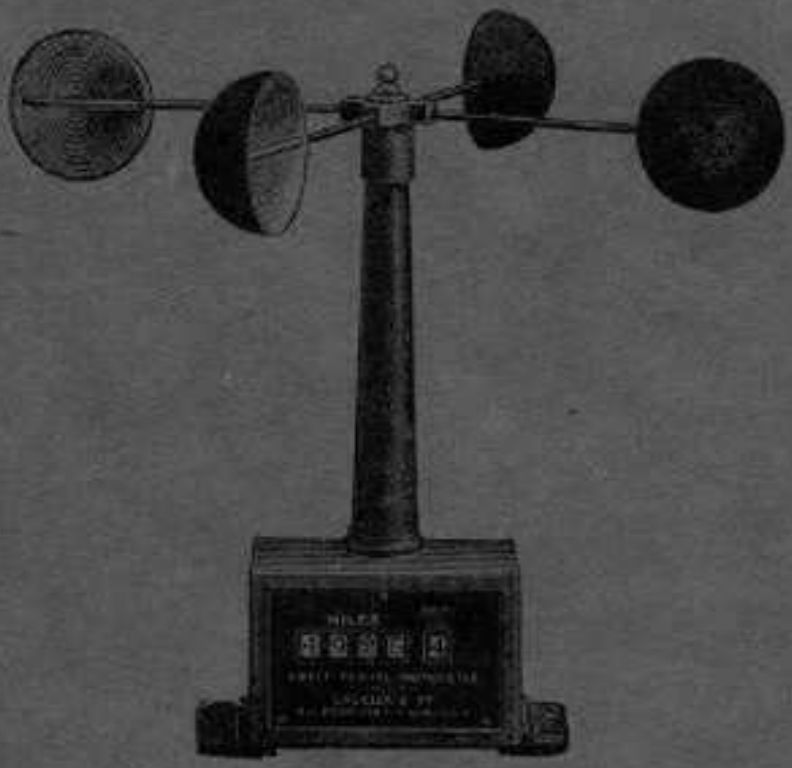
ANEMOMETERS, AIR METERS & WIND DIRECTION INSTRUMENTS



PATENT.

CASELLA & CO.,
11—15, ROCHESTER ROW,
LONDON, S.W.

1908

AIR METERS &

WIND DIRECTION INSTRUMENTS,

SELF-RECORDING

AND

DIRECT READING.

CASELLA & CO.,

Scientific Instrument Makers and Mechanical Engineers to the Admiralty, War Office, Ordnance Survey, and all Home Departments, and to the Indian and Foreign Governments,

11 to 15, ROCHESTER ROW,

VICTORIA STREET,

LONDON, S.W.

No. 273. 1908.

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ANEMOMETERS AND WIND DIRECTION INSTRUMENTS.

MECHANICAL APPLIANCES for measuring the strength of the wind have been in use since the seventeenth century. The early instruments were mainly of the pendulum type, consisting of a plate suspended by cords, or hung on hinges, from a vane turning freely on a vertical shaft. These instruments, however, were crude in design and did not give readings at all reliable. Since then successive alterations and improvements have been made from time to time, and a modern anemometer—even one of the simpler types—is a very different instrument from the somewhat primitive appliance represented, for instance, in the *Directions for Seamen*, of which an edition was published by the Royal Society in 1667.

Casella & Co. have constructed anemometers of all kinds for a great many years and have themselves been responsible for some important improvements. In this leaflet are figured and described the instruments most commonly in use, together with some new patterns; other designs and modifications have not infrequently been made for special purposes, and the firm is always grateful for suggestions from meteorological observers and ready to carry out new ideas for the

PRECAUTIONS TO BE OBSERVED IN THE FIXING AND CARE OF ANEMOMETERS AND WIND-DIRECTION INSTRUMENTS.

The most important consideration in the fixing of an anemometer is a good exposure, and a situation must be chosen which is entirely free from the possibility of back currents or sheltering. It is not sufficient, for instance, merely to place the instrument directly on the roof of a building, it must be mounted so that the head is some distance above the roof, and the receiving mechanism unaffected by the influence of the building itself or of any projecting parts, such as chimneys and ventilators.

When the anemometer is mounted on a pole care must be taken to see that it is not sheltered by trees or buildings.

The foregoing remarks apply, of course, equally to instruments for determining the direction of the wind, and in the case of these it is necessary to fix either the North point, by means of the Pole Star, or the South point, by the help of a good local sun-dial, or by a watch set at "local apparent time." The position of the vane should be examined occasionally, as it may twist slightly, owing to changes of humidity.

