Caps, Soles, &c., manufactured under exhibitor's patent, with specially-coated and (where requisite) curved bars (or magnets). A collection of Galvanic Batteries and Coils for medical purposes. A collection of Magneto-Electric Machines for medical purposes.

Western Gallery.

239A.—BLAKEY, ENMOTT, & Co., Northern Telegraph Works, Halifax. Mottershead & Co.'s Continuous Current Leclanché Batteries, with 20, 30, or 50 Cells, with Dr. Dixon Mann's Improved Form of Handle; Carbon Disc Electrodes; Flexible Flat Electrodes; Uterine Electrode; Mackenzie's Laryngeal Electrode; Vertical Electrodes. *Western Gallery and North Nave.*

240.—L. CLARK, MUIRHEAD, & Co., 23, Regency Street, Westminster. Chloride of Silver Medical Battery, with fittings. (*See ADVT.*, p. 131.) *Between Sheffield Court and Chinese Court.*

241.—COXETER & SONS, 23 and 24, Grafton Street, East, Tottenham Court Road, London, W.C. Medical Batteries. First class award, International Medical Congress, 1881. Only medal awarded specially for medical electricity, l'Exposition de l'Electricité, Paris, 1881. *Western Gallery.*

242.—MESSRS. DARLOW & Co., 443, Strand, W.C. Appliances consisting of small Portable Flexible Magnets, made up into Belts, Chest Protectors, Lung Protectors, Knee Caps, Wristlets, and various other articles for applying to different parts of the body for the cure and alleviation of disease; the magnets being doubly protected from oxidation and rust, by being first covered with a bronze varnish, and then insulated between two layers of india-rubber cloth. Also Magneto-Electric Machines for medical purposes. For further particulars see advertisement and descriptive pamphlet, post free. (*See ADVT.*, p. 112.) *Western Gallery.*

243.—JOSEPH DAVIS & Co., Fitzroy Works, Kennington Park Road. Magneto-Electric Machines for medical purposes.

Eastern Gallery.

244.—F. H. FEARN. (Agent, M. Marx, Crystal Palace.) Fearn's Improved Magneto Machines, for the use of nervous diseases of all kinds.

Eastern Gallery.

245.—B. COPSON GARRATT, 16, Finsbury Square. Magneto-Electric Appliances showing the latest and most approved method of healing by means of aura or currents discharged from magnets, enclosed in various garments, and applied to the nerve centres and vital organs simultaneously, to produce more freedom of action between nerve centres and nerve extremities. The exhibitor claims that he has solved the problem of the adaptability of magnetic treatment to intricate cases by introducing compound magnets of superior power in different positions, according to the requirements of the patient, the extreme lightness and flexibility of his special Magnets enabling him to concentrate a high degree of Magnetic power at any desired point, without discomfort or objectionable weight. It is also claimed that Magnets prepared by his special process permanently maintain their therapeutic virtue. For particulars of Mr. Garratt's method of treatment see his published essays:—"Magnetism and Electricity: their Curative Properties explained;" "The True Philosophy of Health and Healing;" "Mental and Physical Maladies;" "Worry: its Dangers and Remedy;" "Nervous Exhaustion and Physical Prostration: their Cause and Cure," &c., to be obtained of the author at his consulting rooms, 16, Finsbury Square, London, E.C., or at the Exhibition. (*See ADVT.*, p. 138.) *Western Gallery.*

246.—J. H. MARTIN, 272, Regent Circus. Belts, Lung Invigorators, and other appliances for all parts of the body, all all of which have encased within them the most perfect medical magnets for conserving and promoting that vital power upon which the healthy action of all the vital functions depends; also acting as an external agent of great value for soothing and invigorating the nervous and general systems. This exhibitor aims from a humanitarian point of view to make the most comfortable, natural, efficient, and economical appliance possible, believing that if health is valuable to the wealthy it is doubly so to the poor. A pamphlet containing fullest particulars sent gratis to all parts on application to the Inventor and Maker, 272, Regent Street, London, W. It may be stated also that these appliances are well known all over the world, and that they bid fair to become the universal favourite. *Western Gallery.*

247.—J. F. PRATT, 43 (late 420), Oxford Street. Electro-Medical Batteries, Reophores, Conductors, &c.: Dr. Stohrer's new 10-cell constant Current Battery; Dr. Stohrer's 30-cell Battery, as used at St. Bartholomew's Hospital; Dr. Stohrer's 20-cell Battery, as used at St. Bartholomew's Hospital; Dr. Stohrer's 20-cell Hospital Battery, as used at St. Bartholomew's Hospital; Dr. Stohrer's 2-cell Induction Battery, as used at St. Bartholomew's Hospital; Dr. Stohrer's 1-cell Induction Battery, as used at St. Bartholomew's Hospital; Dr. Stohrer's Actual Caution, with 4 large cells; Pratt's small 20-cell Battery, constant current; Pratt's 30-cell Battery, constant current; Duchennes large Coil Machine; Magneto Batteries, of various sizes; Magneto Batteries, with dial for regulating the amount or force of shock; Electro-Magnetic Battery, as used at St. Bartholomew's Hospital; Electric Bell for invalids; Duchennes Pedal Rheostat; Metallic Rheophores, with disks and cups; Metallic Brushes; Double Rheophore, for spine; Six-cup Rheophore, for spine; Mothral Vaginal Rectum Reophores; Dr. M. Mackenzie's Laryngeal Rheophore; Mr. Lennox Browne's Laryngeal Rheophore; Serre fine Conductors and Needles, for electrolysis; Dr. Russell Reynolds's Cup Rheophores; Dr. Tibbett's extra large Rheophores; Oliver's Rheophores, covered; Conical Rheophores, covered; Ladies' Belt, fitted with small battery, to apply a constant current to the abdomen, &c. *Western Gallery.*

248.—MESSRS. J. L. PULVERMACHER & Co., 194, Regent Street, W. Medical Batteries for the profession and patients. Auto-Electric Band Batteries; Hydro-Electric Bands; Pocket Batteries with articulated elements; Chain Batteries; Interruptor; Electrolytic Dosometer for delicate measuring of the current; Voltmeter, single and double; Electrodes of all sorts. *Western Gallery.*

249.—W. ROGERS, M.R.C.V.S., 115, New Road, Whitechapel Road, London. A Portable Spring Electric Battery, always charged. It is only necessary to press down the spring to create instantly a powerful or slight shock as may be required. (See ADVT. p. 123) *Eastern Gallery.*

250.—SCRIVENER, GILL, & Co., 221, Regent Street, W. Magnetic Curative Appliances (Amynterion) specially constructed by the original inventor of this therapeutic system of cure, Mr. P. W. Seymour. In this case are exhibited apparatus for developing all those electrical qualities used medically, viz. Franklinism, Galvanism, Faradism, and Magnetism. *Western Gallery.*

251.—H. G. WHITING, Medical Electrician, 11, Poultry Chambers, Cheapside, E.C. Whiting's Patent Perforated Ferruginous and Odic Force Curative Appliances are adapted for all climates, and supply a continuous force in all cases of nervous exhaustion. These magnetic appliances retain their power for many years; they are elegant in appearance, and in best designs. Whiting's Magnetod Belts for the prevention of sea-sickness, Hair-Brushes for removing headache in three minutes, Tooth-Brushes to prevent toothache, Invalid Boots combining mechanical and curative advantages, Medical Coils, Machines, Batteries, etc. "The Magnetod" has been tested by royalty and many distinguished persons, and received special favour in India, Africa, West Indies, North America, Brazil, Malta, Australia, New Zealand, Tasmania, New Guinea, Canada, France, Germany, Switzerland, and other countries; and for curative value these appliances are unequalled. (See ADVT. p. 125.) *Western Gallery.*

252.—ZANNI & Co., 47, Holborn Viaduct, E.C. Magneto-Electric Machines for medical purposes, &c. &c. (Agent, Mr. F. Bertram. *West Corridor.*

Class XI.—Electro-Chemistry.

253.—A. APPS, 433, Strand. Battery Power Indicator. This instrument indicates exactly what rise or decline takes place during the action of a battery, and may be adjusted to almost any current. The progress of polarisation and the establishment of local poles and their extent may be conveniently studied by this method. *North Nave.*

254.—BROUGHTON COPPER COMPANY, Broughton Copper Works, Manchester. Hydraulic Press Rams and Plungers, electro coppered—these Rams will stand the heaviest hydraulic pressure used without the copper separating from the iron, effect great saving in press leathers; Rollers for Starching Machines, &c., electro coppered—these rollers answer the purpose well, and can be recoppered when worn out; Locomotive and Marine Boiler Tubes, wrought iron electro coppered—the copper is deposited so firmly that a tube may be heated to a red heat and plunged in water without showing any blisters. *Eastern Gallery.*

255.—CASSELL, PETTER, GALPIN, & Co., La Belle Sauvage Yard, Ludgate Hill, E.C. Case containing Electrotypes of Engravings, selected from the publications of Messrs. Cassell, Petter, Galpin, & Co., together with printed impressions from the said electrotypes. *Eastern Gallery.*

256.—L. CLARK, MUIRHEAD & Co., 23, Regency Street, Westminster. Muirhead's Improved Form of Thomson and Varley's Slide-resistance Coils, Registered Design; Standard Condenser, $\frac{1}{3}$ Microfarad; Standard Condenser, $\frac{1}{2}$ Microfarad; Standard Condenser, 1 Microfarad; Standard Condenser, 1 Microfarad, subdivided $\cdot 1 \cdot 2 \cdot 3 \cdot 4 = 1$, Microfarad. (See ADVT. p. 131.)

Between Sheffield Court and Chinese Court.

257.—ELKINGTON & Co., Manufacturing Silversmiths, 22, Regent Street, S.W., London. Inventors of the electro-plating processes and fine art reproducers in the precious and other metals; bronzists, &c. Exhibit specimens of objects produced entirely by electro deposition. Articles gilt and silvered by the electro processes; electrotype, bronzes, bas-reliefs, &c., &c. Candelabra, lamps, chandeliers, sconces, &c., fitted with Swan's Incandescent Lights, adapted for the lighting of drawing-rooms, dining-rooms, and other domestic purposes. The various processes of Electro-depositing, Gilding, Plating, Moulding, &c., shown in operation, and explained by skilled operators. *West Corridor.*

258.—WM. ELMORE, 91, Blackfriars Road, S.E. The "Elmore" Dynamo-Electric Machine, and special electro-depositing solutions for depositing Gold, Silver, Copper, Brass, Tin, Zinc, and Nickel, in Electro-plating. The "Elmore" Dynamo-Electric Machines Electrotyping, Manufacturing Tin-plates, Galvanizing, Refining Metals, Extracting Metals from their Ores, Generating Oxygen, Hydrogen, and other gases. Chemicals used in the art processes Electrotypes, Art Subjects, Bank-note Plates, etc., which have been produced by the "Elmore" machine. Metal goods of various kinds which have been electro-plated by the "Elmore" machine. (See ADVT. pp. 110 & 111.)

Avenue between Pompeian House and Chinese Court.

259.—DR. J. H. GLADSTONE and MR. A. TRIBE, 17, Pembroke Square. *Applications of Local Electric Action to Chemical Work* The chief agent employed is named the *copper-zinc couple*. It consists of zinc coated with spongy copper, or zinc mechanically associated by heat with the negative metal. The principal results of its application are: (a) The decomposition of water (exhibited); (b) Preparation of the paraffins, or the hydrides of the alcohol radicals (exhibited); (c) Preparation of many zinc ethers; (d) Reduction of nitrates and nitro-compounds (exhibited); (e) Information concerning the constitution of many organic compounds. Another *couple* is lead coated with spongy peroxide, as in the Planté and Faure accumulators. The results exhibited are: (a) The decomposition of water, with formation of the yellow oxide; (b) The decomposition of dilute sulphuric acid, with formation of sulphate of lead. *South Nave.*

260.—ALFRED TRIBE, F.I.C. (Lecturer on Chemistry in Dulwich College) 14, Denbigh Road. Electrographs: Silver plates on which are deposited copper and silver peroxide. These deposits are obtained while the insulated plate stands immersed in a

solution of copper sulphate undergoing electrolysis, and indicate the influence of varying conditions on the distribution of electricity; analogies between static and dynamic electricity; relation between lines of force and boundary configurations; dissymmetry in non-uniform fields; relation between electric incidence and refraction.

Concert-Room Gallery.

261.—H. WIGGIN & Co., George Street Parade, Birmingham. Pure Nickel in grains, cubes, and shotted; Cast Ingots of Pure Nickel and Nickel Alloys; Malleable Nickel and Cobalt Anodes for Electro-depositing (Patent); Cast Nickel and Cobalt Anodes for Electro-depositing; Single and Double Salts of Nickel and Cobalt for Electro-plating; Sheets of Malleable Nickel and Cobalt (Patent); Pure Nickel Wires (Patent) and German Silver Wires for Electrical purposes; Nickel and Cobalt Oxides; Sulphate of Copper; Sulphate of Iron.

Eastern Gallery.

Class XII.—Magnets, Compasses, Horology, Instruments of Precision, &c.

262.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*)

North Nave.

262A.—HER MAJESTY'S GOVERNMENT (War Office). (*See p. 26 et seq.*)

North Nave.

262B.—HER MAJESTY'S GOVERNMENT (Lords of the Admiralty). (*see p. 30.*)

North Nave.

263.—SIR JOHN BENNETT, 65, Cheapside. An Electric Regulator from which falls a time-ball by current from the Royal Observatory, Greenwich, every hour; the ball being raised three minutes before the hour by horological machinery.

North Nave.

263A.—SIR JOHN BENNETT, 65, Cheapside. Large Electric Time-Ball, 9 feet in circumference, raised by automatic machinery and dropped by current from the Royal Observatory every hour in the day.

Centre Transept.

264.—LOUIS H. BORRELL, 9, Amwell Street, Clerkenwell. Electric Remontoire, centre seconds; Timepiece, kept wound by a current from Leclanché's Battery every $3\frac{1}{2}$ seconds.

Eastern Gallery.

265.—FRED. C. BULL, 61, Great Dover Street, S.E. Well-finished and going Electric Timepiece. Wants no winding up, worked with one cell, which only requires replenishing once in about nine months, and also good made and finished Prismatic Compass.

Eastern Gallery.

