

L. CASELLA,
Scientific Instrument Maker,
MECHANICAL & ELECTRICAL ENGINEER, &c.,
147, HOLBORN BARS,
LONDON, E.C.

[Entered at Stationers' Hall.]



THE ONLY
PRIZE MEDAL AWARDED
FOR
REGISTERING
METEOROLOGICAL INSTRUMENTS.

GOLD MEDAL, HEALTH EXHIBITION, 1884.

LIST OF A FEW INSTRUMENTS
IN GENERAL USE, SELECTED FROM THE GENERAL CATALOGUE OF
STANDARD METEOROLOGICAL
AND OTHER
INSTRUMENTS
FOR
OBSERVATORIES, TRAVELLERS AND EXPLORERS,
AND
THE ARMY AND NAVY.

MANUFACTURED BY

L. CASELLA,

SCIENTIFIC INSTRUMENT MAKER,
MECHANICAL & ELECTRICAL ENGINEER,

TO

H.R.H. the Prince of Wales,

TO THE ADMIRALTY AND ORDNANCE, THE BOARD OF TRADE, THE ARMY MEDICAL AND WAR
DEPARTMENTS; THE GOVERNMENTS OF INDIA, RUSSIA, GERMANY, FRANCE, ITALY,
SPAIN, PORTUGAL, THE UNITED STATES, BRAZIL, CHINA AND JAPAN; THE
UNIVERSITIES OF OXFORD, CAMBRIDGE, AND LONDON, &c.; THE
ROYAL METEOROLOGICAL AND ROYAL GEOGRAPHICAL SOCIETIES;
THE LEADING HOSPITALS AND INFIRMARIES; AND THE
OBSERVATORIES OF GREENWICH, KEW, ARMAGH,
CAPE OF GOOD HOPE, WASHINGTON,
VICTORIA, TORONTO, CALCUTTA,
THE MAURITIUS, ETC., ETC.

147, HOLBORN BARS, LONDON, E.C.
(OPPOSITE STAPLE'S INN).

1894.

METEOROLOGICAL INSTRUMENTS FOR OBSERVATORIES AND FIXED STATIONS.

BAROMETERS.

The following forms of standard barometers are all of the highest excellence, the mercury being boiled in the tubes of each by a simple and improved method, and every care taken in their construction and graduation to render their indications absolutely correct, and accordant with each other :—

In the official report for the year 1873 to the Government of Bengal, by H. F. Blandford, Esq., it is said of these barometers :—

“The best in every respect that I have tried are CASELLA’S Standards, with tubes of uniform bore. They bear transport admirably; and, although they have been in use at some stations for three years, no instance has occurred of leakage or any other injury to them.”

1. **Observatory Standard Barometer**, as designed for the Kew Committee of the Royal Society, and supplied to many of the leading foreign Governments and observatories. A scale on each side of the tube is adjusted to the level of the mercury in the cistern by a rack and pinion motion, and the vernier reads to 0.002 of an inch, or, by estimation to 0.001 inch. The instrument revolves on a cast iron pedestal, and the mounting is of great strength and stability. The internal diameter of the tube is 1.0 inch (*fig. 1*) £35 0 0

If with adjustable Reflectors at back for throwing light on to the mercury and pointers, when the barometer is used in a room with a top light extra £3 0 0

2. **Observatory Standard Barometer**, with extra large column of mercury in neat skeleton iron frame, arranged to revolve in brackets from a wall, or on a pedestal, precisely as the Kew standard, for reading off by means of a cathetometer £33 0 0

For Cathetometers, see page 6.

3. **Standard Barometer (Fortin’s)**. In this construction the mercury in the cistern is adjusted at each observation to a fixed

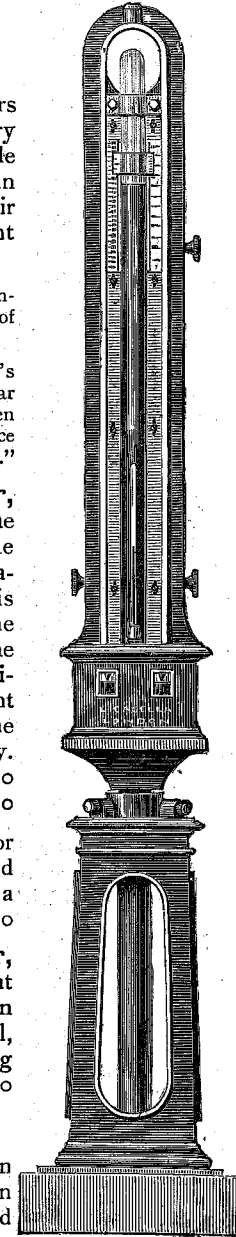


Fig 1.

ivory point, which thus forms the zero of the scale. The tube is 0.45 in. internal diameter. The cistern is made partly of glass, to admit of the zero of the scale being visible, and the mercury is adjustable to the zero or ivory point by means of a thumb-screw acting upon the flexible base. The vernier reads to 0.002 of an inch, or by estimation, to 0.001 inch. In front of the barometer a thermometer is attached, in contact with the tube, with divisions etched on the stem. For facility of reading, a white glass reflector is placed behind the scale and cistern (*fig. 3*) ... £10 0 0

4. **Standard Barometer**, precisely as above, but not so highly finished, internal diameter of tube, 0.4 in. ... £8 10 0

5. **Fortin's Standard Barometer** of extra large size, specially suited for public observatories, tube about 0.7 in. internal diameter, with (at the side) a thermometer immersed in a tube of mercury of the same diameter as the barometer tube £22 0 0

6. **Standard Barometer**, on the Kew Principle, in which the graduations of the scale are arranged to compensate for the rise and fall of mercury in the cistern, by which the necessity of stooping to read from a point in the cistern is obviated. The mounting, &c., the same as No. 3 standard barometer ... £8 10 0

7. **Standard Barometer**, as No. 6, in plainer mounting ... £6 0 0

8. **Standard Barometer**, on the Kew principle, as No. 6, but with handsome and bold ivory, porcelain, or metal scales, with plain and broad graduations for easy reading, revolving in brackets on oak or mahogany board ... £6 0 0

9. **The Student's Standard Barometer**, on the Kew principle, as No. 6, with similar compensation, &c., but smaller in size, for those who do not at first desire a more expensive standard ... £5 5 0

10. **Standard Marine Barometer**, on the Kew principle, as recommended by the Brussels Conference for making correct meteorological observations at sea, and used by the Admiralty and Meteorological Office (*fig. 10*) ... £4 15 0

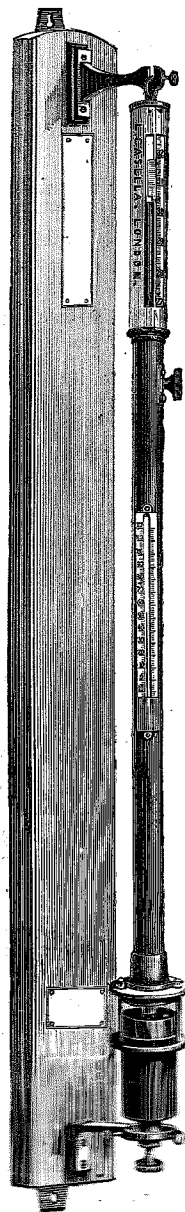


Fig. 3.

11. **The Fisherman's or Storm Barometer**, with thermometer, in a solid oak frame, as adopted by Admiral FitzRoy, Board of Trade, &c., for lifeboat stations. Admirably adapted for the sea coast and public institutions ... £4 15 0

Millimetre scale added to any of the above, £1 extra.

12. **Miner's Barometer**, expressly arranged as an economic instrument for this purpose £1 17 6

13. **Miner's Barometer**, more elaborately finished £2 5 0

14. **Glass Case for Standard Barometer**, of black polished wood, with plate-glass sides and front, forming a neat and elegant protection against dust, &c. ... £2 10 0 to £4 0 0

SELF-RECORDING MERCURIAL BAROMETERS.

15. **King's Barograph**, or Self-recording Barometer. The lofty and elegant form of this instrument, as well as the extreme delicacy of its indications, eminently adapt it for first-class observatories

£230 0 0

Or with suitable Glass Case, extra £40.

16. **Beckley's Kew Observatory Barograph**, as made by L. CASELLA for the Government Observatories, permanently records the various changes of barometric pressure by means of photography, with standard thermometer and all appliances complete, and ample instructions for use (*fig. 16*) ... £92 10 0

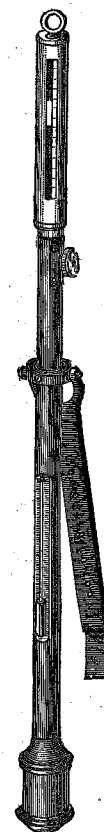


Fig. 10.

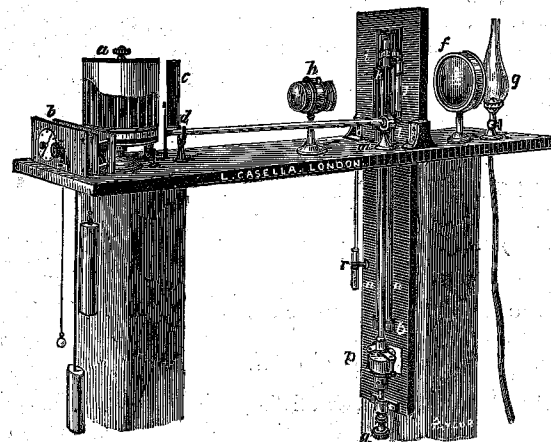


Fig. 16.

17. **Cathetometer**, as constructed by L. CASELLA for the Indian Government, with triangular brass bar divided to 0.1 inches, reading to .001 inches by a vernier, with superior telescope, carrying cross wires and level, rack motion, clamp, erecting and inverting eye-pieces, and fine adjustment to both vernier and telescope. The whole revolves on adjustable centres in a painted arched iron frame, with three levelling screws
- £53 0 0
18. **Cathetometer**, as used at the Kew Observatory, with metal scale divided to millimetres, reading to 0.1 mm. by vernier; telescope and attached level, fine adjustments to level and vernier, and clamp to fix telescope at any height; with extra firm stand carrying three levelling screws ... £28 and £23
19. **Cathetometer**, 6½ feet high, with telescope, surmounted by an adjustable level, erecting eye-piece, tangent screw adjustment, vertical slide motion, with clamp and rack adjustment. Brass pillar stand with folding claws and levelling screws

£12 15 0

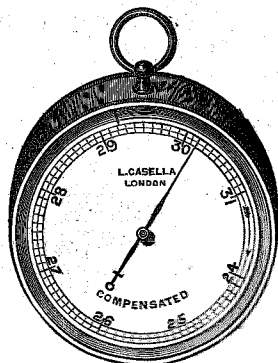
This instrument can be had with rod divided to .5 decimeters, together with vernier reading to .1 mm. ... £14 15 0

Cathetometers in great variety at higher prices, from £60 upwards, can be had on application, or see larger catalogue.

ANEROID BAROMETERS.

20. **Aneroid Barometer**, bold and very handsome, in ebonized, bronzed, or gilt metal frame, 18 inches diameter, for halls and public institutions ... £15 0 0
21. **Aneroid Barometer**, 4½ inches diameter, highly finished, carefully compensated for temperature, extra sensitive, with greatly expanded graduations, divided to .1 inch, each barometric inch being represented by nearly four inches of scale, with circular thermometer and richly engraved ornamental dial ... £5 10 0
22. **Aneroid Barometer**, for measuring heights up to about 8,000 feet (fig. 21) ... £4 15 0
23. **Aneroid Barometer**, cylindrical form, carefully compensated for temperature, with extended scale, available for measuring heights of 6,000 to 8,000 feet ... £4 4 0
24. **Aneroid Barometer**, metal dial, with or without thermometer

Fig. 31.



If with scale of altitudes engraved on the dials, 10s. extra.