After the instrument has been finally placed in position it only requires to be periodically examined, and, if necessary, oiled. This last operation is naturally an important one, for on it largely depends the accuracy of the readings.

The cross-piece bearing the cups should be removed, the pillar unscrewed, and sufficient good watch-oil poured into the oil cup to almost fill it.

The frequency with which a wind instrument requires to be oiled and examined varies, of course, with the kind of weather to which it is

ROBINSON'S ANEMOMETER.

(Improved Design.)

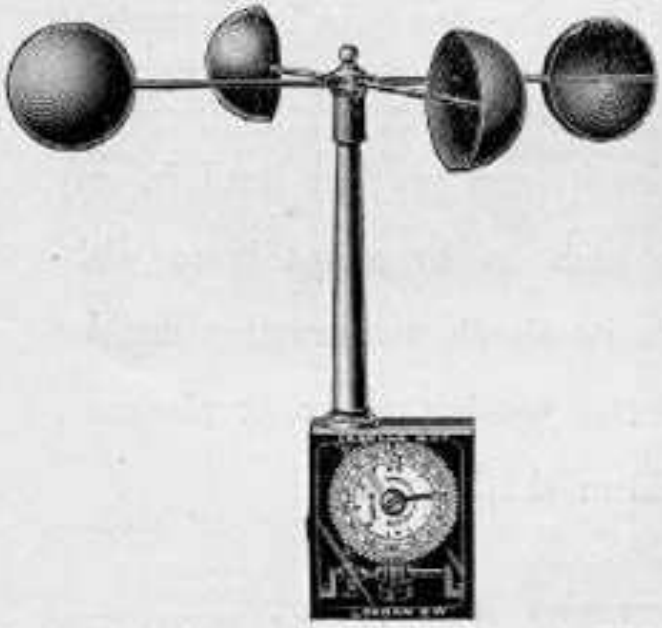

Fig. 1.

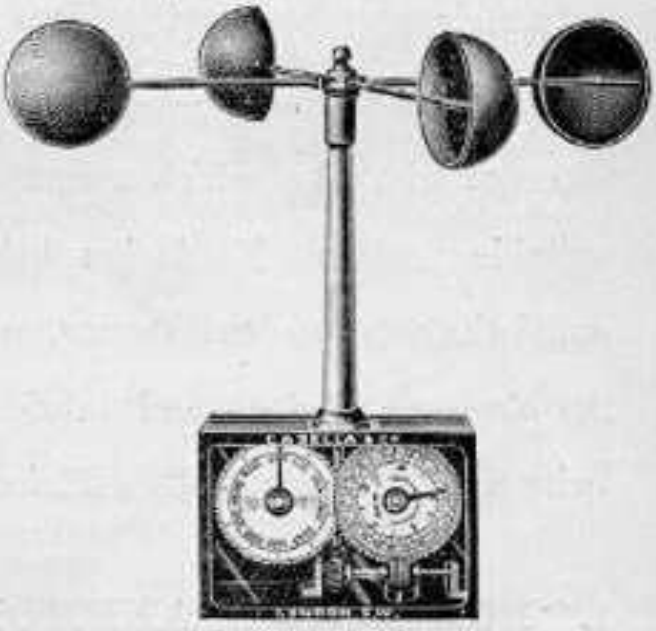

Fig. 3.

Robinson's Anemometer consists essentially of four hemispherical cups, having their diametrical planes exposed to the passing currents of air. They are carried by four horizontal arms attached to a vertical shaft, which is caused to rotate by the force 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. The outer, or front wheel, which revolves once for every five miles, is furnished with two graduated circles, the interior circle being subdivided 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. In

average velocity being obtained by dividing this amount by the time which has elapsed since the last observation. An anemometer is usually observed once every 24 hours. This instrument is rendered extremely portable by the arms which carry the cups being made to take off. When in use it may be screwed on to a shaft or on to the piece of iron pipe which accompanies it, and may be fixed in any suitable position, its design being such as to adapt it to withstand the most violent storms, while its simple construction enables the observer to clean and lubricate the bearing parts at pleasure, twice a year being usually sufficient in most climates.

1. **ROBINSON'S ANEMOMETER** (Fig. 1), 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*. In this arrangement the cups travel at the rate of one-third of the wind's velocity, and each revolution represents 3·14 feet; thus, $3{\cdot}14 \times 3 = 9{\cdot}42$ feet, being the distance travelled by the wind for each revolution. The dials are read from right to left, the amount indicated at the last observation being deducted from that shown on the dials at the time of the current observation.