266.—L. CLARK, MUIRHEAD, & Co., 23, Regency Street, Westminster. Sir William Thomson's Astatic Reflecting Galvanometer, with Ebonite Coil Cheeks to prevent cross-leakage between the wires; Sir William Thomson's Astatic Reflecting Galvanometer on tripod stand; Schwendler's Tangent Galvanometer, as used by the Indian Government; L. Clark's Patent Double Shunt Differential Galvanometer and Set of Resistance Coils used with same. British Association units, 1, 10, 100, 1000 Ohms. (*See ADVT. p. 131.*)

Between Sheffield and Chinese Courts.

277.—T. CRAMPTON & Co., 251, High Holborn, W.C. Electric Clocks, &c. *Southern Gallery.*

278.—JOHN DAVIS & SON, All Saints' Works, Derby; London Office, 118, Newgate Street. Davis's Improved Hedley Dials. This dial combines all the latest improvements of the best Hedley, with the outside vernier of the theodolite. The improvement consists of an arrangement by which the bearings are taken simultaneously with loose needle and vernier, the latter automatically checking the former, thus any error arising from incorrect reading or from any local attraction is detected. Biram's Patent Anemometers to ascertain the ventilation in mines and sewers and the draft of furnaces. *Concert-Room Gallery.*

279.—JOSEPH DAVIS & Co., Fitzroy Works, Kennington Park Road. Compasses, Barometers, and Meteorological Instruments. *Eastern Gallery.*

280.—E. DENT & Co., 61, Strand. Electrical Clocks governed from the Great Exhibition Clock; non-Magnetisable Watches, specially designed for use of telegraphic and electrical engineers; Small Portable Galvanic Chronograph, constructed for the Government; Electrical Relay for 3 currents, as constructed for the Royal Observatory, Greenwich; Mariners' Compasses as used in the British Navy and by the Royal National Lifeboat Institution. *Western Gallery and various parts of the Building.*

281.—F. E. FAHRIG, Electrician, Southampton. Self-acting Regulators, Dials, and Electric Clocks in general. *Southern Gallery.*

282.—J. FAULKNER, 13, Great Ducie Street, Strangeways, Manchester. Diagrams illustrating the great waste of power in electro magnets as heretofore made, and the economy of altandæ electro magnets. In electro magnets, as usually made, only the magnetism in the centre of the coils of wire is used and the external rays entirely discarded. These diagrams are produced by scattering iron filings upon papers prepared with paraffin, placed over ordinary electro magnets and altandæ electro magnets respectively, and they show that round (see *c, d*), half round, and flat covers of iron (see *k, l, m, n, o*) may be used, and thereby the force so shaped and concentrated as to meet any form or position required. —John Faulkner, Manchester. Diagrams taken from: (*a*) End of coil, without any iron core; (*b*) End of coil, containing an iron core; (*c*) End of coil, with an iron core and thin iron outer cover; (*d*) End of coil, with an iron core and thick cover; (*e*) End of coil, with a hollow iron core, a thin iron cover, and an iron washer let in the end; (*f*) Length of coil, with an iron core; (*g*) Length of coil, with an iron core and thick iron cover; (*h*) Length of coil, with an iron core, three sides covered and one side open; (*i*) Length of coil, with an iron core, three sides covered, one side open, and an armature at one end; (*j*) Length of coil, with an iron core, three sides covered, one side open, with two armatures, one on each end; (*k*) End of coil, with one iron flat side; (*l*) End of

coil, with two iron flat sides; (m) End of coil, with two iron flat sides; (n) End of coil, with three iron flat sides; (o) End of coil, with four iron flat sides. (1) Natural Magnet, "The Lodestone"—John Faulkner, Manchester; (2) Artificial Magnets, "Bars," "Horseshoe"—John Faulkner, Manchester; (3) Electro Magnet, "Single," "Horseshoe"—John Faulkner, Manchester; (4) Oersted's Experiment (1819)—John Faulkner, Manchester; (5) Altandæ Electro Magnets, "Faulkner's Altandi Systemæ"—in this system iron cases are used of such size and thickness as ensures the utilisation of the maximum force of magnetism; the object is to accumulate and utilise all or a portion of the electric power as required, and prevent the loss of force that takes place in apparatus where the ordinary electro magnet is used—John Faulkner, Manchester; (6) Altandæ Electro Magnetic Apparatus, for research—John Faulkner, Manchester; (7) Powerful Altandæ Electro Magnets—John Faulkner, Manchester. *Eastern Gallery.*

282A.—W. GROVES, 89, Bolsover Street, London, W. Professor Hughes' Induction Balance and Apparatus connected therewith.

North Nave.

283.—W. T. HENLEY (W. T. Henley's Telegraph Works Company), 8, Draper's Gardens, Throgmorton Street. Magnets, &c. &c. Large Permanent Magnet, magnetized in 1847, and still retaining its power; Large Magnet, magnetized in 1860; Various Magnets constructed at early dates, from 1838 to 1856.

283A.—JONAS & COLVER, Sheffield. Steel for the manufacture of Magnets, and Magnets made of such steel. *Southern Gallery.*

North Nave and West Corridor.

284.—KELWAY & DYER, 29, New Bridge Street, London, E.C. Kelway's Electric Log (C. E. Kelway, Inventor). Uses: Navigation, nautical surveying, speed trials, naval gunnery, recording rate of currents, testing screw propellers.

West Corridor.

285.—J. EVELYN LIARDET, 8, Breakspears Road, Wickham Park, Brockley. A Mariner's Warning Compass, which will ring an electric bell immediately a ship is off her course. *West Corridor.*

286.—E. PATERSON, 76, Little Britain. Apparatus for Science Teaching, as recommended by the Science and Art Department, South Kensington; Apparatus for Laboratory; Research or Class Demonstration. (See ADVT. p. 119.)

South Nave and Southern Gallery.

287.—DR. DAVID S. PRICE, Technological Museum, Crystal Palace. Natural Magnets.

Technological Museum.

288.—F. TREEBY REID, 7, Bartholomew Terrace, Exeter. Self-acting Setting to Time Electric Clock. By this invention any number of clocks at any distance are worked by one regulator, and, by an electric current from the regulator at regular periods, are made to set themselves correctly to time, according to the rate of the regulator. The whole arrangement being entirely electrically self-acting, and neither regulator, nor other clocks ever require winding, setting, or adjusting.

Eastern Gallery.

289.—J. ROTH, SCHLAEFLI, & Co., 35, Queen Victoria Street, E.C. Electrical Clocks. (*See FOREIGN EXHIBITORS*). (*See ADVT.* p. 148.) *Southern Gallery.*

290.—SCIENTIFIC TOY COMPANY, Sun Works, Kirkwood Road, Peckham. Horse-shoe and bar magnets, electro-magnets, boxes of magnetic experiments with apparatus and book of instruction suitable for children's presents, magnetic pocket time-pieces, &c. (*See ADVT.*, p. 139.) *Gallery at back of Concert Room.*

291.—A. R. SENNETT, Kirby Street Engineering Works, Hatton Garden, London, E.C. Photometer for measuring small or powerful lights (Ayrton and Perry's dispersion). This instrument can be used quite close to the most powerful lights, and with it readings can be taken at any angle with the source of light. *North Nave.*

292.—SIEMENS BROTHERS & Co., 12 Queen Anne's Gate, Westminster. 1 Micrometer Gauge, graduated inch and millimeter; 1 Micrometer Gauge, graduated inch. *South Nave.*

293.—E. A. SULLIVAN, 20, Mawbey Road, Old Kent Road. Compound Magnetic Needle (new invention). This instrument is for showing the magnetic poles. It formerly required an inclination and a declination needle to accomplish this. This is the nearest approach to universal motion round a fixed point. *Eastern Gallery.*

294.—S. ALFRED VARLEY & Co., Hatfield, Herts. Powerful Compound Permanent Magnet, for illustrating magnetic phenomena. *Ground Floor.*

295.—ERNEST WEBSTER, 45, Loudoun Road, St. John's Wood, N.W. System for driving all the clocks in a building from one motor clock by electricity, thus dispensing with winding, and ensuring a uniform time being denoted on all the dials. The mechanism can be applied to existing clocks or dials at a trifling outlay; a great desideratum in factories, banks, railways, docks, workhouses, mansions, &c. &c. A Handless Clock, a novelty in time indicators. The time is shown by means of figures (which change every minute) appearing on the dial. This clock has a dead-beat escapement with second pendulum, and is put in motion by electricity. *Eastern Gallery.*

Class XIII.—Miscellaneous.

296.—HER MAJESTY'S GOVERNMENT (Postal Telegraph Department). (*See p. 11 et seq.*) *North Nave.*

296A.—HER MAJESTY'S GOVERNMENT (War Office). (*See p. 26 et seq.*) *North Nave.*

297.—A. APPS, 433, Strand. Apps's Patent Induction Coils: 10-in., 7½-in. spark, and Miniature Coil—insulation permanent, and 250 per cent. greater power than in the old system; large Uranium Vacuum Tube, to illustrate aurora borealis; Fluorescent Liquid Experiment in Vacuo, exhibiting the effect of induction discharge; Gassiot Cascade in Vacuo, with overflowing

discharge illuminating the vase; Spectrum Analysis Stand as used for determining percentage of sulphur, &c., in sample of iron intended for the manufacture of steel. *North Nave.*

298.—R. BAKER & Co., Mica Brokers, 9, Mincing Lane, E.C. Glass case containing specimens of Cut and Uncut Mica, Powdered Mica, Mica Chips, and Mica Waste. Small case glazed with Mica, enclosing an ornament carved from New Zealand Kowrie Gum.

Western Gallery.

298A.—T. BARRACLOUGH, 8, King Street, Manchester. Machine for making Copper Wire Strand for Telegraph Purposes.

Eastern Gallery.

299.—BINKO & Co, 12, Coleman Street, Bunhill Row, E.C. Electric Toys.

West Corridor.

299A.—BLAKEY, EMMOTT, & Co., Northern Telegraph Works, Halifax. Kemp's Speed Indicator; Crossley's Anemometer; Crossley's Electric Log; Thermopiles, &c. &c.

Western Gallery and North Nave.

300.—T. R. BRAILSFORD, Thames Conservancy Board, 41, Trinity Square, Tower Hill. Electric Alarm, and Register of the fluctuation of Water-level, as adopted by the Honourable the Conservators of the River Thames at all locks on the river; Electric Indicator of Water-level, to show level of water in tidal ways, reservoirs, steam-boilers, tanks, &c., at any distance therefrom, by means of a single wire.

Eastern Gallery.

301.—EDWARD B. BRIGHT, C.E., 45, Gerrard Street, London, W. Apparatus for Neutralising Electricity, developed by friction during the spinning of wool, hair, silk, &c., with a diagram in illustration.

North Nave.

303.—CHUBB & SON, 128, Queen Victoria Street, London, E.C. Patent Electric Time Lock, for strong-room door, containing two chronometer movements that can be set to open and close the lock at any desired time, combined with a duplex electric mechanism for effecting the same objects synchronously, if required. Chubb's Electric Burglar Alarm, fitted to a pair of their Patent Bankers' Steel-plated Strong Room Doors and Gates; this alarm will ring (1) if doors be opened, (2) if either or both connecting wires be cut, or (3) if the wires be bridged outside the object protected. Chubb's Patent Wrought Iron Fire and Thief-Resisting Safe, with electric alarm and keyless combination lock. Chubb's Patent Combination Door Latch, fitted with electric alarm to ring on opening latch, either with key from outside or handle from inside, or on an attempt being made to open the door either by a false key or pick. (See ADVT. p. 115.) *West Corridor.*

304.—L. CLARK, MUIRHEAD, & Co., 23, Regency Street, Westminster. Living's Patent Firedamp Indicator and Measurer; Muirhead's Patent Compound Iron Telegraph Pole; Andrews' Patent Insulators, various. (See CLASSES IV. and VI.) (See ADVT. p. 131.)

Between Chinese and Sheffield Courts.

305.—W. WILLSON COBBETT, 60, Queen Victoria Street, E.C. Scandinavian patent Cotton Machine Belting. If the machine

is driven by this belting the electric light is less liable to flicker, and there is a total absence of vibration. Great economy over all other beltings. Enormous tensile strength. (*See ADVT. p. 125.*) *Gallery back of Concert Room.*

306.—J. COLLIS & Co., 138, Fleet Street E.C., & 72, Denmark Hill, Camberwell. Illustrations from Drawings and Engravings on Wood of Electrical Appliances and Machinery, as supplied to The Electrician journal, and to scientific apparatus manufacturers and engineers for insertion in newspapers, trade catalogues, books, and general advertising purposes. *Western Gallery.*

307.—H. WHITESIDE COOK, Stondon Massey, Brentwood, Essex. An Electric Governor for screw steamers. A sensitive pressure-gauge near the screw indicates the pressure of water on it; when this falls to the point where racing begins, the needle of the gauge makes contact with a spring, completing a circuit through a magnet in the engine-room. This magnet opens the valve, of a very small steam-cylinder connected with the throttle-valve and instantly cuts off the steam. When increasing pressure breaks the contact at the gauge, steam is as instantly turned full on. *Avenue between Pompeian House and Chinese Court.*

308.—H. J. DALE, 4, Little Britain. Educational and other apparatus. (*See ADVT. p. 123.*) *Eastern Gallery.*

309.—J. DARLINGTON, 2, Coleman Street Buildings, Moorgate Street, E.C. Bornhardt's Patent Electrical Firing Machine. This machine is designed for the purpose of firing suitable fuses for blasting in mines, quarries, tunnels, &c. The current is generated by turning an ebonite disc, and stored in a Leyden jar, whence it is discharged through the line wires by pressing a knob. The advantages of electrical blasting are safety of life, economy of time, labour, and capital. By the simultaneous ignition of the charges the whole force is developed at the same instant, and, being brought to bear on the entire mass to be rendered, a much greater effect is produced than would be the case if the holes were fired independently, each hole having to shift its own burden without any assistance from the others. The fuses used in connection with this machine are thoroughly reliable, and can be stored any reasonable length of time without deteriorating, whether in hot, cold, or damp climates, and be depended upon to do their work afterwards. The prices of these fuses will be found much lower than any other similar article manufactured. *Eastern Gallery.*

310.—DAVIS & TIMMINS, Bowling Green Lane, Farringdon Road, E.C. Screws, Terminals, Binders, Connectors, Coil Pins, Battery Clumps, Pole Pieces, and all descriptions of turned work, in Brass, Iron, Steel, Ebonite, and Vulcanised Fibre, for electric lights, telephones, and telegraph works. Sole agents for straight drawn brass and iron wire, specially manufactured for turning purposes. All sizes kept in stock up to $1\frac{1}{4}$ inch diameter. (*See ADVT. p. 141.*) *Southern Gallery.*

311.—EDISON ELECTRIC PEN AND WRITING AGENCY, 140, Fenchurch Street, London (representing proprietor of patent,

J. R. Breckon, Esq.). Edison's Electric Printing Apparatus, by which any number of copies of an original manuscript, to an almost unlimited extent, can be produced at the rate of 300 an hour at a nominal cost. Price and freight lists, circulars, postcards, music, drawings, and any other description of work produced neatly and expeditiously. (*See ADVT. p. 117.*)

Southern Gallery.