25. **Aneroid Barometer**, 1½ in., in case, carefully compensated for temperature, for measuring heights up to about 5,000 to 15,000 feet ... £3 15 0 to £4 4 0
26. **Aneroid Barometer**, plain ... £2 0 0
27. **Aneroid Barometer**, 2½ in., with revolving index, finely divided and compensated, for measuring heights up to about 10,000 to 19,000 feet, in case ... £4 15 0
28. **Aneroid Barometer**, ditto, for heights from 6,000 to 8,000 feet ... £4 4 0
29. **Aneroid Barometer**, ditto (plain), for indicating changes in the weather, or measuring heights up to about 6,000 feet £3 3 0
- A scale of altitudes accompanies any of the above instruments gratis, or may be engraved on the dials at an extra charge of 10s.
- Special open range and extra sensitive Aneroids made to order.
- Any of the above Aneroids made in aluminium, if desired, thus reducing the weight by more than one-half:

THERMOMETERS.

30. **Independent or Natural Standard Thermometer**. The highest class that is made; the bore being carefully calibrated, and the freezing and boiling points of water determined with the utmost precision ... £5 5 0

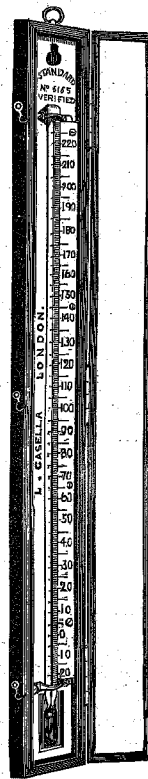


Fig. 31.

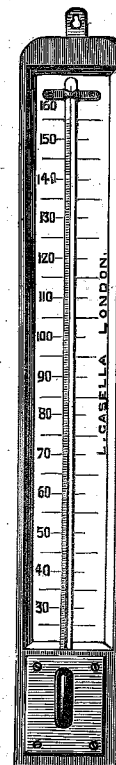


Fig. 32.

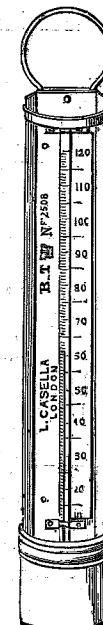


Fig. 33.

31. **Standard Thermometer, Comparative**, carefully tested in all its parts, the tube 15 inches long, engine divided on the stem, and figured on raised metal scale, 0° to 212° Fahrenheit or -20° to $+100^{\circ}$ Centigrade, in maroon case, with verification from Kew Observatory (*fig. 31*, p. 7) ... £2 5 0
32. **Standard Thermometer, Comparative**, as No. 31, with porcelain scale on mahogany, for out-door use, range about 0° to 130° , as made by L. CASELLA for various departments of the Government (*fig. 32*, p. 7) ... £2 5 0
33. **Kew Observatory Thermometer** (*Meteorological Office and Admiralty Pattern*), 12 inches long, with divisions etched on the stem, and the figures indelibly burned on the porcelain scale, range about 0° to 120° ; as arranged at the Brussels Conference, for taking reliable observations at sea. An excellent instrument, with which others may at any time be compared. In copper case (*fig. 33*), with verification from Kew Observatory ... £0 15 6
- 33A. Do., but without Kew verification ... £0 12 6
34. **Thermomètre Fronde**, in brass case for pocket, as designed by M. Renou, for ascertaining the true temperature of the air ... £0 10 6
35. **Maximum Thermometer**, for registration of temperature in shade; engine divided on the stem, and indelibly figured on CASELLA'S improved porcelain or white glass scale, which effectually resists frost and all effects of weather (*fig. 35*) £1 0 0
(Plainer kinds of this instrument are made at 12s. 6d. and 8s. 6d.)

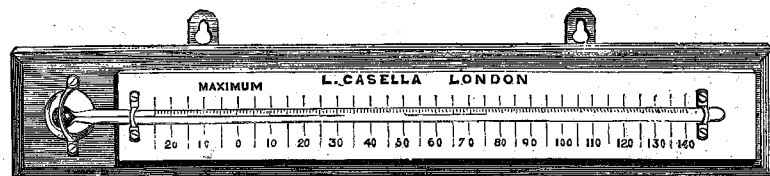


Fig. 35.

36. **Casella's Mercurial Minimum Thermometer** (for temperature in shade), on porcelain scale, with hardwood back, and divided on the stem (*fig. 36*) ... £2 10 0

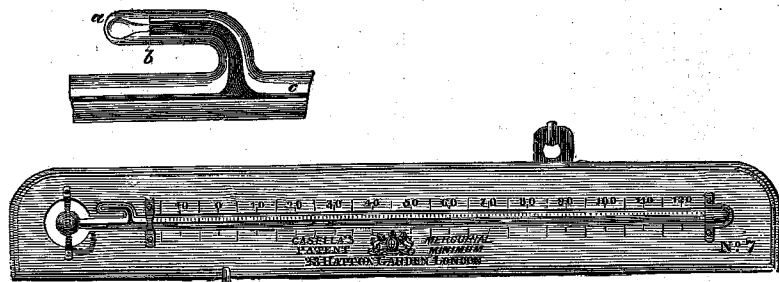


Fig. 36.

THIS IS THE ONLY PRACTICAL MERCURIAL MINIMUM THERMOMETER HITHERTO INVENTED. The bulb and column are of the same size as in the standard maximum thermometers; and cold is thus registered under precisely the same conditions as heat; no steel or other index is employed, whilst the annoyance arising from vaporization and breakage of the column, as in the spirit minimum thermometer, is entirely avoided. Advantage is here taken of the tendency of fluids to recede first from the smaller bore and rise in the larger, whilst the return of the mercury from any point to which it may descend is prevented by capillary action.

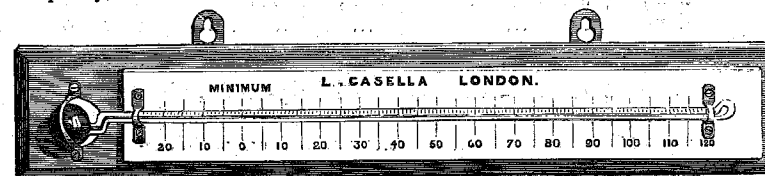


Fig. 37.

37. **Minimum Thermometer**, filled with pure alcohol, for ordinary registration; engine divided on the stem, and mounted to correspond with the standard maximum No. 35 (*fig. 37*) £1 0 0

(Plainer qualities at various prices down to 4s. 6d. each.)

38. **Casella's Extra Sensitive Minimum Thermometer**, forked bulb, as *fig. 52*, p. 11, on porcelain or white glass scale, hardwood back ... £1 5 0
39. **Sixe's Self-Registering Thermometer**, for showing accurately the present temperature, and registering the extremes of heat and cold during the absence of the observer. The only instrument that registers cold in a vertical position, or that does not require handling or removal from its place in setting the indices.

PRICES.

- No. 1. Improved self-registering thermometer, as above, on mahogany board, with bronzed bracket for outside of windows, with clear black figures and divisions on opal or porcelain, impervious to all the influences of weather ... 10 in., £1 15s.; 12 or 14 in., £2
- No. 2. Improved self-registering thermometer, on opal, as above, for gardens, greenhouses, &c., &c., in japan case, ... 10 in., £1 1s.; 12 in., £1 6s.; 14 in., £1 10s.
- No. 3. Improved Thermometer, as above, on polished boxwood scale, in japan case ... 10 in., 15s. 6d.; 12 or 14 in., £1.
- Diminon Thermometer (horizontal), very portable, for present temperature, and maximum and minimum registration, 10s. 6d.
40. **Casella's Electrical Sixe's Self-Registering Thermometer**.—This instrument, made at the suggestion of W. T. Goolden, Esq., M.A., &c., is well adapted for forcing-houses, hospital wards, or for the ventilation of theatres and public buildings. The indices can be set at any desired range of temperature, and if the temperature either rises above or falls below these limits, a bell is sounded at any convenient

distance from the instrument; for instance, in the gardener's cottage, or in the room of the medical officer or man in charge of the heating or ventilating apparatus. It can also be used as an ordinary Sixe's Thermometer £3 5s.

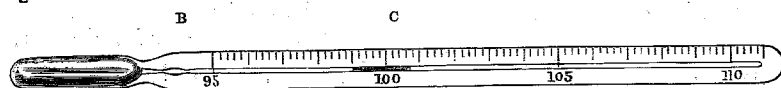
41. **Cripp's Self-Recording Thermometer.** This instrument records thermometric changes on a vertical cylinder carrying a ruled metallic paper, and revolving once in seven days £20 0 0
42. **Earth Thermometer,** for ascertaining the temperature below the soil, or the heat developed in hay-stacks, pine and melon pits, &c., with pointed brass or copper tube (according to length), from 4s. 6d. to £1 5 0
43. **Well or Earth Thermometer,** self-registering; for immersion to any depth in the earth or wells, and showing the maximum and minimum temperature for any interval of time £1 10 0
44. **Well Thermometer,** Sir William Thomson's (Lord Kelvin) 7 inch maximum, in stout glass shield, as supplied to the self-registering Underground Temperature Committee of the British Association £1 1 0

Symons' New Earth Thermometer, to lower into an iron pipe to any depth, expressly arranged to obviate all the difficulties hitherto felt in obtaining ground temperatures.

45. Thermometer with tube for showing temperature 6 in. below the surface £1 1 0
46. Do. do. do. 1 foot do. 1 1 0
47. Do. do. do. 2 feet do. 1 5 0
48. Do. do. do. 4 feet do. 1 10 0
49. Do. do. do. 10 feet do. 2 5 0

The iron tubes for these thermometers are intended to project six inches above ground, and the length supplied is therefore that much more than the depth at which the thermometer is to indicate.

50. **Casella's Patent Infallible Clinical Thermometer.**



For saving time in taking observations and saving trouble and effort in setting the index. It cannot become disarranged, having the patent arrangement, by which the loss of the index is rendered impossible.

These advantages are obtained by means of a contraction below an expansion of the bore of the tube, as seen enlarged in the above sketch, by which the index, whilst perfectly free in its action, is yet rendered absolutely indestructible.

Thus C is the ordinary index, B a small chamber or trap. The index C, being mercury, on reaching the chamber expands and fills the space, whilst by the aid of the contraction below, it is preserved and prevented from being lost or shaken into the bulb.

- Casella's Patent Infallible Clinical Thermometer,** with bold magnified index, 4 and 6 inch, in neat pocket case,

£0 5 6

51. **Casella's Standard Clinical Thermometer,** guaranteed of equal accuracy, and with bold magnified index, without the patent contracted expansion, 4 and 6 inch, in neat pocket case £0 3 6
52. **Casella's Clinical Thermometer,** with index to rise from bulb, 4 and 6 inch, in neat pocket case ... £0 3 6
53. Do., do., lens front, 4 and 6 inch, in neat pocket case £0 4 6
54. Do., do., 30 seconds, 4 and 6 inch, in neat pocket case £0 5 6
Kew verifications to any of the above, 1/6 extra.
55. **Surface Clinical Thermometer,** various patterns, to order £0 10 6
56. **Improved Patent Portable Spirometer,** in neat mahogany case, $6\frac{3}{4} \times 3\frac{1}{4}$ inch £5 10 0
57. **Fick's Kymograph or Blood Apparatus,** with improved adjustment £4 10 0
58. **Schafer's Warm Stage for the Microscope,** complete with furnace, mercurial regulator, and thermometer, £4 4 0

TERRESTRIAL HEAT AND RADIATION.

59. **Minimum Thermometer,** for terrestrial radiation, divided and figured on the stem, which is enclosed in a glass cylinder for protection (*fig. 51*), or mounted on ebonite if desired, £1 0 0



Fig. 51.

60. **Casella's Extra Sensitive Minimum Thermometer** for terrestrial radiation. The unavoidably high price of CASSELLA'S Mercurial Minimum Thermometer, as well as the care required in using it, have induced him to design the one shown in *fig. 52*, in which the bulb, being extended in the forked form there shown, exposes a greatly increased surface

to the air, and thus renders it little, if at all, less sensitive than the mercurial one. It is really interesting to note the increased sensitiveness of this over even the best instruments of the usual construction. Mounted on ebonite if desired £1 5 0

[See paper on this subject by Mr. G. J. Symons, F.R.S., in "Quarterly Journal of Meteorological Society" for July, 1874.]

