

SCIENTIFIC INSTRUMENTS

BY

L. CASELLA

The greatest care is taken to adapt each instrument to the climate and conditions in which it is required to be used; and, as all are plainly and truthfully described, intending purchasers may at once know the real capabilities of any they may desire to select.

A TABLE OF CONTENTS, and general Index, referring to the number of each article, together with ample illustrations, will enable the reader readily to find any instrument or apparatus required.

The utmost attention is given to shipping, packing, etc., so that even trivial loss from this cause is of the rarest occurrence.

With orders from the country or abroad, instructions should be given as to the mode of conveyance, shipment, etc.; and, in all first transactions, it is requisite to send either a reference or approximate remittance, or order for payment in London.

MERCHANTS, SHIPPERS, AGENTS, ETC., sending orders, will find the most liberal attention given to meet their interests and desires.

LOUIS P. CASELLA.

147, HOLBORN BARS, LONDON, E.C.

August, 1871.

REMOVED FROM 23, HATTON GARDEN.

N.B.—I regret to have to caution intending purchasers (particularly at a distance) against false imitations of many of my articles, not only by evasive descriptions, but even to the extent of affixing my name. To prevent this as far as possible, consecutive numbers are affixed to all my specialities and first-class instruments. Purchasers are therefore respectfully solicited to apply for them either direct, or to respectable agents only; see that the name is properly spelt, and give direct intimation of any such attempt which may come under their notice, that every care may be taken to meet such conduct as it deserves.

To Directors of Meteorological Observatories and other Institutions, the beginning of this Catalogue presents a practical selection of Standard Instruments, and in many, I believe, will be found a degree of excellence that is unequalled; in proof of this, I may state that the Standard Thermometers for most of the important investigations at the Kew Observatory, as well as those of the equally comprehensive researches of the most eminent Professors of Cambridge, Oxford, London, etc., have been made at my establishment. I may also mention the arrangements which I designed to meet the requirements of various Scientific Expeditions and Geographers of our own and other countries, including Livingstone, Burton, Speke, Grant, Hooker, Baker, etc., whilst the whole series of Portable Meteorological Instruments for Travellers, as now used, were expressly designed by me to meet the desires of the Alpine Club.

To amateurs and others, desirous of taking plain trustworthy meteorological observations, other instruments are described of a simpler kind, at a moderate cost, the indications of which will bear the strictest examination.

The numerous changes and additions to the Microscope, and at reduced cost, have also received my best care, as shown by the illustrations and descriptions; whilst Telescopes and Field Glasses have been so improved and simplified, as to enable me with much pleasure to refer to their respective lists in the Catalogue.

I have also great pleasure in referring to the improvements which I have made in Aneroid Barometers, whether for indicating changes of the weather, or for measuring great heights or low elevations, which they now do with a degree of precision hitherto unlooked for in these instruments, as described on pages 33, 34, and 35.

Though many instruments are enumerated in Optics, Mechanics, Surveying, etc., in which great changes are often being made, my attention is constantly given to such as are really practical and useful, whilst an extended intercourse with the leading authorities and scientific bodies enables me to introduce every novelty of interest as soon as it appears.

ADDRESS.



The previous editions of this General Catalogue having been out of print for some time, I have now great pleasure in presenting this new and extended impression.

Had my object been the mere enumeration of the names and prices of instruments, etc., the present edition would have been completed long since; but my desire was to unite with these a brief description of many of them, including not only those of recent design, but also of others for which explanations are often required.

Amongst the new arrangements, I may mention the Deep Sea Thermometer, with which the real temperature of the sea at any depth has at length been determined; the Pocket Standard Barometer, by means of which the highest mountains or deepest shafts can be measured accurately; the extremely portable Traveller's Transit Theodolite, Pocket Altazimuth, Pocket Spirometer, and various important arrangements of Solar Radiation Apparatus, Anemometers, etc.

To self-registering instruments much of my attention is constantly given, and several of them are now described for which I was honoured with the only Prize Medal awarded to this class of instruments at the Great Exhibition of 1862, as well as the much extended patronage of the leading Governments and Observatories of the world, as shown on the title page.

For clinical, general medical and physical investigations of temperature, my arrangement of Self-registering Thermometers is now used exclusively, and many instruments of my design for these purposes are now also regarded as indispensable.



AN ILLUSTRATED

AND

DESCRIPTIVE CATALOGUE OF

SURVEYING,

PHILOSOPHICAL, MATHEMATICAL,

OPTICAL, PHOTOGRAPHIC,

AND

STANDARD METEOROLOGICAL

INSTRUMENTS.

MANUFACTURED BY

L. CASELLA,

SCIENTIFIC INSTRUMENT MAKER

To the Admiralty.



BOARD OF TRADE, BOARD OF ORDNANCE, THE GOVERNMENTS AND OBSERVATORIES OF INDIA, RUSSIA, SPAIN, PORTUGAL, THE UNITED STATES, AND THE BRAZILS;

THE BRITISH METEOROLOGICAL AND THE ROYAL GEOGRAPHICAL SOCIETIES, THE ROYAL OBSERVATORIES AT KEW, CAPE OF GOOD HOPE, AND OF THE WAR DEPARTMENT;

THE UNIVERSITIES OF CAMBRIDGE, OXFORD, AND LONDON;

THE LEADING HOSPITALS AND INFIRMARIES; AND THE OBSERVATORIES OF ARMAGH, WASHINGTON, VICTORIA, TORONTO, CALCUTTA, THE MAURITIUS, ETC. ETC.



INTERNATIONAL EXHIBITION,

1852.

THE ONLY PRIZE MEDAL AWARDED

FOR

REGISTERING METEOROLOGICAL

INSTRUMENTS.



147, HOLBORN BARS, LONDON, E.C.,

Removed From 23, HATTON GARDEN.



STANDARD METEOROLOGICAL INSTRUMENTS,

MANUFACTURED BY

L. CASELLA.

BAROMETERS.

1. **Standard Barometer** (*figs. 1 and 1**, p. 3). The construction of this barometer is that known as Fortin's, in which the mercury in the cistern is adjusted, at each observation, to a fixed ivory point, which is the zero of the scale. The mercury is boiled in the tube, which is 0.45 inch. 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 a flexible base. The vernier reads to 1-500th part of an inch, or, by estimation, to .001 inch, and is adjusted by a rack and pinion motion. 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 sheet of white note paper should be placed behind the scale. The barometer is mounted in a brass frame, and suspended from a bracket at the top of a mahogany board, so as to ensure perpendicularity. At the bottom of the board is a socket, with clamping screws for steadying the barometer in a vertical position, when an observation is made. The instrument is so mounted that it can be turned at pleasure to any source of light
£10 0 0
2. **STANDARD BAROMETER**, precisely as above, but not so highly finished, inside diameter of tube, 0.40 inch. £8 10 0
(If with Millimetre Scale additional, £1 0 0 extra.)
3. **Standard Barometer of extra large size**, tube 0.7 inch. internal diameter, with a thermometer immersed in a tube of mercury (at the side) of the same diameter as the barometer tube; specially suited for public observatories
£22 0 0

Barometers on Fortin's principle are the most reliable. The index error can suffer no change from lapse of time, because it is independent of the loss of mercury from oxidation, etc.; and, should any air find access into the tube, it can be easily known, and readily removed. To know if air has entered the tube, take down the barometer and incline it gently till the mercury reaches the top, when, if air be present, a soft dull tap will be heard; but if there is no air present, then a sharp clear click will be elicited. To remove air from the tube, incline the instrument gently as above, and invert it so as to allow the air to pass slowly into the cistern. If the quantity be very small, the head may be tapped slightly on the ground to facilitate its exit. It is best, however, to prevent the admission of air whenever possible.

Instructions.—When sent into the country or abroad, the barometer is packed apart from the mahogany board, in some soft elastic material, the mercury being screwed up so as to fill the tube and cistern. It should be unpacked carefully, but not handled until a position has been selected for it. The barometer may be placed in any convenient room, where it is not near a fire or exposed to the sun's rays. It should be in a good light, with the scale about five feet from the ground, so that the zero point in the cistern, and the vernier on the scale may

be easily seen. First, hang the board on the wall, then insert the lower part of the cistern through the bottom bracket, and suspend the instrument as in *fig. 1*, p. 3. When the barometer is thus suspended, unturn the thumb-screw till the mercury falls in the cistern to the level of the ivory point

To Set the Barometer.—First read the attached thermometer, then adjust the mercury, by means of the thumb-screw, so that it barely touches the ivory point in the cistern, which, with its reflection will then appear as a double cone; the height of the column is then taken by adjusting the lower edge of the vernier, so that it shall exactly form a tangent to the convex surface of the mercury in the tube, just excluding the light by keeping the eye in the same plane with the back and front lower edges of the vernier. Every care should also be used to avoid influencing the temperature whilst making the observation.

How to Read the Vernier (*fig. 1***, p. 4).—By means of the annexed diagram, the use of the vernier in ensuring accurate measurement is readily understood. *c d* represents part of the fixed scale of the barometer, and *a b* is the sliding scale, or vernier. The scale *c d* is divided into inches, tenths and half-tenths of an inch, so that each division of the scale is $\cdot 05$ —*a b* is made equal to 24 divisions of the scale, and is divided into 25 equal parts. It follows, therefore, that each division of the vernier is smaller than each division of the scale, by the 25th part of $\cdot 05$; which is $\cdot 002$ inch. The lower edge of the vernier, *a*, is set to the top of the barometrical column, and hence we have to find the height of *a*. First, we read on the scale $29\cdot 15$; next, we look along the vernier until we find one of its lines which lies evenly with a line of the scale. As shown in the figure, this line is the second above 3. Now, each of the figures engraved on the vernier count as hundredths, and each intermediate division as two thousandths ($\cdot 002$); hence the vernier shows $\cdot 034$, and this added to the scale reading $29\cdot 15$, gives the reading sought $29\cdot 184$.

4. STANDARD BAROMETER, to revolve on cast-iron pedestal, as designed for the Committee of the Royal Kew Observatory, and most of the leading Foreign Observatories; size of tube $\frac{1}{8}$ in. internal diameter (*fig. 4*, p. 3) £24 0 0
5. Standard Barometer for observatories, with extra large column of mercury, in neat skeleton iron frame, arranged to revolve in brackets from the wall, or on pedestal, precisely as the Kew standard, for reading off by means of the cathetometer £18 10 0
6. CATHETOMETER, large size, precisely as used at the Kew Observatory (*fig. 6*, p. 4) £18 0 0 and £21 0 0
7. 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 reading from a point in the cistern is obviated. The mounting, etc., the same in every respect as No. 1 standard barometer £8 10 0
8. STANDARD BAROMETER, as No. 7, in plainer mounting 6 0 0
9. THE STUDENT'S STANDARD BAROMETER, on the Kew principle (as No. 7), with similar compensation, etc., but smaller in size, for those who do not at first desire a more expensive standard £4 15 0
10. STANDARD BAROMETER, on the Kew principle as No. 8, but with handsome bold ivory or metal scale, with plain and broad graduations for easy reading, revolving in brackets on oak or mahogany board £6 0 0

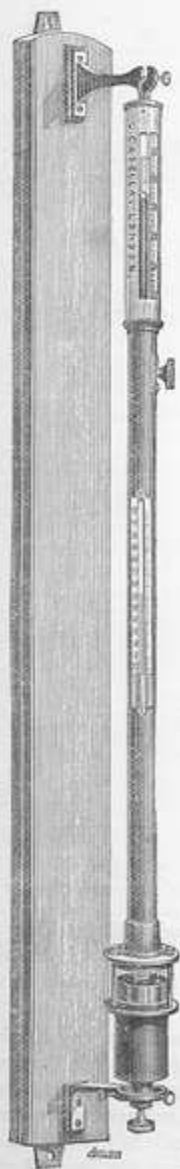


FIG. 1*.



FIG. 1.

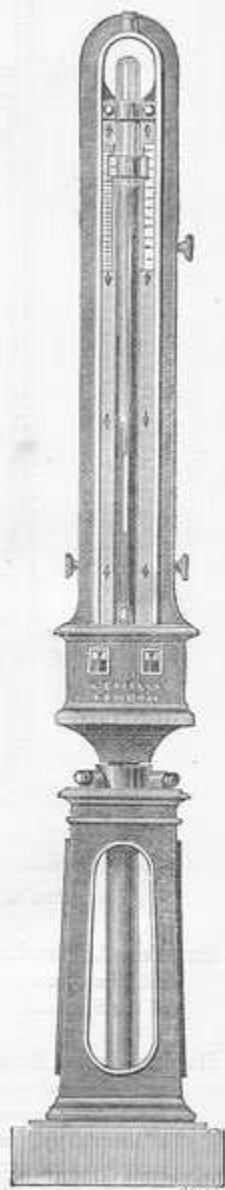


FIG. 4.

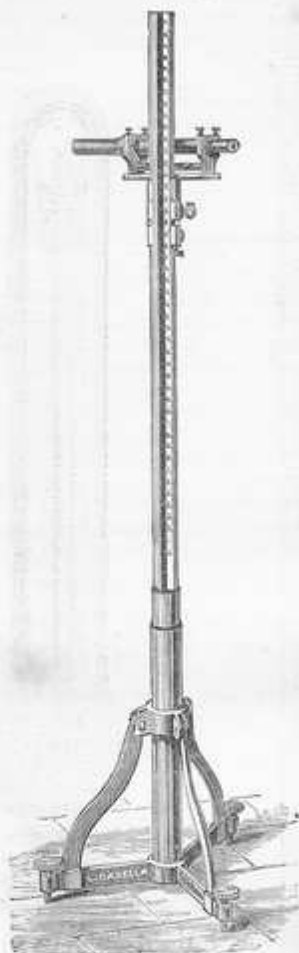


FIG. 6.



FIG. 1**.

12. **Glass Case for Standard Barometer**, of black polished wood, with plate-glass sides and front, forming a neat and elegant protection against dust, etc., for either of the Standard Barometers £3 0 0 to £4 0 0
13. **Standard Marine Barometer** on the Kew principle, as used by the Admiralty and Meteorological Office, and recommended by the Brussels Conference, for making correct meteorological observations at sea. The cistern is made of bronzed polished iron. The frame is brass bronzed, and revolves in gimbals, having a stout spring arm for suspension. The scale reads to 500ths of an inch, and the tube is contracted to prevent oscillations during the heaviest rolling of the ship (*fig. 13, p. 5*) £4 5 0

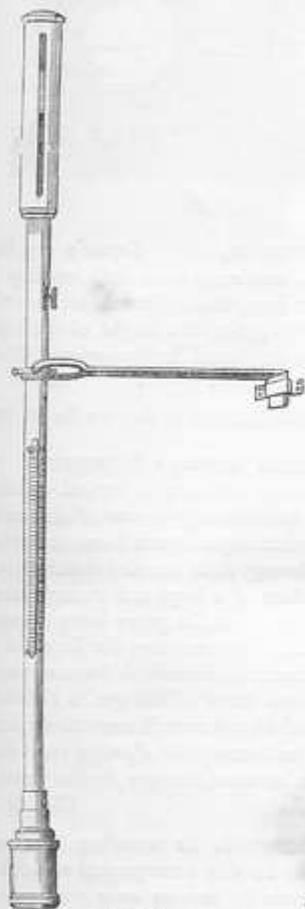


FIG. 13.

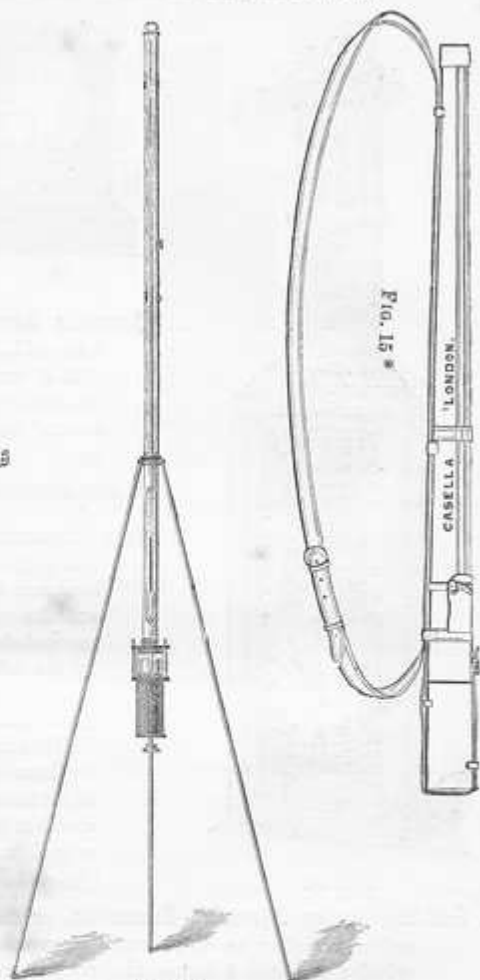


FIG. 15

14. **Gun Barometer**, being a special modification of No. 12, to enable it to withstand the concussion arising from the discharge of the largest modern guns on board ships of war at sea. This is really the *ne plus ultra* of marine barometers, possessing the utmost attainable accuracy combined with the best security against breakage. It is expressly made for H. M.'s service . . . £5 10 0
15. **STANDARD MOUNTAIN BAROMETER**, on the same principle as the Standard Barometer No. 1, 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 English and millimetre scale and tripod stand, complete, in CASELLA'S improved leather-covered shield case (figs. 15 and 15*) . . . £8 10 0

If without case 25s. less.

* * * A verification from the Royal Kew Observatory is supplied with any of the preceding standard or marine barometers, if required, at an extra charge of 7s. 6d. to 12s. 6d.