312.—J. FAULKNER, 13, Great Ducie Street, Strangeways, Manchester. Altandæ Electric Brass and Iron Separators and Pottery Glaze Extractors.

Eastern Gallery.

313.—W. M. FOXCROFT, 54, Compton Street, Clerkenwell. Comprises Block Instrument Cases, single needle, North Eastern Railway pattern; Speaking Instrument Cases, single needle, Midland Railway pattern; Speaking Instrument Cases, G.P.O. pattern for commutator instrument; also Gower Bell Telephone Cases, as adopted by Her Majesty's Government, or G.P.O.; also special Telephone and Battery Case combined—Wollaston's patent. Being portable, they can be used for men of war, torpedo and field purposes. Each division, boat, &c., being supplied with one by the paying out of a wire, communication is easily maintained. Transmitter and receiver case. Specialities in telephone cases. (*See ADVT. p. 143.*)

Concert-Room Gallery.

314.—FENN & CARLE, 22, Pigott Street, Limehouse, E. Electrical and Mechanical Self-acting Registering Money Till. The registering apparatus is placed in any convenient position inside the till, and arrange the dials and indices in such a manner that the dials can easily be seen and the indices rest at "zero" on the dials at any time, without interfering with or affecting the internal machinery. The dials are concealed by a cover, secured by a lock the key of which is retained by any authorised person. Electrical communication may be fitted to the apparatus, so that the register can be fixed near or distant by renting overhead wires.

Concert-Room Gallery.

316.—ALFRED B. HARDING, 1, Albion Villas, Catford. Metals Fused into Glass by Lightning. Strips of various metals having been laid on these sheets of glass, an actual flash of lightning—collected by means of Mr. Crosse's "exploding wires," stretched over his grounds, and accumulated in his great Leyden battery of 50 jars—was passed successively through each strip. The discharge partially volatilized the metal, leaving the metallic residue fused into the glass, as may be seen. A stereograph of the Leyden battery by which the effect was obtained, accompanies the frames.

Eastern Gallery.

317.—T. R. HARDING & SON, Tower Works, Leeds. Revolution Counters and Speed Indicators, for ascertaining and recording the speed of engines and dynamo-electric machines. Pocket Counters—counters suitable for actuating at a distance by electricity.

Eastern Gallery.

318.—F. HAWKINS, Valentine Villa, Disraeli Road, Upton, near Stratford, E. The Triplex Check Till, of cabinet form, combining

a handsome piece of furniture and the following three checks
The impossibility of giving change for a larger amount than the
coin deposited, an effective means of communicating the value
of the coin taken, and the absolute certainty that abstraction cannot
be even attempted without detection. *Concert-Room Gallery.*

319.—JOHNSON & PHILLIPS, 16, Union Court, London, E.C.;
and Charlton, S.E. Steel wire Sounding Machines; Lead Sinkers,
and Lucas's Clips; Shot Sinkers and Phillips's Tube; Sounding
Wire, and oil tank for ditto; Taping Machine; Spider Wheel;
Opening Bell Mouths; Shackles; Tank Valve; Rope Fittings;
Stern Sheave and Dynamometer; Cable Cutters and Pliers;
Tool and Jointers' Chests, and Stretching Screws. (*See ADVT.*
p. 127.) *South Nave and Southern Gallery.*

320.—W. LADD & Co., 11 and 12, Beak Street, Regent Street.
Autograph Letter (framed) from P. Reis, describing his
telephone to W. Ladd, dated Friedrichsdorf, July 13, 1863.

North Nave.

320A.—LANCASHIRE PATENT BELTING AND HOSE COMPANY. Patent
Belting, specially adapted for driving electric generators. Used
for driving machines in various parts of the building. (*See ADVT.*
p. 121.) *Various parts of the Building.*

321.—LEE & Co., 4, Exchange Arcade, Manchester. Lee's
Patent Circular Lattice Pillar, specially manufactured for carrying
the electric light. Can be made from 15 to 100 feet high. They
resist the strongest gale of wind, are very ornamental and durable
will carry from 2 to 8 wires, without stays. *Railway Corridor.*

322.—ARMAND LÉVY, 252, Goswell Road, London. Leads to
any specification, Terminals, Binding Screws, Clamps, Couplings,
Bolts and Nuts, &c. &c.; Telephone Receivers; Magnets;
Flexible Tubes; Celluloid Vulcanite Rod, Sheet, and Mouldings;
Wire Leads; Cables; Silk, Cotton, and Celluloid Wire; Clock
Bells and Electric Bells complete; Lamps constructed; Gutta-
percha and India-rubber raw and manufactured Taping, fine
cut sheet Taping-cloth, &c. &c.; Carbons; Globes any shape;
Glass-blowing Work of the best foreign manufactures.

Eastern Gallery.

323.—J. & J. MACKIE & Co., Reading, Berks. Collection of
Mackie's patent Wrought Iron Spring Pulleys, "Electric" design,
specially constructed for driving Dynamo-Electric Machines
direct from the engine. Also Improved Shafting, Couplings,
Standards, Hangers, Plummer Blocks, Brackets, Belting, Lubrica-
tors, &c. (*See ADVT. p. 130.*) *Concert-Room Gallery.*

323A.—MASON & ELKINGTON, Pembrey, South Wales, Copper
Smelters and Makers of Electro-deposited Copper for Tele-
graphic Wire and other purposes. Products of Electro-Metallurgy
in all its branches; specimens of Rough Copper used in the
electrolytic refining process and of Refined Copper; specimens
of Pure Gold and Silver separated from rough copper by electro-
lytic process; specimens of Copper Tubes, Wire, Plates for Rolling,
&c., produced by electrolytic process. *Near High-Level Entrance.*

324.—J. ORME & Co., 65, Barbican, E.C. A Collection of Apparatus used in teaching the science of electricity; Burglar Alarms, Fire Alarms, &c., for use in manufactories and for domestic purposes. (See ADVT. p. 119.) *Western Gallery.*

325.—E. PATERSON, 76, Little Britain. Instantaneous Electric Gas Lighting Apparatus, as used for nearly 1,000 gas jets at the Grand Hotel, Trafalgar Square. (See ADVT. p. 119.)

South Nave and Southern Gallery.

326.—J. HURLY PRING, M.D., Enfield, Taunton. Specimens of Ornamental Engraving on Hardened Steel by means of Voltaic Electricity. A steel plate, sword blade, razor, or other object to be engraved is attached by means of a wire to one extremity of an electro-magnetic arrangement, whilst another wire coming from the other extremity serves the purpose of the graving tool. During the process, the electric scintillations produced by the combustion of the steel are very beautiful. Some of the specimens here shown were in the exhibition of 1851, where, however, they came into competition, and attracted attention only as objects of "the fine arts." As showing the advance now made in this application of the electric agency, a specimen is also introduced of printing by electricity, believed to be the earliest attempt of the kind. It is the work of Sir Joseph Banks, in the year 1802. A drawing, showing the apparatus here employed accompanies the specimens. *Eastern Gallery.*

327.—F. MURRAY ROGERS, 21, Finsbury Pavement, E.C. Rotating Table for mounting Microscopic Objects; Office Indicator for placing at street door; Stocks and Dies for small work.

Southern Gallery.

328.—JULIUS SAX, 108, Great Russell Street, Bloomsbury. Electric Tell-tale Clock for watchmen; Electric Water Gauge Apparatus for recording high and low water, by means of which the engineer at pumping station can tell the exact height of water in reservoir.

Eastern Gallery and South Nave.

329.—SCIENTIFIC TOY COMPANY, Sun Works, Kirkwood Road, Peckham. Boxes of electrical Novelties and Scientific Toys (prices from 1s. to 2s. 6d.) suitable for the instruction and amusement of youth: comprising, Electricity, Magnetism, Electro-plating, a Shocking Machine, Model Electric Lamp, Electric Telegraph, Electric Bells, and Moving Figures. (See ADVT. p. 139.) *Gallery at back of Concert Room.*

330.—ARTHUR SHIPPEY & Co., 13 and 14, King Street, Cheap-side. Electric Light Signal Balloons for saving life at sea, and for signalling communications between light-ships, light-houses, and the shore.

Concert-Room Gallery.

331.—C. E. SPAGNOLETTI, Great Western Railway, Paddington Station, London. Electric Fire Alarm. *South Nave.*

332.—F. VAN STAN, 9, Havelock Terrace, High Street, Peckham. An improved Cement for electricians, opticians, experimental chemists, &c., possessing the following advantages: Perfect insulation, extraordinary tenacity—resisting boiling water and dry heat—joining equally well the finest blown-glass flasks or tubes or heavy cylindrical machines, also ebonite and wood to

metals. The cement can be applied instantly, and can be supplied transparent or of any colour. *Concert Room Gallery.*

333.—J. STORER, Stamford Brook Villa, Goldhawk Road, Hammersmith. A Portable Electric Fountain, suitable for the dinner-table, drawing-room, &c.; it is complete in itself, and requires only a half-pint of water; will play for an unlimited time, and is not liable to get out of order. The design may be varied according to taste. Invented and patented by Joseph Storer, of Stamford Brook Villa, Goldhawk Road, Hammersmith.

Eastern Gallery.

334.—EVAN THOMAS, Cambrian Lamp Works, Aberdare. Case of Miners' Safety Lamps, comprising various patterns of patents, and including the following: Old Steel Mill, Davy's, Clanny's, Stephenson, Mueseter's, Grey's, Thomas's, &c., &c.; made to the most modern improvements, and fitted with Evan Thomas's patent glass ring, which admits of the expansion of the glass when heated, and thus prevents its breaking. *Eastern Gallery.*

335.—UNITED ASBESTOS COMPANY, LIMITED, 161, Queen Victoria Street. Samples of Articles manufactured from the crude Asbestos obtained from the Company's mines in Italy. Asbestos is a perfect non-conductor, and is invaluable for all purposes where power to resist heat produced by electric currents is a desideratum. It is shown here as a covering for dynamo floors, accumulators, armature and electric coils and caps, &c. &c. (See ADVT. p. 124.) *Eastern Gallery.*

336.—B. VERITY & SONS, 31, King Street, Covent Garden only. (See EDISON'S Exhibit.) The Chandeliers and other appliances constituting the exhibit of this firm are especially designed and registered for the Edison Incandescent Lamps. (See ADVT. p. 117.)

Concert Room and Entertainment Court.

337.—P. DE VILLIERS, M.D., 234, Marylebone Road, London. Articles prepared by the "Mirium" Process (patent): viz. Steel and iron made inoxidizable by impregnation with an inoxidizable alloy and finished by electric power: knives, table and dessert cutlery, carvers, dinner-service plates, swords, scabbards, revolvers, guns, rifles, electric appliances, various specimens of machinery impregnated by the "Mirium" process.

Gallery at back of Concert-Room.

337A.—MAGNUS VOLK, Telegraph Works, Ditchling Rise, Brighton. Collection of Parts used in connection with Submarine Mining, Electric Lamp-making, Telephony, Telegraphy, &c. &c. *Eastern Gallery.*

338.—JOSEPH WALLIS, 133 and 135, Euston Road. A Music Electrograph (patented). A new and very simple invention for recording, by means of telegraphy, selections of music played extempore or otherwise upon pianos, organs, or harmoniums. Specially valuable to composers, preserving as it does every note they may strike. *North Nave.*

339.—DAN WALTERS & SONS, 44, Newgate Street, E.C. Wire Insulating Machine (patented, 1881). Apparatus for covering copper wire with silk or cotton, for use in telephones and other electrical appliances. This machine covers so uniformly that

perfect insulation is obtained with the thinnest possible covering, the rate of production being more than double that of any process hitherto in use.

Gallery at back of Concert-Room.

339A.—BROWNE WOLSEY WEBB, 22, Harrington Square, N.W. Specimens of an Electrical Automatic Tell-Tale Till, for the prevention of fraud and mistakes by persons entrusted to take cash in retail businesses. Patented in Great Britain and abroad. It not only records and rings out each separate payment, but adds it to the former amount; it cannot be worked backwards or falsified. Will be constructed to suit any kind of business.

Southern Gallery.

340.—WEBSTER & WILLIAMS, 45, London Road, N.W. The Webster-Williams Patent Anerithmoscope. The Anerithmoscope (patented)—a magic-lantern for displaying pictorial or other advertisements, changing them automatically at short intervals by means of mechanism actuated by electricity. The instrument is constructed to act for a week without attention, illuminating and putting itself in action for a given number of hours each evening. Also applicable to theatrical transparencies and naval or military signalling.

Eastern Gallery.

341.—R. WEBSTER, F.R.A.S., 5, Queen Victoria Street, E.C. Non-magnetisable Watches, for the use of electric engineers and attendants on dynamo-electric machines, &c. These watches are totally uninfluenced by the proximity of magnets, however powerful. Manufactured by R. Webster, Chronometer Maker, 5, Queen Victoria Street, London, E.C.

Eastern Gallery.

342.—WILCOX & GIBBS, Regent Street, and Cheapside. Sewing Machines with Electric Attachment. *Eastern Gallery.*

343.—J. WILLING, 366, Gray's Inn Lane, W.C. Electricity adapted to Electric Signs, Name Plates, Trade Specialities, Electric Advertisements, Novelties, &c. &c. Novel and most attractive. Bright concave discs are suspended within the letters written upon a sheet of zinc, tacked to a strainer. This is suspended by hinges to a suitable frame, and allowed to move freely. Behind is an electro-magnate, with make and break apparatus, actuated by a single cell of a constant battery of the gravity kind requiring but little attention and working daily for 12 months without cleaning, the resultant pure copper, recouping a considerable portion of the cost of sulphate required for maintenance.

Various positions.