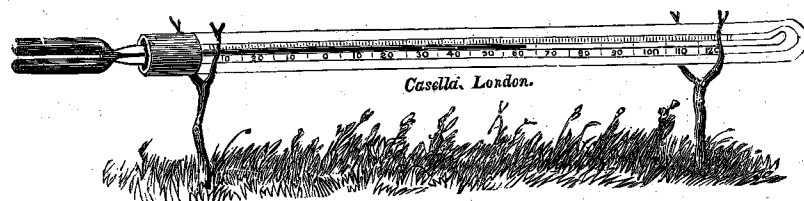


Fig. 52.

61. Casella's Newly-designed Sensitive Minimum Thermometer, Registered ... £1 5 0

The flat side of this thermometer being turned to the sky, greatly increases its power of indicating the effect of radiation.

SOLAR RADIATION THERMOMETER AND APPARATUS.

62. Solar Radiation Thermometer, maximum, with black bulb, tube divided and figured on the stem, and enclosed in glass shield for protection ... £1 0 0
63. Casella's Insulated Solar Radiation Thermometer, as first made by him, at the suggestion of Sir J. Herschel (see *Admiralty Manual of Scientific Enquiry*). In this arrangement the thermometer being in a nearly perfect vacuum, the maximum registration of the heat of the sun's rays is obtained divested of the influence of vapour or passing currents of air £1 5 0

Kew verification for do., 5/6.

64. Vacuum Radiation Thermometer, bright bulb, as arranged for the observatories of the Meteorological Society £1 5 0

Kew verification for do., 5/6.

65. Stand for the above, it being essential for strict comparison, that all instruments of this kind should be similarly placed. To hold one thermometer ... £0 7 6
66. Do., for two thermometers ... £0 9 6
67. Solar Intensity Apparatus, invented by Padre Secchi, for measuring the comparative heat of the sun's rays. Two thermometers are here kept immersed in a fluid at any

temperature, and a third surrounded by the same conditions, but not immersed, is exposed to the rays of the sun. The increase of temperature thus obtained is found to be the same irrespective of temperature of the fluid which surrounds it. Cylindrical form, about 3 x 10 in. Price, with the requisite three thermometers ... £3 18 0

68. Tripod Stand, with universal joint, by which the above may be kept in any position at any temperature ... £1 5 0

69. Beckley's Thermograph as made by L. CASSELLA for Government observatories. This instrument is designed to show changes of atmospheric temperature and moisture, by

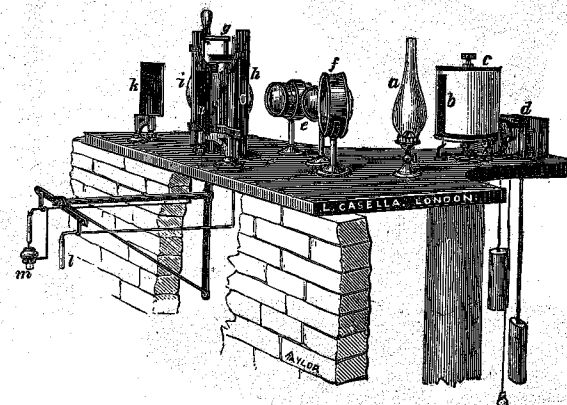


Fig. 59.

means of photography. When in use the top is covered with a mahogany box, for the exclusion of light in the same way as the barograph; in this case, however, the artificial light is only admitted to the paper through an air-speck in each thermometer, which separates the mercury in the same manner as that arranged by L. CASSELLA to detach the index in his maximum registering thermometer. An ingenious arrangement is made to support the thermometer bulbs in the open air; they project about one foot from the wall, upon the edge of which the slabs rest, the general arrangement being as in fig. 59. With bent thermometers, two standard thermometers and all appliances complete ... £120 0 0

70. The Whipple-Casella Universal Sunshine Recorder, for ascertaining and recording the daily amount of direct sunshine. A strip of cardboard is arranged so that the sun's rays, concentrated to a focus by a large spherical lens, shall trace a charred line on it when they are unobscured by cloud or mist. The instrument is universal, and can be used in any part of the world, having divided latitude and diurnal circles, and thus can be easily set for any locality and for any day in the year (fig. 70) ... £15 0 0

Blue Strips of Card, ruled and figured for one year, for use with the above Universal Sunshine Recorder ... £1 4 0

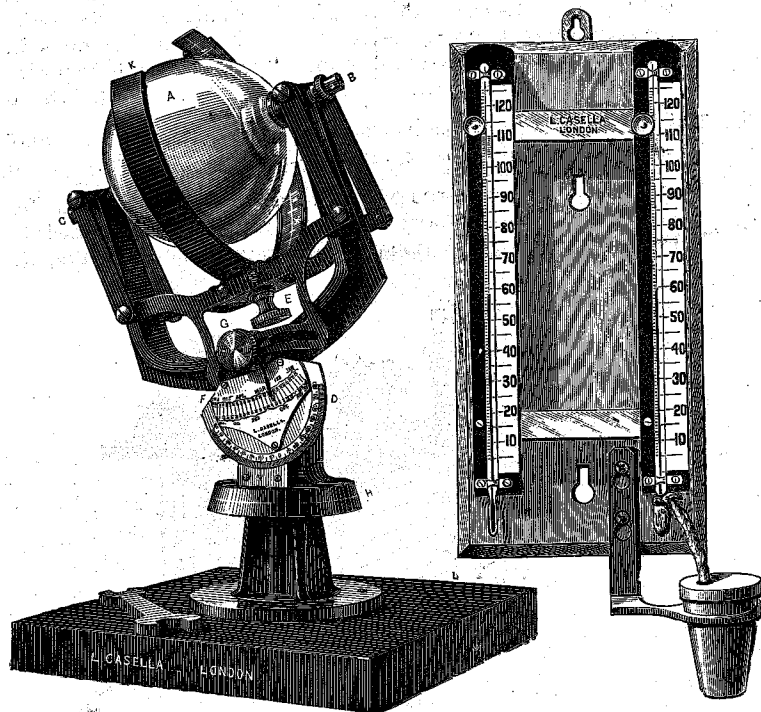


Fig. 60.

Fig. 63.

Sunshine Recorder for fixed stations as used by the Meteorological Office ... £9 9 0
Curves for Do. for one year ... £1 15 0
Photographic and other Sunshine Recorders supplied to order.

HYGROMETERS.

71. Mason's Hygrometer, or August's Psychrometer, extra large size, with 18 inch tubes, divided to fifths of degrees, for delicate investigations ... £5 5 0
72. Mason's Hygrometer, large size, 15 inch tubes, divided to 0° 2 ... £3 10 0
73. Mason's Hygrometer, with metal scales, mounted on mahogany board for suspension. The Thermometers are divided on the stem, and the figures indelibly burnt in on porcelain slips at the side, as supplied by L. CASELLA to the various Government Departments and to the Fellows of the Meteorological Society (fig. 63) ... £2 5 0
74. Mason's Hygrometer, like fig 63, but mounted on porcelain scales ... £1 15 0
75. Mason's Hygrometer, mounted on brass pedestal £2 2 0
L. CASELLA has instruments of this pattern, but not so strictly accurate, at various prices, down to 13s. 6d

76. Daniel's Hygrometer, the thermometers divided on the stems, with ether test-jar, bottle, &c., complete in mahogany case ... £3 10 0
 77. Regnault's Condensing Dew-Point Hygrometer (CASELLA'S Improved), with ether bottle, &c., can be used either with an aspirator or with an inhaler, complete, in mahogany case ... £4 4 0
 78. Dines's Sensitive Hygrometer, vertical or horizontal form. A most interesting instrument ... £3 10 0
 79. Stevenson's Thermometer Stand, to be placed four feet above the grass ... £1 15 0
- The pattern adopted by the English and Scottish Meteorological Societies.*
80. Stevenson's Screen. New form, M.O. pattern £3 15 0
- N.B.—Prices of above Screens do not include the legs, these being extra, 22/, but to save expense of carriage they are usually supplied by a local carpenter.
81. Louvre Board Case, for Hygrometer, out of doors or on board ship ... £0 15 0

RAIN GAUGES.

EIGHT-INCH GAUGES.

82. Mountain Rain Gauge. The pattern adopted by Mr. Symons (see British "Rainfall," 1867, p. 16), for rough mountain work, and for waterworks purposes in wet districts. It is capable of containing 48 inches of rain, and may be read off to tenths of an inch. It is constructed with much care, and all known sources of error (such as frost, evaporation, insplashing, &c.) are guarded against

Zinc, £2 15 0; Copper, £5 10 0

The gauge No. 82 is intended for weekly or monthly observation, but can be read at any time, daily or otherwise.

83. Meteorological Office Rain Gauge, with a high rim to secure the more correct measurement of snow (fig. 83).

Japanned zinc, £2; Copper, £2 15 0

84. Ditto, cheaper form, with glass bottle receiver and cylinder for overflow. Total capacity, 11 inches.

Japanned zinc, £1 10 0

Copper ... £2 5 0

85. Ordinary Japanned Gauge, without Snowdon rim ... £1 1 0

86. Large Tropical Rain Gauge, cylindrical form, with deep brass rim and inside receiving can and bottle, by which large or small quantities are measured, while efficient protection is secured against evaporation, frost or overflow during the heaviest rains.

Japanned zinc, £2 10 0; Stout copper, £3 15 0

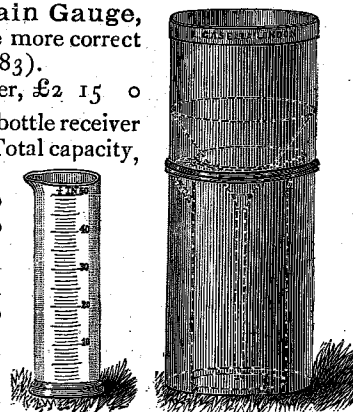


Fig. 83.

FIVE-INCH GAUGES.

87. Symons' Snowdon Rain Gauge, with cylinder prolonged beyond the funnel to secure accurate measurement of snow as well as rain, with measuring jar and foot to same
Japanned zinc, 17s.; Copper, £1 4 0
88. Ditto, but jar without foot
Japanned zinc, 15s. 6d.; Copper, £1 1 0
89. Rain Gauge, improved cylindrical, with receiving bottle and graduated jar ... Japanned tin, 15s. 6d.; Copper, £1 1 0
90. Cheaper form of ditto ... 10 6
91. Small Tropical Rain Gauge, ($4\frac{1}{2}$ in. diam.), to measure up to 4 inches of rain in hundredths of inches, with brass rim
Japanned tin, £1 10 0; Copper, £2 10 0

SELF-RECORDING RAIN GAUGES.

92. Self-Recording Rain Gauge (CASELLA'S), simple and efficient, in stout metal case, 15 by 15, adapted for every position and climate. In this arrangement the amount of rain to the hundredth of an inch and the time of its fall is shown on a continuous diagram ... £50 0 0
93. Crossley's Self-Recording Rain Gauge (CASELLA'S improved). Specially arranged for the tropics. Showing the amount of rainfall in hundredths of an inch on a dial £6 6 0

AGRICULTURAL AND GARDEN WEATHER INSTRUMENTS,

FOR THE COTTAGE, GARDEN, FARM, DAIRY, OR SEA-COAST.

For these Instruments the First Class Certificates of the Royal Horticultural Society have been awarded. They are strictly arranged as reliable and trustworthy Instruments for easy and practical use. Though, designed, in the first instance, as Horticultural and Garden Meteorological Instruments, they are all equally adapted for use along the Sea Coast, and are suited alike for all climates.