PRICE, registering to 505 miles* ... ... **£4 4s. 0d.**

2. The same instrument, but registering to 1,010 miles* ... ... **£5 0s. 0d.**

3. **ROBINSON'S ANEMOMETER** (Fig. 3), with extra dial extending the registration to 5,050 miles* ... ... **£5 5s. 0d.**

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* In the case of Robinson's anemometers we are compelled to charge 5s. 0d. extra when

4.—CASELLA'S PATENT TOTALISING ANEMOMETER.

No. 4.

The advantages of this pattern are so obvious that a glance at the illustration will show them much better than a written description. It may be added, perhaps, that the possibility of accidental mistakes is here reduced to a minimum, and that where this anemometer is used the reading may be entrusted, if desired, to the most unscientific or ill-educated person, provided he can only read. In foreign countries where the observations have sometimes to be left to natives, this point will be fully appreciated.

The construction is of a simple and durable character, and the instrument has been carefully tested by the authorities at Kew, with the most satisfactory results.

This instrument is arranged to register miles (or kilometres) and tenths, up to **ten thousand**, at which point it automatically sets itself to zero again.

6.—C. F. CASELLA'S Patent ANEMOGRAPH.

No. 6.

In this instrument the total amount of wind in any period of time can be directly read off from the silvered dial at the right-hand side, while on the chart, fixed on the drum at the left-hand side, are recorded both the total amount of wind and also the actual velocity at any particular moment.

The curve obtained on this anemometer is much more extended than is usually the case, owing to a special device for enabling a long chart to be used. By this means very valuable records may be obtained, from which it is possible to follow, at a glance, the exact courses of storms, and to accurately compare the amounts of wind in different periods of time.

The drum can be instantly withdrawn from the case for the purpose of conveniently winding the clock and changing the chart.

Every precaution is taken to ensure that the construction and materials shall be of the best. The clockwork is of the highest quality, and is particularly suitable for use in the exposed positions and trying circumstances in which it must of necessity be placed.

This anemometer is in use in all parts of the world, and gives entire satisfaction.

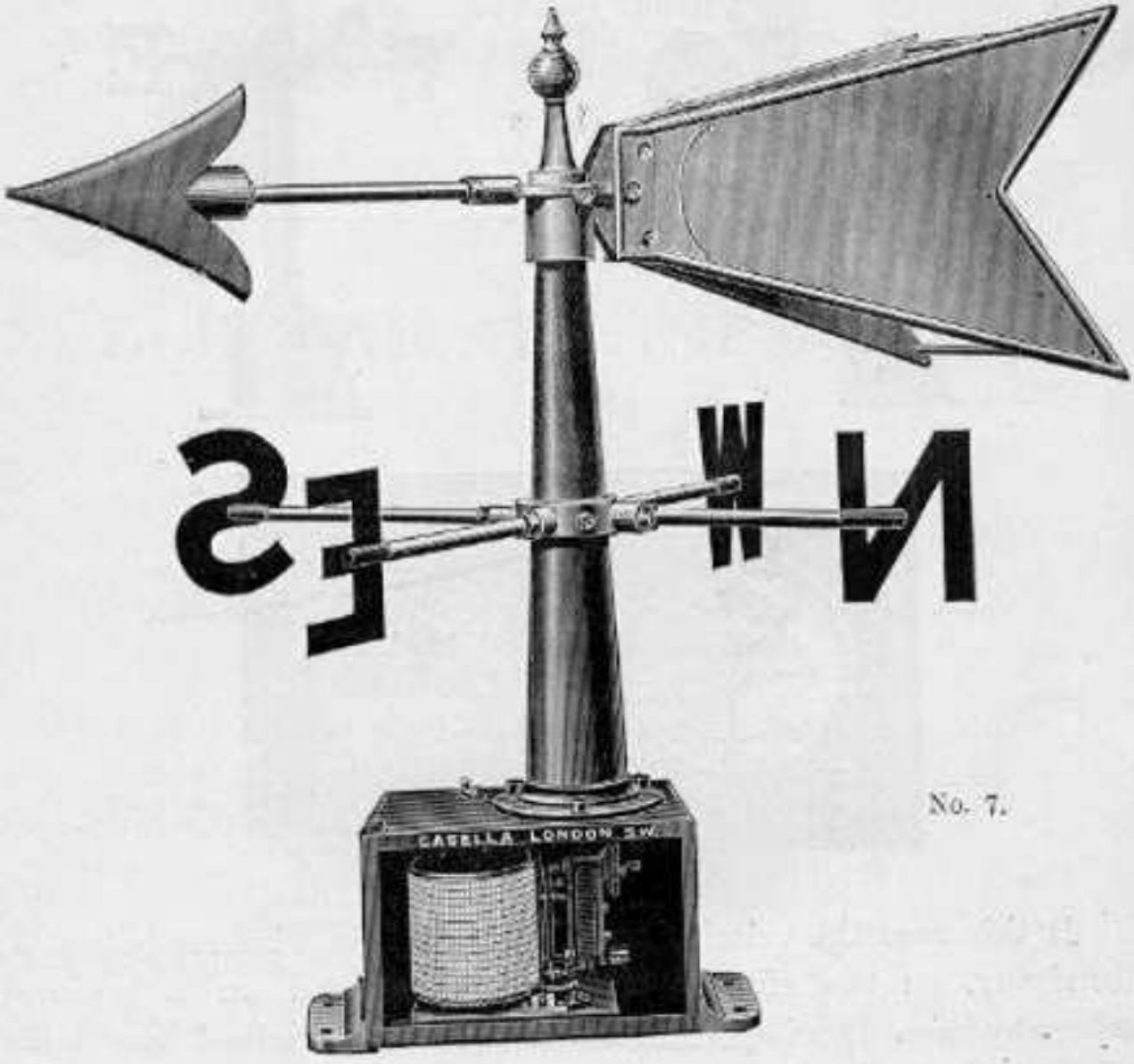
Size of Case, 12 in. × 6 in. × 5 in.