343A.—WILLING & Co., 366, Gray's Inn Road, W.C. Reflectors, Lamp Panels, &c., in enamelled iron, for Electric Light or Gas. Have the advantage of a pure white glazed surface; are clean and unbreakable. Incorrodible Iron Pans for Electric Batteries, Accumulators, &c. &c.; Stove Panels, Grate Fronts, Cones for Sunlights, Clock Dials, Gauges, &c.

South-East Gallery.

343B.—WITTY & WYATT, 9, Fenchurch Street, E.C. Asbestos Articles of every description. Being acid-proof, as well as fire-proof, they are specially adapted for insulators, &c. Samples of Asbestos fire and acid proof Articles manufactured by Exhibitors and by the H. W. John's Manufacturing Company, New York. (Sole European and Colonial Agents: Witty & Wyatt.) Frequent experiments.

Western Gallery.

344.—W. B. WOODBURY, Manor House, South Norwood. Electric Camera, for obtaining, by means of a captive balloon, photographic plans of towns, fortified places, movements of an enemy; also for use in Arctic or other exploring expeditions, comprising: (1) Camera, with arrangements for instantaneously exposing and changing the sensitive plates while at an altitude by means of the electric current passing through the cable; (2) Model of Balloon and Camera, showing attachments; (3) Model of Car to carry the necessary apparatus in the field.

Concert-Room Gallery.

345.—WOODHOUSE & RAWSON, 11, Queen Victoria Street. Ragosine Oil specially prepared for dynamo-electric machines.

Eastern Gallery.

Class XIV.—Generators, Steam, Gas, and Hydraulic Engines, &c., Applicable to Electric Industries.

346.—ANGLO-AMERICAN BRUSH LIGHT CORPORATION, Belvedere Road, Lambeth. The dynamo machines will generally be driven by steam engines supplied by Messrs. Robey & Co., of Lincoln. There will be also a Dynamo Machine driven by a Hodson's Patent Rotary Engine. (See ADVT. p. 122.) *In Building at North End.*

348.—CROSSLEY BROTHERS (Limited), Great Marlborough Street, Gloucester Street, Manchester; London, 24, Poultry, E.C.; 193, Sauchiehall Street, Glasgow. Sole English makers of the "Otto" silent gas-engine. One 16 horse-power nominal Patent "Otto" Silent Gas Engine, to indicate 40 horse-power, fitted with new patent electric light governor, varying the charges of gas to suit power required; Three 12 horse-power nominal Patent "Otto" Silent Gas Engines, to indicate 23 horse-power each, and fitted with new patent electric light governor, varying the charges of gas to suit power required; One 8 horse-power nominal Patent "Otto" Silent Gas Engine to indicate 14·7 horse-power, with new electric light governor, varying the charges of gas to suit the power required; One 3½ horse-power nominal Patent "Otto" Silent Gas Engine, to indicate 5·9 horse-power, with new electric light governor, varying the charges of gas to suit power required; One 2 horse-power nominal Patent "Otto" Silent Gas Engine, to indicate 3·96 horse-power, with new electric light governor, varying the charges to suit power required; One ½ horse-power nominal Patent "Otto" Silent Gas Engine, to indicate 2 horse-power, driving one Dynamo-Electric Machine attached, and incandescent lamps; One 3½ horse-power nominal Patent "Otto" Silent Gas Engine, with Dowson Gas Apparatus, burning 1½ lbs. Anthracite coal per horse-power per hour. (See ADVT. p. 134.) *West Corridor.*

348A.—DEAKIN, PARKER, & Co., Salford. One Sandon set of apparatus, consisting of Gas Engine, Generator, and Lamps.

West Corridor.

349.—DOWSON ECONOMIC GAS COMPANY, LIMITED, 3, Great Queen Street, Westminster. Half full-size model of apparatus producing 1,000 cubic feet gas per hour. This gas is suitable for

driving gas engines, and trials with this gas and some Otto engines have proved that 1 horse-power (indicated) is obtained with a consumption of gas derived from 1·4 pound of coal only. With this gas an Otto engine can be worked at a saving of over 50 per cent. compared with coal-gas at 3s. per 1,000 cubic feet, and when so worked a gas engine is cheaper than steam for motive-power.

Eastern Gallery.

350.—DURHAM & Co., 9, East India Chambers. Patent Duplex Velometer or Speed Governor, for keeping engines at uniform speed.

North Nave.

351.—ELECTRIC LIGHT AND POWER GENERATOR COMPANY, LIMITED. Offices: 47, Cannon Street, London, E.C. Works: 29, Bankside, S.E. Weston, Maxim, Rapieff, and Lontin Generators, Exciters, and Regulators; Ransomes, Head, and Jefferies' Steam Engine (20 horse-power), semi-portable. Several machines are driven by this one engine. (*See ADVT. p. 4 of Wrapper.*)

North End of Ground Floor.

352.—ELECTRIC LIGHT ENGINEERING COMPANY, 35, Queen Victoria Street, E.C. Combined Portable Steam-engine, combined with dynamo-electric machine.

Ground Floor.

353.—THE ELECTRIC LIGHTING SUPPLY COMPANY, 25, Queen Anne's Gate, Westminster, S.W. Hedges' Patent Belt-Frictional Driving Gear for dynamo machines. With this the strain on the spindle of the machine is equalised, and the tendency to heat avoided. Model showing action of same, and the belt tightening apparatus. Portable Electro-Lighting Tackle, fitted with Gramme Machine of 6,000 candle-power.

West Corridor.

354.—FAWCETT, PRESTON, & Co., Liverpool. The Fawcett Silent Gas Engine. This Engine imparts power at each revolution of the shaft, even under varying loads; a most important advantage when steady turning is required, as in the case of electric lighting, &c. Moreover, the amount of gas consumed at each revolution is regulated so as to vary in proportion to the work to be done, by which means the greatest possible economy of gas consumption is obtained. *Railway Corridor and West Corridor.*

354A.—R. HURRELL FROUDE, 8, Courtland Terrace, Kensington, W. Dynamometer for giving a prolonged trial to the horse-power of steam or other engines.

Near High Level Entrance.

355.—GALLOWAY & SONS, W. & J., Knott Mill Iron Works, Manchester. 180 horse-power engine; also the boiler, shafting, and steam-pipes for working the machinery of the Exhibition. A careful test of one of the "Galloway" engines was made by Mr. R. B. Longridge, the chief engineer of the Boiler Insurance and Steam Power Company, Limited, Manchester, at the Mills of Messrs. Henry Bazley & Co., Ancoats, Manchester. This engine had high-pressure cylinder, 18 in. bore, condensing cylinder, 30 in. bore, with a stroke of 3 ft., running at a speed of 65 revolutions per minute, and turning an average of 163 indicated horse-power; the result of two full days' work being a consumption of coal of 1·97 lb. per indicated horse-power per hour. A "Galloway" boiler, 24 ft. long by 7 ft. diameter, was used in the above test, also a Green's economiser. The economy would probably have been still greater had the engine

been turning, say, 250 horse-power, as, during the experiments, it was much under-loaded. The following are some of the advantages of the "Galloway" patent engine: (1) Direct passage between high and low pressure cylinder; (2) Independent exhaust valves; (3) All valves on the flat slide principle and of improved construction; (4) Instantaneous cut-off, controlled automatically by improved governor; (5) Simplicity of general arrangement and few working parts. The form of boiler used at the Crystal Palace was also supplied to the Philadelphia Exhibition of 1876, where it (also 12 others), was officially tested by the American authorities. The test was made under ordinary working conditions, the pressure being maintained at 70 lb. to the square inch; the result was that the "Galloway" boiler evaporated 11.72 lb. of water at 212° Fahrenheit per pound of combustible, which was the highest duty obtained from any of the boilers; and in addition to this the "Galloway" boiler was ascertained by careful calorimeter experiments to give the driest steam—a point of great importance in the working of steam-engines. The advantages claimed for the "1875" patent are: (1) Stronger back flue, owing to the tubes being brought close together at their lower ends; (2) All tubes interchangeable, thus ensuring mathematical exactness in putting together; (3) Avoiding all bevel flanges of the tubes, which have always been an objectionable feature; (4) Allowing more space for cleaning and examination of the under side of flue; (5) Introducing the contracting pockets at back end of the flue, thus relieving the end plates of strains caused by unequal expansion.

Avenue between Entertainment Court and Sheffield Court.

355A.—JOHN & HENRY GWYNNE, Hammersmith Iron Works, London. No. 1. "Invincible" Direct-Acting High-Speed Vertical Engine, coupled to spindle of and combined with one Siemens' D_2 Dynamo Electric Machine and one Siemens' $S D_8$ Machine; engine makes 700 revolutions per minute, provides 9 to 10 actual horse-power, the dynamo machines worked by it maintain one Siemens' arc lamp of 7,000 candle-power and five Siemens' arc lamps of 1,000 candle-power each. No. 2. "Invincible" Direct-Acting High-Speed Horizontal Engine, combined and coupled directly with one Siemens' W_2 Alternate Current Machine and one D_7 Exciter for same; engine makes 800 revolutions per minute, provides 10 to 12 actual horse-power, the dynamo machine worked by it maintains six Siemens' differential arc lights and 75 incandescent lamps. No. 3. "Invincible" Horizontal Engine, running 280 revolutions per minute, provided with special bearing to carry properly heavy fly-wheel, and driving by straps one Siemens' W_1 Alternate Current Machine and one D_7 Exciter for same; engine makes 280 revolutions per minute (but will run at about double the speed); W_7 machine makes 700 and D_7 Exciter 1000 revolutions per minute; actual horse-power provided; at 280 revolutions, 25; the Alternate Current Machine maintains 200 Swan incandescent lamps. No. 4. "Invincible" High-Speed Engine, similar in all respects to No. 3, but arranged vertically; drives one Siemens' W_1 Alternate Current Machine and one Siemens'

D₇ Exciter for same; revolutions—engine, 300 per minute; machine maintains 100 Swan incandescent lamps. *West Corridor.*

356.—THE HAMMOND ELECTRIC LIGHT AND POWER SUPPLY COMPANY, LIMITED, 110, Cannon Street, London. Fowler's 25 N.H.P. Compound Engine; Hornsby's 10 N.H.P. Double Cylinder Engine; Davey Paxman's 12 N.H.P. Engine; Fawcett Preston's 7 N.H.P. Gas Engine. (*See ADVT.*, p. 137.)

Railway Corridor leading to L. B. & S. C. R.

357.—G. HAWKES & Co., 9, Victoria Chambers, Westminster. Hodson's Patent Direct-acting Rotary Engine. *West Corridor.*

358.—E. S. HINDLEY, Bourton, Dorset. Steam Engines and Boilers, designed to drive electrical apparatus. *West Corridor.*

359.—RICHARD HODSON, Thames Iron Works, Blackwall. Patent High-Speed Direct-Acting Rotary Engine. These engines are exhibited driving dynamo machines direct at from 450 to 1,000 revolutions per minute. They are compact and simple in construction, and, as they work expansively, are most economical. They are recommended as specially suited for electrical purposes, on account of their extreme regularity, and wherever great speed is required they are invaluable. These Engines are in operation at West Corridor (Space 18); The "Brush" Co., North End; The British Electric Light Co. (Ground Floor East, Space 3); stand in North Nave; and Western Gallery (Spaces 9 and 10). Patentee's Agent, Mr. Norwood Earle, 80, Cannon Street, E.C. (*See ADVT.* p. 145.) *West Corridor.*

360.—R. HORNSBY & SONS, LIMITED, 84, Lombard Street. 10 horse-power Portable Engine. *Railway Corridor.*

361.—J. EVELYN LIARDET, 8, Breakspears Road, Wickham Park, Brockley. Vertical Spiral Wheels; Water Motors and Machinery utilising wasted power, giving rapid, regulated, and indicated velocity to work dynamos, to store electricity for lighting and signalling purposes on shore, lightships, and lighthouses; Double-acting Machinery, to give rapid, regulated, and indicated velocity to work dynamos, to store electricity for lighting and signalling purposes; Application of Machinery to railway and other carriages, to give rapid, regulated, and indicated velocity to work dynamos, to light signal, and afford motive power to railway and tram carriages. *West Corridor.*

361A.—MARSHALL, SONS, & COMPANY, LIMITED, Gainsborough, and 3, King Street, Cheapside, London, E.C., have the following Steam Engines employed at the Crystal Palace Exhibition, all of which are fitted with Patent Automatic Expansion Valve Gear, and are specially constructed to drive Electric Light Machinery: One 8 horse-power Compound Stationary Engine, and two 16 horse-power High Pressure Portable Engines, with The British Electric Light Company; one 10 horse-power Semi-portable Engine with The Compagnie Générale d'Electricité, and one each 8 and 12 horse-power Semi-portable Engines, with The National Electric Company. (*See ADVT.* p. 143.) *Ground Floor.*

362.—RICHARD MILLS, 90, Ramsden Road, Balham. Non-explosive Copper Steam Generator for Electric-dynamo Engines, Fire Engines, &c. *Railway Corridor (with W. R. Sykes).*

362A.—F. NELL, 26, Mark Lane. "Victor" Turbine (drawings), suitable for driving dynamo machines. (*See ADVT. p. 140.*)
Eastern Gallery.

363.—RANSOMES, HEAD, & JEFFERIES, Ipswich, and 9, Gracechurch Street, London. Semi-portable (20 horse-power) Engine, fitted with patent automatic governor expansion gear and all the latest improvements. This engine is similar to the engines on the Thames Embankment, in the South Kensington Museum, &c., and is employed at the Crystal Palace to drive the dynamo machines of the Electric Light and Power Generator Company, Limited. (*See ADVT. p. 116.*)
Ground Floor.