94. Farmer's Weather Indicators for forecasting the exact changes in the weather (Particulars free by post) £2 10 0
95. Plantation or Farm Barometer, designed for Natal as a reliable Weather Indicator by Dr. Mann, Vice-President of the Meteorological Society (with instructions) ... 32s. & 42s.
96. Barometer, of larger size, with oak, mahogany, or rosewood frame, ivory plates and portable screw ... £1 5 0
97. Ditto ditto, with long Thermometer in front, ivory plates, with rack-work, vernier reading to the one-hundredth of an inch, and covered with plate-glass ... £2 10 0
98. Hygrometer, dry and wet bulb, for general gardening purposes, showing amount of moisture in greenhouses ... £0 13 6
99. Hygrometer, as above, with CASELLA'S improved porcelain scales ... £0 17 6

100. Maximum Thermometer (CASELLA'S Improved) arranged to show existing temperature and register correctly the extreme of heat during absence ... £0 8 6
101. Maximum Thermometer with larger index, set by merely raising the top end ... £0 10 6
- *** In this thermometer an air speck is made to detach a small portion of the mercury, which acts as an index; the end furthest from the bulb being used in taking the indication.
102. Minimum Thermometer, for registering cold during absence, and showing present temperature, to correspond with No. 100 ... £0 4 6
103. Minimum Thermometer, to correspond with Maximum, No. 101 ... £0 5 6
104. Double Registering Thermometer (on Sixe's principle), for registering the extremes of heat and cold during absence, and showing present temperature; in japan case, with Magnet, complete, 14 in., 17/6; 10 in. ... £0 12 6
105. Dipping Thermometer, for ground or bottom heat, with round metal point for inserting in the earth, or in hot-beds, prior to putting in cuttings or sowing seeds, 18 in. £0 7 6
12 in. £0 4 6
106. Hot-Bed Thermometer, for pine and melon pits, with pointed metal tube for protection whilst forcing into the earth £0 18 6
107. Hot-Bed Thermometer, as above, with Thermometer on door ... £1 5 0
108. Dairy Thermometer, for ascertaining the temperature of milk ... £0 1 8
109. Brewing or Bath Thermometers, with enamel tubes, and metal scales, in copper cases, 8 in., 5s. 6d.; 10 in., 7s.; 14 in. ... £0 9 6
110. Brewing or Bath Thermometers, in black japan cases, 8 in., 3s. 4d.; 10 in., 4s.; 14 in. ... £0 4 6
111. Brewing or Bath Thermometers, in black japan cases, plain, reliable, 8 in., 2s.; 10 in. 2s. 8d.; 14 in. £0 3 4
112. Pedestal Thermometer, on ebony base, with ivory scale, and glass shade for mantelpiece, &c., most useful for moving from place to place ... 7s. 6d. to 15s. 6d.
113. Plain Reliable Thermometer, for ordinary temperature, 1s. 8d. each, or 18s. per dozen ... £0 1 8
114. Ditto, ditto, with polished scale and enamel tube, very clear for defective sight ... £0 2 6
115. Cream Test, to indicate the percentage of cream from different cows. (Particulars free by post) ... £0 2 6
116. Lactometer, for testing the quality of milk, and its adaptability for butter or cheese. (Particulars free by post, with instructions) ... £0 3 6

117. **Magnifying Lenses**, most useful for examining seeds, &c., for the pocket, 1s., 1s. 6d., 2s.; and with treble lenses £0 3 6

118. **Hand Magnifying Lenses**, for reading or viewing maps, flowers, seeds, &c. ... 2s. 6d. to 8s. 6d.

For Rain-Band Spectroscopes, see page 36.

ANEMOMETERS AND WIND VANES.

119. **Anemometer (Lind's)**, in which the pressure or force of the wind is shown by the depression and elevation of a column of water below and above the zero of the scale ... £2 2 0

120. **Anemometer (Lind's)**, improved by Sir W. Snow Harris £2 5 0

121. **Anemometer** (Robinson's improved), for registering the velocity of the wind in miles and tenths, up to 505 miles, as *originally* made by L. CASELLA for the Royal Engineers, and described by Sir Henry James, R.E., F.R.S., in his *Instructions for taking Meteorological Observations* (fig. 121) £4 4 0

122. The same instrument, but registering to 1010 miles. £5 0 0

123. **Robinson's Anemometer**, as No. 121, with extra dial extending the registration to 5050 miles £5 10 0

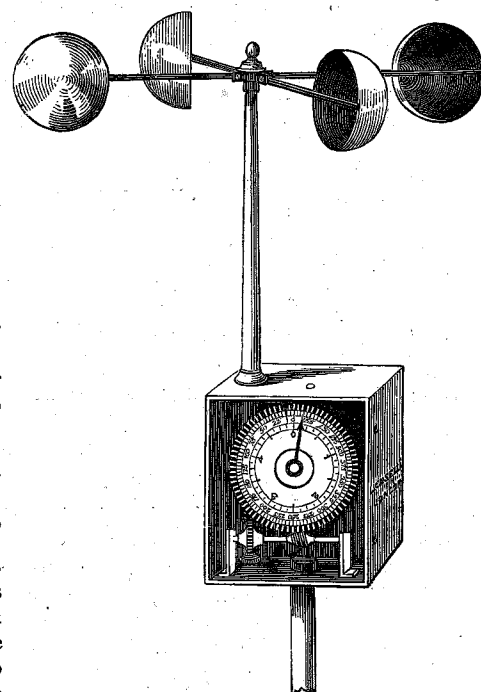


Fig. 121.

124. **Electrical Anemometer**, on the above principle, with simple apparatus, by means of which the anemometer may be placed at any distance or height, whilst the indicating dial is kept for observation in any part of the house £10 10 0

125. **Casella's Electrical Anemometer and Wind Vane** combined, as made for the Indian Government, &c. from £22 0 0

SELF-RECORDING ANEMOMETERS.

126. **Casella's Embossing Anemometer**, for registering the velocity and direction of the wind, and the time of its various changes ... £65 to £70

127. **Enlarged Anemometer, or Anemograph**, for harbours and public observatories, a much improved form of the instrument as originally constructed by L. CASELLA for the Kew Observatory and the other observatories of the Meteorological Office of the Government ... £95 to 125

128. **Anemograph**, but self-contained, as used in the principal observatories in Spain and Portugal ... £45 0 0

129. **Casella's Air Meter, or Pocket Anemometer**, for mines, hospitals and other public buildings. The object of this little instrument is to give correct means of measuring the velocity of currents of air passing through coal and other mines, and the ventilating spaces or shafts of hospitals, &c. Although now badly copied, it was *originally* arranged and made by L. CASELLA for Dr. Parkes, F.R.S., of the Royal Victoria Hospital, Netley... £4 4 0

ATMOSPHERIC ELECTRICITY.

130. **Thomson's Quadrant Electrometer**, with lamp and scale, complete in mahogany box, with full directions for use £35 0 0

131. **Thomson's Quadrant Electrometer** (CASELLA's pattern) of simpler form than the above, sufficiently sensitive to show the potential of a single cell, in case ... £8 0 0

132. **Thomson's Portable Electrometer** (attracted disc) complete, in mahogany box, fitted with electrophorus £11 11 0

133. **Peltier's Electrometer**, as used by Professor Palmieri in his observatory at Vesuvius. In pine case ... £3 3 0

TERRESTRIAL MAGNETISM.

134. **Magnetograph**, as used at the Kew Observatory £330 0 0

This instrument furnishes, by the aid of photography, a continuous record of the changes continually occurring in the magnetic force of the earth, both in direction and intensity.

For observations of declination made in a less refined manner azimuth compasses are usually employed, and CASELLA's Dipping Needle Instrument should also be mentioned. For prices see page 20.

135. Inclinometer or Dip Circle, (fig. 135), with all recent improvements. This instrument, known as the Kew Pattern Dip Circle, is an arrangement for delicately suspending a needle on a transverse axis resting on two agate pillars, with cylindrical surfaces; a microscope, carried on a 4-inch circle divided on silver, enables the position of the needles to be observed with the greatest accuracy. It is furnished with LLOYD'S APPARATUS, by which the TOTAL FORCE can be measured at any place, if observations have been first taken at a base station to determine the constants

£36 10 0

Kew verification fee,
£3

The same without Lloyd's Total Force Apparatus ... £31 10 0
Kew verification fee, £1 10s.

136. Kew Pattern Unifilar Magnetometer ... £65 0 0

A table of constants, which are specially computed for each instrument, is supplied from the Kew Observatory at a charge of £5. Forms for use with this instrument extra.

137. Fox's Circle, or Inclinometer, for use on board ship, £35 0 0

Kew Constants extra.

138. Casella's Dipping Needle Instrument ... £5 10 0

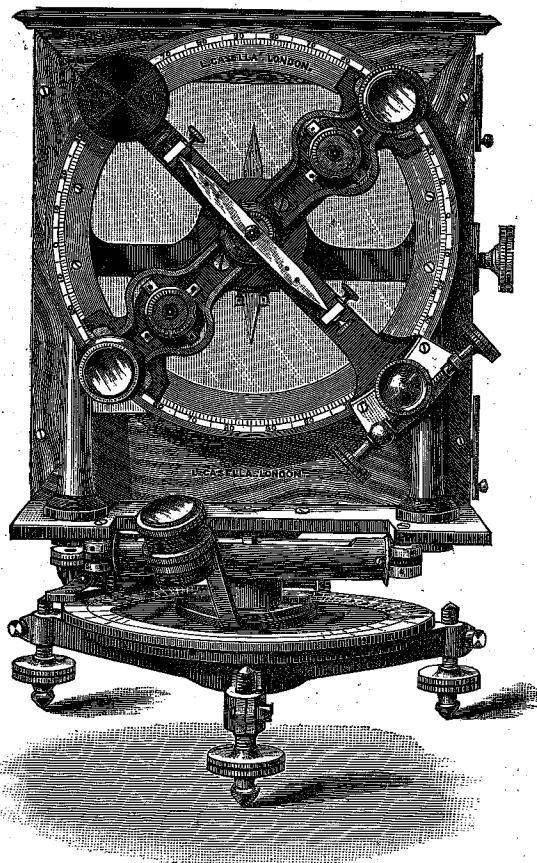


Fig. 135.

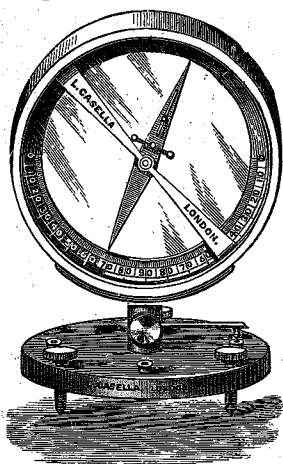


Fig. 138.

TIDE GAUGES.

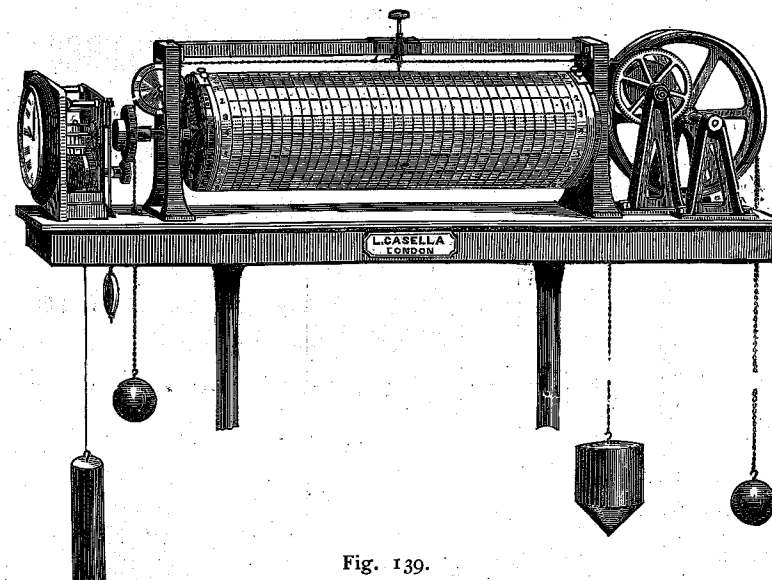


Fig. 139.

139. Tide Gauge (Self-Recording), for showing the rise and fall of water in harbours, rivers, canals, locks, &c., recording the exact time at which any increase or reduction may have occurred ... from £48 0 0 to £60 0 0

140. Do., do., with vertical cylinder, portable form, an entirely new instrument ... £60 0 0

Other patterns made to order.

BOOKS ON METEOROLOGY, ELECTRICITY, &c.

GLAISHER, J., "Hygrometrical Tables" ...	£0 2 6
"Hints to Travellers," Royal Geographical Society ...	0 8 0
SCOTT, R. H., "Instructions for the use of Meteorological Instruments" ...	0 2 6
"Elementary Meteorology" ...	0 5 0
STEWART, BALFOUR, "Elementary Treatise on Heat" ...	0 7 6
SYMONS, G. J., F.R.S., "British Rainfall," 1865, and subsequent years ... per year	0 5 0
"Monthly Meteorological Magazine" ...	0 5 0
WELLS, W. C., On Dew; new Edition, by L. CASELLA, F.R.A.S., &c., with Appendix, by R. STRACHAN, F.R.M.S. ...	0 4 0
"Electrical Pocket Book," by J. MUNRO and A. JAMIESON ...	0 7 6

N.B.—All Scientific Books, Charts, Nautical Almanacs, &c., supplied to order.