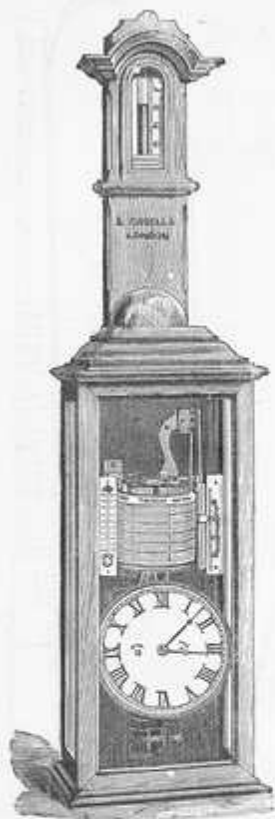


FIG. 18.

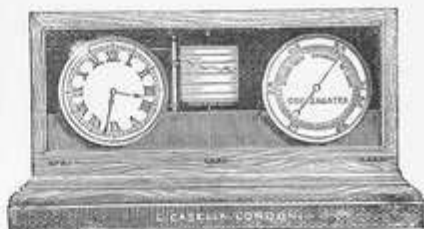


FIG. 17.

16. **Mountain Barometer**, Gay Lussac's syphon tube, with vernier to each limb, reading to $\cdot 002$ of an inch, the difference between the two readings giving the height of the barometer. In improved leather-covered shield case £6 6 0

(If with tripod stand, similar to that for No. 15, £8.)

17. **SELF-REGISTERING ANEROID BAROMETER**. In this elegant arrangement a vertical cylinder is caused to revolve by means of clockwork, and the barometric variations accurately marked at every hour on ruled metallic paper by the action of a large and strongly made Aneroid Barometer, the paper being changed once a week. By connecting the lines (as in No. 18) an accurate barometric diagram, showing dates and times of changes is obtained, whilst the clock and aneroid respectively, form excellent instruments for showing exact time as well as constant changes in the weather (fig. 17) £22 0 0

18. **Self-Registering Mercurial Barometer**, or Barograph, for recording the barometric variation on ruled metallic paper. In this arrangement a vertical cylinder of about 4 inches diameter, is made to revolve once every seven days, by means of clock-work. A metallic pencil rising and falling with the mercury marks this paper at every hour, the paper being changed once a week. The date, time, etc., of every change of pressure is thus correctly indicated, and being connected by lines drawn from point to point gives a correct continuous diagram of whatever changes may have occurred. The mercurial column and timepiece are also observable at any moment, the instrument thus forming an ordinary barometer as well as an excellent eight-day clock (fig. 18). The size being about 13 inch. wide \times 8 inch. deep \times 36 inch. high £18 10 0

19. **King's Barograph**, or Self-registering Barometer, as erected in the Liverpool Observatory. In this construction the barometric column may be caused to range from five to ten inches for each inch in the ordinary barometer, and to record continuously the smallest as well as the largest fluctuations which may occur in the pressure of the atmosphere. £25 0 0

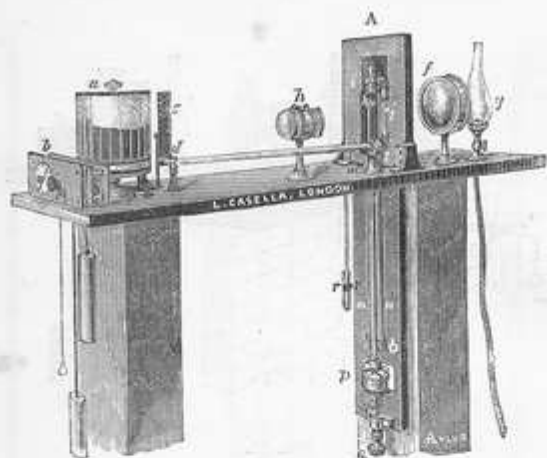


FIG. 20.

Barograph and Thermograph, Self-registering (BECKLEY'S). These interesting arrangements were designed by Mr. Beckley at the express desire of the Kew Committee of the British Association for the Advancement of Science. They faithfully and permanently record the varying changes in atmospheric pressure, temperature, and moisture, by means of photography. And together with the anemometer No. 82 are now in constant use at their observatory. Where ordinary gas is at hand its light is employed, but, when otherwise, a convenient form of lamp is arranged, in which colza or paraffine oil is used, and although requiring rather more care, is even preferable to gas. The knowledge of photographic manipulation in these arrangements is easily attained, and the time and attention required for this purpose is reduced to a minimum by using prepared paper and changing it every twenty-four hours

20. Barograph. The design of this instrument is to record the varying changes of barometric pressure by means of photography, as shown on *fig. 20.* £68 0 0

When in use the upper part is enclosed in a mahogany box or cover, which is here removed to show the various parts. Artificial light alone is employed, and is admitted only through the vertical slit in the shield *k*. *a* is the cylinder, or drum, on which the photographic paper is placed, and is turned round once in twenty-four hours by means of the clock *b*. Besides turning the cylinder the clock also liberates the small shutter *c*, which then turns sharply round once every two hours, thus stopping off the light for four minutes each time, leaving white lines on the photographic curve which represent intervals of two hours each. *g* is the burner or light; *f* a condensing lens through which the rays pass over the top of the mercurial column. On the light passing through the slit at *k*, from the lamp *g*, it passes through the photographic lens *h*, and thence on to the cylinder *a*; *p* is the barometer, the mercury of which rises and falls immediately behind the shield *k*; *q* is a screw by which the barometer is lowered

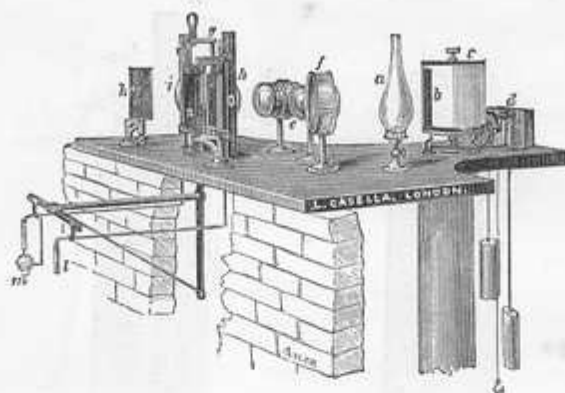


FIG. 22.

or raised when adjustment is required; *a a* are two zinc rods firmly screwed at their lower ends to the vertical slab *A*, and at their upper end a plate and socket are fixed which carries the short pendant glass rod *j*, together with small rollers by which its movements are kept free on the slab *A*; the lower point presses on the horizontal glass lever *d*, near the fulcrum *l*; by this arrangement the expansion and contraction of the zinc rods from varying temperature are so expanded as just to compensate for the thermometric changes in the mercurial column, an undulating line being thus formed which is always the zero line of the curve; *r* is a glass tube of the same internal diameter as that of the barometer, and is half filled with mercury in which the bulb of a standard thermometer is immersed.

22. Thermograph. This instrument is designed to show changes of atmospheric temperature and moisture, by means of photography; and when in use is enclosed in a mahogany box, for the exclusion of light in the same way as the barograph; in this case, however, the artificial light to the paper is only admitted through an air-speck in each thermometer, separating the mercury in the same manner as that arranged by L. CASSELLA to detach the index in his maximum registering thermometer. An ingenious arrangement supports the thermometer bulbs in the open air, they project about one foot from the wall, upon the edge of which the slab rests. The general arrangement being as in *fig. 22* £82 0 0

m. Wet bulb thermometer. *l.* Atmospheric thermometer. *g.* The screw for adjusting the thermometers to the height required. *a a.* Artificial lights. *f i.* Condensers to throw the light on the mirrors *k n.* *k n.* The mirrors passing light through the air-speck in each thermometer. *o o.* The slits through which the light passes from the mirrors *k n.* *e e.* The lens throwing an image of the air-speck of each thermometer on to the cylinder *c* on which the photographic paper is placed. *d.* The clock which turns the cylinder *c* once round in forty-eight hours. *b.* The shutter which cuts off the light from the prepared paper for four minutes, every two hours, and thus leaves a white line in the photographic indication.



Fig. 24.



Fig. 26.

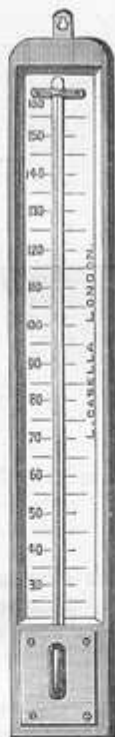


Fig. 25.

STANDARD THERMOMETERS.

Besides the precision with which thermometers may be graduated, where excellence is wanted, the greater part really depends on the care and skill employed in constructing the tube. In this respect L. CASELLA has much pleasure in referring to the guarantee afforded by his name, as well as that most critical test, viz., his well-known success in constructing thermometers for mountain measurement, as also his self-registering thermometers for clinical purposes; with which he believes he almost exclusively supplies the profession, and was alone identified with them full five years before they were adopted for general use. At the Exhibition of 1862, L. CASELLA obtained the only prize medal for registering meteorological instruments.

23. **Independent or Natural Standard Thermometer**, engine divided on the stem, the internal diameter of the bore being carefully calibrated, and the exact value of all its parts further determined by comparison at the freezing and boiling points of water £5 5 0
24. **STANDARD THERMOMETER, COMPARATIVE**, carefully tested in all its parts, tube 15 inches long, engine divided on the stem, and figured on raised metal or porcelain scale, 0° to 215° Fahrenheit, or 102° centigrade, in maroon case, with verification from the Royal Kew Observatory (*fig. 24*) £2 5 0



FIG. 28.



FIG. 39.

25. **Standard Thermometer, Comparative**, as No. 24, with porcelain scale on mahogany, for out-door use, range about 0° to 130° , as made by L. C. for various departments of the Government (*fig. 25, p. 9*) £2 5 0
26. **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° ; with verification from the Kew Observatory, as arranged at the Brussels Conference, for taking reliable observations at sea. This is an excellent instrument, by which others may at any time be compared, within the range stated, and is, moreover, the only kind of thermometer which can be used at sea without deteriorating from the corrosive action of salt-water and damp, in copper case (*fig. 26, p. 9*) £0 15 0

N.B.—A set of six thermometers as No. 26, with two copper cases, in a neat box, as supplied by L. CASELLA to the Board of Trade and Admiralty £3 3 0

27. **Kew Observatory Thermometers**, a set of six, as above, with 1 each maximum and minimum thermometers, for use on board of ship £4 10 0

CASELLA'S STANDARD MAXIMUM THERMOMETERS.

These registering instruments are made on the principle designed by Professor Phillips, F.R.S., of Oxford, and were first employed for meteorological purposes at the Royal Kew Observatory in 1851, by John Welsh, F.R.S., director of that establishment. Next to its ingenious inventor, L. CASELLA claims the exclusive merit of the introduction and arrangement of these most perfect maximum thermometers. In the report of the Kew Committee of the British Association for the Advancement of Science in 1856, they are described as "valuable for their extreme simplicity," "capable of greater accuracy than any others," "the most convenient form of all maximum thermometers." In 1862 they were amongst the chief causes of the decision of the

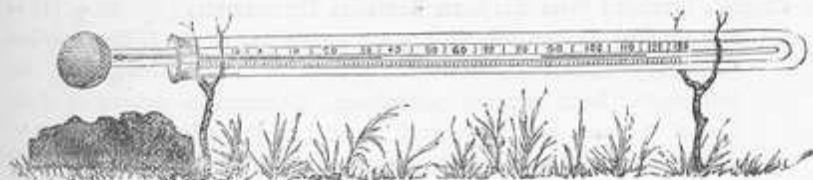


FIG. 29.

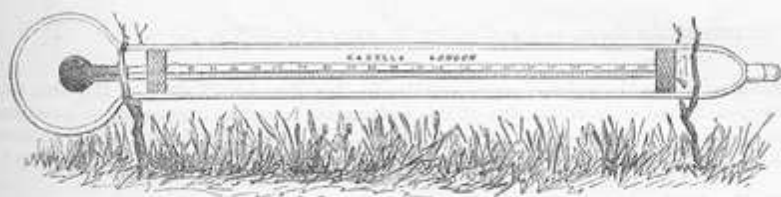


FIG. 30.

jury in awarding *the only prize medal* for registering meteorological instruments to L. CASELLA, and since then their adoption may be called universal. Thus, on this principle only, are those now made that are used by the faculty in the delicate investigations of the temperature of the body. It is exclusively used in registering thermometers for travellers, as well as for mines, deep wells, on ship-board, and indeed in any position in which portability and a true and reliable registration of temperature is required. The great advantage of this arrangement consists in the index, being formed of a small portion of the mercury itself, which is detached from the rest and made of any required length, according to the kind of thermometer to which it is applied; thus, for stationary instruments, it is kept sufficiently long to be set by merely lowering the bulb, whilst in others it is made short, so as to retain its indication in whatever position the thermometer may have to be used, whether erect or inverted. Thus, as a medical thermometer for clinical investigations, no other arrangement is of any service (see Nos. 127 to 130), whilst for safety of transit also, this principle leaves nothing to be desired.

28. **Maximum Thermometer**, for ordinary registration; engine divided on the stem and indelibly figured on CASELLA'S improved porcelain scale, *which effectually resists frost and all effects of weather* (fig. 28, p. 10) £1 0 0

29. **SOLAR RADIATION THERMOMETER**, maximum, with black bulb; tube divided and figured on the stem, and enclosed in glass shield for protection (fig. 29) £1 0 0

For other maximum thermometers, see Nos. 30, 46, 47, 48, 128, 176, and 204.

Directions for Using the Maximum Thermometer.—Suspend the instrument by means of the brass loops attached to the back, so as to keep it fairly horizontal, as shown in fig. 28, p. 10. To set the index, disengage and lower the bulb end to allow the detached portion of mercury to approach the rest, which it will do within about one-quarter of a degree. On an increase of temperature the mercury will rise as in an ordinary thermometer, and continue to do so as long as the heat increases, propelling the detached portion to whatever extreme the heat may attain. On a decrease of temperature the mercury will contract and recede in the usual manner, leaving the detached portion to indicate the highest temperature, which it does at the end furthest from the bulb.

30. **Casella's Insulated Solar Maximum Radiation Thermometer** (*fig.* 30, p. 11), as first arranged by him agreeably to the suggestions of Sir J. Herschel (see 'Admiralty Manual of Scientific Enquiry'). In this arrangement, the thermometer being in nearly perfect vacuo, the maximum registration of the heat of the sun's rays is obtained, divested of the influence of vapour or passing currents of air. Indeed, this is the only form of thermometer suitable for making comparable observations on solar heat . . . £1 5 0

30* **STAND** for the above, as described by Mr. Stow (*fig.* 30*, p. 16) . . . 1 1 0

From an admirable series of experiments by the Rev. Fenwick W. Stow, of Hawsker, near Whitby, on the principle and action of this instrument, important improvements have been made, by which uniformity of action is secured, and the indications of temperature thus obtained rendered perfectly comparable. (See following interesting description by the Rev. Mr. Stow.)

The insulated solar maximum thermometer, usually called the black bulb in vacuo, is a sensitive maximum thermometer, having the bulb and a given portion of the stem covered with lamp-black, the whole being enclosed in a glass tube *fig.* 30, p. 11, from which all air and moisture have been removed, so that the heat of the sun's rays are thus obtained, divested of the influence of vapour or passing currents of air. In an extended series of experiments with a number of these thermometers as usually made, Mr. Stow found that when the stem within the large bulb was not properly blackened, the bulb lost much of its heat by induction, and that the indication of different thermometers so varied as not to be fairly comparable with each other. Mr. Stow also recommends that a stand like *fig.* 30*, p. 16, be adopted, and that the following rules should be observed:—

1.—Place the instrument four feet above the ground, in an open space, with its bulb directed towards the S.E. It is necessary that the globular part of the external glass should not be placed in contact with, or very near to, any substance, but that the air should circulate round it freely. Thus placed its readings will be affected only by direct sunshine and by the temperature of the air.

2.—One of the most convenient ways of fixing the instrument will be to allow its stem to fit into, and rest upon two little wooden collars fastened across the ends of a narrow slip of board, which is nailed in its centre upon a post steadied by lateral supports.

3.—The maximum temperature of the air in shade should be taken by a thermometer placed on a stand in an open situation. Any stand which thoroughly screens it from the sun and exposes it to a free circulation of air, will do for the purpose.

4.—The difference between the maxima in sun and shade thus taken is a measure of the amount of solar radiation.

The Rev. Mr. Stow will be glad to receive from time to time copies of observations made according to these rules.

32. **Helio-pyrometer**, as arranged by T. SOUTHALL, Esq., at his observatory, near Birmingham, by which the following extraordinary results were obtained:—

July 11th, 1859,	maximum temperature of air	87°	—	in the sun	216°
" 12	"	"	"	"	89.1— " 231.5
" 13	"	"	"	"	80.5— " 217



FIG. 35.



FIG. 42.



FIG. 36.