364.—ROBEY & Co., Globe Works, Lincoln. One 50 horse-power Patent Robey Electric Light Engine and Locomotive Boiler combined; one 30 horse-power ditto; one 25 horse-power ditto; one 20 horse-power ditto; one 20 horse-power ditto. These Engines are specially designed for providing economical steam power in a small space. The boiler is connected to the engine by being bolted to the cylinder only, and carried by rollers working in grooves at firebox end, thus relieving the boiler of all strain. The baseplate is formed at one end into an ashpit with damper doors, and is made suitable for receiving the firebox end of the boiler, the other end of which is carried by a crutch-shaped casting fixed over the cylinders. The end of the baseplate under the cylinders is formed into a feed-water heater tank, into which the cylinder cock discharges all condensed water, and into which a portion of the exhaust is so directed as to heat the feed-water to nearly boiling point before going into the boiler. The whole of the parts of both engine and boiler being included on one foundation or baseplate, heavy and expensive foundations are dispensed with, the weight of the boiler and its contained water acting as an extra weight to assist in keeping the whole machinery in rigid position. Each Engine is fitted with improved expansion gear, and patent equilibrium governors, whereby the greatest steadiness in working is secured. (Silver Medal: Paris Electric Light Exhibition.) The five Engines above described are employed in driving the Dynamo Machines of the Anglo-American Brush Electric Light Corporation in Class VIII., Nos. 194 and 195, in Alhambra Court. One 25 horse-power Patent Robey Electric Light Engine and Locomotive Boiler combined; one 25 horse-power ditto; one 25 horse-power ditto. These three Engines are similar in design to those above described, and they are employed in driving the Dynamo Machines of Professor T. A. Edison in the Crystal Palace. One 20 horse-power Patent Robey Electric Light Engine and Locomotive Boiler combined, similar in design to those above described, and is now employed in driving the Dynamo Machines of the Gerard Electric Light Co., in the Crystal Palace. (Silver Medal: Paris Electric Light Exhibition.)
North End.

364A.—ALFRED R. SENNETT, Kirby Street Engineering Works Hatton Garden, London, E.C. Transmission Dynamometer

(devised by Professors Ayrton and Perry) for measuring the power transmitted to electric generators or other machinery driven by belting, &c. ; Dynamometer Couplings for showing the power transmitted to electric generators or other machines when working direct from the shaft of the engine, or for measuring the power transmitted by lines of shafting, &c. ; Dynamometer Pullies for use upon the machine shaft. *North Nave.*

365.—THOMSON, STERNE, & Co., Limited (Managing Directors, L. Sterne and J. B. Handyside), the Crown Iron Works, Glasgow ; 10, Victoria Chambers, Westminster, London ; and 10, Rue Laffitte, Paris. Clerk's Patent Gas Engine. The engine possesses the distinctive feature of making an explosion at every revolution. The engine comprises two cylinders, one the working and the other the so-called "displacer" cylinder. The diameter of the former is 6 in., and the stroke is 12 in. ; the piston is connected to the crank in the ordinary manner, but the piston of the displacer cylinder, in which the pressure is very slight, never exceeding 4lb. to the square inch, is driven off a pin in one of the arms of a fly-wheel. The pin is at right angles to the crank, and in advance of it. When the piston in the displacer advances, a combustible mixture of gas and air is drawn in during the first half of the stroke, the admission valve is then closed, and air is admitted during the remainder of the stroke. On the return of the piston a valve is opened automatically, making a communication between the two cylinders. At this time the piston of the motor cylinder is at the outer end of its stroke, and an annular port opens, communicating with the exhaust. Through this opening the products of combustion from the last explosion pass, the pressure in the cylinder falls, and the cylinder is ready to receive its next charge from the displacer chamber. The first portion that enters the cylinder from the displacer is the pure air that passed in after its piston had reached the half-stroke, and the combustible mixture of gas and air had been cut off. This flows through the motor cylinder, scouring it out at each stroke, and escaping through the exhaust ports until the latter is closed by the piston on the return stroke. Meanwhile the explosive mixture has followed the pure air into the motor cylinder, and remains there, as the exhaust ports have now been closed. The piston, on its return stroke, compresses this mixture in a space at the end of the cylinder to about 45lb. pressure, when the charge is ignited, the pressure rising to some 250lb. per square inch, and driving forward the piston of the motor cylinder, when the exhaust ports are again opened, and the exploded gases escape, leaving the cylinder free for the next charge from the displacer. This series of operations takes place at every stroke. This engine can be worked up to its full available power without irregularity, and for electric lighting is specially adapted, and all other power where a steady power is absolutely necessary. *West Corridor.*

366.—TURNER GAS ENGINE COMPANY, St. Alban's Iron Works. 1 horse-power Patent Gas Engine, £65 ; $\frac{1}{2}$ horse-power Patent

Gas Engine, £50; 2-man Patent Gas Engine, £35; 1½-man Patent Gas Engine, £30. These engines work without making any objectionable noise, and are suitable for driving small dynamo machines, printing machines, pumps, chaff-cutters, saws, &c. 3 horse-power Turner's Patent Enclosed Steam Engine, for driving dynamo machines; 6 horse-power Turner's Patent Enclosed Steam Engine, Double Cylinder; 3 horse-power Turner's Patent Reversing Steam Engine, Single Cylinder. *West Corridor.*

367.—The Corrugated Iron Annexe for the Machinery in connection with the Lighting Arrangements of THE ANGLO-AMERICAN BRUSH COMPANY has been erected on the North Lawn by MR. J. CHARLTON HUMPHREYS, of Ludgate Hill (adjoining Ludgate Hill Station). (*See ADVT. p. 142.*)

Foreign Exhibitors.

Class I.—Static Electricity, Frictional Apparatus, etc.

368.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Leyden Jars and Condensers; Apparatus to show the ethric force. *Entertainment Court*

369.—J. ROBERT VOSS, Pallisaden-Strasse, 20, Berlin. Automatic Induction Electrical Machine. Silver Medal at the Paris Electric Exhibition. London Agent, F. E. Becker & Co., 34, Maiden Lane, W.C. (*See ENGLISH SECTION.*) *Concert-Room Gallery.*

Class II.—Batteries and Allied Apparatus.

370.—L. AMETTE, FILS, 145, Boulevard Voltaire, Paris. Accumulator on a new system. *West Corridor.*

371.—EDME BLOUZON, 30, Rue Notre Dame de Nazareth, Paris. Batteries and Allied Apparatus. *Eastern Gallery.*

372.—G. CHAPUIS, 17, Rue Lourmel, Grenelle, Paris. Primary and Secondary Batteries. *Eastern Gallery.*

373.—M. DAUDIGNY, 16, Place de la Chapelle, Paris. Accumulator, replenished by direct calorific action. *West Corridor.*

374.—DES RUELLLES & SERRE, 8 bis, Avenue Perrier, Paris. Dry Batteries of all sorts and forms; Secondary Batteries, dry and portable. *Western Gallery.*

375.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Chalk Battery; Gravity Battery. *Entertainment Court.*

375A.—THE ELECTRO-DYNAMIC COMPANY OF PHILADELPHIA. Automatic Batteries for use with sewing machine motors. Offices: 8A, Bush Lane, Cannon Street, E.C. *Eastern Gallery.*

376.—CHARLES R. GOODWIN, 166, Quai Jemmapes, Paris. Leclanché and other Batteries—plain, plated, or coppered, by a new process. Medal at Electrical Exhibition, Paris. *Eastern Gallery.*

377.—C. MOURLON ET CIE., 61, Rue de Ruysbreeck, Bruxelles. Batteries on the Leclanché system. Gold Medal at the Brussels Exhibition, 1880. Bronze Medal at the International Exhibition Paris, 1881. *Eastern Gallery.*

378.—GREGORY SKRIVANOFF, 32, Rue Vignon, Paris. Skrivanoff's New Electric Dry Battery, capable of every kind of use. This new battery requires no care. It is applicable to military telegraphy, to telephones, to railway signals, to domestic uses, &c. *South Nave.*

379.—LÉON SOMZÉE, 217, Rue Royale, Brussels, Belgium. 1. Voltaic Pile of great intensity and of very small size, principally employed where a constant current and long working are required. 2. Secondary Electric or Galvanic Batteries and Regulator for the distribution of the energy accumulated. These secondary batteries contain more energy than those of Faure or Planté; they are composed of divided material, such as metallic grains for the positive electrode and small charcoal or charcoal dust for the negative electrode; both being mixed with oxide of lead. Chemical reaction is the same as in Faure batteries, only our system gives more energy per weight of material. Another battery is composed of a special form of electrode, they being both of lead; but our surface is far greater than those of the now known system, and less in weight. The system is completed by the use of a new condensor, by means of which the distribution, by tension or quantities, is easily obtained, and by which one or more batteries may be set in action or out of action, without interfering with the energy needed. *Southern Gallery.*

Class III.

Magneto-Electric and Dynamo-Electric Machines.

380.—M. A. CANCE, 11, Rue St. Florentin, Paris. Dynamo-Electro Machines, with continuous or alternative currents; constructed with Cance's electro-magnetic bobbins. *West Corridor.*

381.—CHARLES DION, Hotel Burgundy, 8, Rue Dauphot, Paris. Two new Magnetic Bobbins, made of a straight strip of metal turned on its edge into a circular or elliptic helix, so as to be instantly applied upon any kind of revolving armature or round or more or less elongated core. *Eastern Gallery.*

382.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Steam Dynamo; Dynamo Machine, made on a new principle; small Dynamo Machine. *Ground Floor.*

383.—A. GÉRARD, Paris. (See LORRAIN, in ENGLISH SECTION.)

384.—MESSRS. GRAVIER, KUKSZ, LUEDTKE, ET GRETHER, 25, Rue Leszno, Varsovie, Russie. A set of eight Dynamo-electric machines, each of 4-horse power. Two distributors with double commutators, each of 32 directions. *West Corridor.*

385.—WHITE HOUSE MILLS, Hoosac, New York. Agents, Jas. S. Mackie & Sons, 194, Broadway, New York. Arago Disc Dynamo, for electric lighting, electro-plating, and telegraphy. *West Corridor.*

Class IV.—Cables, Wires, Lightning Conductors, and allied Apparatus.

386.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Specimens of Street Pipes and Service Boxes used in the Edison underground system of conductors; System of House Conductors with devices for preventing abnormal increase of energy in house circuits. *Entertainment Court.*

387.—E. PERRODY, 3, Rue Chaponnière, Geneva, Switzerland, Subterranean Electric Line for Railways, forming only one with the metallic sleeper of E. Perrody's system. The same line can be placed independently of the railway, and can be applied anywhere else. *Eastern Gallery.*

Class V.—Apparatus for Measuring Electricity.

388.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Apparatus for measuring the resistance of the lamps; Apparatus for measuring the energy consumed in the lamps; Rheostat for restoring currents; Thermogalvanometer; Carbon Rheostat; Dynamometer; Photometer; Carbon Regulator; Weber Meter; Current Regulators; Circuit Breakers for controlling electric light circuits. *Entertainment Court.*

389.—MESSRS. GRAVIER, KUKSZ, LUEDTKE, ET GRETHER, Rue Leszno, Varsovie, Russie. Galvanometers, as applied to their new dynamo machines. *West Corridor.*

Class VI.—Telegraphs, Signals and allied Apparatus.

390.—VICTOR BARTELOUS, 1, Rue du Persil, Brussels. An Automatic Transmitter of Signals in case of fogs, &c. &c. *Western Gallery.*

391.—D. COHN, 34, Rue du Sentier, Paris. Electric Bells, with a lighting application. *Eastern Gallery.*

392.—G. CUMMING, 303, East 19th Street, New York. Periphery Contact Telegraph Key. Exhibited with Professor Edison's exhibits. *Entertainment Court.*

393.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Carbon Relay; Motograph Relay; Pressure Relay; Expansion Relay; Private Line Instrument; Gold and Stock Reporting Instrument; 2 Systems of Domestic Signalling Telegraph; Quadruplex Telegraph; 2 Systems of Duplex Telegraph; Telegraph System in Morse characters; Roman character Automatic Telegraph. *Entertainment Court.*

394.—SALVATORE GARAU, Dr., Samassi, Sardinia. 4 Models of Railway Carriages with a new alarm apparatus. *Eastern Gallery.*

395.—M. J. GRAS, 41, Rue Bellechasse, Paris. Military Speaking Signals, with instantaneous changes of communication, effected by either continuous or intermittent currents, variations in resistance, permanent calls, constant controllers of the wire, &c. *Eastern Gallery.*

396.—C. MILCHSACK & Co., Gladbach, Rhenish Prussia. London Agent, Max Sabel, 2, Coleman Street Buildings, Moorgate Street, E.C. (a) Rolls of Telegraph Tape for Wheatstone machine, rapid writer; for Sir W. Thomson's recording machine, submarine cable; for Cowper's telegraph writer; for the Morse, Hughes, and Meyer Systems &c. &c.; for automatic machines. (b) Rolls of Ribbon-paper, or winding-tapes. (c) Rolls of Tape for railway metals testing machines, train velocity gauges, and all other technical purposes, according to instructions. *Concert-Room Gallery.*

397.—ROOS & OSTROGOVICH, Chez l'Officina Galileo, Florence. Italy. Various Telegraphic Apparatus (new system). Automatic Telegraphic Apparatus with alphabetic characters, with multiple alphabets and manipulation. 25,000 to 40,000 signals (letters, figures, or spaces) or more in an hour, without reducing the duration of the current of the line, while remaining the same as in the Hughes apparatus. *North Nave.*

398.—GREGORY SKRIVANOFF, 32, Rue Vignon, Paris. Morse Apparatus working by means of a Skrivanoff battery, field model; various Railway Signals; Electric Table Bell; Signal Calls for hotels, apartments, carriages, cars, &c. *South Nave.*

399.—WESTERN ELECTRIC COMPANY, New York, Chicago, Boston, and Indianapolis, U.S.A. No. 2, Phelps's Relay; No. 3, Box Relay and Key; No. 1, Legless Lewis Key; No. 1, Sounder; No. 2, Sounder; Patent Pocket Relay; Private Line Instrument; Milliken's Repeater Sounder; Quadruplex Compound Polarised Relay; Patent Cut-out, with lightning arrester and ground-switch; Plug Cut-out; Peg Switch board; Various apparatus: *With L. Clark, Muirhead & Co. Between Chinese and Sheffield Courts.*

400.—WHITE HOUSE MILLS, Hoosac, New York. Agents, Jas. S. Mackie & Son, 194, Broadway, New York. Arago Disc Dynamo, for telegraphic systems. *West Corridor.*

Class VII.

Telephones, Microphones, and Photophones.

401.—VICTOR BARTELOUS, 1, Rue du Persil, Brussels. Automatic Commutator for telephonic purposes. *Western Gallery.*

402.—CONNOLLY BROTHERS & McTIGHE, Palais de l'Industrie, Paris. Automatic Telephone Exchange, for enabling the subscribers or members of a telephonic exchange to inter-communicate without the aid of call-boys or attendants at the central office.

Tropical End, in front of Byzantine Court.