PRICE, English or metric scale, with 52 charts, pen, £30 0s. 0d.

7.—C. F. CASELLA'S

Patent WIND DIRECTION RECORDER,

Corresponding in Size with C. F. Casella's Patent Anemometer (No. 6).



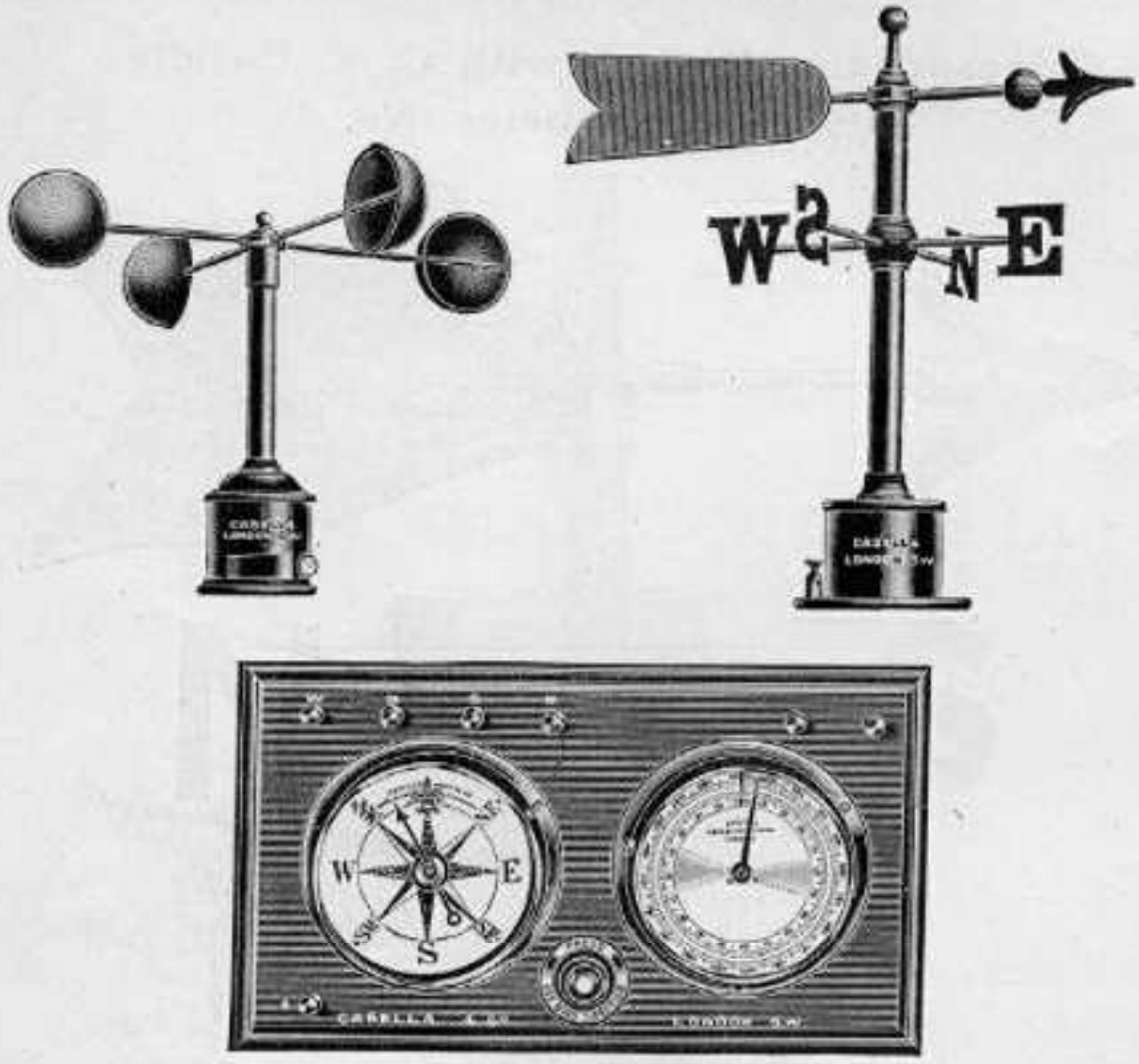
No. 7.