It is thus described by Mr. Southall:—

"The helio-pyrometer is an instrument which I have adopted for ascertaining as far as practicable the heating power of the sun's unconcentrated rays. A self-registering maximum thermometer with black bulb, made by CASSELLA, on Professor Phillips's principle, is fixed on a cushion at the bottom of a box, the sides of which are also cushioned, and a thick piece of plate-glass is laid upon the top to prevent currents of air carrying off the heat, also with the view of preventing the cooling effects of terrestrial radiation. The box is placed in such a position that the sun's rays may fall as nearly as possible perpendicularly on the glass, and it may require a change of position two or three times in the day to accomplish this; if, however, the sky be free from clouds from 11½ to 12½, the maximum heat will be then obtained, and no change of position will be required. A portion of the sun's heat, the amount of which may be calculated, is necessarily lost by reflection from the two surfaces of the glass, but, as this amount bears a uniform proportion to the intensity of the sun's rays, its loss is of no practical importance. A black bulb thermometer placed on grass, according to the usual method, is much influenced by the cooling effects of evaporation from the grass and soil, and the effect of the sun's direct rays is sometimes nearly lost by the counteracting power of strong currents of air, and at all times the reading of the thermometer is lowered by a current which is generated by the heat of the thermometer itself, as well as by terrestrial radiation. A small vessel has since been added, in which water boils violently in the box, with a piece of tube to carry off the steam."

Price, complete £2 5 0

33. **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 the temperature of the fluid which surrounds it. Cylindrical form, about 3 × 10 inches. Price, with the requisite three thermometers £3 18 0

Tripod stand, with universal joint, by which the above may be kept in any position at any temperature £0 17 6

34. **Actinometer** (Sir JOHN HERSCHEL'S), for ascertaining the absolute heating effect of the solar rays, time being considered one of the elements of observation. To take an observation, the Actinometer is placed in the shade for one minute and read off; it is then exposed for one minute to the sun's rays, and its indication taken; it is finally restored to the shade, and its reading also taken, the mean of the two readings in the shade subtracted from that in the sun, gives the actual amount of expansion of the liquid produced by the sun's rays in one minute of time. (See Report of the Royal Society on Physics and Meteorology). £5 18 0

35. **POUILLET'S PYHELIOMETER** (fig. 35), for ascertaining the effect of the sun's heat upon a given area by the number of degrees of heat imparted to mercury in five minutes, as described in Dr. Tyndal's 'Heat Considered as a Mode of Motion.' £4 4 0

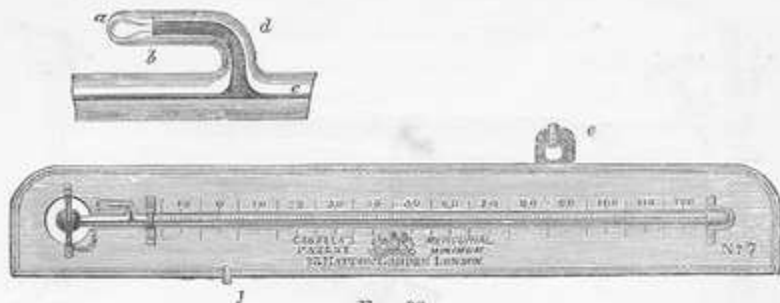


FIG. 38.

36. **Aethroscope**, the invention of Sir JOHN LESLIE, for ascertaining the absolute intensity of terrestrial radiation, with which instrument time is an element of an observation (*fig. 36*, p. 13) £1 1 0

37. **FLUCTUATION THERMOSCOPE**, as designed by Dr. B. STEWART, of the Royal Observatory, Kew £1 10 0

In this arrangement two stems with unequal bores are united to one bulb, and the instrument used horizontally, the scale extending to one hundred divisions. On setting the mercury to the zero, every increase of temperature raises the mercury in the large stem, whilst every reduction in temperature abstracts it from the small one, illustrating a principle in the action of fluids well worthy of extended investigation.

38. **Casella's Mercurial Minimum Thermometer**, on porcelain scale, with hardwood back, and divided on the stem (*fig. 38*) £2 10 0

This is the only practical mercurial minimum thermometer hitherto invented, and the result of quite ten years universal effort to achieve. Mercury is the only fluid employed in its make. 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 in the spirit minimum, is entirely avoided. The general form is shown in *fig. 38*; *d* being a tube with large bore, at the upper end of which a flat glass diaphragm is formed by the abrupt junction of the small chamber *a b*, the inlet to which at *b* is larger than the bore of the indicating tube. The result of this is, that having set the thermometer, the contracting force of the mercury in cooling withdraws the fluid in the indicating stem only; whilst on its expanding with heat, the long column does not move, the increased bulk of mercury finding an easier passage through the larger bore into the small pear-shaped chamber attached. It is here most interesting to notice that the weakest natural force is thus capable of resisting the action of the heaviest fluid, as adhesion or capillary attraction seems to be the only force which holds the mercury, and prevents its recession from this point. Great care and a steady situation are essential in using this instrument.

Directions for Using the Mercurial Minimum Thermometer.—Place it in a horizontal position, with the back plate *e* suspended on a nail, and the lower part supported on a hook *f*. The bulb end may now be raised or lowered, causing the mercury to flow slowly until the bent part *d* is full, and the chamber *a b* QUITE EMPTY. At this point the flow of mercury in the long stem of the tube is arrested by adhesion to the diaphragm *b*, and indicates the exact temperature of the air at the time. On an increase of heat the mercury will expand into the small chamber *a b*; and on a return of cold will cause its recession from this chamber only, until it reaches the diaphragm *b* to which it adheres. Any further diminution of heat withdraws the mercury down the bore to whatever degree the cold may attain, where it remains until further withdrawn by increased cold, or till reset for future observation. When out of use, or after transit, it may be that raising the bulb may not, at first, cause the mercury to flow from the small chamber as above; in such a case a slight tap or jerk with the hand on the opposite end with the bulb up, or the application of the extreme tip of the chamber to the flame of a candle, will readily cause it to do so.



FIG. 40.



FIG. 43.

The Value of this Instrument is shown by the following Testimonials:—From SIR HENRY JAMES, R.E., F.R.S., Director of the Ordnance Survey and Topographical Depot of the War Department, Author of 'Instructions for Taking Meteorological Observations,' with Tables, Notes, &c. :—

"I have great pleasure in stating that, after having had one of your Mercurial Minimum Thermometers carefully observed and registered at this office, and one at Southampton, during a period in which we have had a great range of temperature, I have found it to act perfectly, and never once to get out of order. I therefore think you have achieved a great success, and hope you will receive its reward."

B. STEWART, LL.D., F.R.S., Director of the Kew Observatory, in his Description of the instrument before the meeting of the British Association for 1862, said :—

"Before bringing this instrument to the notice of this association I have carefully tested its action at the Observatory, and find its indications in every way satisfactory."

From T. LAWRENCE, ESQ., Medical Staff, Mooltan, Punjab :—

"Your Mercurial Minimum Thermometer works admirably. It seems to me the only instrument adapted for minimum registration in this climate."

39. **Minimum Thermometer**, filled with pure alcohol, for ordinary registration, engine divided on the stem, and mounted to correspond with the Standard Maximum, No. 28 (*fig.* 39, p. 10) £1 0 0
40. **MINIMUM THERMOMETER**, for terrestrial radiation, divided and figured on the stem, which is enclosed in a glass cylinder for protection (*fig.* 40) £1 0 0
42. **MINIMUM THERMOMETER**, on brass pedestal stand (*fig.* 42, p. 13) 1 4 0
43. **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, has induced him to design the one shown in *fig.* 43, in which the bulb, being extended in the forked form therein shown, exposes a much increased surface to the air, and thus renders it little, if anything, less sensitive than the mercurial thermometer. It is really interesting to note the increased sensitiveness of this over standard instruments of the usual form £1 5 0
44. **CASELLA'S EXTRA SENSITIVE MINIMUM THERMOMETER**, forked as *fig.* 43, on porcelain scale, with hardwood back to correspond with standard maximum, No. 28 £1 5 0

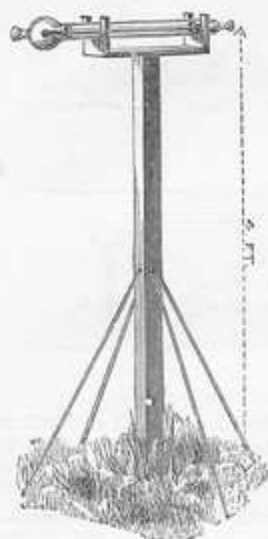


FIG. 30.



FIG. 47.

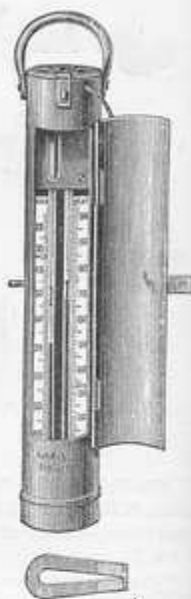


FIG. 48.

45. **Earth Thermometer**, for ascertaining the temperature below the soil, or the heat developed in hay-stacks, pine and melon pits, etc., with pointed copper tube, from (according to length) £0 18 6
46. **MAXIMUM AND MINIMUM THERMOMETERS**; the pair, in a neat pocket mahogany case for travellers, as arranged for Dr. Livingstone and Captains Burton and Speke. They are divided on the stem, and cannot be injured in travelling, unless by actual breakage £2 2 0
47. **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. 47*) £1 5 0

In these improved portable maximum thermometers, the index will not shift its position by disturbance, or in unsteady situations, as on shipboard, etc., whilst the instrument may be used either erect, inverted, or in any other position, and is certainly the most portable, and of more extended application than any other registering thermometer, whether it be in meteorological observations, or in physical or clinical researches.

Directions.—To set the index of Maximum Thermometers Nos. 46 and 47, bring it to its place with a moderate swing of the arm, keeping the bulb down at the time. This will bring it within about a degree of the rest of the mercury, at which point also it shows the existing temperature, the reading being taken from the end furthest from the bulb. To set the minimum index of Nos. 46 and 47, raise the bulb as No. 39. It may then be either laid down or suspended, as convenient, with the bulb kept a little lower than the opposite end.

Directions for Using the Spirit Minimum Thermometer, No. 39, etc.—Suspend it by the loops, or lay it down with the bulb a good half inch lower than the opposite end; and, to set the thermometer, disengage the bulb end, and raise it up until the index flows to its place in

the spirit, viz., to the extreme edge. Then suspend or lay it down as before; and, as the temperature decreases, the spirit will recede and take the index back with it; but, on an increase of temperature, the spirit will advance, leaving the index to mark whatever extreme of cold may have occurred; this it does at the end furthest from the bulb, whilst the spirit itself indicates the temperature at the time. If in transit the spirit is separated, it is easily united by a swing or two of the arm, holding the bulb downwards, and when thus united, let the thermometer hang with the bulb down for about ten minutes, to allow the fluid to settle from the sides of the tube.

Deep Sea Maximum and Minimum Thermometer on Six's principle. For registering past extremes of heat and cold, and showing present temperature.

This most ingenious and useful thermometer is named after the inventor, Mr. James Six, of Canterbury, and was described by him in the Philosophical Transactions of 1782. Excepting one or two arrangements of metallic thermometers, including a very ingenious instrument by Henry Johnson, Esq., F.R.A.S., this is the only thermometer which registers both extremes, in a vertical position. These metallic instruments, however, together with other forms tried, being found wholly inadequate for their purpose, and this alone being selected by the Government, as well as the Royal Society, for registering deep sea temperature, would seem to warrant its description here. As originally made, the Six's thermometer consisted of a long cylindrical bulb, united to a smaller tube of more than twice its length, bent up and down in the form of a syphon, with the cylinder in the centre, and terminated in a smaller oval-shaped bulb at the top. The lower portion of the syphon being filled with mercury, the long bulb, the other part of the tube, and about a third of the small bulb with rectified alcohol; the remaining part of the small bulb being filled with highly compressed air, which acts as a spring to depress the mercury and cause it to rise in the opposite tube on any contraction (from cold) of the spirit. A steel index enclosed in glass, moves in each limb of the syphon. The two indices are terminated at top and bottom with flattened projecting glass ends, to enable them to move with the least possible friction and prevent the mercury from passing them. They are supported in their position by means of a delicate hair spring. On this principle strictly, but in modified form, the deep sea thermometer has lately been made. Instead, however, of the long centre bulb, a short bulb filled with spirit is joined to the upper end of the syphon, about parallel with but rather lower than the opposite bulb (see form of the tube *fig.* 210, p. 49), thus keeping the instrument more strong and compact with but one bend, and adapting it better for the comparative rough usage to which it is subjected. The extent to which sea pressure at great depths might effect thermometric indications, however, was not yet known, and therefore the authorities at the Hydrographic Office having applied to the Royal Society on the subject, at their desire, towards the end of 1869, L. CASELLA constructed an hydraulic machine in which to make this interesting test. The result was startling, as, at a pressure equalling 2500 fathoms in depth equal 3 tons per square inch, the error equalled 12 to 13 degrees Fahrenheit in excess, whilst in other kinds of registering thermometers, it reached the extraordinary extent of 70 degrees. To remedy this, Dr. W. A. Miller, Vice-President of the Royal Society, suggested an effective remedy, which he thus describes in the 'Proceedings of the Royal Society,' No. 113, 1869:—

Self-registering Thermometers adapted to Deep Sea Soundings.—"Several of these thermometers have been prepared for the purpose with unusual care by Mr. CASELLA, who has determined the conditions of strength in the spring and diameter of tube most favourable to accuracy. He has also himself had an hydraulic press constructed expressly with the view of testing these instruments. By means of this press the experiments hereafter to be described were made.

"The expedient adopted (as suggested by Dr. Miller) for protecting the thermometers from the effects of pressure, consisted simply in enclosing the bulb of such a Six's thermometer in a second or outer glass tube, which was fused upon the stem of the instrument in the manner shown in the accompanying figure 48, p. 16. This outer tube was nearly filled with alcohol, leaving a little space to allow of variation in bulk due to expansion. The spirit was heated to displace part of the air by means of its vapour, and the outer tube and its contents were sealed hermetically.

"In this way, variations in external pressure are prevented from affecting the bulb of the thermometer within, whilst changes of temperature in the surrounding medium are speedily transmitted through the thin stratum of interposed alcohol.

"Notwithstanding the great pressure to which these instruments had been subjected, all of them, without exception, recovered their original scale-readings as soon as the pressure was removed."

In sea-water of sp. gr. 1.027, the pressure in descending increases at the rate of 250 lbs. upon the square inch for every 100 fathoms, or exactly one ton for every 800 fathoms.

On completing this arrangement, a few of the instruments were immediately forwarded by Captain Richards from the Hydrographic Office to Dr. Carpenter and Dr. Wyvell Thompson then on board Her Majesty's Ship *Porcupine*, Captain Calver, at that time on a voyage of deep sea investigation in the North Atlantic, the results of which were shortly afterwards given to the Royal Society by Dr. Carpenter (see "Proceedings of the Royal Society," 1870), and this thermometer, under the name of the CASELLA-MILLER THERMOMETER was at once exclusively adopted by the Government for all investigations of deep sea temperature, with the guarantee of Mr. CASELLA to the authorities, that all should be subjected in his apparatus to an hydraulic pressure of not less than two and a half tons to the square inch—2000 fathoms depth in the sea.

Instructions.—The Six's thermometer is used vertically, and should always be kept upright or with the head well raised—especially in carriage. Before observation the indices should be set by applying the ends of the accompanying magnet close to the glass, and drawing them gently down to the surface of the mercury in each stem. On a rise of temperature, the spirit will expand and depress the mercury in the left-hand stem, while it raises it in the other, carrying up with it the index to whatever degree the heat may attain. A return of cold will contract the spirit in the bulb, allowing the elastic force of the compressed air in the opposite bulb to depress the mercury in the right-hand stem, which then rises on the opposite side, raising the index in like manner to register the extreme of cold; the indication in each case is at the end nearest the mercury, whilst the mercury at each end shows the temperature of the time being. The greatest heat is shown at the *top* of the right-hand stem, and at the *bottom* of that on the left.

48. **The Casella-Miller Deep Sea Self-Registering Thermometer**, as above, protected in vulcanite mounting, with black divisions, etc., on glass, very legible, in round copper case $7\frac{1}{4}$ -inch. by $1\frac{1}{4}$ -inch. outside (*fig.* 48) p. 16 £2 5 0

For other Six's Thermometers, see Nos. 203, 204, 204*, 210.

49. **Babinet's Apparatus**, with two thermometers, for taking the exact temperature of the air (*fig.* 49) p. 21 £1 10 0

The slow and unequal transmission of heat by air and water is well known; the temperature of a body of the latter being only obtainable by its constant agitation. The above arrangement gives the same means of agitating the ambient air in order to ascertain its true temperature as well as the effect of its friction on the thermometer bulb.

HYGROMETERS.

50. **Mason's Hygrometer** (wet and dry bulb) 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 the Members of the British Meteorological Society (*fig.* 50) p. 19 £2 5 0

52. **MASON'S HYGROMETER**; like *fig.* 50, but mounted on porcelain scales 1 15 0

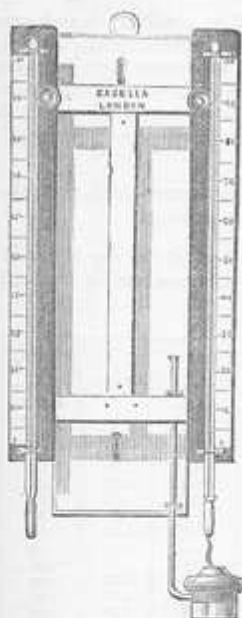


FIG. 50.