METEOROLOGICAL and MISCELLANEOUS INSTRUMENTS
FOR THE
ARMY AND NAVY, TRAVELLERS AND EXPLORERS.

Most of the following instruments having been expressly designed or rearranged for distinguished explorers and travellers, equipped by L. CASELLA, he can confidently recommend them as perfect and efficient for their respective purposes.

N.B.—Practical instruction and demonstrations can be given in the use of any of the instruments referred to in this list.

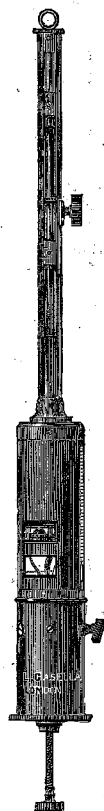


Fig. 143.

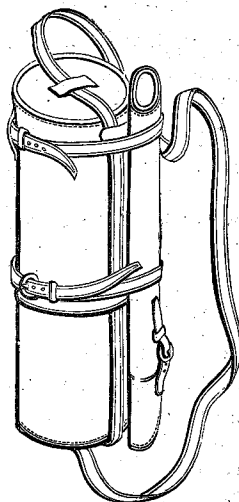


Fig. 144A.

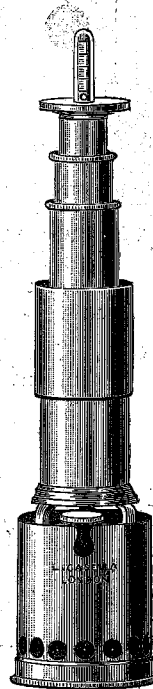


Fig. 144.

141. **Standard Mountain Barometer**, the same as the Standard Fortin Barometer No. 3 (p. 3), but much reduced in size of frame, by which it is rendered so portable as to remove nearly every difficulty hitherto found by travellers in carrying a mercurial barometer. With inch and millimetre scales and tripod stand, complete, in improved leather-covered shield case £10 10 0

If without case, 25s. less.

. Kew verification, if required, at an extra charge of 10s. 6d.

**MERCURIAL BAROMETERS AND
THEIR SUBSTITUTES.**

142. **Mountain Barometer**, Gay Lussac's syphon tube, with vernier to each limb, reading to '002 of an inch, the difference between the two readings giving the height of the barometer. In improved leather-covered shield case £6 10 0
If with tripod stand, £8.
143. **The Boylean-Marriotte, or Mercurial Standard Pocket Barometer**, invented and patented by Telford Macneill, Esq., C.E. (page 22), and now considerably improved and modified £10 10 0
Full description and instructions will be sent on application.
144. **Casella's Hypsometer**, for measuring mountain heights by the vapour of boiling water. In portable leather case packed for travelling. Price, with one thermometer, divided to 0°·1, as arranged and made by L. CASELLA for the Government (figs. 144 and 144A) £4 15 0
Extra thermometers for the above, in brass case, each £1 5s.
145. **Pocket Hypsometer**, in portable leather sling case, with one thermometer, divided to 0°·2, as supplied to the Royal Geographical Society £2 10 0
Extra thermometers, in brass case, each £1 1s.
- The above Hypsometrical Thermometers may be had self-registering, if required.
146. **Casella's Tables**, with instructions for using the hypsometer, second edition £0 1 0

THERMOMETERS, &c.

147. **The Casella-Miller Deep-Sea Thermometer**, for registering the maximum, minimum, and present temperatures of the sea to its greatest depths, as supplied only by L. CASELLA, to the English, Indian, French, American, Russian, Italian, German, Austrian, Norwegian, Danish, and other Governments and scientific authorities (fig. 147).

If tested to bear a pressure of $2\frac{1}{2}$ miles deep in the sea, with table of errors at various pressures if required £2 10 0

If tested for three miles deep, or three tons per square inch, with tables above £3 3 0

If tested for five miles deep £3 10 0

Ditto, Buchanan's Large Size £5 10 0

Ditto, do. Small Size £4 10 0

These thermometers, for higher pressures, made to order.

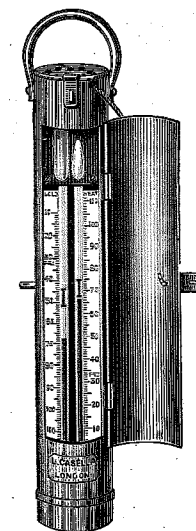


Fig. 147.

148. Maximum and Minimum Thermometers; the pair, in a neat pocket mahogany case for travellers, as first arranged by L. CASELLA for Dr. Livingstone and Captains Burton and Speke. They are indelibly divided on the stem, and cannot be injured in travelling, unless by actual breakage £2 2 0

149. Maximum and Minimum Thermometers, of smaller size, as specially designed by L. CASELLA for the Alpine Club, and for use at sea; very portable, and admirably adapted for travelling invalids (*fig. 149*)... £1 5 0

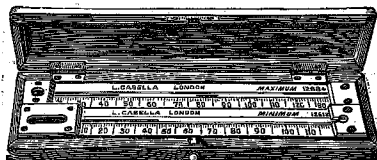


Fig. 149.

150. Portable Pocket Hygrometer (Wet and Dry Bulb). A most convenient form of instrument for travellers (*fig. 150*), especially designed by L. CASELLA as a companion instrument to his Alpine, or pocket, maximum and minimum registering thermometers (*fig. 149*), aneroid barometers (pages 6 and 7), and Livingstone's rain gauge ... £2 5 0

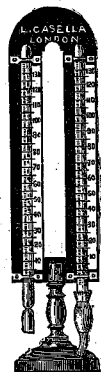


Fig. 150.

151. Do., do., in folding wood case, very compact, £1 10 0
152. Pocket Thermometer, for showing temperatures of air or water, divided on ivory, and mounted on ebonite, revolving in metal shield; length $4\frac{1}{2}$ in. £0 12 6
153. Current Meter ... £6 10 0

Larger sizes and varieties made to order.

SURVEYING INSTRUMENTS.

THEODOLITES, LEVELS, &c.

154. Travellers' Transit Theodolite, of best make, with telescope at side, in a small and complete form, light and handy for Alpine and Military Surveying, and occasional Astronomical Observations, with diagonal, inverting and erect eye-pieces, and reflector in case, $7\frac{1}{4} \times 5\frac{1}{2} \times 4\frac{1}{2}$ inches, weight $4\frac{1}{4}$ lbs., with tripod stand complete (*fig. 154*) ... £16 10 0

155. Travellers' Transit Theodolite, as above, but with telescope in centre, much used by the Indian Government, as well as by the United States Coast Survey (*fig. 155*), in case complete, $10\frac{1}{2} \times 5 \times 4$ inches, weight $5\frac{1}{4}$ lbs. ... £19 10 0

Special Portable Stands with jointed legs for either of the above, extra 38/.

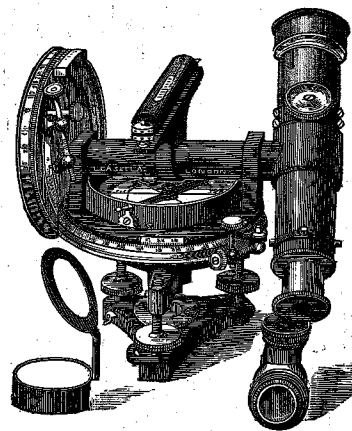


Fig. 154.

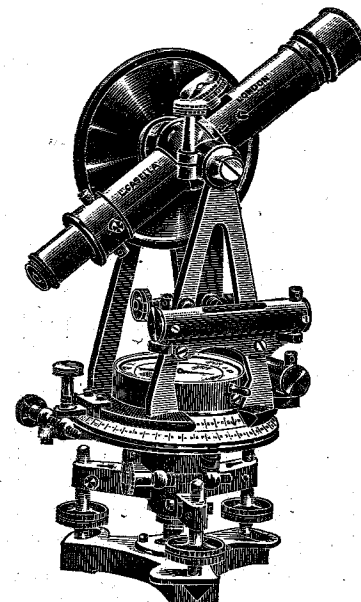


Fig. 155.

156. 3-inch Theodolite, best construction, divided on silver with verniers reading to 1 minute, with rack adjustment, best achromatic telescope, erect and inverting eye-pieces, tangent screw and clamp adjustments, compass, cross levels, parallel plates, &c., &c., in mahogany case, with tripod stand, complete £18 0 0
157. 4-inch Do., with all improvements, as above, to 1 minute, £19 10 0
158. 5-inch Do., ,, ,, ,, 1 minute, £22 10 0
159. 6-inch Do., ,, ,, ,, 30 seconds, £28 10 0

To 10 seconds, 10s. extra.

Larger sizes and special patterns made to order.

160. 3-inch Transit Theodolite, best construction, with vertical and horizontal circles, divided on silver with verniers reading to 1 minute, readers, compass, rack adjustment, best achromatic telescope, with level, diagonal, erect, and inverting eye-pieces, cross levels, tangent screw and clamp adjustments, parallel plates, in mahogany case, with tripod stand, complete £22 12 0

161. 4-inch Transit Theodolite, best construction, with vertical and horizontal circles, divided on silver with verniers reading to 1 minute, readers, compass, rack adjustment, best achromatic telescope, with level, diagonal, erect, and inverting eye-pieces, cross levels, tangent screw and clamp adjustments parallel plates, in mahogany case, with tripod stand, complete
£24 0 0
162. 5-inch Do., do., „ „ 1 minute, £27 5 0
163. 5-inch Do., do., „ „ 30 seconds, £27 15 0
164. 6-inch Do., do., „ „ 20 seconds, £32 0 0

To 10 seconds, 10s. extra.

Nos. 156 to 164 may be had with 3 screws and locking plate, instead of 4 screws and parallel plates, at an extra cost of 22s. for 3 inch, 30s. for 4 inch, 45s. for 5 inch, and 60s. for the 6 inch.

165. 7-inch Transit Theodolite, to 10 seconds, as the 6-inch above, with illuminated axis, axis level, lamp, tripod, and locking-plate, &c., &c., in case, with extra strong lath stand, complete
£43 10 0
166. 8-inch Do., do. „ „ „ „ £51 0 0

Larger sizes and special patterns made to order.

167. 5-inch Engineers' Transit Theodolite, strong American pattern, as used in the United States, with 3-inch needle, horizontal covered limb, divided on brass with two verniers, telescope, large parallel plates, and tangent screw adjustments, in case, with tripod stand, complete ... £25 0 0
168. 6-inch Do., do., do., as above, with 4-inch needle £28 0 0
- If with locking-plates, 45s. extra.
If divided on silver, either of above, 28s. extra.
If with vertical circle divided on silver, £4 15s. extra.

169. 4-inch Tacheometer, or Transit Theodolite, parallel plates, for rapid surveying, and showing the distance without the use of tape or chain, in mahogany case, with tripod stand, complete ... £28 0 0

170. 5-inch Do., as above ... £32 0 0
- Nos. 169 and 170. If with tripod and locking-plate, £2 5s. extra.

Accessories for Use with Tacheometer—

Station Staff, £2 15s.; Metal Logarithmic Scale ... £5 0 0
Horn Protractor, 10s.; Book of Instructions ... £0 7 6
Moveable Stand Heads fitted to any of the above at an extra charge.

171. 18-inch Y Level, improved, best achromatic telescope, with rack motion to eye and object ends erect and inverting eye-pieces, and key adjustments, compass with raised divided silvered ring, ground level tube divided to tenths, with locking plate and three-screw adjustment, in case, with tripod stand, complete ... £24 0 0
172. 15-inch Do., do., as above ... £22 10 0
173. 12-inch Do., do., „ rack to object end only £13 10 0

174. 10-inch Gravatt's Level, improved, best achromatic telescope, with rack motion, compass with graduated aluminium ring, two eye-pieces, reflector, parallel plates, &c., in case, with tripod stand, complete... £13 10 0
175. 12-inch Do., do. „ „ „ „ £14 0 0
176. 14-inch Do., do. „ „ „ „ £14 10 0
177. 16-inch Do., do., with extra large telescope, with 2-inch object glass, and 5-inch compass, &c., &c., as above £18 0 0
- Any of the above may be had with 3 screws and locking plate at an extra charge.