403.—A. E. DOLBEAR and H. E. BUCK, 70, Washington Street, Boston. Electro-Telephonic Apparatus, Transmitters, and Receivers; also Telephonic Attachment for Relay and Sounder. Rotaphone. *Western Gallery and Trop. Dept.*

404.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Carbon Telephone; Electro Motograph; Combination Musical Telephonograph; Telephone Repeater; Microtasimeter; Odeoscope; numerous Apparatus for demonstrating the method of varying the resistance of a closed circuit by contact with

carbon, illustrative of the experimental phases of the Edison carbon transmitter. *Entertainment Court.*

405.—LÉON DE LOCHT LABYE, 49, Mont St. Martin, Liège Belgium. Pantelephonic Posts and Telephonic Alarms, invented by M. Léon de Locht Labye, Liège. Telephonic correspondence will be carried on between two points established in the Crystal Palace. The Léon de Locht Labye (silver medal at the Paris Exhibition) is at once the most simple, the most sensitive, and most regular telephonic word-transmitter known. It has been adopted by the Government of the Argentine Republic, and at Buenos Ayres is used by 600 subscribers. This apparatus suits all situations, allowing of conversation in loud or low voice, without the necessity of approaching near the instrument to speak. Telephonic auditions have a marvellous effect when applied to concert-rooms, theatres, or elsewhere. *St. Nave & Pompein House.*

406.—C. F. RACAGNI, Verona, Italy, and E. A. GUGLIELMINI, Paris. Practical Application of the Telephone to every kind of Telegraphy. Telegraph Telephone applicable to armies in the field, to the navy, to railways, to mines, &c. *Southern Gallery.*

407.—SCHWEIZERISCHE TELEPHON GESELLSCHAFT, 7, Bären Gasse, Zurich, Switzerland. Telephone Stations, shown working.

Western Gallery and Concert-Room Gallery.

408.—GREGORY SKRIVANOFF, 32, Rue Vignon, Paris. Telephonic Station, with battery enclosed at the base of the instrument, avoiding the use of batteries encumbered with liquid, and requiring constant attention. *South Nave.*

409.—WESTERN ELECTRIC COMPANY, New York, Chicago, Boston, and Indianapolis, U.S.A. Telephones: Blake Transmitters and Bell Hand Telephones. Telephonic Calling Apparatus: Magneto-Electric Generators, for hand, foot, or other power; and Polarised Bells, in combination and separate, worked by same; also Push Button Magneto-Electric Calls, with Polarised Bells, worked either by magneto or battery currents. Central Office Apparatus: Switch Boards of various forms; Duplicate, Williams' Plug Switch, Gilliland, and Slide Switch, with Lightning Arrester, Calling Apparatus, &c. Subscribers Telephonic Sets—Combinations of Calling Apparatus, Telephones and Batteries, with and without desks. Telephonic Apparatus for private lines: Sets for use where two or more stations are connected by a single line; also Central Office Set for private exchange system; Switch Board on Duplicate System, suitable for offices with 500 lines and upwards; Pole Changers, for use at exchange offices, for ringing any description of bells. *With L. Clark, Muirhead & Co.*

Between Sheffield and Chinese Courts.

Class VIII.—Electric Lighting.

410.—CLINTON M. BALL, Troy, New York, U.S.A. Arc Lamp System. *Picture Gallery.*

411.—EDMÉ BLOUZON, 30, Rue Notre Dame de Nazareth, Paris. Carbons for electric light. *Eastern Gallery.*

412.—M. A. CANCE, 11, Rue St. Florentin, Paris. Regulator Lamp, with fixed luminous point, on the Cance system.

West Corridor.

413.—CHERTEMPS, Paris. New Electric Light Regulator.

Western Gallery.

414.—M. DAUDIGNY, 16, Place de la Chapelle, Paris. Electric Lighter, working by a single wire; Model employed by the Jablochhoff, Janin, &c., Companies; worked notably in the lighting of the Place de la Bastille, and the Halles Centrales. Electric Uniform Subdiviser, for the uniform division of the light from generators of large size.

West Corridor.

415.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Incandescent Lamps; Process in the manufacture of Lamps; Various Designs of Electric Light Chandeliers.

Concert-Room, Entertainment Court, & Industrial Avenue.

416.—A. GÉRARD, Paris. (See LORRAIN, in BRITISH SECTION.)

417.—CHARLES R. GOODWIN, 166, Quai Jemmapes, Paris. Carbons for Electric Lights.

Eastern Gallery.

418.—MESSRS. GRAVIER, KUKSZ, LUEDTKE, ET GRETHER, 25, Rue Leszno, Varsovie, Russie. Various Arc Lamps, for use in the distribution of electricity. System Gravier.

West Corridor.

419.—MIGNON ET ROUART, 137, Boulevard Voltaire, Paris. "Gauduin" Carbons for electric light; ordinary Carbons of every size and form, hollow or solid; Enamelled Carbons, lasting 35 to 40 per cent. longer than ordinary carbons. (English Agent, W. B. Davis, 105, Leadenhall Street, E.C.)

West Corridor.

420.—SIEMENS FRÈRES, Paris. (See SIEMENS BROTHERS, in BRITISH SECTION.)

South End of Palace.

421.—LÉON SOMZÉE, Ingénieur, 217, Rue Royale, Brussels. Automatic and Regulating Electric Lamps. Six models of these lamps. The principle of this invention consists chiefly in constructing electric lamps made luminous by incandescence, as well as by the voltaic arc; by means of continuous or alternating currents which produce the incandescence of a thin rod (preferably of carbon) and a voltaic arc at the circumference of a rod of refractory material, which may be fixed or movable on the second electrode of large section. One model showing inventions and improvements in electric lighting and apparatus therefor. The improvements consist in illuminating a flame of gas by passing therein and thereby an electric current, so that the passage of the current in the flame excites and transforms into luminous vibrations certain undulations of the gas-flame. The invention consists in the use of materials, relatively slight conductors of electricity, in a finely divided state, such as powdered coal and magnetizable metals, or carbon and combustible gases (simple or compound), or steam or liquids in a globular form. Also in the double mode of feeding the lamp.

Southern Gallery.

422.—WHITE HOUSE MILLS, Hoosac, New York. Agents, Jas. S. Mackie & Son, 194, Broadway, New York. Arc Lamps, Ball's system.

Picture Gallery and West Corridor.

*Class IX.***Electric Motor Power and Transmission of Energy.**

423.—L. AMETTE, 145, Boulevard Voltaire, Paris. Electro-motor applied to a wood-cutting machine. *West Corridor.*

424.—A. CANCE, 11, Rue St. Florentin, Paris. Electric Motors on the Cance system. *West Corridor.*

425.—M. DAUDIGNY, 16, Place de la Chapelle, Paris. Circular Selenoid Motor; Dandigny's Railway Wheel, worked by electricity; Carriages constructed on this mode of working. *West Corridor.*

426.—DES RUELLES ET SERRE, 8 bis, Avenue Perrier, Paris. Small Electric Motors. *Western Gallery.*

427.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Electric Pen and Press for copying; Motograph Bells; Magnetic Motograph. *Entertainment Court.*

427A.—THE ELECTRO-DYNAMIC COMPANY OF PHILADELPHIA. Double Induction Motors for sewing machines, lathes, fans, saws, &c. Offices: 8A, Bush Lane, Cannon Street, E.C. *Eastern Gallery.*

428.—CHERMONT RODRIGUEZ, Belgium. Electric Machine, working directly with the battery and giving motion to a Sewing Machine. *Gallery.*

429.—MESSRS. GRAVIER, KUKSZ, LUEDTKE, ET GRETHER, 25, Rue Leszno, Varsovie, Russie. A variety of Electro Motors for use in the distribution of electricity. *West Corridor.*

Class X.—Electro-Medical Apparatus.

430.—DR. B. BARDA, 49, Rue Blanche, Paris. Electrical Bath Apparatus. By means of this apparatus a constant current, or an induction current, is applied to or focussed upon any part of the body, through the water in the bath, with such force as may be required, whilst avoiding the usual shocks and unpleasant sensation. From numerous experiments made by the faculty, electric baths are chiefly effectual in cases of rheumatism, gout, paralysis, and neuralgia. *Western Gallery.*

431.—GREGORY SKRIVANOFF, 32, Rue Vignon, Paris. Medical Case, $4\frac{1}{2}$ inches \times 3 inches \times $\frac{3}{4}$ inches, enclosing an induction bobbin, battery, and accessories. *South Nave.*

Class XI.—Electro-Chemistry.

432.—EDMÉ BLOUZON, 30, Rue Notre Dame de Nazareth, Paris. Natural and Prepared Graphite. *Eastern Gallery.*

433.—S. COHEN, 14, Rue Cloche Perce, Paris. Electro-plating for optical instruments. *Eastern Gallery.*

434.—PROF. T. A. EDISON, care of E. H. Johnson, Esq., 57, Holborn Viaduct. Meters; Weber Meter; Specimen of Bamboo and other carbonised materials; Mirror Regulator. *Entertainment Court.*

435.—GRENET FRÈRES, 114, Rue du Temple, Paris. Plating machine working by electricity. Nickel Baths, &c. *West Corridor.*

436.—NEUJEAN & DELAITE, 52, Rue Hors Château, Liege. Apparatus and Chemical products for galvanoplasty, gilding, &c. *Gallery at back of Concert Room.*

Class XII.—Magnets, Compasses, Horology, Instruments of Precision, &c.

437.—AUTOMATIC TIME REGISTER AND ALARM COMPANY, Boston, Mass., U.S.A.—Electric Tell-Tale Clock for detecting irregularity in the service of watchmen, with Fire Alarm.

Between China and Sheffield Courts.

437A.—A. BARDILLON, 185, Rue d'Aléna, Paris. Instrument serving to indicate, in public carriage, whether empty or full.

Gallery at Back of Concert-Room.

438.—BUSS, SOMBART, & Co., Magdeburg, Germany. Patent Tachometers (Speed-Indicators), 500 in use; Patent Cosine Governor, the only perfect centrifugal governor in the market.

Eastern Gallery.

439.—T. B. DE HENNAULTS ET FILS, Fontaine l'Evêque, près Charleroi, Belgium. Compasses of great simplicity and precision, having the property of always keeping horizontal, shortening considerably the labour of mining engineers. Largely employed in mining operations in Belgium and France. *Concert-Room Gallery.*

440.—J. ROTH, SCHLAEFLI, & Co., 35, Queen Victoria Street. Electric Clocks. (See ADVT. p. 148.) *Southern Gallery.*

Class XIII.—Miscellaneous.

441.—EDME BLOUZON, 30, Rue Notre Dame de Nazareth, Paris. Oil for engines.

442.—A. CANCE, 11, Rue St. Florentin, Paris. Electro-Magnetic Bobbins, of special construction on the Cance system. *West Corridor.*

443.—G. CHAPUIS, 17, Rue Lourmel, Grenelle, Paris. Electric Flood Indicator; Electric Alarm Taps; Electric Fly Killer.

Eastern Gallery.

444.—D. COHN, 34, Rue du Sentier, Paris. Electric Lighters; the Gay-Lussac Lighters; Electric Bells, with lighting attachment. *Eastern Gallery.*

445.—DESRUILLLES & SERRE, 8 bis, Avenue Perrier, Paris. Electric Lighters for gas, for use in private mansions, &c. &c.; Automatic Lighters for distances; Apparatus indicating escape of gas; Electric Scent Consumers. *Western Gallery.*

446.—ALPH. FREMOND, 5, Avenue Rapp, Paris. Egg-hatching Machines and Artificial Mothers, warmed and regulated by electricity; Automatic Regulator, for hatching machines warmed by water or by thermo-syphon; Electric Alarms; Electric Testers for Eggs; Artificial Feeders; Electric Apparatus of various kinds for poultry yards. *Eastern Gallery.*

447.—MESSRS. GRAVIER, KUKSZ, LUEDTKE, ET GRETHNER, 25, Rue Leseno, Varsovie, Russie. A Memoir on the divisibility of electricity for private houses and all kinds of industrial applications, by A. Gravier. *West Corridor.*

448.—LOUIS POYER, 5, Rue de Provence, Paris. Proofs of wood engravings representing electric apparatus, and various scientific and industrial apparatus. *Western Gallery.*

449.—PROFESSOR DENIS MONNIER, University, Geneva, Switzerland. The Automatic Methanometer, or, Automatic Analyser of Firedamp, by Denis Monnier, Professor of Chemistry at the University of Geneva, is not only a detector of firedamp, but an instrument which analyses, at a great distance, automatically and quantitatively, the hydrogen at the carburets of that metalloid. The Methanometer consists of two distinct portions: (1) The Analyser; (2) The Receiver. The Analysers are placed in the galleries of mines, the Receivers outside in a central office, under the eye of the engineer. Each Analyser transmits every hour to the Receiver the proportions of firedamp, between 1 and 9 per cent., contained in the air of the locality where it is placed. The proportion 9 per cent. is that which determines the explosion. It is at the central office that the instrument becomes an alarm-signal; for the engineer himself places on the receiver the contacts which will set going a continuous alarm, as soon as the gaseous compound shall have attained the proportion beyond which it must not pass. He will give the necessary instructions, and the apparatus will allow to be watched at a distance the effect of the ventilation directed on the threatened spot. *South Nave.*

450.—NAUDIN & SCHNEIDER, Montreuil-sous-Bois, France. Purification of Alcohol by Electricity. *Eastern Gallery.*

451.—LÉON POULTIER, 267, Rue du Faubourg St. Martin, Paris. Drawings representing Electric Machinery for putting on the breaks. This apparatus has been found useful (1) for stopping trains as safely and as swiftly as possible; (2) for deadening the jolting and shaking of ordinary carriages. The inventor has a wood apparatus used by him in studying his system.

Eastern Gallery.

452.—LÉON RAGEOT, 26, Rue Notre Dame de Nazareth, Paris. An Apparatus for quadrupling any kind of light fixed in its centre, and for softening the intensity of electric light. *Southern Gallery.*

453.—JOSEPH SAUVAJON, Tournon, Ardèche, France. A Design showing an Automatic Apparatus to prevent railway collisions; another Diagram, an Automatic Alarm, showing the rise of water in the event of floods.

Eastern Gallery.

454.—EDWARD W. SERRELL, JUN., C.E., of New York, U.S. Automatic Silk-reeling Machine. This machine reels the silk from the cocoon. It is driven by any suitable power, but its automatic action is regulated and controlled by means of a current of electricity. It is the first successful machine of its kind, and bears the same relation to the silk manufacture that spinning machinery does to that of cotton. Seregraph or Silk-testing Machine. This is a machine, driven by electricity, which has recently been invented for testing the regularity and other qualities of silk threads. By passing a thread through it at the rate of about a mile in eight minutes, the thread itself writes upon a band of paper all its excellences and defects in such a way that they are clearly indicated and made known. Inventions of Edward Serrell, jun., C.E.