This instrument is intended as a companion to the anemometer just described. It is fitted with clockwork of the same good quality, and similar provision has been made for a long chart, and hence an open scale.

The direction of the wind is recorded by means of three styles, rotating over two horizontal drums, which are ingeniously arranged so that one of the styles is always ready to mark on one side of the chart as soon as another one is leaving the chart at the other side. By this means the obstacles, hitherto insuperable, in the way of obtaining a record of the wind direction on a chart moving vertically or horizontally, are successfully overcome.

PRICE, with 52 charts, pen, ink, &c. ... **£35 0s. 0d.**

ELECTRICAL ANEMOMETER AND WIND DIRECTION INSTRUMENT.



No. 8.

It this case the velocity and direction of the wind are indicated, electrically, on two silvered metal dials mounted on a polished mahogany base. An important advantage of this method lies in the fact that the indicating apparatus can be fixed in the place most convenient for the observer, while the vane and anemometer cups may be at any distance from the dials. Observations of the wind can therefore be taken at frequent intervals, indoors, without the discomfort of mounting to some more or less inaccessible place and taking readings, often in rainy and boisterous weather.

The electrical anemometer is easily set up, cannot get out of order, and the amount of current consumed is trifling. The total mileage of wind is read off from the right hand dial, and the direction of the wind at the moment of observation is obtained by pressing the button in the centre, when the needle on the other dial instantly takes up a position corresponding to the direction of the wind vane. The object of this button is to prevent the cells from becoming exhausted owing to continual use, and it forms an important feature in the

This anemometer has no delicate parts to get out of order, and it will work for years without any attention beyond an occasional oiling, say once in six months. The coils are wound with double silk-covered wire and carefully insulated. The dials are protected by plate-glass covers, in polished brass frames, and are handsomely mounted on a stout mahogany base.

With English or metric scales—

PRICE ... ... **£25 0s. 0d.**

Batteries and wire, extra.

9.—ELECTRICAL ANEMOMETER.

COUNTER PATTERN.

No. 9.

In some respects this anemometer resembles that just described. The head, or receiving apparatus, is precisely the same, and the registration of the number of revolutions of the cups is also effected by means of an electric current.