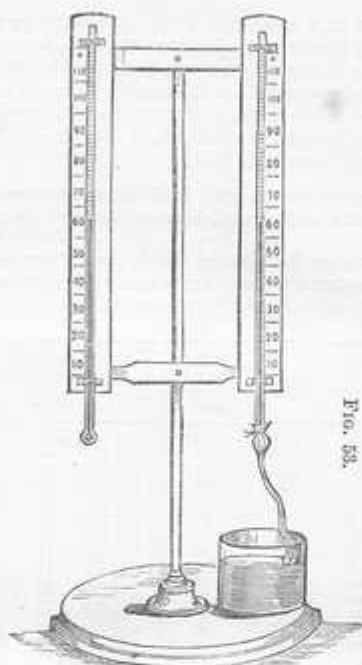


FIG. 53.

53. **Mason's Hygrometer**, exact as No. 50, but mounted on brass pedestal (*fig. 53*)
£2 2 0
55. **MASON'S HYGROMETER**, as *fig. 50*, but of extra size, with expanded graduations, the tubes being fifteen inches long, and divided to 0.2° £3 10 0
56. **Mason's Hygrometer**, with 18-inch. tubes, divided to 5ths for delicate investigations £5 5 0
57. **PORTABLE POCKET WET AND DRY BULB HYGROMETER**. A most convenient form of instrument for travellers, especially designed by L. CASSELLA as a companion instrument to his Alpine, or pocket maximum and minimum registering thermometers, Nos. 46, 47, and pocket aneroid barometer, No. 118, and Livingstone's rain gauge, No. 62 £2 2 0

The wet and dry bulb hygrometer or psychrometer may be fairly said to supplant the use of all others as an easy and practical means of indicating the humidity of the air. It consists of two thermometers placed parallel, about four inches apart, with their graduations as nearly as possible identical. The bulb of one is covered with thin muslin, from which trail a few threads of lamp cotton; these, being first wetted, are passed into a small attached vessel of water, two or three inches distant, and the bulb thus kept continually moist, causes this thermometer to indicate a *lower temperature in proportion to the rate of evaporation*, whilst the dry bulb thermometer shows the temperature of the air. From the readings of the dry and wet thermometers, the dew-point is obtained by means of the accompanying table. During frost, however, when the capillary action of the cotton is stopped, the bulb should be wetted

by means of a camel-hair brush, with water as near 32° as possible. In such cases it is not necessary to remove the ice from the bulb, but merely remove the drop which first forms from the water, the temperature will then speedily settle so as to indicate the point of evaporation. A piece of cotton-wick, well washed in clear soft water, is usually supplied with the instrument, and used to cover the bulb instead of the muslin. In placing fresh covering on the bulb, it should be loosened as is shown in the sketch above, and care taken not to restrict capillary action by tying it beneath the bulb.

The porcelain employed in all these instruments is of an improved kind, especially made for L. CASELLA, and warranted impervious to all changes of the weather.

TABLE OF FACTORS by which the difference of readings of the dry bulb and wet bulb thermometers is to be multiplied in order to produce the difference between the readings of the dry bulb and dew-point thermometers.

Reading of Dry Bulb Thermometer.	Factor.	Reading of Dry Bulb Thermometer.	Factor.	Reading of Dry Bulb Thermometer.	Factor.	Reading of Dry Bulb Thermometer.	Factor.	Reading of Dry Bulb Thermometer.	Factor.
10 ^h	8.78	29 ^h	4.63	47 ^h	2.12	65 ^h	1.82	83 ^h	1.67
11	8.78	30	4.15	48	2.10	66	1.81	84	1.66
12	8.78	31	3.70	49	2.08	67	1.80	85	1.65
13	8.77	32	3.32	50	2.06	68	1.79	86	1.65
14	8.76	33	3.01	51	2.04	69	1.78	87	1.64
15	8.75	34	2.77	52	2.02	70	1.77	88	1.64
16	8.70	35	2.60	53	2.00	71	1.76	89	1.63
17	8.62	36	2.50	54	1.98	72	1.75	90	1.63
18	8.50	37	2.42	55	1.96	73	1.74	91	1.62
19	8.34	38	2.36	56	1.94	74	1.73	92	1.62
20	8.14	39	2.32	57	1.92	75	1.72	93	1.61
21	7.88	40	2.29	58	1.90	76	1.71	94	1.60
22	7.60	41	2.26	59	1.89	77	1.70	95	1.60
23	7.28	42	2.23	60	1.88	78	1.69	96	1.59
24	6.92	43	2.20	61	1.87	79	1.69	97	1.59
25	6.53	44	2.18	62	1.86	80	1.68	98	1.58
26	6.08	45	2.16	63	1.85	81	1.68	99	1.58
27	5.61	46	2.14	64	1.83	82	1.67	100	1.57

In order to obtain all the data deducible from the wet and dry bulb thermometers, Glaisher's Hygrometrical Tables should be used.

58. **Daniel's Hygrometer**; the thermometers divided on the stems, with ether test, complete in mahogany case (*fig.* 58) p. 21 £3 10 0

This elegant instrument consists chiefly of a bent glass tube, with two balls—a black one, about one-fourth filled with the highest rectified ether. The stem incloses a sensitive thermometer with the bulb placed rather below the centre of the ball, and a white one covered with thin muslin, the interior of the tube being thoroughly deprived of air and the greatest care observed not to over-boil or impoverish the ether.

Directions for Using Daniel's Hygrometer.—Turn the instrument up so that by applying the warm hand to the covered bulb all the ether goes into the black bulb, then place it upright as shown in the sketch, and pour ether upon the muslin enveloping the white ball, and when sufficient cold is produced by evaporation of the ether from the black ball to condense the moisture of the atmosphere upon its surface, in the form of a ring just below the centre, the internal thermometer will show the exact temperature at which the deposition of dew takes place, which is called the dew-point.

59. **Regnault's Condensing Dew-Point Hygrometer (Casella's Improved)**, with ether bottle, etc., complete in mahogany case (*fig.* 59) p. 21 £4 4 0

. Agreeable to the suggestions of Colonel Sykes, F.R.S., and Dr. Miller, F.R.S., L. CASELLA has adapted to this instrument a black glass bottle, with silver neck and tube, which may be had instead of the silver bottle, or extra, at an additional charge of 20s.



FIG. 59.

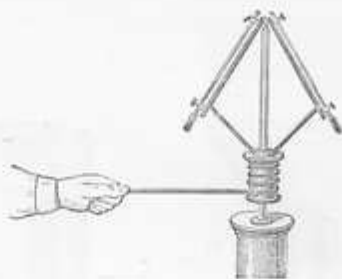


FIG. 49.

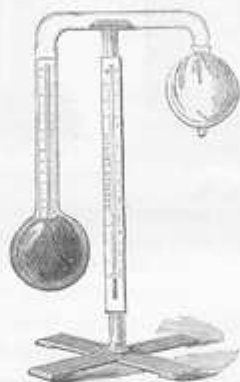


FIG. 58.

Although Mason's Hygrometer has for some time been in general use, yet Regnault's is still much employed for taking direct observations of the dew-point. It consists chiefly of two sensitive thermometers, one exposed to the action of the atmosphere and the other to the influence of a current of air passing through ether. An important part of this instrument is the small polished silver bottle into which, through a stopper, one of the thermometers is inserted. On one side, within the bottle a small silver tube descends nearly to the bottom; the other end passing outwards is connected with a small flexible aspirating tube. Supporting the bottle is a hollow bent neck connecting it with a telescopic stand that is also hollow, by which the air freely escapes at the base.

Directions for Using Regnault's Hygrometer.—Pour just as much ether into the silver cup as will cover the thermometer bulb, and insert the thermometer as shown in the drawing. On causing the air to bubble slowly through the ether, by breathing through the tube, the immersed thermometer will show a decline in the temperature; and when a film of moisture forms on the larger part or shoulder of the silver bottle, the temperature at that instant indicates the dew-point. The observer should stand so as not to allow the breath or heat of the person to affect the instrument.

60. **Atmidometer** (Dr. BABINGTON'S), for measuring the evaporation from water, ice, or snow; exhibited at the meeting of the Royal Society, by Dr. Babington, F.R.S., and explained to the Society in his paper on "The Spontaneous Evaporation from Various Fluids," November 24, 1859.

£2 0 0 to £3 10 0



FIG. 63.

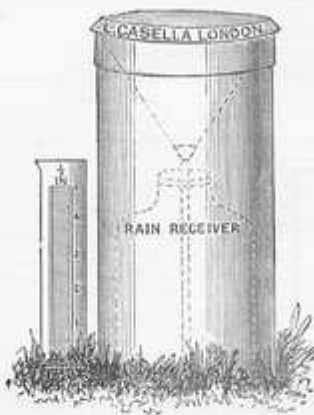


FIG. 68.

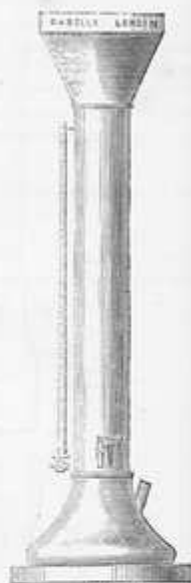


FIG. 65.

RAIN GAUGES.

The increasing importance attached to a knowledge of rainfall, as well as evaporation, in various localities, has for some time contributed to the exercise of considerable skill in arranging the most suitable instruments for these purposes. The instruments, however, being simple in themselves, the great question was, as to the most desirable size, as well as height from the ground on which they should be placed, large areas as a rule obtaining the preference. In an extended series of careful experiments, however, liberally conducted by Colonel Ward, at his own expense, and assisted by that eminent authority on rainfall, Mr. Symons, it was found that the best sizes were between five and eight inches of circular area; Mr. Glashier, F.R.S., then President of the Meteorological Society, also preferring the latter size, the following are made according to this result. The height again is fixed at ten to fourteen inches above the surface of the ground, the rain caught decreasing in quantity in proportion as gauges are raised above that height.

62. **Rain Gauge** (Dr. LIVINGSTONE'S portable), expressly arranged by L. CASELLA for the Zambesi expedition, with receiving surface of 3-inch diameter, whereby (See Stratton, "New Edinburgh Philosophical Journal,") the greatest accuracy is obtained, with graduated jar, in maroon case for the pocket £0 16 6
63. **RAIN GAUGE**, as described by Howard in his "Climate of London" (*fig. 63*), in which evaporation is prevented and the rain collected in a stone bottle by a copper funnel of five inches diameter; turned brass ring, and strong glass measure divided to 100th of an inch depth of rain . . . £0 15 6



FIG. 64.



FIG. 73.

64. **Rain Gauge**, of stout copper, height twelve inches, receiving surface ten inches square, and funnel formed inside to prevent evaporation, with jar graduated to hundredths of an inch, and small receiver to prevent the necessity of lifting the gauge when measuring the rain (*fig. 64*) £2 10 0
65. **RAIN GAUGE (CASELLA'S)**, pedestal form, 3 feet high, receiving surface 8 inches in diameter, made of stout copper japanned, with strong glass tube graduated to show 3 inches of rain in tenths and hundredths, with extra stop-cock for frosty weather. In this arrangement the rain is measured as it falls, being visible at all times in the glass tube, and is poured off by simply turning the stop-cock, without removing the gauge from its place (*fig. 65*) p. 22 £3 10 0
66. **Rain Gauge**, cylindrical form, of stout copper, 8-inch. diameter, with deep brass rim, and inside receiving-can or bottle, by which large or small quantities are measured without disturbing the gauge, and efficient protection secured against evaporation or frost or of overflow during the heaviest rains of the tropics £3 15 0
67. **RAIN GAUGE (CASELLA'S TROPICAL)**, to measure up to 40 inches of rain, in 100ths of inches, in japanned tin, with brass rim £1 10 0
68. **Rain Gauge (SYMON'S)**, 5-inch. diameter, japanned tin, with receiving-bottle etc. (*fig. 68*) p. 22 £0 15 6
69. **RAIN GAUGE (SYMON'S)**, of copper, for durability 1 1 0

Instructions for Use.—The funnels of this rain gauge and the five preceding ones are made to lift on and off the cylinder, and a can or bottle for receiving the rain from the funnel is placed inside. When rain is to be measured, remove the funnel, take out the can, and pour the rain collected into the glass measure, which is graduated to represent hundredths of an inch, up to 0.50, or half an inch. Place the glass upon a table or other horizontal surface for support and steadiness, bring the eye on a level with the surface of the water and read off. Should more than half an inch of rain have been collected, successive measurements will be necessary. For instance, having measured half an inch, or 0.50, empty the glass, fill up again from the collecting-can, and add the result of this second measurement, to the half-inch measured previously. For example, should the second reading be 0.07, the two readings added together will give the total rainfall or 0.57 of an inch.

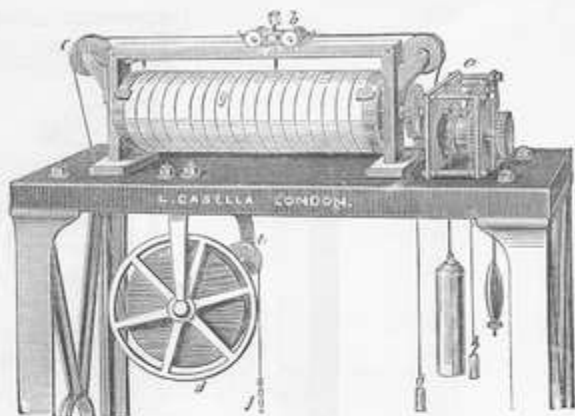


FIG. 72.

70. **Evaporating Dish or Gauge**, of copper, with wirework edge for protection from birds, etc. The receiving surface of same diameter as the gauge with which it is used, say five inches, with graduated glass measure . . . £0 15 6

71. **EVAPORATING GAUGE**, as above, eight inches diameter inside . . . 1 4 0

Instructions for Evaporating Gauge.—Nearly fill it with water, measured by the graduated glass measure, and place it out-of-doors freely exposed to the air. After exposure, again measure the water, and the difference between the first and second measurement shows the amount that has evaporated. Should rain have fallen, however, during the interval, the quantity equal to that collected in the adjoining rain gauge must first be deducted from the evaporator, the remainder, compared with the measured quantity put in, shows the amount that has evaporated. For districts which are subject to very heavy rainfall, an evaporating gauge, with overflow pipe to meet any exigency, may be had at a slight increase in the price.

72. **SELF-RECORDING EVAPORIMETER OR TIDE GAUGE** (*fig. 72*) shows the general design of this new and interesting instrument. It answers equally well for a rain gauge as for either of the above-named purposes, or for the rise and fall of water in a river, canal, lock, or any other body of water, the rate of evaporation, etc., showing the exact time at which any increase or reduction may have occurred . . . £32 0 0

DESCRIPTION.—*a* is a 30-hour timepiece of best English make; *b* the carriage carrying the pencil which marks the paper on the cylinder *g*; *c* pulley over which the cord runs to communicate with the float-wheel *d*; *e* small wheel communicating with *d*, from which the line is connected with the float resting on the water. The paper is changed every 24 hours. The angles of pulleys, etc., may be altered to adapt it for almost any position.

73. **Rain Gauge**, improved self-registering, receiving surface 100 inches diameter, 10 inches square. In this arrangement the rain is measured to tenths and hundredths of inches, and a continuous record is kept to the depth of 100 inches of the quantity of rain fallen (*fig. 73*) p. 23 . . . £4 10 0

The registering parts are all of copper, carefully tinned, and the arrangement so simple that any one can clean the works when needed, or adjust the gauge to the greatest nicety; indeed, this adjustment is so simple that it may be as well for the purchaser to test it on receiving it, or at any time after its removal; thus the small measure, when quite full, holds five cubic inches of water; this quantity passed through the instrument should move the hand of the hundredth circle five divisions, or half-way round, and is equivalent to half a tenth of an inch in depth of rain; and the receiving trough being ten inches square at the top or =100 superficial inches, five cubic inches equals one-twentieth, or half a tenth of an inch = 0.05.

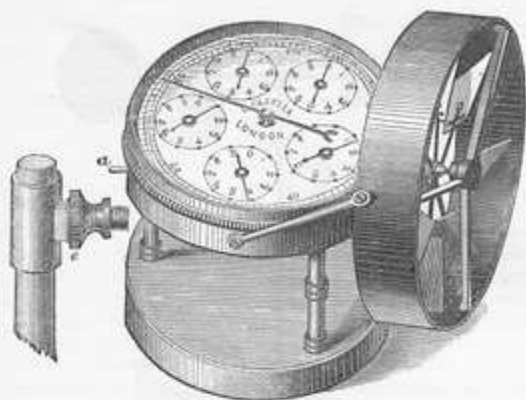


FIG. 75.

ANEMOMETERS.

The anemometers and air meters in the following list include only such as are approved of by the highest authorities, and in constant use at the present time. The table for converting velocity into force is introduced on account of the little confidence usually felt in reports of the wind's force; the authoritative course now followed being almost exclusively confided to reports of velocity, from which the comparative force is thus easily obtained.