West Corridor.

455.—GREGORY SKRIVANOFF, 32, Rue Vignon, Paris. Indicators for Hotels, with accessories allowing of an economy of 50 per cent. in wires and fixing; various motors for toys. *South Nave.*

456.—LÉON SOMZÉE, 217, Rue Royale, Brussels. Apparatus for indicating the presence of firedamp. 1. The application to ordinary mining lamps for mining purposes of two metallic plates, bands, or wires of different capacity of dilatation, rendered susceptible to slight variations of temperature, placed in connection with an electric current, which shall at a certain temperature give alarm by ringing a bell. One band may be steel and the other zinc, united by a soldering of tin. If firedamp is present in the air feeding the lamp it produces an excess of heat in its interior: the metallic plates expand and close the electric current. 2. The use of glass-tubes subjected to heat, in connection with a thermo-electric pile indicating the difference of heat between the two tubes, one of which is filled with air from the outside of the mine and the other with the air of the mine. 3. An electro-chemical mode of detection by the use of the electric light in combination with chlorine, causing by explosive action the vibration of the membranes of one or more telephones. 4. The use of sonorous tubes of certain lengths, placed over a flame produced by the combustion of pure air, and which tubes give normally no sound; but as soon as firedamp is present the flame grows longer, the tubes are subject to heat, and then give forth sounds by causing a vibrating tongue, within the tube, to expand, and so produce certain notes and thus give alarm. 5. The application to lamps for mining purposes of a little tube filled with pieces of coal compressed therein, the extremities of the tube mounted in metal. The coal is compressed in the tube by a screw and the tube's metallic extremities are in connection with the wires of a galvanometer. If firedamp is present in the air feeding the lamp, it produces an excess of heat in the interior; the coal in the tube absorbs this excess heat and becomes less conducting. This thermoscope, placed in connection with an electric current, will then indicate the composition of the air in the mine. 6. Improvements consisting of a glass vessel, containing mercury covered with a partition of porous earth, having in the middle a central tube communicating with the mercury in the vessel. The pressure of air being equal in the tube and vessel, the mercury lies at the same level in both; but when firedamp is in the air it penetrates through the porous partition and presses on the surface of the mercury, the level of which is raised in the tube, where it touches a platinum-wire in contact with an electric current and rings an alarm. *Southern Gallery.*

457.—GEORGE VIAN, 53, Rue de Chateaudun, Paris; London Representatives, Castel & Latta, 3, Lombard Court, E.C. Electric Machine, specially constructed for exploding dynamite from a distance in mining and subaqueous works. Fac-simile of Dynamite Cartridges, Detonators, &c., suitable to be used in connection with the above. *Western Gallery.*

ALPHABETICAL CATALOGUE OF EXHIBITORS.

HER MAJESTY'S GOVERNMENT (Postal Telegraph Department) p. 11 North Nave.
 " " " (War Office) p. 26 North Nave.
 " " " (The Lords of the Admiralty) p. 30, XII. North Nave.

Names.	Page.	Class.	Place of Exhibit.
Amette, L.	93, 99	II., IX.	West Corridor.
André, G. G.	64	VIII.	Terrace, Technological Museum, part of North Nave, Renaissance & Greek Courts.
Andris, Ormes, & Eldred ...	55, 60	V., VII.	Eastern Gallery.
Anglo-American Brush Light Corporation	34, 64, 87	III., VIII., XIV.	Tropical Department and North Lawns.
Anglo-American Telegraph Co. ...	38	IV.	Western Gallery.
Apps, A.	31, 45, 48, 70, 71, 74, 79	I., II., V., VI., IX., X., XI., XIII.	North Nave.
Arnold & Sons	71	X.	Western Gallery.
Asbestos Company, United, Lmt'd. ...	44, 86	IV., XIII.	Eastern Gallery.
Ashworth Brothers	71	X.	Western Gallery.
Automatic Telegraph Company ...	48	VI.	South Nave.
Automatic Time Register and Alarm Company	100	XII.	Between Chinese and Sheffield Courts.
Baker, R., & Co.	80	XIII.	Western Gallery.
Ball, Clinton M.	97	VIII.	Picture Gallery.
Barraclough, T.	80	XIII.	Eastern Gallery.
Bapty, F.	71	X.	Western Gallery.
Bartelous, V.	95, 96	VI., VII.	Western Gallery.
Barda, Dr.	99	X.	Western Gallery.
Bardillon, A.	100	XII.	Concert-Room Gallery.
Beanham, W.	38	IV.	Concert-Room Gallery.
Becker, F. E., & Co.	31	I.	Concert-Room Gallery.
Bennett, Sir John	76	XII.	North Nave and Centre Transept.
Bernard, E. Barber	49	VI.	Western Gallery.
Binko & Co.	31, 34, 49, 64, 80	II., III., VI., VIII., XIII.	West Corridor.
Blackwell, G. G.	32, 49, 64, 80	II., VI., VIII.	Southern Gallery.
Blakey, Emmott, & Co.	31, 34, 45, 49, 60, 71, 80	I., II., III., V., VI., VII., X., XIII.	Western Gallery and North Nave.
Blouzon, Edmé	93, 97, 99, 100	II., VIII., XI., XIII.	Eastern Gallery.
Borrell, L. H.	76	XII.	Eastern Gallery.
Bourne, J., & Sons	32	II.	Eastern Gallery.
Brailsford, T. R.	80	XIII.	Eastern Gallery.
Britannia Rubber Company	38	IV.	Eastern Gallery.
British and Irish Telephone and Electric Works Company ...	51, 60	VI., VII.	North Nave.
British Electric Light Company ...	35, 64	III., VIII.	Italian and Egyptian Courts, part of North Nave, and Ground Floor.
Bright, E. B.	49, 64, 70, 80	VI., VIII., IX., XIII.	North Nave and various parts of Building.
Brookie. (See British Electric Light Company)			
Broughton Copper Company ...	74	XI.	Eastern Gallery.
Brush Light Corporation, Anglo-American	34, 64, 87	III., VIII., XIV.	Tropical Department &c.
Bull, F. C.	76	XII.	Eastern Gallery.
Burgin (See Crompton)			
Buss, Sombart, & Co.	100	XII.	Eastern Gallery.

Names.	Page.	Class.	Places of Exhibit.
Cance, A.	94, 98, 99, 100	III., VIII., IX., XIII.	West Corridor.
Chertemps	98	VIII.	Western Gallery.
Cassell, Petter, & Galpin	74	XI.	Eastern Gallery.
Chapuis, G.	93, 100	II., XIII.	Eastern Gallery.
Chubb & Son	80	XIII.	West Corridor.
Clark, Muirhead, & Co.	32, 38, 45, 50, 72, 75, 76, 80...	II., IV., V., VI., X., XI., XII., XIII.	Between Sheffield and Chinese Courts.
Coad, T.	32	II.	Concert-Room Gallery.
Cobbett, W. Willson	80	XIII.	Concert-Room Gallery.
Cohn, D.	95, 100	VI., XIII.	Eastern Gallery.
Collis, J., & Co.	81	XIII.	Western Gallery.
Compagnie Générale d'Électricité (Jablochkoff)	35, 65	III., VIII.	Opera Theatre, South Nave, Eastern Gallery, & Ground Floor.
Connolly Brothers & W. Tighe	96	VII.	Tropical Department.
Consolidated Telephone Construction & Maintenance Co.	60	VII.	South Nave & Southern Gallery.
Country Mansions Portable and Economical Electric Light Co.	65	VIII.	Western Gallery.
Cox, Pope, F. W.	51, 60	VI., VII.	Eastern Gallery.
Cohen, S.	99	XI.	Eastern Gallery.
Cook, H. Whiteside	81	XIII.	Avenue between Pompeian House and Chinese Court.
Coxeter & Sons, J.	72	X.	Western Gallery.
Crampton, T., & Co.	31, 32, 46, 70, 77...	I., II., V., IX., XII....	Southern Gallery.
Crompton, R. E.	35, 65	III., VIII.	Centre Transept, Chinese Court, and West Corridor.
Crossley Brothers	87	XIV.	West Corridor.
Cumming, G.	95	VI.	Entertainment Court & West Corridor.
Cutting, R. C., & Co.	38, 51, 60	IV., VI., VII....	Eastern Gallery.
Dale, H. J.	31, 32, 51, 81	I., II., VI., XIII.	Eastern Gallery.
Darlington, J.	81	XIII.	Eastern Gallery.
Daudigny, M.	93, 98, 99	II., VIII., IX....	West Corridor.
Darlow & Co.	72	X.	Western Gallery.
Davis, J., & Co.	38, 51, 61	IV., VI., VII....	Western Gallery.
Davis, Joseph, & Co.	72, 77	X., XII.	Eastern Gallery.
Davis, J., & Son... ..	38, 77	IV., XII.	Concert-Room Gallery.
Davis & Timmins	81	XIII.	Southern Gallery.
Deakin, Parker, & Co.	87	XIV.	West Corridor.
Dent, E. & Co.	77	XII.	Western Gallery & various parts of Building.
Desruelles & Serre	93, 99, 100	II., IX., XIII.	Western Gallery.
Dion, Charles	94	III.	Eastern Gallery.
Direct United States Cable Co.	38	IV.	Southern Gallery.
Dolbear & Buck... ..	96	VII.	Tropical Department.
Domestic Electric Lighting Co.	65	VIII.	Victoria Cross Gallery.
Doulton & Co.	32, 39, 51	II., IV., VI.	Eastern Gallery.
Dowson Economic Gas Company	87	XIV.	Eastern Gallery.
Durham & Co.	88	XIV.	North Nave.
Eastern Telegraph Company	39, 51, 61	IV., VI., VII.	Eastern Gallery and South Nave.
Edison, T. A.	93, 94, 95, 96, 98, 99	I., II., III., IV., V., VI., VII., VIII., IX., XI.	Concert-Room, South Nave, Industrial Aven., & Entertainment Ct.
Edison Electric Pen and Writing Agency	81	XIII.	Southern Gallery.
Edison-Gower-Bell Telephone Company of Europe	61	VII.	Eastern Gallery.

Names.	Page.	Class.	Place of Exhibit.
Electrical Trading Company ...	46 ...	... V. ...	South Nave.
Electric Light and Power Generator Company ...	35, 66, 88 ...	... III., VIII., XIV.	North Nave, Roman Ct., Mediaeval Ct., and Ground Floor.
Electric Light Agency (London) ...	33 ...	... II. ...	Concert-Room Gallery.
Electric Light Carbon Company ...	66 ...	... VIII. ...	West Corridor.
Electric Light Company, British ...	35, 64, ...	... III., VIII. ...	(See British Electric Light Company).
Electric Light Co., National ...	36, 46, 68 ...	... III., V., VIII. ...	N. Nave, W. Corridor.
Electric Light Engineering Co. ...	35, 66, 88 ...	... III., VIII., XIV.	Ground Floor.
Electric Lighting Supply Co. ...	35, 39, 46, 66, 88... ...	... III., IV., V., VIII., XIV. ...	West Corridor.
Electric Railway Signal Co. ...	51 ...	... VI. ...	Eastern Gallery.
Electro-Dynamic Company ...	93, 99 ...	... II., IX. ...	Eastern Gallery.
Elkington & Co. ...	75 ...	... XI. ...	West Corridor.
Elmore, W. ...	35, 66, 75 ...	... III., VIII., XI.	Btwn. Pompeian House and Chinese Court.
Exchange Telegraph Company ...	52 ...	... VI. ...	South Nave, Eastern Gallery, Library, Reading-Room, &c.
Exton, Berridge, & Partners ...	39 ...	... IV. ...	Eastern Gallery.
Fahrig, F. L. ...	67, 70, 77 ...	... VIII., IX., XII.	Southern Gallery.
Fawcett, Preston, & Co. ...	88 ...	... XIV. ...	West Corridor and Railway Corridor.
Faulkner, J. ...	39, 53, 61, 77, 82... ...	... IV., VI., VII., XII., XIII. ...	Eastern Gallery.
Faure. (See La Force et la Lumière)			
Fearn, F. H. ...	72 ...	... X. ...	Eastern Gallery.
Fynn & Carle ...	82 ...	... XIII. ...	Concert-Room Gallery.
Foxcroft ...	82 ...	... XIII. ...	Concert-Room Gallery.
Fremont, A. ...	100 ...	... XIII. ...	Eastern Gallery.
Froude, R. H. ...	88 ...	... XIV. ...	High Level Entrance.
Fuller, T. ...	53 ...	... VI. ...	Concert-Room Gallery.
Fyfe, A. L. ...	35, 67 ...	... III., VIII. ...	Ground Floor and Queen's Corridor.
Galloway & Sons ...	88 ...	... XIV. ...	Betwn. Entertainment Court & Sheffield Ct.
Garau, Salvatore ...	95 ...	... VI. ...	Eastern Gallery.
Garnham & Co. ...	53 ...	... VI. ...	Eastern Gallery.
Garratt, B. Copson ...	72 ...	... X. ...	Western Gallery.
Gent, J. T., & Co. ...	61 ...	... VII. ...	Western Gallery.
Gerard, A. ...	94, 98 ...	... III., VIII. ...	South Nave.
Gerard & Co. ...	68 ...	... VIII. ...	Grand Nave and West Corridor.
Gladstone, Dr. J. H., & A. Tribe	33, 75 ...	... II., XI. ...	South Nave.
Glover, Walter T., & Co. ...	39 ...	... IV. ...	Western Gallery.
Goodwin, C. R. ...	93, 98 ...	... II., VIII. ...	Eastern Gallery. [dor.
Graham, D. S. ...	36, 46, 68 ...	... III., V., VIII. ...	North Nave, West Corridor.
Gramme. (See various Lighting Exhibits in Class III.)			
Gras, J. ...	95 ...	... VI. ...	Eastern Gallery.
Gravier, Kuksz, Luedtke, et Grether ...	94, 95, 98, 99, 100 ...	... III., V., VIII., IX., XIII. ...	West Corridor, Nave, and Scientific Court.
Gray, J. W., & Son ...	40, 46, 53, 61 ...	... IV., V., VI., VII. ...	Eastern Gallery.
Grenet Frères ...	99 ...	... XI. ...	West Corridor.
Groves, W. ...	78 ...	... XII. ...	North Nave.
Guglielmini & Racagni ...	96 ...	... VII. ...	Southern Gallery.
Gutta-percha Company ...	40 ...	... IV. ...	Western Gallery.
Gwynne, J. & H. ...	89 ...	... XIV. ...	West Corridor.
Hammond Electric Light and Power Supply Company ...	36, 67, 90 ...	... III., VIII., XIV. ...	Railway Corridor, Technological Museum.
Harding, A. B. ...	82 ...	... XIII. ...	Eastern Gallery.
Harding, T. R., & Son ...	82 ...	... XIII. ...	Eastern Gallery.
Harrison, Cox Walker & Co. ...	40, 53, 62 ...	... IV., VI., VII. ...	E. Gallery & W. Gallery.
Hart, Son, Peard, & Co. ...	40 ...	... IV. ...	Concert-Room Gallery.
Hawkes, G. & Co. ...	36, 67, 90 ...	... III., VIII., XIV. ...	West Corridor, Western Gallery.
Hawkins, F. ...	82 ...	... XIII. ...	Concert-Room Gallery.