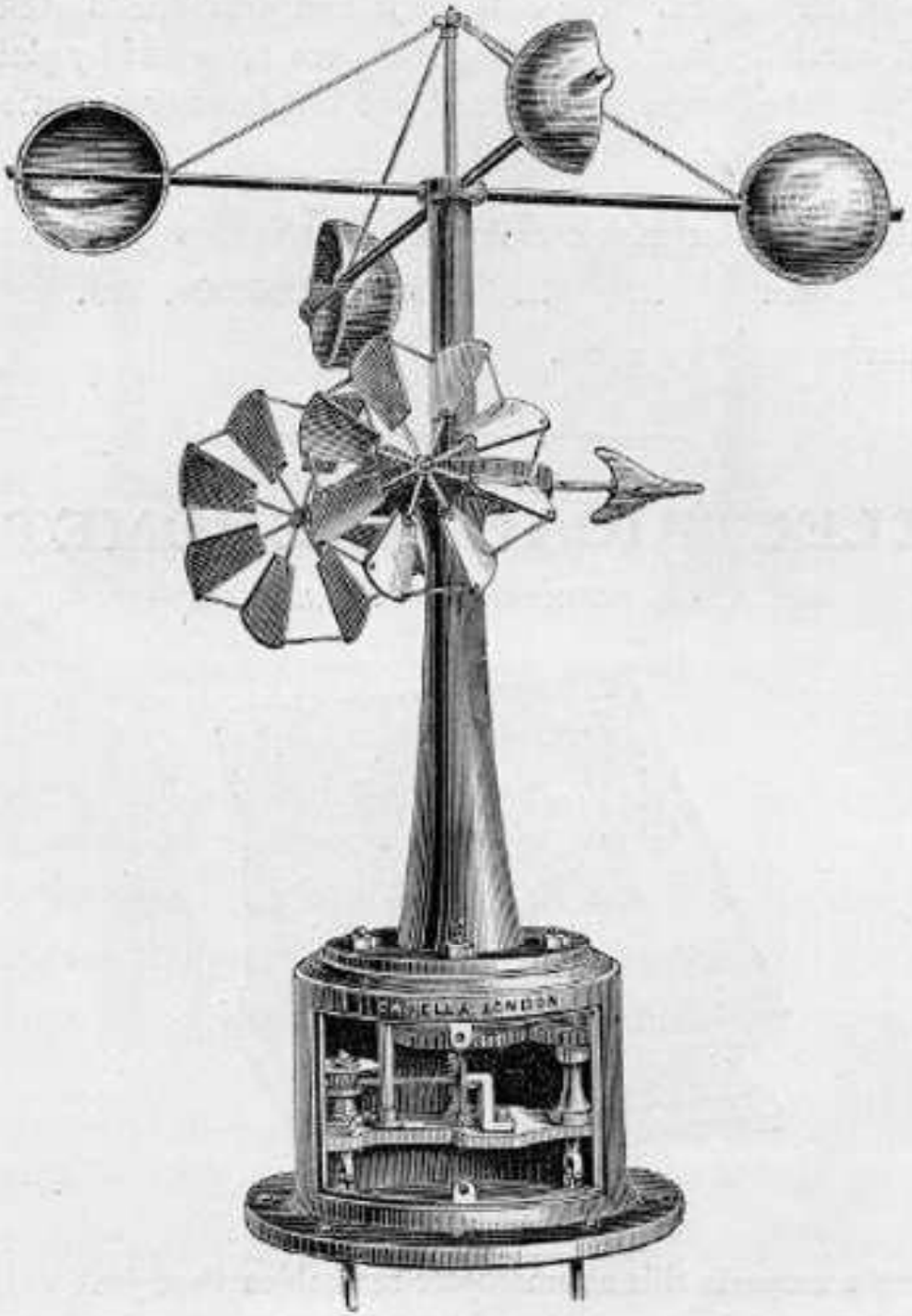
It is, however, a much simpler instrument, and only indicates the amount of wind, not the direction.

The readings are given on five small dials, somewhat similar in appearance to those of a portable air meter.

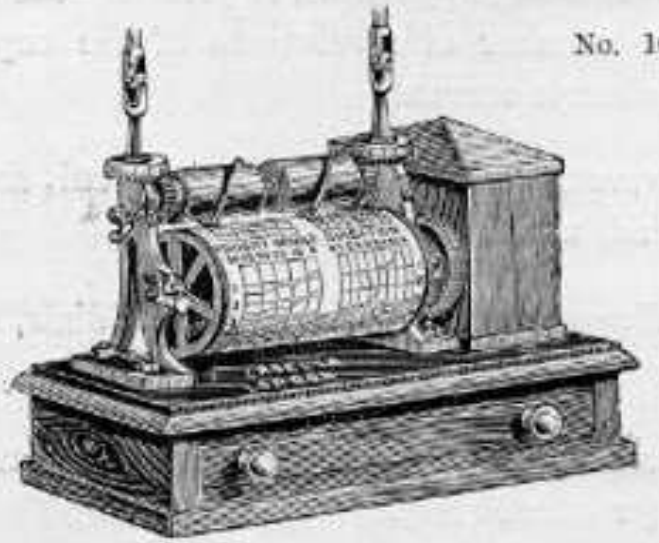
This anemometer indicates to tenths the amount of wind up to 10,000 miles (or kilometres).

PRICE ... ... **£10 10s. 0d.**

BECKLEY'S ANEMOGRAPH.



No. 10.



(*The present instrument has been somewhat modified since this cut*

10.—BECKLEY'S ANEMOGRAPH,

Recording both the Velocity and Direction of the Wind.

For harbours and public observatories; this is an improved form of the instrument originally constructed by L. Casella for the Kew Observatory and for the observatories of the Meteorological Office.

A ball-bearing head reduces the friction to a minimum; the registration is obtained by means of a revolving cylinder to which a chart is attached, and the direction as well as velocity is continuously shown 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 lower down in a room or other covered place for observation. For purposes of comparison, the charts supplied with these anemographs are similar to those used with the Government instruments. This pattern can be made with drum arranged to revolve in any time desired, but is usually constructed either for daily or weekly records. With connecting shafts, patent self-lubricators, 52 charts, ink, pens, &c.