178. Improved Drainage or Builder's Level, with telescope, cross lines and parallel plates, in case, with round firm tripod stand, complete... £4 10 0
179. 8-foot Levelling Staff, one fold for Do. ... £0 19 0
180. Cushing's Reversible Level, 14-inch, greatly improved, in case, with lath-stand, and locking-plate complete, £24 0 0
181. 11-inch Builder's Level, strong American pattern, as used in the United States, with large parallel plates, clamps and screw adjustments, large level and divided scale to telescope and level, &c., in case, with round tripod stand, complete, £12 0 0
182. 15-inch Do., do., as above ... £14 10 0

(Sling leather cases for the boxes of any of the preceding instruments may be had at an extra cost.)

183. 4-inch Circumferentor, or Miner's Dial, plain dial, plain cover, no levels, in case, with stand complete, £6 0 0
184. 5-inch Do., do., plain dial, divided cover, with case and stand, complete ... £7 15 0
185. 5-inch Do., do., with folding sights, divided circle to compass, cross levels, &c. „ „ „ „ £9 0 0
186. 6-inch Do., do., with folding sights, rack adjustment, divided cover, vernier divided to 3 minutes, cross levels, ball and socket joint and jointed legs ... £11 10 0
187. 5-inch Do., do., best improved, with telescope, rack adjustment, graduated arc, with vernier reading to 3 minutes, cross levels and shifting folding sights, &c., &c., with jointed stand and parallel plates, in two cases ... £16 0 0
188. 6-inch Circumferentor, with all improvements, as above, £17 0 0
189. Headley's Dial with telescope and quadrant, &c., £18 0 0
190. Do. do. „ sights „ „ £14 0 0
191. Headley's or Miner's Dial, greatly improved, 6-inch compass and rack motion to raised divided circle, ground divided cross levels, round jointed stand, and improved ball and socket adjustment, with spare points to use at half-length, in separate case ... £12 17 6
192. Levelling Staves, 14-feet, strong improved, with English or metric divisions ... £2 5 0

193. Levelling Staves, 14-feet, strong, improved, with painted figures and divisions £2 15 0
194. Levelling Staff, 4 metre or 14-feet, painted, and red dots, £2 5 0
195. Land Chains, in every variety, including strong Government pattern, with oval links—
33 ft., 7s. 6d.; 66 ft., 10s. 6d.; 100 ft., 11s. 6d. each.
196. Do. do. hardened tempered steel, japanned—
33 ft., 9s. 6d.; 66 ft., 18s.; 100 ft., £1 1 0 each.
Sets of Arrows for the above, 1s. to 1s. 3d. per set.
197. Land Chains, steel band, coiled on cross frames when not in use—33 ft. and links, 12s. 6d.; 66 ft. and links, 20s.; 100 ft. and links £1 13 0 each.
(The above divided into feet and inches at a slight increase in price, and other sizes at prices in proportion.)
198. Plotting Scales, in boxwood and ivory, as specially made by L. CASELLA for the Ordnance Survey and other Government Departments.
199. Scales and Rules, Rolling and Plain Parallel Rules, in every variety. (See Catalogue.)
200. Drawing Boards, most approved construction, grooved deal, ebony edge, battans, brass slots, &c.—
32 × 23, 13s. 6d.; 41 × 28, 19s. 6d.; 54 × 32, £1 7s.
201. Tee Squares, mahogany taper-blade, ebony edge—
best 24 inches, 5s. 6d.; 32 inches, 7s. 6d.; 42 inches, 9s. 6d.
202. Set Squares, in pearwood, vulcanite, framed mahogany, &c., to any angle.

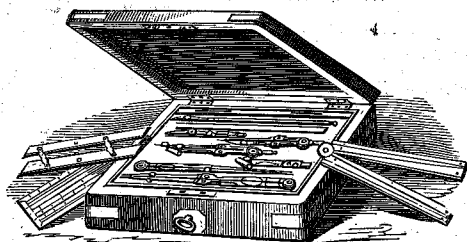


Fig. 208.

203. Set, in mahogany case, with compasses, ink and pencil points, 5-inch divider, bow pen and pencil, drawing pen, pencil, sector, protractor, ebony parallel rule, and steel key; in brass, well suited for schools or public institutions £1 1 0
204. Set, as above, in electrum £1 8 0
205. Set, as used at the Military Training Colleges, with 6-inch best brass compasses with sector joints, ink and pencil points, lengthening bar, bow pen and pencil, 5-inch best divider, large and small drawing pen, knife key, military protractor, sector, parallel rule, and set of marquois scales, in 13-inch polished mahogany box with lock and key £2 17 6
206. Set, as above, with instruments in electrum £3 10 0

207. Set of Electrum Instruments, in rosewood case, lined with silk velvet, containing 6-inch compasses, best sector joint, with ink and pencil points and lengthening bar, bow pen and pencil, set of three spring bows, hair divider, large and small drawing pen, pricker, knife key, and three ivory scales £3 16 0
208. Set of Electrum Instruments, in rosewood case, 7 in., with silk velvet lining, bound with electrum for warm climates, with best tumbler lock and key, containing 6-inch compasses, pen and pencil points, all with best sector joints, and improved points for needles, bow pen and pencil, lengthening bar, hair divider, set of three spring bows, large and small drawing pen, pricker, and knife key, with either three architect's or engineer's scales, or ivory sector, protractor and parallel rule (fig. 208) £5 10 0
209. Set, the same as No. 208, but with case not bound and the points not to hold needles £4 10 6
210. Set of Best Electrum Instruments, in walnut or rosewood case, lined with silk velvet and bound with electrum, with best tumbler lock and key, containing improved 6-inch compasses with pen and pencil points, bow pen and pencil, with best double joints and improved points for needles, lengthening bar, improved 5-inch hair divider, set of three spring bows, with points to hold needles, proportional compasses engine divided, large and small drawing pens, railway or road pen, pricker, knife key, with three best ivory scales for architects or engineers, or with ivory protractor, sector, and rolling parallel rule £8 10 0
211. Set of Superior Electrum Instruments, in walnut case, bound with electrum, with silk velvet lining, two trays, and Hobbs's patent lock and key, containing 6-inch compasses with pen and pencil points, bow pen and pencil, all with best double joints and improved points for needles, long and short lengthening bar, 5-inch hair divider, set of three spring bows with improved points for needles, best proportional compasses engine divided, railway or road pen, three assorted drawing pens, pricker, knife key, improved vulcanite angles and curves, best ivory protractor, rolling parallel rule, sector, and set of three metrical or duodecimal scales £10 15 0
212. Set of Electrum Instruments, in handsome walnut Magazine case, bound with electrum, best patent lock, and silk velvet lining, containing 6-inch compasses, with double joints and improved points for needles, pen and pencil points and lengthening bar, 4-inch double-jointed compasses with pen and pencil points, and improved point for needles, bow pen and pencil with double joints and needle points, set of three spring bows, hairspring divider, beam compass heads with ink and pencil points and fine adjustment, proportional compasses engine divided, three assorted drawing pens, dotting

- wheel pen with set of wheels, railway or road pen, needle pricker, tracer, knife key, six 12-inch best boxwood chain scales with offsets, 12-inch rolling parallel rule with ivory divided edges, protractor, angles and curves... £15 10 0
213. Set of Electrum Instruments, in rosewood, walnut, or mahogany Magazine case with silk velvet and Hobbs's lock and key, containing 6-inch best compasses with double joints, pen and pencil points and lengthening bar, hair spring divider, bow pen and pencil with double joints, proportional compasses engine divided, beam compass heads with ink and pencil points and fine screw adjustments, three spring bows, three drawing pens assorted, railway or road pen, needle pricker, tracer, knife key, 12-inch rolling parallel rule with ivory edges, set of three chain scales with offsets, horn protractor, angles and curves £8 10 0
214. Set of Electrum Instruments, in rosewood or mahogany case, with silk velvet lining, and tumbler lock and key, containing 6-inch compasses with best sector joints, pen and pencil points, lengthening bar, bow pen and pencil, railway or road pen, hair spring divider, needle pricker, large and small drawing pen, set of three spring bows, beam compass heads with pen and pencil points, and knife key, 12-inch ivory engineer's or architect's scale, 12-inch rolling parallel rule, set squares, curves, and horn protractor ... £6 10 0
215. Sets of Instruments, in pocket cases, of best Russian or Morocco leather, with best electrum instruments, made up to order at corresponding prices.
216. Ditto, ditto, as above, in neat and compact oak case, with rounded edges and bar fastening, to order.
217. Drawing Sets of Instruments, Admiralty pattern £3 10 0
 " " " Ordnance " £2 15 0
 " " " Woolwich " £1 12 6
 " " " Geographical Society's pattern
 in brass bound case ... £3 7 6
218. Beam Compass Heads, superior brass or electrum mounts, two verniers, clamps and fine adjustments, Ordnance pattern, for any length beam, to order.
219. Beam Compass, tubular, in electrum, with 3 drawers extending to 30 inch and closing up to 12 inch, ink and pencil points, best quality, in case ... £2 7 6
220. Ditto, ditto, as above, with screw adjustment and improved points for needles, in case ... £2 17 6

221. Proportional Compasses, 6-inch electrum, fully divided, in case ... £1 10 0
222. Ditto, ditto, as above, with adjustment ... £2 5 0
223. Ditto, ditto, 9-inch fully divided, in case ... £2 10 0
224. Ditto, ditto, 9-inch fully divided, with adjustment, in case £3 17 0
225. Pillar Compasses, in electrum, with reversing ends, forming a complete set of drawing instruments, in case £1 7 6
226. Ditto, ditto, as above, with lengthening bar ... £1 12 6
227. Napier Compasses, in electrum, ink and pencil points to revolve, in morocco case, with spare leads in ivory box £1 5 0
228. Ditto, ditto, as above, in silver ... £2 8 0
229. Compasses and Dividers, in brass or electrum, in every variety, plain and needle points.
230. Bow Pen and Pencil, in brass or electrum, plain or needle points.
231. Steel Spring Bows, a set of three, or single, best plain or needle points, any size, to order.
232. Drawing Pens, plain or jointed, best.
233. Bordering or Colouring Pens.
234. Lithographic do.
235. Railway or Road do.
236. Dotted do.
237. Needle Prickers and Tracers.
238. Map Meters.
239. Centrolinead.
240. Semi-Elliptic Trammels.
241. Lithographic Crow Quill or Mapping Pens.
242. Drawing Materials, paper, solid, moist or liquid colours &c., &c.

ALTAZIMUTH.

243. Casella's Pocket Altazimuth, for travellers and military surveyors, improved and modified by the kind assistance of Francis Galton, Esq., F.R.S. Altitudes, azimuths, compass bearings, clinometric degrees and levels are all obtainable by this handy and accurate little instrument, whose diameter is

$2\frac{1}{4}$ inches, thickness $1\frac{1}{8}$ inches, and weight 8 ounces. Its usefulness has been so much increased by the recent addition of an excellent telescope for distant objects, as well as in the

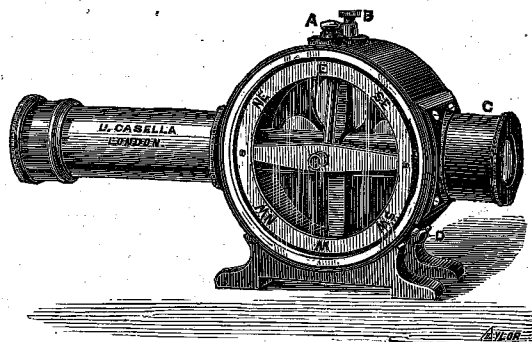


Fig. 243.

arrangement of stops, as to make it perfect for the various purposes to which it is applicable (*fig. 243*) ... £6 6 0

244. Goad's Patent Altazimuth, with improved compass, &c., &c., adapted for use as a hand instrument in reconnoissance on preliminary or rapid exploring works, as well as for surveys of greatest precision on surface, underground mine or other workings, in leather sling case (the compass always preserves the horizontal position) ... £12 0 0
245. Ditto, ditto, as above, with Theodolite Base, and Folding Stand ... £32 0 0

SEXTANTS.