74. **ANEMOMETER (LAND'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 (*fig. 74*) p. 31 £2 2 0
75. **Casella's Air Meter**, 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 of hospitals and other public buildings. It was first constructed for Dr. Parkes, F.R.S., of the Royal Victoria Hospital, Netley, for measuring the state of ventilation in that large military establishment, and declared to be the most perfect instrument of the kind in use. Since then it has been adopted in our Houses of Parliament, the United States Senate, most of our northern mines, and many of the leading prisons and hospitals throughout the country. The graduations for each instrument are obtained by actual experiment by means of machinery made for the purpose, so that the indications of all are as comparable with each other as the weight or measure of ordinary substances. The indications are shown by means of the large dial and hand, and five smaller ones, as shown in the annexed plate. The whole circumference of the large dial is divided into 100 parts, and represents the number of feet up to 100 traversed by the current of air. The five smaller dials are each divided into ten parts only, one revolution of each being equal to ten of the preceding dial, and representing 1000, 10,000, 100,000, 1,000,000, and 10,000,000 respectively. By means

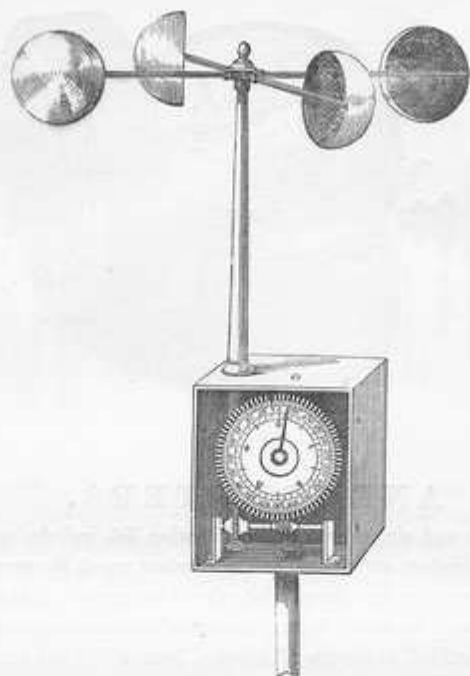


FIG. 78.

of the large dial the low velocity of fifty feet per minute may be measured, and by the smaller ones continuous registration is extended up to 10,000,000 feet, or 1893 miles, being practically beyond what the most extended observations can require, whilst jewelling in the most sensitive parts, ensures the utmost delicacy of action, FORMING ALSO AN ADMIRABLE POCKET ANEMOMETER FOR TRAVELLING, (*fig. 75*) p. 25 £4 4 0

76. **Air Meter**, as above, with large dial to 100, and only one smaller dial to 1000 £3 10 0
77. **Anemometer** (ROBINSON'S), plain, with four index wheels, registering successively 100, 1000, 10,000, and 100,000 revolutions. In this arrangement the cups travel at the rate of one-third the wind's velocity, and each revolution represents 3.14 feet; thus, $3.14 \times 3 = 9.42$ feet, being the distance travelled by the wind for each revolution. This, multiplied by the number of revolutions indicated on the dial, shows the distance the wind has travelled between one observation and another. The dials are read from right to left, and the amount indicated at the last observation is to be deducted from that shown on the dials at the time of the current observation £3 3 0
78. **ANEMOMETER** (ROBINSON'S IMPROVED), for registering the velocity of the wind in miles and tenths, up to 505 miles, and described by Sir Henry James, R.E., F.R.S., in his 'Instructions for taking Meteorological Observations' (*fig. 78*) £4 4 0

79. **Robinson's Anemometer**, as No. 78, with extra dial extending the registration to 3050 £5 5 0

Robinson's Anemometer consists essentially of four hemispherical cups, having their diametrical planes exposed to a passing current of air. They are carried by four horizontal arms attached to a vertical shaft, which is caused to rotate by the velocity of the wind. Dr. Robinson found that the cups, and consequently the axis to which they are attached, revolve with one-third of the wind's velocity, which is here measured by a simple arrangement of two wheels, working in endless screws, and, by means of two indices, shows, on inspection of the dial, the velocity of the wind. The outer, or front wheel, which revolves once for every five miles, is furnished with two graduated circles, the interior circle being sub-divided to miles and tenths of miles, whilst the outer circle is divided into 101 parts, each part being equivalent to five miles, so that it measures 505 miles of wind. The stationary index at the top of the dial marks on the inner circle the number of miles (UNDER FIVE) and tenths, that the wind may have traversed, in addition to the miles shown by the traversing index, which revolves with the dial and indicates on the outer circle the transit of every five miles. This anemometer is rendered extremely portable by the arms which carry the cups being made to take off. When in use it may be screwed on a shaft or ordinary piece of iron pipe which accompanies it, and may be fixed in any desirable position, their construction being such as to adapt them to withstand the most violent storms, and the simplicity of their make enables the observer to clean and lubricate them at pleasure, twice a year being sufficient.

To Place the Anemometer, No. 78, and take the first reading.—If after placing the instrument the hands are at 0, the next observation will show the distance travelled by the wind during the interval; but if the hands stand otherwise, then read them as they are, by noting down the divisions and figures indicated by the traversing hand and stationary index at the top. Thus, say that the former points to 125, and the latter to 2.6, making together 127.6, this will now be the starting-point of the gauge.

I. *Example*.—Let the traversing hand point to any increased number on the outer circle, say 375, and the stationary index to 3.6; these two numbers added together give the true reading, *i.e.* (378.6) miles. From this reading 378.6 must now be subtracted the first reading of the instrument, *viz.*, 127.6, giving 251 miles as the distance traversed by the wind during the interval.

II. *Example*.—Let the traversing hand now point to 425, and the stationary index to 4.7, adding these two together we have 429.7, from which take the last reading, *viz.*, 378.6, and the remainder, 51.1, will be the velocity of the wind for the interval between the two readings.

III. *Example*.—Lastly, let the traversing hand be at 175, and the stationary index at 2.8; here it is evident that the traversing hand, which at the last reading was at 429.7, must have passed the highest number marked on the dial, *viz.*, 505. Hence, to obtain the true reading in this case, we must add together the three numbers, *viz.*, 505, 175, and 2.8, together making 682.8; from this, taking the last reading 429.7, we have 253.1 miles as the distance travelled by the wind in the interval.

To save time and dispense with figures, it is usual, when the traversing hand has passed the 505, to place an asterisk at this point in the register, to denote that 505 must be added to the next reading.

To read the Anemometer, No. 79.—The divisions and figures on the left-hand dial are precisely the same as those in No. 78, and are read off in the same way. Each division on the dial to the right represents 505 miles, the subdivision of which are shown on the left-hand dial.

Example.—Take the reading of both dials as they are found to be at the time, say the left-hand dial showing 275.4 and the one to the right 505, and a little over a half; these figures added give 780.4 as the true reading, from which must be deducted the former reading, if any, to show the distance traversed by the wind in the interval.

80. Casella's Embossing Self-recording Anemometer, for registering the velocity and direction of the wind and the time of its various changes.

The general principle of this instrument is that of Dr. Robinson, of Armagh, in which four hemispherical cups revolve with the pressure of the wind, and give action to most of the other parts. The registering parts of the instrument, however, as well as the vane are *entirely new*, and the result of the joint efforts of myself together with those of Mr. Beckley, the ingenious engineer of the Royal Kew Observatory. The Force-and-Die principle of embossing is the means of registration herein adopted. The paper employed is a narrow strip, wrapped round a small attached roller, from which it is drawn, and embossed on one edge by the action of the rollers, as shown in the sketch. The rollers are divided to represent miles; they are figured at every ten, and one revolution shows the wind to have travelled fifty miles. The clock (*a*) raises the small hammer (*b*) which falls once in every hour, impressing the other edge of the paper with a small arrow  whose movements are identical with the larger one at the top, and thus shows the exact direction of the wind at the time, as well as its rate of speed during each preceding hour. The paper is of sufficient length to last from four to six weeks without being changed, and the clock may be wound up daily or weekly, as may be desired. The projection (*c*) contains metal balls, which firmly support the top, and aid

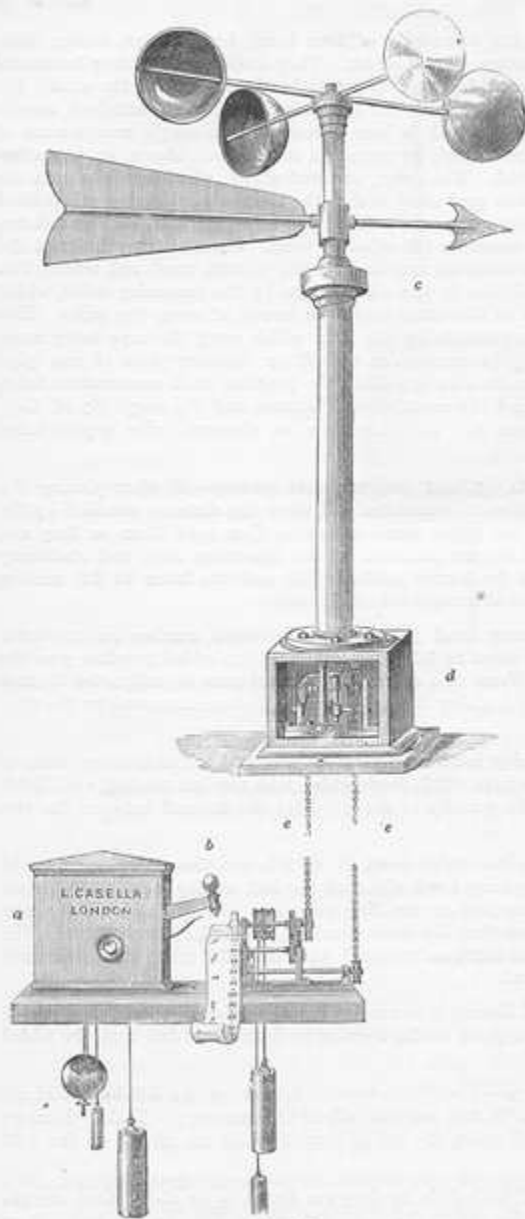


FIG. 80.

in giving freedom of action. The square box (*d*) is of cast iron, and contains the

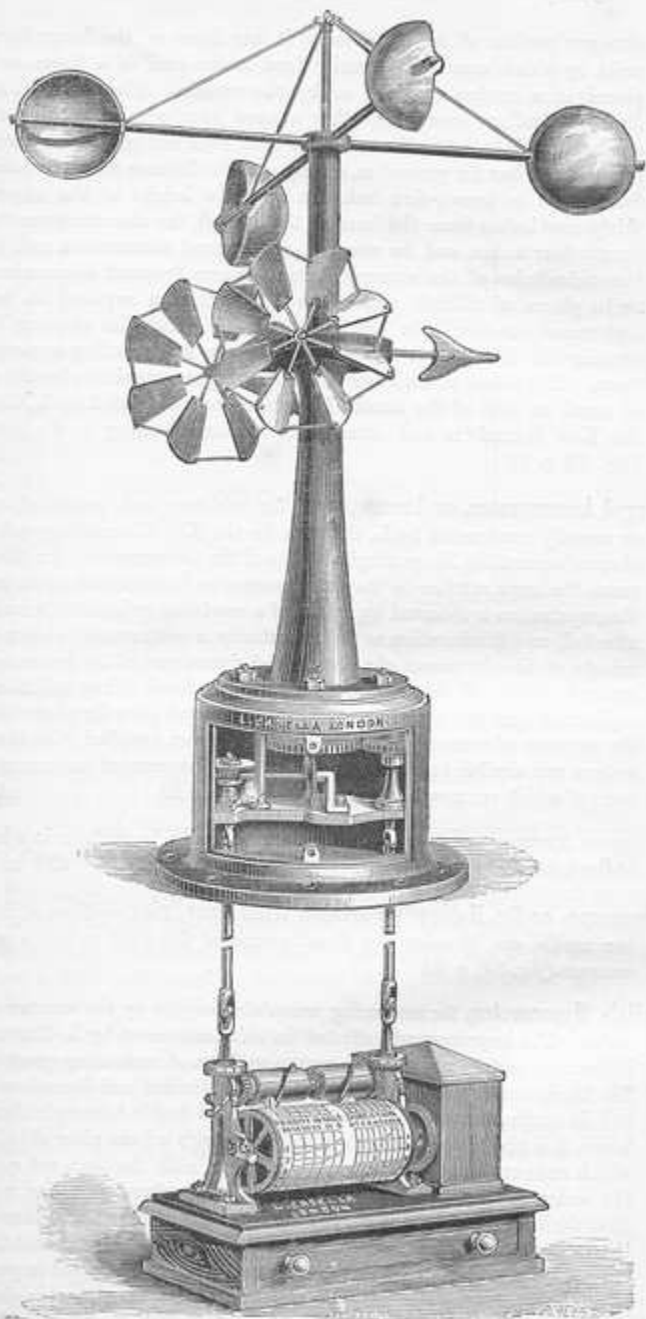


FIG. 82.

stronger portion of the wheelwork; it has holes on the flange for screws or nails, by which means it is easily fixed to the roof of a house, or to a pole placed in a garden, or field, or by the seaside. The chains (*c c*) act on *improved* rollers, over which they *cannot pass* without turning them, and are brought into connection with the clockwork and registering parts, placed in a room or box for protection, at any vertical distance from the base (*d*), say from three to twenty-five feet. In size, the height of the upper part is thirty-nine inches from the base of the box (*d*), the diameter over the cups is twenty-four inches, and its strength and general construction such as to bear the vicissitudes of the severest storm. Where frequent absence is requisite, or in places of difficult access, the little attention required in using this instrument can hardly be over-estimated. A small dial showing time, and another the direction, is also attached to the self-recording apparatus in the room. The action of each one is tested and guaranteed to give the same rate of speed as that of the standard anemometer constructed by L. CASELLA for the Kew Committee and other Observatories belonging to the Government (*fig.* 80) p. 28 £38 0 0

82. **Enlarged Anemometer, or Anemograph**, for harbours and public observatories, as recently constructed by L. CASELLA for the Kew Observatory and the other observatories of the Meteorological Office of the Government. In this arrangement the cups revolve in the same manner as in the smaller instrument, but the registration is obtained by means of a revolving cylinder to which paper is attached, and the direction as well as velocity is continuously shown for every minute of time by means of a clock which forms part of the instrument. The exposed portion of this anemometer may be placed at any height, whilst the registering part is kept in a room or other covered place for observation. For the purposes of comparison, the registering papers supplied with these anemometers are similar to those used with the Government instruments, several more of which are now being erected (*fig.* 82) p. 29 £70 0 0

83. **ENLARGED ANEMOMETER, or ANEMOGRAPH**, if made to register in a lower room of the building £75 to 80 0 0

84. **Anemoscope, or Dr. Halleur's Portable Wind Vane**, for travellers, with compass, bar needle, etc., showing the direct course of the wind to half a point of the compass (*fig.* 84) p. 31 £2 2 0

85. **Casella's Hypsometer**, for measuring mountain heights by the vapour of boiling water. The improvements effected in this instrument by L. CASELLA render it the most certain and portable means we have of measuring great elevations. The thermometer, strong, with small bulb, is divided and figured on the stem, and is sheltered from cold when in use by a double telescopic chamber, into which it is placed to any required depth through a loose piece of india rubber, which rests on the top. The proper depth is, with the bulb, not quite so near the water as is shown in the sketch. The chamber being filled with vapour from the boiling water beneath, and the inner chamber and tube thus enveloped, the vapour descends in the outer chamber, and escapes by the outlet. By this means the mercury, both in the bulb and stem, is immersed in pure vapour, whatever kind of water may be employed; less than a wine-glass full of water and half as much spirits serve for several observations. The thermo-

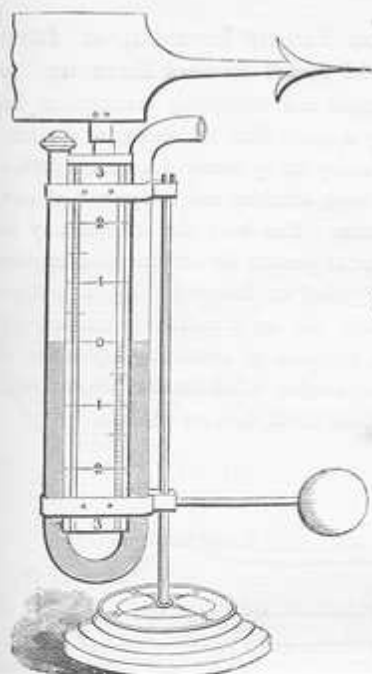


FIG. 74.

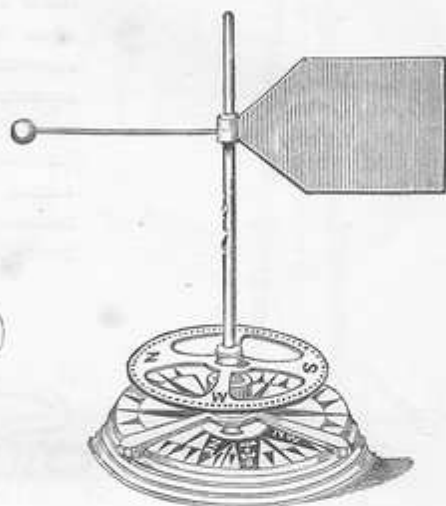


FIG. 84.

meter is kept in a light metallic case, lined with india rubber. The portable leather case (*fig. 85**) p. 32, contains the whole when packed for travelling. Price, with one thermometer, divided to $0^{\circ}1$, as arranged and made by L. CASSELLA for the Government (*fig. 85*) p. 32 £4 15 0

86. **Pocket Hypsometer.** The success attending the above has induced L. CASSELLA to construct a still smaller instrument on the same principle, which is much used by Alpine travellers. It may be carried with ease in the pocket, and by those a little experienced in its use, is often preferred for its simplicity and certainty to the mountain barometer. With one thermometer divided to $0^{\circ}2$, as supplied to the Royal Geographical Society £2 10 0

Wherever the measurement of mountain heights is required to be taken by other means than the theodolite, or standard barometer, or where there may be danger of damage or breakage of either, without an easy means of comparing or replacing them, this cheap and simple means of measuring heights will be found as efficient as it is handy, and at all times a reliable test of the aneroid or any other instrument, which from time to time require to be compared and adjusted.