Price, from **£95** to **£125**, according to the relative positions and distance apart of the receiving and recording portions.

Expanded Scales.

Casella & Co. have sometimes made their instruments to record on a very long chart, which is not fastened round the drum of the clock, but merely passes over it. In this way a chart of any length may be used and the scale extended in proportion.

Two interesting Anemometers—Casella's Embossing, and Casella's Self-Contained Anemometer—have now been superseded by one or other of the patterns described in this leaflet, but the firm will be glad

11.—ALTAZIMUTH ANEMOMETER.

(L. CASELLA'S PATENT.)

Recording the Pressure, Direction and Inclination of the Wind.

The special features of this instrument, which distinguish it from most other anemometers are (1) the provision which has been made ensuring that the receiving apparatus shall be at right angles to the inclination of the wind at any particular moment, and (2) the recording of the **inclination** as well as the **pressure** and **direction** of the wind.

It is unnecessary to dwell at length on the existence of air currents moving in a direction more or less inclined to the plane of the horizon, for to anyone acquainted with meteorology they must be almost a self-evident fact.

Irrespective of the inclination to the horizontal plane of the greater air currents, irregularities of surface, in all but the most extensive plains, tend to produce inclined currents, and the presence of observatories and other buildings affects the inclination of the wind to a large extent, so that an ordinary anemometer, in all probability, rarely experiences a wind exactly at right angles to its receiving surfaces.

The fact of the existence of inclined currents of air has been recognised for a great many years, but, with the exception of an anemometer of a rather elementary type used by Dechevrens about 1880, no instrument was constructed for recording the inclination of the

The apparatus for indicating the **direction** of the wind consists of a vane, mounted so as to rotate freely about a vertical axis, the motion of this vane being transmitted by a vertical tubular shaft to the registering mechanism. This direction tube operates the recording styles by means of pinions and wheels, conveying motion to two discs, which carry vertical pencils equidistant from each other. Three styles are used, so that one is always ready to enter on the scale at one side when another leaves it at the other side.

The apparatus for indicating the **inclination** of the wind consists of a similar vane, mounted on a horizontal axis within the direction vane, balanced so as to take up a horizontal position when no wind is blowing. In order to make this vane as sensitive as possible, it is fixed in a position approximating to unstable equilibrium.

The oscillating motion of this inclination vane is transmitted to its recording mechanism by a tubular connecting rod, joined to the vane by a pair of links, which move up and down inside the direction tube.

The oscillations of the vane, due to the varying inclination of the wind, actuate a carriage bearing a style.

The **pressure plate** is a disc having an area of 1½ square feet, fitted with a cone at the back. This plate slides between pairs of guide rollers in the frame of the inclination vane, and moves with it. A moveable weight at the opposite side of the vertical shaft, running on rollers, serves to prevent the varying positions of the pressure plate affecting the balance of

The motion of the pressure plate is transmitted to the apparatus for measuring the force by means of a counterpoised chain attached to the guide rod of the plate, and passing down over a pulley through the tubular shaft of the inclination vane.

The pressure plate is in this way kept perpendicular to the direction of the air current, not only in azimuth but also in altitude.

The **apparatus for measuring the force** consists of a displacement plunger immersed in a cistern containing mercury. The plunger has a varying ratio of displacement for successive depths of immersion, so that the scale may be open for the smaller and compressed for the greater—and less frequent—pressures. The lower end of the plunger is fitted with a disc of the size experiment has shown to be the best for checking its motion and avoiding any inaccuracy due to the momentum of the parts. Great care and consideration have been devoted to this part of the mechanism with the result that the evils due, on the one hand, to momentum, and on the other to friction, have been eliminated. The pencil returns to zero a few seconds after displacement.

Almost all the moving surfaces in this anemometer run on rollers, and all the moving parts are counterbalanced by moving weights. The plunger in the cistern of mercury acts with perfect success and obviates the well-known difficulties attaching to springs or weights.

The scales for the different records are worked upon a single chart of "metallic" paper wrapped round a cylinder rotated by a clock movement in the usual manner.

12.—DINES'S PATENT PRESSURE-TUBE ANEMOMETER, Portable Form.