Names.	Page.	Class.	Place of Exhibit.
De Hennaults et Fils ...	100 ...	XII. ...	Concert-Room Gallery.
Henley, W. T. ...	36, 40, 67, 78	III., IV., VIII., XII....	West Corridor, North Nave, Western Gallery.
Hodson, R. ...	90 ...	XIV. ...	West Corridor.
Hornsby & Sons ...	90 ...	XIV. ...	Railway Corridor.
Hindley, E. S. ...	36, 90	III., XIV.	West Corridor.
Humphreys, Charlton ...	93 ...	XIV. ...	North Lawns.
Hutchinson, A., & Co. ...	62 ...	VII. ...	Southern Gallery.
Jennings, G. ...	54 ...	VI. ...	Southern Gallery.
Joel. (See Rowatt & Fyfe)			
Johnson & Nephew ...	40 ...	IV. ...	Concert-Room Gallery.
Johnson and Phillips ...	33, 41, 46, 54, 62, 67, 83...	II., IV., V., VI., VII., VIII., XIII.	South Nave, Southern Gallery, and North Nave.
Jonas & Colver ...	78 ...	XII. ...	Southern Gallery.
Kelway & Dyer ...	78 ...	XII. ...	West Corridor.
Knight, J. P. (L.B. & S. C. Rail.)	33, 54	II., VI.	North Nave.
Ladd, W., & Co....	36, 83	III., XIII.	North Nave.
La Force et la Lumière (Faure's Accumulator)...	33 ...	II. ...	West Corridor.
Lancashire Patent Belting and Hose Company ...	83 ...	XIII. ...	Various.
Lane-Fox. (See Anglo-American Brush Light Corporation)			
Laws & Chatterton ...	71 ...	IX. ...	Concert-Room Gallery.
Lee & Co. ...	83 ...	XIII. ...	Railway Corridor.
Lévy, A. ...	33, 41, 62, 83	II., IV., VII., XIII.	Eastern Gallery.
Legrand & Sutcliff ...	54 ...	VI. ...	Eastern Gallery.
Lewis, J. Slater... ..	62 ...	VII. ...	Eastern Gallery.
Lewis, G. C. & Son ...	54 ...	VI. ...	Southern Gallery.
Liardet, J. E. ...	78, 90	XII., XIV.	West Corridor.
Locht-Labye, Léon de ...	97 ...	VII. ...	South Nave and Pompeian House.
L. B. and S. C. Railway ...	33, 54	II., VI.	North Nave.
London Electric Light Agency	33 ...	II. ...	Concert-Room Gallery.
L. and S. W. Railway Co. ...	54 ...	VI. ...	North Nave.
Lorrain, J. G. ...	62 ...	VII. ...	Eastern Gallery and Concert-Room Gallery.
Macdonald, J. Hay Athole	55, 68	VI., VIII.	South Nave.
Mackenzie. (See Strode)			
Mackie & Co. ...	83 ...	XIII. ...	Concert-Room Gallery.
Martin J. H. ...	73 ...	X. ...	Western Gallery.
Marshall, Sons, & Co. (Limited)	90 ...	XIV. ...	Ground Floor.
Mason & Elkington ...	83 ...	XIII. ...	High-Level Entrance.
Maxim. (See Electric Light and Power Generator Co.)			
McWhirter, Roberts, and Co. ...	41, 55	IV., VI.	Eastern Gallery.
Meyer, H. R. ...	41 ...	IV. ...	Concert-Room Gallery.
Mignon et Rouart ...	98 ...	VIII. ...	West Corridor.
Milchsack, C. ...	96 ...	VI. ...	Concert-Room Gallery.
Mills R. ...	90 ...	XIV. ...	North Nave.
Monnier, Denis, Professor	101 ...	XIII. ...	South Nave.
Moser & Sons ...	41 ...	IV. ...	Eastern Gallery.
Mourlon et Cie. ...	94 ...	II. ...	Eastern Gallery.
Muller E. ...	68 ...	VIII. ...	Eastern Gallery.
National Electric Light Company (Limited) (D. S. Graham) ...	36, 46, 68	III., V., VIII....	North Nave, West Corridor.
Naudin et Schneider ...	101 ...	XIII. ...	Eastern Gallery.
Nell, F. ...	91 ...	XIV. ...	Eastern Gallery.
Neu Jean and Delaite ...	99 ...	XI. ...	Concert-Room Gallery.
Newall, R. S. & Co. ...	41 ...	IV. ...	Eastern Gallery.
Nicoll Donald ...	55 ...	VI. ...	Eastern Gallery.

Names.	Page.	Class.	Place of Exhibit.
Orme, J., & Co. ...	31, 55, 63, 84	I., VI., VII., XIII.	Western Gallery.
Ormes, Eldred, & Andris ...	55, 60	VI., VII.	Eastern Gallery.
Patent Plumbago Company ...	33	II.	Eastern Gallery.
Paterson, E. ...	31, 33, 41, 47, 55, 63, 71, 78, 84	I., II., IV., V., VI., VII., IX., XII., XIII.	South Nave & Southern Gallery.
Penn, Thomas ...	36	III.	West Corridor.
Perrody, E. ...	95	IV.	Eastern Gallery.
Phillips Brothers ...	41	IV.	Southern Gallery.
Phosphor Bronze Company ...	42	IV.	Eastern Gallery.
Pilsen. (See Rowatt & Fyfe)			
Poultier, Léon ...	101	XIII.	Eastern Gallery.
Powell, T. Teale ...	55	VI.	Concert-Room Gallery.
Poyet, Louis ...	100	XIII.	Western Gallery.
Pratt J. F. ...	73	X.	Western Gallery.
Price, David S. ...	42, 78	IV., XII.	Technological Museum.
Pring J. H. ...	84	XIII.	Eastern Gallery.
Probert & Steljes ...	56	VI.	Eastern Gallery
Pulvermacher & Co. ...	73	X.	Western Gallery.
Racagni & Guglielmini... ..	97	VII.	Southern Gallery.
Rageot, L. ...	101	XIII.	Southern Gallery.
Ramsden, Camm, & Co. ...	42	IV.	Concert-Room Gallery.
Ransomes, Head, & Jefferies ...	91	XIV.	Ground Floor.
Reddall, W. ...	42	IV.	Eastern Gallery.
Reid, F. T. ...	78	XII.	Eastern Gallery.
Robey & Co. ...	91	XIV.	North Annexe, &c.
Rodriguez, Chermont ...	99	IX.	Gallery.
Rogers, F. Murray ...	46, 56, 84	V., VI., XIII.	Southern Gallery.
Rogers, W. ...	73	X.	Eastern Gallery.
Roos & Ostrogovitch ...	96	VI.	North Nave.
Roth, Schlaefli, & Co. ...	79, 100	XII.	Southern Gallery.
Rowatt & Fyfe ...	36, 68	III., VIII.	West Corridor, Handel Orchestra, Pompeian House.
Rustless and General Iron Co... ..	42, 43, 56	IV., VI.	Eastern Gallery.
Sabel, Max ...	56, 95	VI.	Concert Room Gallery.
Sanderson & Co. ...	42, 47, 57	IV., V., VI.	Eastern Gallery.
Sauvajon, J. ...	101	XIII.	Eastern Gallery. [Nave.
Sax, Julius ...	57, 63, 84	VI., VII., XIII.	Eastern Gallery & South
Saxby & Farmer. (See L. B. & S. C. Railway)	57		North Nave.
School of Submarine Telegraphy	42, 47, 57, 68	IV., V., VI., VIII.	North Nave.
Schuckert (See Rowatt & Fyfe)			
Schweizerische Telephon Gesellschaft ...	97	VII.	Western Gallery & Concert-Room Gallery.
Scientific Toy Company ...	34, 63, 68, 79, 84...	II., VII., VIII., XII., XIII.	Concert-Room Gallery.
Scrivener, Gill, & Co. ...	74	X.	Western Gallery.
Sennett, A. R. ...	37, 79, 91	III. V. XII. XIV.	North Nave.
Serrell, E. ...	101	XIII.	West Corridor.
Shippey, A., & Co. ...	84	XIII.	Concert-Room Gallery.
Skrivanoff, Gregory ...	94, 96, 97, 99, 102	II., VI., VII., X., XIII.	South Nave.
Siemens Brothers & Siemens Frères ...	37, 43, 47, 57, 69, 79, 98	III., IV., V., VI., VIII., XII.	South Transept, South End of Palace, West Corridor, South Nave.
Signal Engineering Company... ..	57	VI.	Concert-Room Gallery.
Smith, F., & Co. ...	43	IV.	Eastern Gallery.
Smith, F. J. ...	63	VII.	Southern Gallery.
Somzée, Léon ...	94, 98, 102	II., VIII., XIII.	Southern Gallery.
South-Eastern Railway Co. ...	58	VI.	North Nave.
South-Western Railway. (See London & South-Western Ry.)			
Spagnoletti, C. E. ...	57, 84	VI., XIII.	South Nave.
Spencer, James E., & Samuel... ..	42, 43, 56	IV., VI.	Eastern Gallery
Stanley, W. F. ...	31	I.	Eastern Gallery.

Names.	Page.	Class.	Place of Exhibit.
Stiff & Sons	34 ...	II. ...	Concert-Room Gallery.
Storer, J.	85 ...	XIII. ...	Eastern Gallery.
Strode & Co.	34, 69, 71 ...	II., VIII., IX.	West Corridor & South
Submarine Telegraph Company	34, 43, 57 ...	II., IV., VI.	North Nave. [Nave.
Submarine Telegraphy, School of. (See School of Sub- marine Telegraphy.)			
Sullivan, E. A.	58, 79 ...	VI., XII.	Eastern Gallery.
Swan's Electric Light Company	69 ...	VIII. ...	Picture Gallery and South Nave.
Sykes, W. R.	58 ...	VI. ...	North Nave.
Tasker, Sons, & Co.	63 ...	VII. ...	Southern Gallery.
Telegraph Construction and Maintenance Company ...	44 ...	IV. ...	South Nave.
Telephone Company (British and Irish). (See British and Irish Telephone Company.)			
Telephone Construction and Maintenance Company (Con- solidated)	60 ...	VII. ...	South Nave & Southern Gallery.
Thomas, Evan	85 ...	XIII. ...	Eastern Gallery.
Thomson, Sterne, & Co. ...	92 ...	XIV. ...	West Corridor.
Thomson, Sir W. ... ..	...	...	[To follow.
Tisley & Co.	37 ...	III. ...	Eastern Gallery.
Tribe, A.	75 ...	XI. ...	Concert-Room Gallery.
Turner Gas-engine Company	92 ...	XIV. ...	West Corridor.
United Asbestos Company ...	44, 85 ...	IV., XIII.	Eastern Gallery.
United States Cable Co., Direct	38 ...	IV. ...	Southern Gallery.
United Telephone Company	63 ...	VII. ...	Eastern Gallery.
Van Stan, F.	84 ...	XIII. ...	Gallery.
Varley, S. A., & Co.	37, 58, 79 ...	III., VI., XII.	Ground Floor.
Varley, Cromwell, F. ... ..	...	...	[To follow.
Verity, B., & Sons	85 ...	XIII. ...	See Edison.
Vian G.	102 ...	XIII. ...	Western Gallery.
Villiers, P. De	85 ...	XIII. ...	Concert-Room Gallery
Volk, Magnus	44, 58, 63, 85 ...	IV., VI., VII., XIII.	Eastern Gallery.
Voss, J. R.	93 ...	I. ...	Concert-Room Gallery.
Vyle, S.	45, 48 ...	IV., V. ...	Concert-Room Gallery.
Walker, C. V., F.R.S. (S.E.Ry.)	58 ...	VI. ...	North Nave.
Wallis, Joseph	85 ...	XIII. ...	North Nave.
Walters, Dan	85 ...	XIII. ...	Concert-Room Gallery.
Waterlow & Sons	59 ...	VI. ...	Eastern Gallery and South Nave.
Webb, Browne Wolsey	86 ...	XIII. ...	Southern Gallery.
Webster, E.	79 ...	XII. ...	Eastern Gallery.
Webster, R.	86 ...	XIII. ...	Eastern Gallery.
Webster & Williams	86 ...	XIII. ...	Eastern Gallery.
Western Electric Company	96, 97 ...	VI., VII.	Between Sheffield and Chinese Courts.
White House Mills	94, 96, 98 ...	III., VI., VIII.	West Corridor and Picture Gallery.
Whiting, H. G.	74 ...	X. ...	Western Gallery.
Wiggin, H., & Co.	76 ...	XI. ...	Eastern Gallery.
Wigner, G. W.	70 ...	VIII. ...	Eastern Gallery.
Willcox & Gibbs	86 ...	XIII. ...	Eastern Gallery.
Willing, J., & Co.	86 ...	XIII. ...	Various Positions in
Winter & Craik	59 ...	VI. ...	North Nave. [Building.
Witty & Wyatt	86 ...	XIII. ...	Western Gallery.
Woodbury, W. B.	87 ...	XIII. ...	Concert-Room Gallery.
Woodhouse & Rawson ..	63, 70, 87 ...	VII., VIII., XIII.	Eastern Gallery.
Zanni & Co.	34, 37, 45, 59, 74, ...	II., III., IV., VI., X. ...	West Corridor.