246. Pillar Sextant (highly finished), 7 inch radius, divided on silver, with verniers reading to 10 seconds, four telescopes, spring tangent screw, seven neutral shades, star-finder, and swing reflector, in best polished mahogany case £15 10 0
247. Metal Sextant (Midshipman's), with three telescopes, seven neutral shades, divided on silver to 10 seconds, in polished mahogany case ... £7 10 0
If with star-finder, extra, 15s.
248. Metal Sextant, with best centre, three telescopes, seven neutral shades, and ground glass reflector, divided on ivory to 15 seconds, in polished mahogany case ... £4 15 0
Other sizes and prices, *see* Catalogue.
249. Pocket Sextant, with telescope, levels, and supplementary arc, in leather sling case ... £6 5 0
250. Pocket Sextant, with telescope, and supplementary arc, in leather sling case ... £5 15 0
251. Pocket Sextant, with telescope, in case, as supplied to the Royal Engineers ... £3 10 0 & £4 15 0

ARTIFICIAL HORIZONS.

252. Casella's Mercurial Artificial Horizon. A metal box containing mercury is covered by a glass with parallel surfaces. When not in use, a slide valve admits the mercury into a lower compartment, so that it cannot be spilled. $3\frac{1}{2}$ inches diameter. In leather sling case ... £3 15 0

This is the most perfect portable Artificial Horizon yet made.

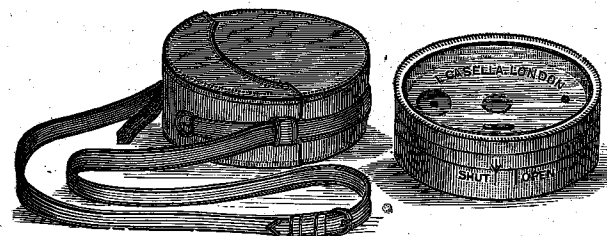


Fig. 252.

253. Artificial Horizon, mercurial, improved, Ordnance pattern, metal roof, with perfectly parallel glasses, iron trough, highly polished iron bottle with mercury, in polished mahogany case, with improved packing ... £4 10 0
254. Artificial Horizon, portable, Admiralty pattern, of perfectly parallel black glass, with two levels and three adjusting screws, in mahogany case, for the pocket ... £2 10 0
- Kew Certificate for ditto, extra ... £0 5 0
- Artificial Horizons of any other pattern made to order.

STATION POINTERS.

Station Pointer, or treble arm protractor, with which two angles relative to a base may be taken together; a convenient instrument for plotting or sketching in new countries, where magnetic bearings may lead to error, from local and other causes.

255. Station Pointer, 4-in. brass divided circle, with 10-in. arms and tangent screw adjustment, best construction ... £7 10 0
256. Do. do. divided on silver, with arms lengthening to 18 inches, in case complete ... £8 8 0
Other sizes up to 8-in. and length of arms in proportion, or if divided on silver, 12s. to 20s. extra.
257. Abney's Level, improved ... £2 10 0

258. 6-inch Protractors, circular, brass, divided on silver, with two folding arms, and verniers reading to 1 minute, clamps and tangent screw adjustments, in neat polished mahogany case ... £6 0 0
259. 6-inch Do. do. Electrum, divided to 20 seconds, as above ... £7 0 0
260. 7-inch Do. do. Brass, divided on silver to 20 seconds, as above ... £7 0 0
261. 8-inch Do. do. do. do. do. £8 c 0
- If divided on brass instead of silver ... 15s. to 20s. each less
- If divided to 10 seconds instead of 20 seconds, 17s. 6d. to 20s. extra
262. 6-inch Protractor, semi-circular, electrum, ordnance pattern, with arm and vernier reading to 1 minute, with clamp, in neat polished mahogany case ... £4 15 0
263. 8-inch Do. do. Brass, divided on brass, arm and vernier reading to 1 minute, with clamp, in neat polished mahogany case ... £4 15 0
264. 9-inch Do. do. Electrum, ordnance pattern, arm and vernier reading to half minutes, with clamp, in neat mahogany case ... £7 15 6
265. Protractors, circular, brass, 6-inch, 14s.; 7-inch, 17s.; 8-inch, 20s.; 9-inch, 22s.; 10-inch, 25s.
266. Do. do. Electrum, ... 5s. to 7s. 6d. extra
267. Protractors, semi-circular, brass, 6 inch, 8s.; 7-inch, 9s. 6d.; 8-inch, 11s. 6d.; 9-inch, 13s. 6d.; 10-inch, 18s.
268. Do. do. Electrum ... 3s. to 5s. extra.
269. Contouring Hand Level, for rapid surveying and military observations ... £1 12 0 to £2 5 0
270. Optical Squares, from 21s. to 25s.; Cross Staff Heads, with or without compass ... 6s. 6d. to £2 17 0
271. Graphometer, or Semi-Circle, with fixed and revolving sights, compass, &c., from ... 31s. to £3 15 0
272. Pantometers or Surveyor's Cross Staff Heads, with telescope, level, compass, rack motion to graduated centre, 3 adjusting screws, divided semi-circle and vernier, in case, with tripod stand, complete; from ... £6 10 0
273. Clinometer Level, brass, 6-in. or 9-in., with level, sights, and graduated arc, for determining inclination of strata, also for draining and levelling, in neat case with socket for staff 6-in., £1 15 0; 9-in., £2 15 0
274. Clinometer, with two levels and sights, compass, inclination scale and scale of fathoms, in 6-in. case, best quality £1 17 6

275. Clinometer (Geographical), having 12-in. boxwood rule, folding to 6 inches, divided arc and pendant, with scale of angles and the comparative scale of thermometers £1 1 0
276. Angles and Set Squares, &c., in ebonite, pearwood, and mahogany frames.
277. Railway or Radii Curves, in sets of 50 or 100, in pearwood, cardboard, or vulcanite.
278. Sun Dials, for the pocket, &c., &c., in proportion to size, see Catalogue.

COMPASSES.

279. Prismatic Compass, with sight, plain, in maroon or sling case ... 2½ in., £2; 3½ in., £2 10 0
280. Prismatic Compass, with sights, shades, and mirror, in maroon or sling case ... 2½ in., £2 13s.; 4 in., £3 12 0
- Any of the above with extra light aluminium ring, 15s. additional.
281. Prismatic Compass, 2¾ in., with sights, graduated aluminium ring, in maroon case; Ordnance and War Office pattern ... £2 10 0
282. Yacht or Boat Compass, with chrysolite cap, floating dial and gimbal movement, in round polished metal cases with lid 1½ in., 14s. 6d.; to 3 in., £1 3 0
283. Dipping Needle Compass (Casella's), with 3 in. needle, in neat pocket case ... £3 10 0

INSTRUMENTS FOR MEASURING DISTANCES.

284. Tape Measures, superior linen, Casella's improved, in best leather cases, with folding handles— 33 ft., 7s. 6d.; 66 ft., 8s. 6d.; 100 ft., 13s. 6d. each
- The above may be had with Casella's patent tape boxes at proportionate extra cost.
285. Steel Tape Measures, in leather cases, with folding handles, 33 ft., 19s.; 66 ft., 34s.; 100 ft., £2 7 6 each
286. Pocket Tape Measures, of various sizes.
287. The Passometer, or Step Indicator.—This admirable little instrument is used to show the number of steps traversed by the wearer ... 35s. to 80s.
288. Pedometer, with strong crystal glass ... 20s. to 45s.
289. Perambulator. An instrument of great utility for measuring the distance of places from each other, the length of roads, &c. Specially adapted for tropical climates £6 to £10 10 0
290. Trocheameter, for registering the revolutions of a carriage wheel, and thereby recording the distance travelled. Applicable also for counting with certainty the rotations of Machinery, however high the velocity ... £2 15 0

MEASUREMENT OF TIME.

291. Chronometer (Ship's) of the best construction and highest finish, as made for various Governments
2 days, £32; 8 days, £42 to £60
292. Improved Chronograph, for the correct registration of any number of rapidly passing objects, as at regattas and races, as well as eclipses and occultations of stars, the exact speed of machinery, &c. ... £4 to £7 10 0
293. Transit Instruments. See Standard List and Catalogue.

TELESCOPES.

294. Economic Telescope, for astronomical or terrestrial purposes, with brass pillar and metal stand for the table
£5 to £16 16 0
295. Astronomical Telescope, superior, with brass body and stand for the table ... £13 to £20 and upwards.
296. Sea Coast or Station Telescope ... £22 10 0
297. Equatorial Mountings, Stands and Apparatus. &c., &c., see Yellow List.
298. Telescopes and Binoculars for the army, navy, deer-stalkers, travellers and tourists, and target practice, see Catalogue.
299. Deer - Stalking (General Gordon's Portable) Telescope, with extra large field and increased light, closing up to 10 inches (as constantly used by the General in Egypt), with Binocular No. 300 ... £6 10 0
300. Captain's and Pilot's Binoculars (General Gordon's). Finest quality, in sling case (fig. 300) ... £4 10 0 to £6 15 0



Fig. 300.

SPECTROSCOPES.

301. Pocket Spectroscope, closing to $3\frac{1}{2}$ inches, with achromatic object glass and adjustable slit, suitable for rain-band observations, in brass case ... £2 5 0
302. Spectroscopes, Automatic, &c. from £4 10 0 upwards

CALCULATING AND DRAWING INSTRUMENTS.

303. Arithmometer or Calculating Machine, eight figures, £52; six figures, £42
304. Do. do. ... twelve figures, French make, £18

305. Pantagraphs, improved, flat bars, in cases complete, as supplied to the Government Departments, for extracting portions of plans of land to a reduced scale, &c.—18 in., £5 10s. 6d.; 24 in., £6 10s.; 30 in., £7 10s.; 36 in., £8 5s.; 42 in., £9 10 0
306. Pantagraphs, improved, with square tubular bars, for firmness and greater stability, in cases, complete—18 in., £6 5s.; 24 in., £8; 30 in., £10 5s.; 36 in., £11 10s.
307. Pantagraph or Engraving Machine, for enlarging or reducing maps and drawings, or multiplying small writing on valuable documents, as cheques, &c. ... £10 5 0 0
308. Eidographs, admirably adapted for reducing plans, &c., from any point of full size down to one-third, complete in case—36 in., £13 10s.; 30 in., £10 10s.
309. Planimeter, for calculating the areas of figures on paper, in case ... £3 10 0
Particulars of other sizes and kinds on application.
310. Drawing Sets. Admiralty pattern, £3 10s.; Ordnance pattern, £2 15s.; Woolwich pattern, £1 12s. 6d.; East India Company's pattern, £1 4s.; Sappers and Miners, 12s. 6d.

ELECTRICAL TEST INSTRUMENTS.

For Electrometers, see page 19.

311. Detector Galvanometer, with vertical needle, from £1 0 0 to £3 3 0
312. Portable Horizontal Astatic Galvanometer, 1500 ohms resistance, with jewelled centres, and small bar magnet, fitted in leather travelling case, best make
£3 10 0 and £4 15 0
313. Sir W. Thomson's Reflecting Galvanometer, tripod pattern, short thick wire, in case, fitted with lamp and scale
£10 and £12
314. Sir W. Thomson's Reflecting Differential Galvanometer, four coils, resistance from 5000 to 7000 ohms, glass cylinder pattern, £18; square pattern ... £19 0 0
315. Copy of B. A. Unit, as issued by the Committee of the British Association ... £3 0 0
316. Sets of Resistance Coils, various patterns
£8 10 0 and upwards

For other Electrical Test Instruments and Apparatus see larger Catalogue, and made to order.

Sprengel Air Pumps, Gimmingham's Improved, Crookes' Radiant Matter Tubes and other Physical Apparatus.
GIMMINGHAM'S PATENT DOUBLE BLOW PIPES £2 15 0

SPECIAL MILITARY AND NAVAL INSTRUMENTS.