87. **Casella's Tables,** with instructions for using the hypsometer, second edition £0 1 0

"For the elevation of great mountain masses and continuously elevated areas I conceive that hypsometrical results are as good as barometrical ones; for the general purposes of botanical geography, the boiling-point thermometer supercedes the barometer in point of practical utility, for under every advantage the transport of a glass tube full of mercury, nearly three feet long, and cased in metal, is a great drawback to the unrestrained motion of the traveller."—Dr. J. D. HOOKER'S "Himalayan Journals" Vol. II.

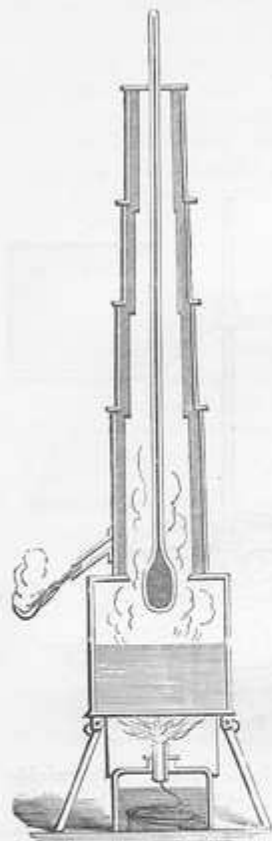


FIG. 85.

88. **The Boylean Mariotti Barometer, or Patent Mercurial Pocket Standard Barometer.** In this elegant and interesting arrangement the mercury is raised from the cistern to the fiducial or zero point by means of a screw, a portion of air being admitted and compressed at each observation. The body and cistern may be separated at pleasure for convenience of carriage in the pocket or knapsack. As a portable barometric test or standard instrument for mining purposes, or measuring any extent of mountain heights, it is believed to have no equal. For fig. and description, see addenda.

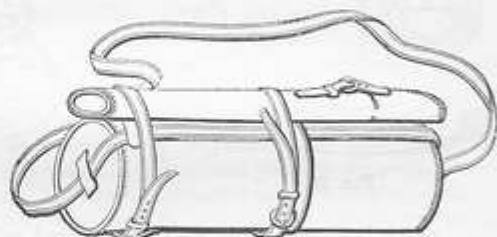


FIG. 85*

89. **Ozonometer** (DR. SCHONBEIN'S), consisting of strips of paper prepared with iodide of potassium and starch. The papers are to be suspended so as to be exposed to the free access of air, but sheltered from wet and the direct rays of the sun; when affected by ozone, they become tinged, the intensity of which is measured by a graduated scale of twelve tints, which accompanies the ozonometer. L. CASELLA is the sole agent for Dr. Schonbein's ozone test papers. In case to last one year. £0 6 6
90. **Dr. MOFFATT'S OZONOMETER** 0 8 6
91. **Sedan's Ozonometer** 0 8 6
92. **OZONE CAGE** of fine wire gauze, as recommended by Sir Jas. Clark 0 12 6
93. **Smaller Size, ditto, for travellers** 0 12 6
94. **Casella's Forms for Registering Ozonometer Indications** 0 1 6
95. **CASELLA'S FORMS FOR REGISTERING METEOROLOGICAL OBSERVATIONS**, with concise remarks and instructions, in twelve monthly forms for one year £0 4 0
96. **Portable Meteorological Register and Note Book** (STRACHAN'S), with weather diagrams, tables, and instructions, second edition £0 2 6



FIG. 119.



FIG. 100.

THE ANEROID BAROMETER.

This ingenious and elegant instrument is now regarded as almost indispensable to all who take interest in the weather, whilst, to travellers in particular, it presents advantages which hitherto they could not obtain. Before the introduction of the aneroid, limited indeed were the means of those, who, moving from place to place, desired in their progress to take reliable notice of meteorological phenomena, whilst the measurement of heights by any convenient or simple and portable arrangement was quite out of the question. Not only are all these difficulties entirely overcome by this instrument, but the older fragile form of barometer used at sea is almost entirely superseded. The action is obtained by the compression by the atmosphere of a thin, flat, circular metallic box, which is deeply corrugated to increase its elasticity, and from the interior of which the air has been carefully removed; the upper and lower surfaces are held in a state of tension or separation from each other by means of strong springs; the atmosphere pressing with varying force on these surfaces, conveys action to smaller springs, and thus show by hands on the dial the variation of heights, as well as changes of the weather.

No. 100 shows the general interior arrangement. In the measurement of small differences of height, as well as great elevations, the improved aneroid is alike interesting and valuable; not only does it show with precision the differences in height between one room and another, or the varying gradients in travelling on a railway, but it is now so improved as to show with much precision elevations up to fifteen to sixteen thousand feet.

The sizes vary from those of a small watch, to those of the largest dials; the form being usually circular, though that is also varied according to the position or place, such as large halls, public buildings, etc., for which it may be required.



FIG. 100*.



FIG. 120 and 120*.

97. **Aneroid Barometer**, with $4\frac{1}{2}$ -inch. dial, in neat leather case £1 0 0 and £1 5 0
98. **ANEROID BAROMETER**, with silvered metal dial 1 10 0 and 1 15 0
99. **ANEROID BAROMETER**, with thermometer 2 5 0
100. **Aneroid Barometer**, with $4\frac{1}{2}$ -inch. open dial, showing the interior mechanism, with thermometer (*fig.* 100, p. 33) £3 0 0
If with stand as *fig.* 100*, 15s. 6d. extra.
102. **ANEROID BAROMETER**, cylindrical form, more finely divided and engraved, with extra compensation for temperature, with or without thermometer, as supplied to Her Majesty's Navy (*fig.* 102, p. 35) £4 4 0
103. **ANEROID BAROMETER**, extra sensitive, with greatly extended graduations, divided to $\cdot 001$ -inch. each barometric inch being equal to nearly four inches, with circular thermometer and richly engraved $4\frac{1}{2}$ -inch. dial £5 10 0
The extreme sensitiveness of this instrument is very remarkable.
104. **Aneroid Barometer**, in bronze metallic frame with 8-inch. dial, for use at sea £2 10 0
105. **ANEROID BAROMETER**, as above, with thermometer 2 15 0
106. **ANEROID BAROMETER**, with handsome turned wood frame, oak or imitation of ebony, 10-inch. dial £4 4 0
107. **Aneroid Barometer**, with 18-inch. dial, very bold and handsome, for large halls or public institutions £15 0 0 to £25 0 0
108. **ANEROID BAROMETER** of superior finish, with richly engraved $4\frac{1}{2}$ -inch. dial, raised circle, and revolving index, with or without thermometer £5 0 0
109. **Pedestals** of various designs, for aneroid barometers for the mantel-piece £0 7 6 to £1 1 0
110. **ANEROID BAROMETER**, for the pocket, in maroon case, $2\frac{1}{2}$ -inch. by $1\frac{1}{2}$ -inch., finely divided and compensated, very sensitive, for indicating changes in the weather, or measuring heights up to 1000 feet, with revolving index £4 4 0
112. **Aneroid Barometer** (plain), for the pocket, in neat leather case $2\frac{1}{2}$ inches by $1\frac{1}{2}$, for indicating changes of the weather or measuring heights up to about 7000 feet £2 10 0



FIG. 102.

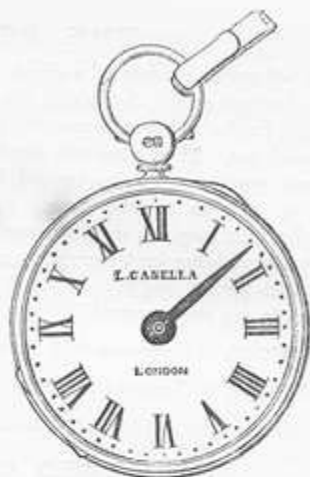


FIG. 124.

- | | |
|---|---------|
| 113. ANEROID BAROMETER, with revolving index to about 8000 feet | £3 0 0 |
| 114. Aneroid Barometer, rather smaller in size, and carefully compensated | 3 10 0 |
| 115. ANEROID BAROMETER, with scale of heights | 4 10 0 |
| 116. Aneroid Barometer, with circular thermometer and raised barometric circle, carefully compensated for measuring up to 10,000 to 12,000 feet | £4 10 0 |
| 117. ANEROID BAROMETER, pocket size, in neat case, about 2½ inches by 1½, carefully compensated for temperature, with superior compass and thermometer; an excellent traveller's companion | £4 10 0 |
| 118. Alpine Aneroid Barometer, very carefully compensated and tested for measuring heights up to 15,000 feet (small pocket size) | £5 10 0 |
| If in silver | 6 6 0 |
| 119. Aneroid Barometer, with extra small dial, about the size of a small Geneva watch, carefully tested and compensated, with every improvement, graduated from about 23 to 31 inches, or more if desired (<i>fig.</i> 119, p. 33) | £5 0 0 |
| 120. ANEROID BAROMETER, same size, in silver, with double back to open with spring (<i>fig.</i> 120, p. 34) | £6 6 0 |
| If on neat gilt watch stand (<i>fig.</i> 120*, p. 34), 10s. 6d. extra. | |
| 122. Aneroid Barometer, in best gold, 18 carat | 12 0 0 |

N.B.—A scale of altitudes accompanies any of the above instruments *gratis*, or may be engraved on the dial of either, from No. 108, at an extra charge of 7s. 6d.

* * * The larger sized aneroids, as 4½ inch., can have self-registering indices added, by which the highest and lowest point during absence may be registered at, extra £1 1 0

- | | |
|---|--------|
| 123. Sympiesometer (CASSELLA'S IMPROVED) for measuring mountain heights up to 15 to 21,000 feet, as adopted by some of the leading members of the Alpine Club, in neat mahogany case with straps | £4 0 0 |
|---|--------|

For other Sympiesometers, see Nos. 142, 143, and 144.

REGISTERING ANEROIDS, BAROMETERS, ETC., see Nos. 17 to 22 inclusive.

THE PEDOMETER.

The pedometer consists of a simple arrangement of weight and pendulum acting on plain toothed wheels, by which the distance walked by the wearer is accurately measured. In size and form it resembles a small watch, the annexed plate being rather over the real size. The figures and divisions represent one to twelve miles, divided into halves and quarters. To the invalid lady or gentleman requiring limited walking exercise, as well as to the hearty active pedestrian, it is equally valuable and trustworthy. It may be worn suspended from the neck, or placed in a front or waistcoat pocket, being kept upright by means of the small hook (*a*). The pedometer is adjusted with perfect ease to the step of the wearer, however long or short, and altered at pleasure to any step required.

124. Pedometer, in silver case with strong crystal glass (*Fig. 124, p. 35*) £2 15 0
 125. Pedometer, in German silver case 2 5 0

IMPROVED CHRONOGRAPH,

For the correct registration of any number of rapidly passing objects, as at regattas and races, as well as eclipses and occultation of stars, the exact speed of machinery, etc., by merely touching a spring without removing the eye from the objects. In size and form the chronograph precisely resembles a watch; it is made of silver, and consists of an ordinary quick train lever movement, with the addition of a centre seconds-hand, which traverses the dial as in a stop seconds watch. By this means time is taken to the tenth of a second, in either scientific or sporting pursuits, without the confusion and anxiety of taking the eye from the object.

126. Chronograph, as above £9 9 0

CLINICAL THERMOMETERS.

CASELLA'S Clinical Thermometers, as expressly arranged by Dr. Aitkin of the Royal Hospital, Netley, for use at that great military establishment. In Aitkin's arrangement two thermometers are used, the one bent for reading *in situ*, the other straight for reading by registration where the danger of fever, defective sight, and other causes might render direct observation difficult, or even dangerous. Of the many uses to which CASELLA'S Maximum Thermometers are now applied, perhaps none are equal in importance to their application for clinical purposes, and though many desultory efforts were made at various times, none certainly assumed the distinct form of applying this principle until taken up by Dr. Aitkin. See Aitkin's "Science and Practice of Medicine," 1st, 2nd, and 3rd Editions which show that his description of clinical temperature by registration, considerably precedes all other names associated with it. This thermometer registers the greatest heat of the body in any position. It may be inserted in the mouth, the axilla, or between the thighs, so as to be well covered, and in two and a half to three minutes removed to the light and read off at leisure. Length 9 inches, divided and figured on the stem from 80° to 115° or 120° in 5ths of degrees.

127. The two in neat pocket case, as above £1 5 0

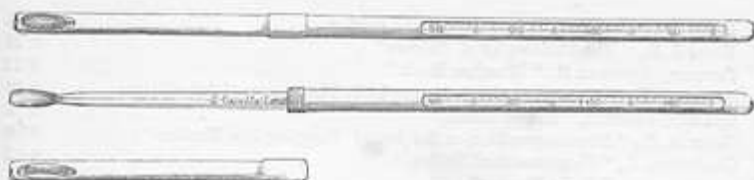


FIG. 134*.



FIG. 128.

128. **Clinical Thermometer** (self-registering), 10-inch. (*fig.* 128), in neat case for the pocket £0 12 6
129. **CLINICAL THERMOMETER**, 6 or 7 inch. 0 12 6
130. **Clinical Thermometer**, 4 or 5 inch. 0 12 6
132. **CLINICAL THERMOMETER** (non-registering), 10 inch. 0 7 6
 No shorter Non-Registering Clinical Thermometer than this should be used.
- If silver case for the 4 or 5-inch. size extra £0 5 0
- If ivory case for the 5 or 6-inch. size " 0 3 0
133. **Dr. Aitkin's Clinical Chart of Temperature, Pulse, Respiration, and Excreta**, arranged for thirty-one days, with comparative scale of Fahrenheit and centigrade degrees, per dozen. £0 1 8
134. **GUY'S HOSPITAL CHART**, per dozen 0 1 6

N.B.—The 7-inch. Clinical Thermometer is also now much used by veterinary surgeons, for the treatment of animals in cases of fever, etc., during the cattle plague especially, when applied in the rectum, no other first symptom was found so distinctive and positive as the indication thus obtained.

- 134* The above-named thermometer, especially arranged for the treatment of cattle, with instructions, and shield for protection 10-in. (*fig.* 134*) £0 14 0

BOOKS ON METEOROLOGY, ETC.

1. "A Manual of Scientific Enquiry," by SIR JOHN HERSCHEL and ROBERT MAIN. £0 10 6
2. ARAGO, F., "Meteorological Essays," translated by SABINE. 0 10 0
3. BEARDMORE, N., "Manual of Hydrology." 1 15 0
4. BLODGET, L., "Climatology of the United States." 1 0 0*
5. BUCHAN, A., "Handy Book of Meteorology," 2nd edition. 0 8 6
6. CASELLA, L. P., new edition of "WELLS on Dew," with notes and appendix by R. STRACHAN, F.M.S. 0 5 0
7. CLARK, Sir J., Bt., M.D., "On Climate," 4th edition. 0 7 6*
8. CLOUSTON, Rev. Dr., "Explanation of Popular Weather Prognostics. 0 1 6
9. DALTON, J., "Meteorological Observations," 2nd edition. 0 10 0*
10. DANIELL, PROFESSOR J. F., "Elements of Meteorology," 3rd edition, 2 vols. 0 16 0
11. DOVE, PROFESSOR, "The Law of Storms," translated by SCOTT 0 10 6

THE PEDIOMETER.

The pedometer consists of a simple arrangement of weight and pendulum acting on plain toothed wheels, by which the distance walked by the wearer is accurately measured. In size and form it resembles a small watch, the annexed plate being rather over the real size. The figures and divisions represent one to twelve miles, divided into halves and quarters. To the invalid lady or gentleman requiring limited walking exercise, as well as to the hearty active pedestrian, it is equally valuable and trustworthy. It may be worn suspended from the neck, or placed in a front or waistcoat pocket, being kept upright by means of the small hook (*a*). The pedometer is adjusted with perfect ease to the step of the wearer, however long or short, and altered at pleasure to any step required.

- | | |
|---|---------|
| 124. Pedometer, in silver case with strong crystal glass (<i>Fig. 124</i> , p. 35) | £2 15 0 |
| 125. Pedometer, in German silver case | 2 5 0 |

IMPROVED CHRONOGRAPH,

For the correct registration of any number of rapidly passing objects, as at regattas and races, as well as eclipses and occultation of stars, the exact speed of machinery, etc., by merely touching a spring without removing the eye from the objects. In size and form the chronograph precisely resembles a watch; it is made of silver, and consists of an ordinary quick train lever movement, with the addition of a centre seconds-hand, which traverses the dial as in a stop seconds watch. By this means time is taken to the tenth of a second, in either scientific or sporting pursuits, without the confusion and anxiety of taking the eye from the object.

- | | |
|--------------------------------------|--------|
| 126. Chronograph, as above | £9 9 0 |
|--------------------------------------|--------|

CLINICAL THERMOMETERS.

CASELLA'S Clinical Thermometers, as expressly arranged by Dr. Aitkin of the Royal Hospital, Netley, for use at that great military establishment. In Aitkin's arrangement two thermometers are used, the one bent for reading *in situ*, the other straight for reading by registration where the danger of fever, defective sight, and other causes might render direct observation difficult, or even dangerous. Of the many uses to which CASELLA'S Maximum Thermometers are now applied, perhaps none are equal in importance to their application for clinical purposes, and though many desultory efforts were made at various times, none certainly assumed the distinct form of applying this principle until taken up by Dr. Aitkin. See Aitkin's "Science and Practice of Medicine," 1st, 2nd, and 3rd Editions which show that his description of clinical temperature by registration, considerably precedes all other names associated with it. This thermometer registers the greatest heat of the body in any position. It may be inserted in the mouth, the axilla, or between the thighs, so as to be well covered, and in two and a half to three minutes removed to the light and read off at leisure. Length 9 inches, divided and figured on the stem from 80° to 115° or 120° in 5ths of degrees.