317. Torpedo Instruments, with sight bars, in case, complete
£15 15 0
318. Gun Directors, or Concentrating Ship's Directors, as used in Her Majesty's Navy ... each £18 18 0
Do. do. latest improved ... „ £40 0 0
319. Gunner's Quadrant, for giving the gradient in directing guns, in case ... £5 10 0
320. Stadiometer, for the rapid measurement of distances, for rifle practice, &c. ... £4 10 0
321. Measuring and Weighing Machines, for measuring and weighing recruits ... £7 10 0
322. Standard, for measuring the height of recruits, as used in the Army ... £4 10 0
323. Ballooning, Military. Particulars on application.
324. Ship's Pendulum, as used in Her Majesty's Navy, for ascertaining the inclination or rolling of ships £5 10 0
325. Ship's Clinometers ... £2 15 0 and £3 15 0
326. Portable Heliograph, "The Brighton," by Colonel Bonham, complete, in leather case, with instructions for use. See p. 41.
- Spherometers, Wire Gauges, Callipers, &c. Particulars on application.
- Travellers' Photographic Sets, and all Photographic Apparatus, most improved Dry Plates, &c.

MISCELLANEOUS.

327. Improved Bourdon's Pressure and Vacuum Gauges, to any diameter and range.
328. Water Pressure Gauges, Improved Bourdon's, graduated in lbs. and feet of water to any range, for Water Companies, &c.
329. Hydraulic Pressure Gauges, to any pressure up to 10 tons.
330. Engine Counters, for rotary or reciprocal action, &c., four to seven figures.
331. Steam Engine Indicators, Richards'.
For fuller details of the foregoing, apply for Pressure Gauge List.
332. Water Test Glass Tubes, with clear plate-glass discs to unscrew at both ends, for testing the quality of water, as used by Water Companies, mounted vertically or horizontally.
333. Hydraulic Press, for physical investigations, &c.
334. Comparing Micrometers, pair, for comparing rules or measures and other standard bars, reading to $\frac{1}{1,000,000}$ th of a metre, in cases... £29 0 0

335. Steam Engine Indicator, Richards', with one spring, stop-cock, screw-tap, parallel rulers, and steel square, in mahogany case ... £8 10 0
Any of the parts may be had separately.
336. Camera Lucida, best, to clamp on drawing board or table, in mahogany case ... £2 5 0 and £3 10 0
337. Corndrometer, or Corn Balance, in mahogany case, complete, 1 pint, £3 7 6; $\frac{1}{2}$ pint, £2 11 0; $\frac{1}{4}$ pint, £2 5 0
338. Corndrometer, with attached funnel, &c., in mahogany case, complete ... 1 pint, £6; $\frac{1}{2}$ pint, £4 10 0; $\frac{1}{4}$ pint, £4 2 6

HYDROMETERS.

339. Standard Hydrometers, glass, with thermometer, &c., &c., in case complete ... £1 5 0
340. Standard Hydrometers, glass, in sets; with thermometer, &c., &c., in case complete ... £4 10 0 to £6 0 0
341. Sikes's Hydrometer, best gilt, complete, with thermometer, &c., in case ... £4 4 0
342. Casella's Direct Reading Proof Hydrometers and Book of Tables, as specially arranged for the Indian Government.

METEOROLOGICAL INSTRUMENTS

REQUISITE FOR SANITARY ENQUIRIES IN TOWNS, &c.

The Local Government Board having instituted an enquiry into the causes of **Summer Diarrhoea**, and other fatal Diseases of Infancy in this Country, has charged Dr. BALLARD with the investigation.

One important branch of the enquiry has relation to the **Climatic Conditions** existent in different Towns; and with a view to assisting it the Sanitary Authorities of several Towns have, at his request, undertaken to establish therein one or more Stations for accurate Observations as to **Atmospheric and Earth Temperatures, Atmospheric Humidity, Air Movement, and Rainfall.**

It may be added that, apart from this special enquiry, an acquaintance with the **Climatology** of his District seems now to be a *sine qua non* for a Medical Officer of Health in the due execution of his ordinary functions.

Inasmuch as observations made with instruments of doubtful accuracy would be valueless, the accuracy of these Instruments is guaranteed.

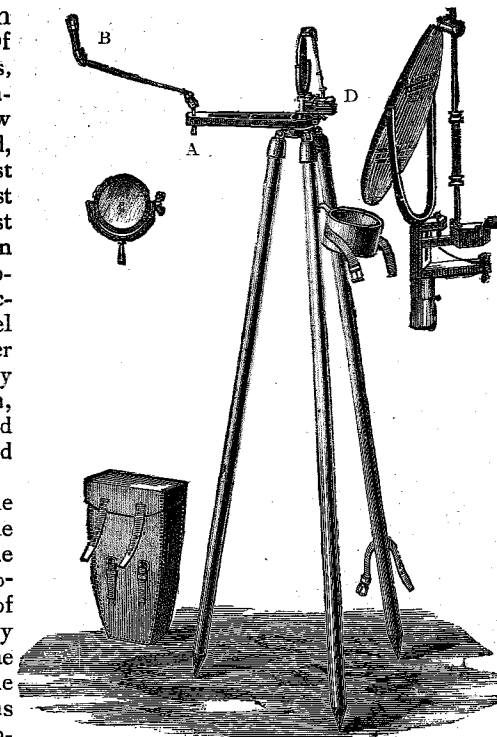
The following are the Instruments selected by Dr. BALLARD for this purpose:—

	£	s.	d.
Barometers, see pages 3 and 4.			
Maximum Thermometer	1	0	0
Minimum "	1	0	0
Wet and Dry Bulb Hygrometer	1	15	0
Stevenson's Thermometer Stand	1	15	0
Symons's Earth Thermometer (1 foot)	1	1	0
" " " (4 feet)	1	10	0
Rain Gauge	1	1	0
Robinson's Anemometer	5	10	0
Verification of Thermometers	0	10	0

(Sheets ruled for recording Observations can be supplied at a moderate cost.)

The Brighton Heliograph. Of theseveral Heliographs, the BRIGHTON or Combination form is now decidedly preferred, being not only the least expensive but the most complete and easiest to use. Improved on the Etchowe Heliograph (Major Macgregor's), by Colonel Bonham, Grenadier Guards. As used by the British, Indian, Colonial, French and Swedish armies, and by the Volunteers.

In setting up the Heliograph, place the legs as shown in the diagram, put the support A on the head of the stand and lightly clamp it, insert the long arm B, place the mirror in its socket as at D, letting the projecting or steadying pin on its stem into the slot. It may then be turned by the milled-headed screw, which should be on the left hand side, so as to face the distant station, and regulate the length of the flash by means of the capstan-headed screw on saddle piece over the lever arm, the pin for which should be in the top front of the case.



TO USE THE HELIOGRAPH.

WHEN THE SUN IS IN FRONT OF SIGNALLER.—Stand in front of, but a little on one side of mirror, and looking into it bring the mirror, by means of the horizontal and vertical screws, into such a position that the spot in centre of mirror cuts off the reflection of distant station; then move the sighting rod and vane until its reflection comes into an exact line with itself and the distant station. The flash is then thrown on to the vane (which must be firmly clamped and not shifted), and is rightly aligned when the dark shadow spot from centre of mirror is thrown on to the vane. The mirror must then be moved up or down and to the right or left until the spot falls on the vane; it is then ready for use.

WHEN THE SUN IS BEHIND THE SIGNALLER.—It is then necessary to use both mirrors, place the signalling mirror facing the sun and the auxiliary mirror inclining to the distant station, stand in front of the Heliograph and looking into the mirror, so that the whole of the

auxiliary mirror can be seen reflected. Move the latter horizontally or vertically until the distant station, the spot on the auxiliary mirror, and the unsilvered spot on the signalling mirror are in the same line; the auxiliary mirror can then be firmly fixed in its socket, and the mirror clamped with the nut at the side.

In signalling the left hand is kept on the milled head and the right on the signalling key; the necessary adjustments to suit the motion of the earth, and to keep the shadow spot on the sighting vane can be made with the left hand, by turning the Vertical telescope piece, while in the act of signalling, without interruption or delay.

Extracts from a Lecture delivered by Major A. S. WYNNE, 51st L. I., on Monday Evening, March 15, 1880—Gen. Sir Daniel Lysons, K.C.B., Quartermaster-General, in the Chair.

(Page 1) . . . and subsequent reports testified to the success of experiments which had been tried to ranges of 50 miles without telescopes, one memorandum going so far as to state that with a 6-inch or 8-inch mirror, signals could be seen with the naked eye at a distance of 100 miles in India.

(Page 8.) From the Khandahar field force it is reported that on the 12th December, 1878, a camp being discovered lying under the Kejak range, distant 20 miles, a Heliograph was laid on it and a reply soon received.

After marching eight miles further on the same day communication was opened with a camp 25 miles off, which turned out to be the headquarters of General Biddulph's division.

Discovered a camp, which proved to be Gundamuck, distant about 30 miles. With a 3-inch Heliograph he attracted attention, and in fifteen minutes Generals Roberts and Brown, commanding the Peshawur and Kuram columns, were in communication.

PRICES.

3-in. in leather cases, weight about 4 lbs. each	per pair	£10 0 0
5-in. " " 5½ lbs. each (these are very portable)	"	13 13 0
8-in. semi-portable ditto	"	20 0 0
10-in. for fixed stations, in wooden box	"	25 0 0
Lanterns (copper) with the nearest approach to parallel rays, on jointed tripod, and packed in leather case, with key and shutter for night signalling, so as to be used either with or without the Heliograph	each	4 15 0

Any of the above Instruments can be supplied with all the mirrors perfectly parallel, at an extra cost.

INSTRUCTIONS FOR PRACTICE.

1. Practice making dots at regular intervals until they are produced with the regularity of clockwork, and of definite and uniform duration. The tick of a watch or clock will assist in doing this.

2. Next make dashes; first, at the rate of about one per second, which may be afterwards gradually increased to two or three. The space between dashes must be as short as possible. If the upward motion in forming the space be made full, it cannot be made too quickly.

3. Next try separate dots such as form the letter E.

4. Separate dashes. Let them be of equal length.

T

5. Next the letter A may be taken up.

Time this by the pronunciation of the word *a-gain*, accenting the second syllable. The tendency of beginners is to make the dot too short, and particularly to separate them too much.

6. Having practised sufficiently in A, the student may try N.

This will be found more difficult. The universal tendency is to separate the dot from the dash by too great a space.

Time this by pronouncing the word *nine-ty* slowly.

Having practised the above elements thoroughly, the following exercises should be taken up in order:—

(1.) E I S H 5 Full Stop or Period

These should be practised separately until the right number of dots be made invariably, the last dot in each being neither longer nor shorter than the preceding ones.

(2.) T M O Ch

In practising this exercise be careful not to separate the dashes too much, and also to make the final dash in each

letter exactly equal to the preceding ones. Beginners usually make the final dash too short.

(3.) A U V 4

The usual tendency to make too much space between the dot and the dash in the above letters may be avoided by making them as if prolonging the final dot in I, S, H, and the figure 5.

(4.) I A S U H V 5

These should be practised in couples, the object being to impress upon the student the difference in the characters thus coupled together.

(5.) N D B 6

Having thoroughly mastered the preceding exercises, the student will have no difficulty in forming the above characters.

(6.) A R L Inverted Commas Comma

Fresh Line or Paragraph W P

The only caution necessary in this exercise is to form the letters compactly, with the dashes of equal length (See Exercise 2). Observe that the inverted commas may be formed by running A U together, &c.

(7.) U F Accen- Repeat, or Note ted e of Interrogation

These require no particular directions.

(8.) K C X Inverted Commas

G Z Diphthong OE

C and K are generally considered the most difficult letters in the alphabet. Do not separate C into double N, and be careful that the dashes correspond in length. (See Exercise 2.) The figures 7 and 9 require care in spacing correctly.

The construction and manipulation of the telegraphic alphabet having been thoroughly mastered by the practice of the foregoing exercise, it is now presented in its complete and consecutive form.

INSTRUCTIONS FOR PRACTICE.—*Continued.*I.—*Alphabet.*

A —	N —
B —	O —
C —	P —
D —	Q —
E —	R —
F —	S —
G —	T —
H —	U —
I —	V —
J —	W —
K —	X —
L —	Y —
M —	Z —

II.—*Numerals.*

1 —	6 —
2 —	7 —
3 —	8 —
4 —	9 —
5 —	0 —

III.—*Punctuation*

Period
Comma —
Semicolon —
Interrogation —
Exclamation —
*Parenthesis —
*Italics —
*Paragraph —

In fractions — — — — — is used
to represent the line between the nume-
rator and the denominator.

* *These signs precede and follow the
words to which they refer.*