- | | |
|--|--------|
| 127. The two in neat pocket case, as above | £1 5 0 |
|--|--------|

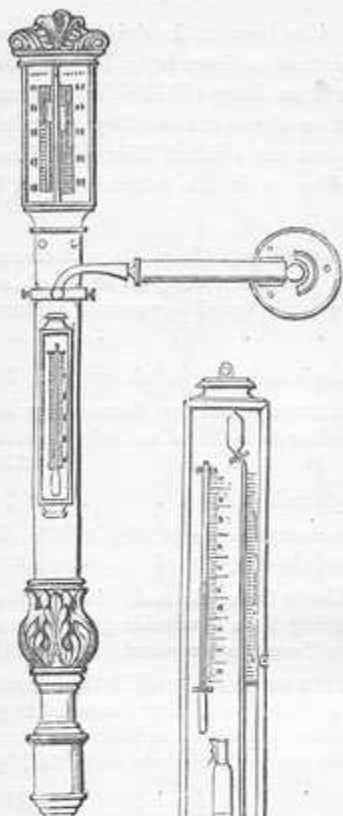


FIG. 136.



FIG. 144.

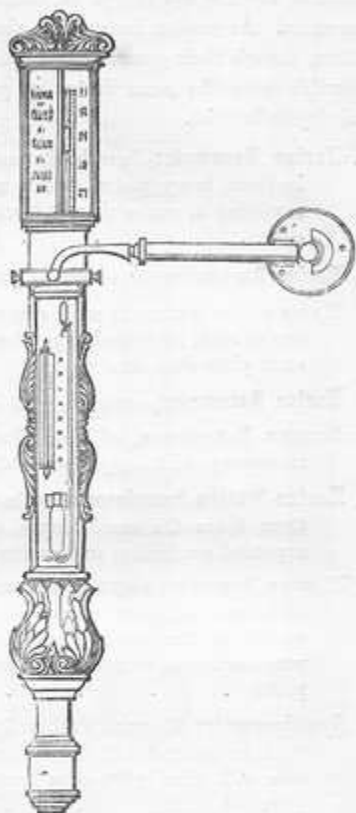


FIG. 143.

BAROMETERS.

Besides the standard instruments as most of those described in the preceding pages, the following are those most employed by the farmer, mariner, etc., as well as for *weather glasses* for ornamental and general use, a few forms and arrangements only are given, but they may be had of any design to correspond with the architecture of halls, libraries, and public buildings, perfect efficiency in the cheapest as well as the most costly being the first consideration, few things keeping nature's laws better before us than such efficient means of seeing and estimating the varying condition of the pressure and heat of the atmosphere.

MARINE BAROMETERS AND SYMPIESOMETERS.

The great change effected in the use of these instruments since the time of the Brussels Conference, as well as the introduction of the aneroid and Bourdon's barometers

must greatly curtail the length of this list. Besides, however, the rigid form suggested at the above conference and adopted by our Government, as shown in *fig.* 13, p. 5, a few other ornamental kinds as *fig.* 136, p. 39, continue in use, being still liked for their handsome appearances. As weather instruments also, when of proper make, they are undoubtedly excellent, though their general construction does not admit of their indications being comparable with the same degree of precision as in the pattern adopted by our Admiralty authorities.

136. **Marine Barometer**, bow front, neatly carved (*fig.* 136, p. 39), with thermometer in front, ivory plates, double rack, verniers reading to 100th of an inch, revolving in centre ring and brass gimbals, complete, rosewood, mahogany, or oak £3 15 0
137. **Marine Barometer**, bow front, as 136, single rack and gimbals, complete 3 5 0
138. **MARINE BAROMETER**, in solid rosewood frame, round top, thermometer in front, double rack, ivory scales, vernier reading to 100th of an inch, protected with stout plate-glass, etc. £3 10 0
139. **Marine Barometer**, complete, with single rack-work 3 3 0
140. **MARINE BAROMETER**, of plain simple construction, perfectly reliable, in solid mahogany, with ivory plates and gimbals, complete £2 2 0
142. **Marine Station Sympiesometer**, in bold oak frame, the scale elongated to about three times the usual length, adapting it as a valuable guide where more expanded graduation and greater sensitiveness are required £4 10 0
143. **MARINE BAROMETER AND SYMPIESOMETER** combined, by which the indications of each are at all times comparable, the tubes of both being contracted to prevent oscillation; rack-work to sympiesometer, and double rack-work to barometer; very handsome, in rosewood, walnut, etc., with gimbals, complete (*fig.* 143, p. 39) £6 10 0
144. **Sympiesometer** (CASELLA'S MUCH IMPROVED) especially arranged for use at sea, the tube contracted to prevent oscillation in stormy weather, in solid rosewood case with stout plate-glass front, the scale reading to the 50th of an inch (*fig.* 144, p. 39) £3 3 0

For Mountain Sympiesometer, see No. 123.

145. **The Fisherman's or Storm Barometer**, as expressly approved by Admiral Fitzroy, Board of Trade, etc., for Lifeboat Stations £5 5 0

This instrument consists of a strong tube with large bore, and very correct and bold thermometer mounted in a solid oak frame, firmly screwed together. The scales are of porcelain, boldly engraved, and impervious to any injury from the weather; the vernier reading is to 1/100ths of an inch. It is strongly recommended as a sound and excellent instrument, admirably adapted for the sea coast and public institutions.

146. **MINER'S BAROMETER**.—The numerous accidents occurring in coal mines in particular, and the close connection of these with diminished atmospheric pressure, as shown by a low state of the barometer, has induced L. CASELLA to arrange an economic and highly portable form of instrument for this purpose; it is plain, hardy, sensitive, and adapted alike for all climates. No manager of mines should be without it £1 10 0
147. **Miner's Barometer**, more elaborately finished 2 2 0



FIG. 156.



FIG. 155.

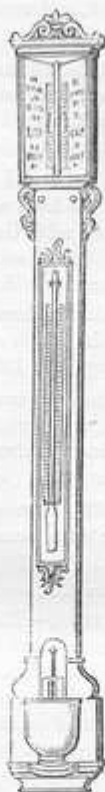


FIG. 153.



FIG. 154.



FIG. 149.

148. THE ANEROID BAROMETER, of plainest form; when well made is also perfectly adapted for this purpose (see also page 34) . . . £1 10 0 to £2 10 0

149. **Plantation Barometer** (*fig. 149*) (see also Nos. 180 and 182) 1 10 0 to 2 0 0

PORTABLE OR PEDIMENT BAROMETER.

In these instruments the action of the mercury is direct and free from mechanical influence; and, when the relative proportions of the cistern and tube are properly arranged on the barometer scale, the nearest approach to a standard barometer is attained.

150. **Portable Barometer**, extra size, very bold, handsomely carved, in rosewood, mahogany or oak, plate-glass in front, with extra large tube 0.45 inch internal diameter, double rack-work, ivory plates, and attached thermometer, suited for large halls or public buildings . . . £7 7 0 £8 8 0 and £10 10 0

152. **PORTABLE ROSEWOOD BAROMETER**, handsomely fitted up, inlaid with pearl, plate-glass in front, double rack-work, and verniers reading to the 100th of an inch
£6 6 0 to £8 8 0
153. **Portable Barometer**, extra size, tube 0·4 inch internal diameter, and cistern 2·75 inch ditto, ivory plates, with verniers reading to 100th of an inch, carved top and sides; thermometer in front covered with plate-glass, floating gauge, for plain standard adjustment when required (*fig.* 153, p. 41) . . . £8 10 0
154. **Portable Barometer**, with large tube and cistern, the graduation of the scale compensating for variation in the level of the mercury in the cistern; handsomely engraved ivory plates, with German silver mountings, and double vernier, each reading to the 100th of an inch; combining every excellence of which this description of barometer will admit (*fig.* 154, p. 41) . . . £4 10 0
155. **PORTABLE BAROMETER**, plain pattern, thermometer in front, ivory plates, rack-work, and vernier reading to the 100th of an inch, portable screw and plate glass, in rosewood or mahogany (*fig.* 155, p. 41) . . . £2 10 0
156. **Portable Barometer**, with open face and ivory plates, vernier reading to 100th of an inch; thermometer at side, and portable screw; in rosewood, oak, mahogany, etc., being a good and hardy instrument, adapted alike for home use or transmission to all parts of the world (*fig.* 156, p. 41) . . . £1 5 0
157. **Agricultural or Cottage Barometer**, expressly designed by L. CASELLA as a cheap, portable, and popular weather glass, accompanied with plain description and instructions (*fig.* 188, p. 47) . . . £0 12 6

For barometers of this construction, see also Nos. 188, 189, and 190.

158. **Long Range Barometer** (DESCARTES).—This interesting arrangement consists of a syphon tube filled with mercury, and having the column of ordinary length, the upper part of the tube and short limb being say half an inch in diameter; to the latter a length of tube is united, extending to the top, the interior diameter being, say one-eighth of an inch. This tube and lower limb of the instrument being partly filled with a fluid of very light specific gravity, the rise and fall of the mercury is shown by it, but extended in length in proportion to the difference in capacity of the two tubes. In this way the ordinary barometric inch may be extended to from seven to ten inches, which being moderately subdivided, the barometric action or changes during a storm are often visible. This instrument, however, is not very portable, and should only be carried by hand from place to place . . . £2 10 0

CIRCULAR OR DIAL BAROMETERS.

This popular and interesting arrangement of household instrument was first designed by that able philosopher Doctor Hook, who took great pains to make it perfect, so much so, that had his plans been carried out with fair progressive improvement, and the instrument been of a slightly more portable character, any other arrangement of weather indicator for general use might almost be considered superfluous; the clear and expanded graduations on the dial, as well as its well-known response to the simple tap so frequently given "to see which way the mercury is going," is familiar to all.

Not only did the Doctor attach a thermometer to it, but a hygrometer also, and even a level for the purpose of carrying out his arrangement with greater delicacy;

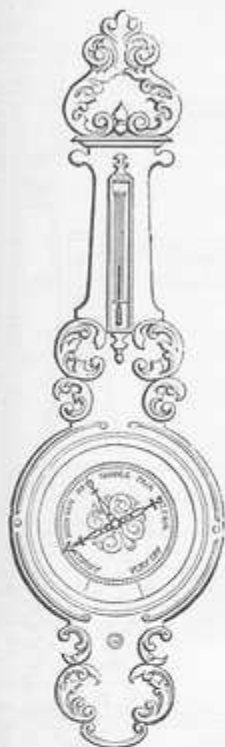


FIG. 167.



FIG. 159.

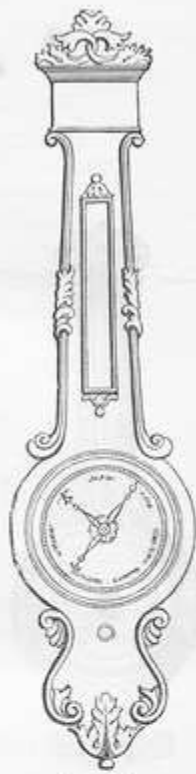


FIG. 162.

the ultimate rude combination, however, of these, from commercial competition has brought an unmerited distrust on the design, and hence its recent unpopularity. As regards the hygrometer, however, the simplicity and efficiency of the wet and dry bulb has subsequently caused it to supplant almost every other form. The following brief list, therefore, combines only instruments in which the desire of the Doctor is fully carried out, excepting that the above-named hygrometer (wet and dry bulb) is advised and its use recommended as a separate instrument.

159. **Circular or Dial Barometer**, in rosewood, walnut, oak, and mahogany, either plain or elegantly carved to any style of furniture or architecture, for halls, libraries, etc. (*fig.* 159) £5 5 0 to £21 0 0
160. **Ten-inch Dial Barometer**, handsomely inlaid with buhl work, plate-glass over dial, and attached thermometer (*fig.* 160, p. 44) £5 5 0
162. **TEN-INCH DIAL BAROMETER**, Egyptian pattern as (*fig.* 162), very chaste, in rosewood, walnut, oak, etc., with plate-glass over dial and bold thermometer £4 4 0



FIG. 164.



FIG. 160.

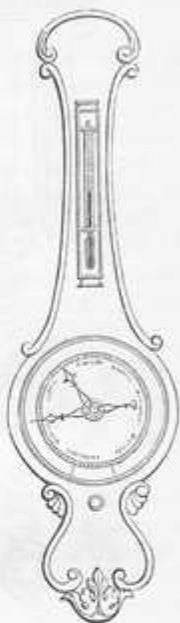


FIG. 166.

163. **Twelve-inch Dial Barometer**, best rosewood, elegantly inlaid with variegated buhl work, with best eight-day pendulum timepiece and attached thermometer, particularly suited for mansions and club houses £21 0 0
164. **TEN-INCH DIAL BAROMETER**, richly carved in rosewood, oak, or mahogany, with bevelled plate-glass in front, very handsome (*fig. 164*) £7 10 0
165. **Eight-inch Dial Barometer**, same pattern as No. 160 (*fig. 160*) 4 10 0
166. **EIGHT-INCH DIAL BAROMETER**, same pattern as No. 162, or (*fig. 166*) £3 3 0
167. **Ten-inch Dial Barometer** (CASELLA'S), richly carved in walnut, oak, or rosewood (*fig. 167*, p. 43), with bevelled plate-glass, and best double ring and thermometer, very chaste and handsome £5 10 0
169. **TEN-INCH DIAL BAROMETER**, very neat, in rosewood or mahogany, with hygrometer, thermometer, and level, equal as a sensitive and accurate instrument with any of the above £3 10 0
170. **Eight-inch Dial Barometer**, same pattern as No. 160 2 10 0



Fig. 174.



Fig. 179.



Fig. 178.

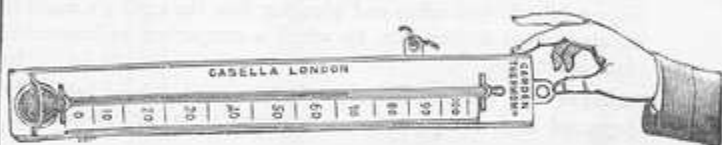


Fig. 175.

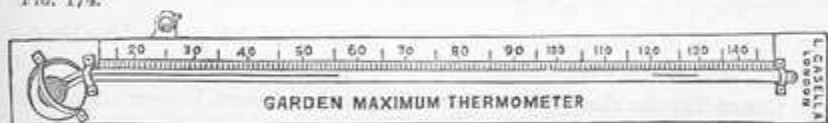


Fig. 176.

172. Ten-inch Dial Barometer, a very neat, good, and practical instrument, in rosewood or mahogany £2 2 0
173. EIGHT-INCH DIAL BAROMETER, same pattern as No. 172 1 5 0

When the better sorts of dial barometers are required for transmission abroad, they are supplied with steel stop cocks to render them portable, so that on reaching their destination they merely require to be suspended and the stop cocks turned to put them in action, the extra charge being 7s. 6d. to 12s.

HORTICULTURAL AND GARDENING BAROMETERS, THERMOMETERS, ETC.,

Embracing several simple weather instruments and appliances; the prices of some are purposely very low with the view of extending their use even to the cottage; the name being affixed to all, however, the fullest confidence may be placed in their precision. The barometers especially are equally available for use along the coast.

174. **Garden Thermometer**, good plain, 8-inch, on boxwood scale (*fig.* 174, p. 45) £0 1 8
 or per doz., 17s.; half doz., 9s.; perfectly adapted for the greenhouse, stable, dairy, etc.
175. **GARDEN REGISTERING MINIMUM THERMOMETER**, to show present temperature, and register the extreme of cold during absence, for pits, greenhouses, and outdoor use (*fig.* 175, p. 45) £0 3/6
176. **Garden Registering Maximum Thermometer**, to show present temperature and register the extreme of heat during absence, for greenhouses, etc., as above (*fig.* 176, p. 45) £0 8 6
177. **THE GARDENER'S WINDOW THERMOMETER**, in revolving frame, to turn to any angle (*fig.* 177, p. 47) £0 4 6
178. **THE GARDENER'S GROUND THERMOMETER**, with brass end for temperature of the ground when sowing seeds (*fig.* 178, p. 45) £0 4 6
179. **Hot-bed Thermometer** (*fig.* 179, p. 45), especially adapted for pine and melon pits, as well as ground temperature to 18 inches below the surface, with pointed copper tube for protection and plunging into the earth; a small thermometer is also affixed to the door, by which a comparison of internal and external heat is obtained £0 18 6 to £1 5 0
180. **Greenhouse or Garden Thermometers**, enamel tubes, boxwood scales and japanned cases for protection, range from 0° to 120°, 8 inch., 2s.; 10 inch., £0 3 0
- * * * The above greenhouse thermometers may be had with porcelain scales, from 1s. to 1s. 6d. each extra.
182. **DAIRY THERMOMETER** (insulated) in glass tube (*fig.* 182, p. 47) especially adapted for testing milk £0 1 8
183. **Milk Test or Lactometer**, for detecting adulteration and showing the relative value of milk from different cows £0 4 6
184. **CREAM TEST** for showing the difference in quantity of cream between one cow and another, with examples £0 3 6
185. **The Gardener's Wet and Dry Bulb Hygrometer**, for showing the exact state of moisture in the greenhouse or open air, with improved porcelain scales (*fig.* 185, p. 47) £0 17 6
186. **THE GARDENER'S RAIN GAUGE**, as described in Symon's work on "Rainfall," and from which many of the results quoted in his monthly returns are obtained £0 12 6 and £0 15 6
187. **School or Garden Microscope** to be used, either simple or compound, with rack-work six powers, with mirror, condenser, infusoria box, forceps, object and glasses, arranged by L. CASELLA to meet the constant wants of the florist and gardener in examining seeds, animalculæ, etc. £1 5 0
188. ***THE GARDENER'S OR COTTAGE BAROMETER** (*fig.* 188, p. 47) 0 12 6

* "The barometer is equal to one in our possession at ten times the price. The thermometer, self-registering and accurately graduated, has proved upon trial to be equally efficient."—**GARDENER'S CHRONICLE**, Sept. 19th, 1857.

"These instruments should be in the hands of every farmer." "My next month's observations will be made with them."—**MARK LANE EXPRESS**, Sept. 14th, and Oct. 5th.

"Would adorn alike the gardener's cottage or the hall of the mansion. We are much obliged to Mr. CASELLA for this popularizing these useful instruments. His name is a guarantee for the character of any instrument."—**COTTAGE GARDENER**, Oct. 27, 1857.

"CASELLA'S cottage barometer has lately been brought under our notice, very much to our delight and profit. They have registered with unerring faithfulness the recent changes in the weather."—**THE FIELD**, Nov. 7, 1857.



FIG. 188.



FIG. 177.



FIG. 182.

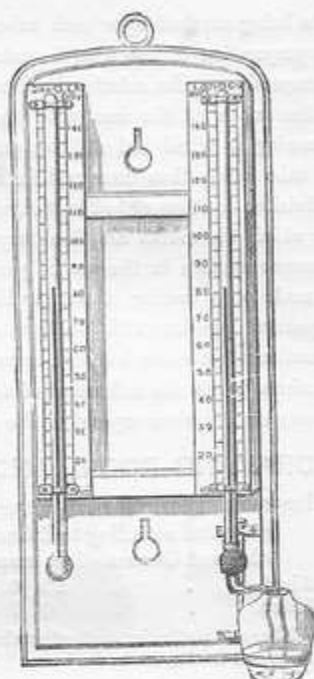


FIG. 185.

189. **Plantation or Farm Barometer** £1 10 0
 190. **PLANTATION OR FARM BAROMETER, more ornamental (fig. 185)** 2 0 0

This instrument has been carefully prepared under the suggestions of Dr. Mann, Vice-President of the Meteorological Society, to meet the special need of a trustworthy indicator of the weather for farmers and planters. It is scrupulously correct, and has the further advantage of being made portable or otherwise by the most inexperienced without possibility of injury.

THERMOMETERS.

The extended application of the use of thermometers to the various branches of the arts and manufactures, as well as the precision and delicacy required in their construction, renders a complete description here of all the varieties impossible. In all branches of chemistry thermometers have long been indispensable, and but few processes of manufacture are now conducted without their use. For most of these purposes the following list will be found to contain the most suitable arrangement, and fresh lists are published by L. CASELLA from time to time of every new kind brought into use. Besides the actual make of many of these thermometers, the mode of dividing is of the greatest importance; this is done on all CASELLA'S thermometers of precision by means of a very beautiful arrangement of dividing engine, devised by the great Ramsden, and now applied with the utmost facility to this purpose, certain

points being marked upon each tube, the stems are coated with black, or immersed in a preparation of hot wax, the tube is then laid upon the engine, the distances of the respective marks calculated and arranged. On setting the engine the divisions are then made on the wax with the dividing needle with mathematical precision, by turning a wheel and shifting and re-arranging the tube from time to time. The tube being then immersed in a preparation of fluoric acid for a few seconds, the divisions are thus etched in, the tube is then washed in water and the wax removed, after which the marks are filled in with a preparation of black. Another great improvement consists in the use of porcelain slips or scales. The divisions on these are first made on a coating of wax or black, as in the case of the tubes, then cleaned off, and painted together with the figures, and permanently burnt in, whilst an improved preparation of porcelain has been arranged by L. CASELLA, by which they are rendered impervious to all the influences of dyes or coloring-matters, or changes arising from frost or moisture when exposed to the weather.

DRAWING-ROOM AND HOUSE THERMOMETERS.

Drawing-room Thermometers, ivory, on ebony or boxwood, double scales, *i.e.*, graduated according to Fahrenheit and Reaumur, or Centigrade, with enamel tubes and German silver mountings; very neat and easily read.

192. 6 inch.	£0 6 6	194. 8 inch.	£0 9 0
193. 7 inch.	0 7 6	195. 10 inch.	0 12 6

. Where no particular kind of graduation is ordered, Fahrenheit in the plainer kind, and Fahrenheit and Centigrade in the better kinds of thermometers is usually sent.

196. **Drawing-room Thermometers**, ivory scales upon *papier mâché*, in various colors, black, blue, or green, of various shades, very neat, double graduations, viz., Fahrenheit and Reaumur, De Lisle or Centigrade (*fig.* 196, p. 50), seven inch., 9s. 6d.; eight inch. £0 10 6

197. **DRAWING-ROOM THERMOMETERS**, polished boxwood, elliptic form, bevelled edges, very neat, with German silver or fancy mountings, graduations as above, eight inch, 4s., ten inch, 6s. 6d., twelve inch (*fig.* 197, p. 50) £0 9 6

An excellent and cheap thermometer, very suitable for libraries, churches, etc.

198. **Drawing-Room Thermometer** divided into half-degrees, very sensitive, with mountings, etc., as above, twelve inch £0 14 0

199. **DRAWING-ROOM THERMOMETER**, eleven inch, on opal, mounted on ebony, with plain clear black figures and divisions, bold and very handsome £0 16 0

200. **DRAWING-ROOM THERMOMETER**, on opal and mahogany, as above 0 16 0

201. **Boxwood Thermometer** polished, for ordinary use, double scale and enamel tube, 8 inch. £0 3 0

202. **BOXWOOD THERMOMETER**, eight inch, plain, good, and reliable, well adapted for bed-rooms, pantries, wine cellars, etc. 18s. per dozen

Or, if less than 3, 1s. 8d. each.

203. **Six's Self-Registering Thermometers** for wine cellars, greenhouses, etc., to show present temperature and register the past extremes of heat and cold during any period of absence, in japan case with magnet, 8 in., 12s. 6d.; 10 in. £0 15 6

204. **SIX'S THERMOMETERS**, as above, 12 in., 18s. 6d.; 14 in. 1 1 0

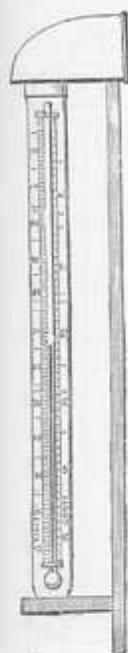


FIG. 209.

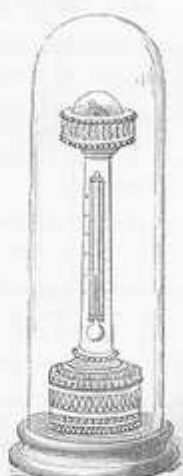


FIG. 207.

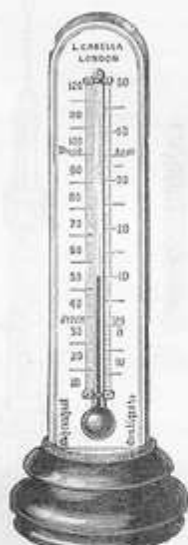


FIG. 205.



FIG. 210.

- 204⁶ Six's THERMOMETER, as No. 204, on improved porcelain scale for out-door use, 10 inch., £1 5 0; 12 inch. or 14 inch. £1 10 0
205. **Pedestal Thermometer** with ivory scale, on neat ebony base (*fig. 205*), with glass shade and German silver mountings, suitable for mantle-pieces, libraries, or bed-rooms, six inch, 7s. 6d. to 9s. 6d.; seven inch. £0 10 6
A most convenient form of thermometer, being movable at pleasure to any part of the house.
206. **PEDESTAL THERMOMETER**, ivory on *papier mâché*, on ebony base with glass shade, graduations, etc., as No. 205, very beautiful £0 15 6
207. **PEDESTAL THERMOMETER**, ivory, handsomely carved, with magnetic sun-dial, arranged to order for any part of the globe (*fig. 207*) £1 10 0
208. **PEDESTAL THERMOMETERS** in various elegant designs, handsomely carved in ivory, with ebony base and glass shade (*fig. 208*), p. 50 £1 1 0 to £3 3 0

WINDOW THERMOMETERS.

209. **Window Thermometer**, ivory scale, enclosed in glass cylinder, mounted to revolve to any angle of sight, in mahogany frame, with copper roof for protection from rain (*fig. 209*), 8 inch, 15s. 6d.; 10 inch. £1 1 0
210. **WINDOW THERMOMETER** (Six's self-registering), showing past heat and cold during absence, as well as present temperature, very clear and distinct, on opal or improved porcelain, with indelible black figures and divisions, on mahogany bracket to revolve to any required angle (*fig. 210*), 10 inch., £1 15s.; 12 inch. or 14 inch. £2 0 0

As an out-door registering window thermometer this arrangement leaves nothing to be desired. See description of this principle p. 17.

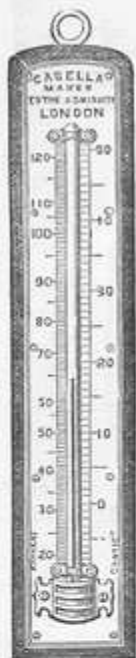


FIG. 196.



FIG. 222.

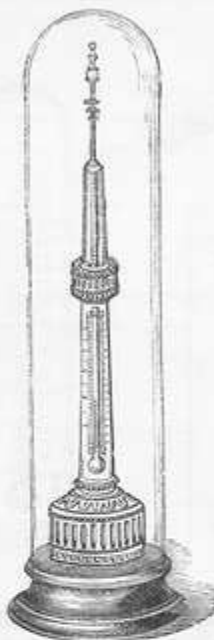


FIG. 208.



FIG. 220.



FIG. 197.

212. WINDOW THERMOMETER (non-registering), on opal glass or improved porcelain scales, revolving in brackets on mahogany frame, etc., as No. 210, 10 inch. £1 12 0
213. Cottage Window Thermometer, with boxwood scale, revolving in mahogany frame, economically arranged for general use, 4s. 6d.; or with double graduations (*fig. 177*), p. 47 £0 5 0

TRAVELLING OR POCKET THERMOMETERS,

Plain, self-registering, or in neat morocco cases, with ivory scales, range 0° to 130° more or less, as required for climate, graduated according to Fahrenheit, Reaumur, Centigrade, etc., or to any language.

ON IVORY SCALES.

214. 3 inch.	£0 6 0	217. 6 inch.	£0 9 6
215. 4 inch.	0 7 0	218. 7 inch.	0 10 6
216. 5 inch.	0 8 6	219. 8 inch.	0 13 6

The eight-inch on metal scale, 6s. 6d. to 8s. 6d.

220. Sensitive Pocket Thermometer, on delicate ivory or metal scales, $3\frac{1}{2}$ -inch, in cylindrical ivory or German silver cases, about $\frac{3}{8}$ -inch diameter (*fig. 220*) 8s. 6d. to £0 10 6
222. The same, in revolving German silver or light brass cases, $\frac{3}{8}$ -inch diameter, (*fig. 222*) £0 9 0

. In ordering thermometers from a distance, it is well to state the country or general purposes they are for, when care will be taken to send them in every way suitable.

223. **Alpine Maximum and Minimum Thermometer**, divided on the stems, on polished boxwood, in pocket case, very portable and convenient (*fig.* 47), p. 16
£1 5 0
224. **PORTABLE MAXIMUM AND MINIMUM THERMOMETER**, on metal scales, larger size, divided on the stems, as arranged by L. CASELLA for Dr. Livingstone, and Captains Barton, Speke and Grant, in mahogany case . . . £2 2 0
225. **Maximum Thermometer**, as designed by L. CASELLA for the Alpine Club, divided and figured on the stem £0 10 6
226. **MINIMUM THERMOMETER**, ditto, ditto 0 8 6
227. **PLAIN THERMOMETER**, ditto, ditto 0 7 6
The three in small mahogany case, £1 10s.
228. **SOLAR RADIATION MAXIMUM THERMOMETER**, black bulb, figured and divided on the stem *Small Size* £0 11 6
229. **ALPINE HYGROMETER**, wet and dry bulb, in morocco case, 6 inches long by 2 wide, and 1 inch deep £2 2 0
230. **RAIN GAUGE**, as arranged for Dr. Livingstone, 3 inches in diameter 0 17 6
- Other instruments for travellers. See Aneroid, No. 112, etc.; Pocket Hypsometer, No. 86; Pedometer, No. 124; Altazimuth, No. 521; Chronograph, No. 126, Nos. 88, 592, and pages 66, 67, 68, 69, 70, etc., etc.

CHEMICAL AND MANUFACTURING THERMOMETERS.

The scales of these thermometers are either etched upon the glass stems, or they are written on paper or milk glass, enclosed in glass tubes, without fittings of metal or wood, so that they can be safely immersed in hot, caustic, or acid liquors (*fig.* 242), p. 52.

The *lowest* point on the scales of these thermometers is generally about 40° or 30° Fahrenheit. The *highest* point to which each ranges, as cited below, is approximate. It may range a few degrees above or under the quotation.

Thermometers with long scales (or wide spaces between the degrees) cost 1s. to 1s. 6d. extra.

Cardboard boxes for the thermometers are included in the following prices:—

WITH FAHRENHEIT'S SCALE.		212°	350°	500° to 600°
232	Paper Scales, outer tube, $\frac{1}{2}$ to $\frac{3}{8}$ inch	2s. 3d.	3s. 0d.	4s. 0d.
233	Paper Scale, outer tube, $\frac{3}{4}$ -inch.	2s. 9d.	3s. 6d.	4s. 6d.
234	Milk-glass Scale, outer tube, $\frac{1}{2}$ to $\frac{3}{8}$ -in.	3s. 6d.	4s. 0d.	5s. 6d.
235	Milk-glass Scale, outer tube, $\frac{3}{4}$ -inch.	4s. 0d.	5s. 0d.	6s. 0d.
236	Scale on Tube with white back, $\frac{3}{4}$ -inch.	4s. 6d.	5s. 6d.	5s. 6d.

The thermometers Nos. 233, 235, and 236, have narrow cylindrical bulbs, to enable them to be passed through corks for insertion into retorts, etc.

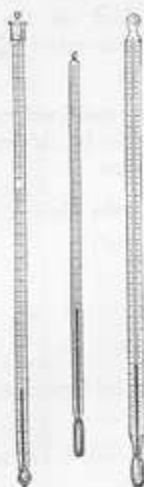


FIG. 242.



FIG. 252.

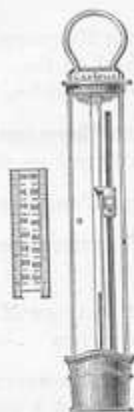


FIG. 264.

WITH CENTIGRADE SCALE.	100°	200°	360°
236* Paper Scale	2s. 6d.	3s. 0d.	3s. 6d.
237 Milk-glass Scale	3s. 6d.	4s. 0d.	5s. 0d.
238 Scale engraved on the tube	4s. 0d.	5s. 0d.	6s. 0d.
239 Scale on tube with white back	4s. 6d.	5s. 6d.	6s. 6d.

The thermometers Nos. 236* to 239 are all contained in tubes of $\frac{1}{4}$ or $\frac{3}{16}$ -inch. diameter; and the bulbs are narrow and cylindrical, to permit the passage of the thermometer through corks for insertion into retorts, etc.

240. Thermometers as above, with two scales, Fahrenheit and Centigrade, 1s. 6d. each more than if one scale only.
242. **Chemical Thermometers** of greater precision, all glass (*fig.* 242), etched on the stem for more delicate experiments scales Fahrenheit or Centigrade 8 inch. in paper case to 212 Fahrenheit, 100 Centigrade £0 7 6
243. **CHEMICAL THERMOMETER**, 9-inch. to 320 cent. 0 9 0
244. **CHEMICAL THERMOMETER**, 12 to 15-inch. to 650 Fahrenheit=320 cent. 0 11 6
245. **CHEMICAL THERMOMETER**, 25 inches long, filled with pure alcohol, tube very carefully calibrated, divided and figured on stem from 100° below zero to 90° above (or as required) in brass case £1 10 0
246. **Chemical Registering Thermometer**, improved on Professor Phillip's principle for registering high temperatures in any position £0 15 6 to £1 10 0



FIG. 262.



FIG. 266.



FIG. 276.



FIG. 278.

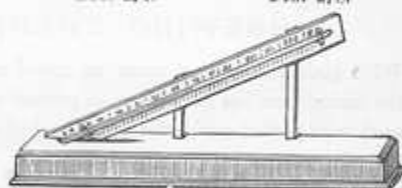


FIG. 254.

MANUFACTURING AND VATTING THERMOMETERS.

247. **Manufacturing Thermometer**, for determining the temperature of oil, tallow, stearine, etc., the scale in copper case about 14 inches long, ranging from 212° to 660° , and furnished with a long projecting copper tube for the preservation of the lower part of the stem, about 4 feet below the scale

£2 10 0

248. Ditto, as above, if five feet below the scale 2 15 0

*. Extra lengths at prices increasing in proportion.

249. **Vating Thermometer**, for brewers and sugar refiners, with hard wood frame and metallic scale, range 30° to 212° (or as required,) projecting 3 feet below scale

£1 8 0

250. **VATING THERMOMETER**, as above, 4 feet below the scale 1 12 0