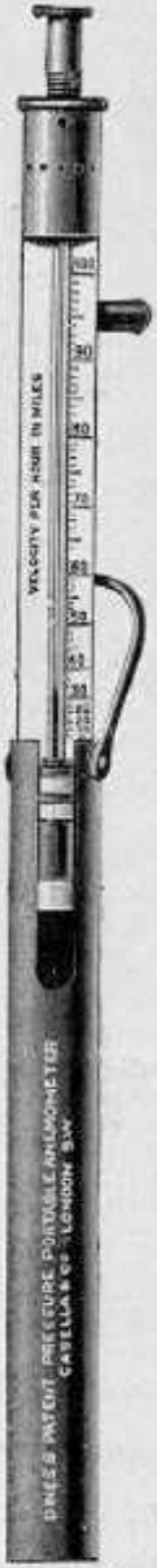
This instrument meets a want long felt in the shipping interest. It is very compact, and with moderate care is not likely to be damaged or to get out of order. It shows accurately the velocity and force of the wind, the scales having been calibrated by direct experiment, that on the right hand side of the glass tube showing the velocity in miles per hour, and that on the left the pressure in pounds per square foot. (The instrument shown in the illustration is not fitted with the latter scale.)

To use the anemometer, hold the case and pull up the projecting nozzle as far as it will go, the case then forms a convenient handle; unscrew the milled head at the top a few turns, and hold the instrument in a vertical position with the nozzle facing the wind. The velocity is then shown on the scale by the height of the coloured liquid in the glass tube. Before replacing in its case and putting away, screw down the milled head gently until the rubber washer inside seals the end of the glass tube, taking care not to screw too hard, for fear of breaking the glass.

When using the instrument be careful to choose a fully exposed situation, and stand facing the wind, holding it at least one foot in front of the body. The nozzle should face the wind as nearly as possible, but the registration is not affected so long as it points within 15 to 20 degrees of the right direction.

If bubbles get accidentally formed in the glass tube, they may be dislodged by gently sucking the nozzle.

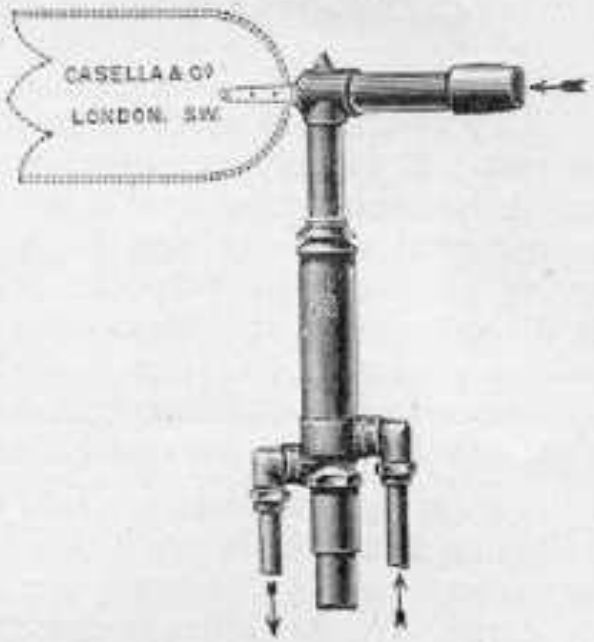
When the milled head is unscrewed and the instrument is held vertically in still air, the liquid should stand at zero, if it does not, a little must be added or subtracted, to make it do so: but the anemometers are sent out with the right amount of liquid in them, and there is no reason why this adjustment should be required. If it is necessary to add more liquid, fix the instrument in a vertical position, then remove the milled head, exposing the top of the glass tube, and slowly pour in two or three drops of the liquid sent in the small bottle. It is advisable to let the instrument stand for some little time, in order that all the liquid added may join the column in the tube.



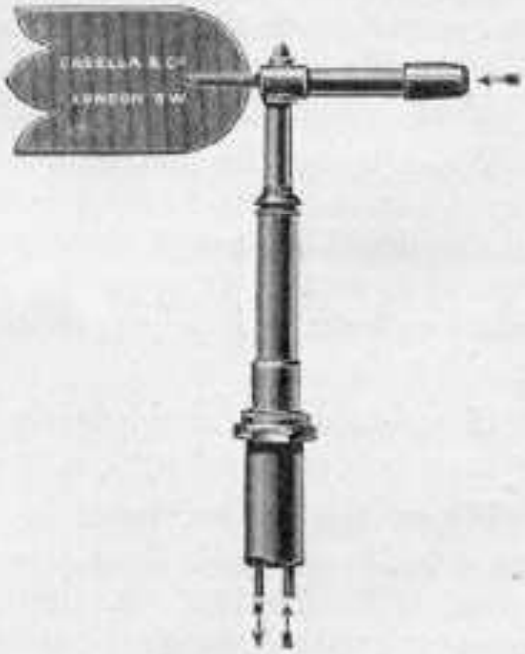
No. 12.

It is desirable, though not essential, to keep these instruments with the upper end of the scale highest, hence a loop has been provided so that they may be kept hung on a nail. The milled head should be screwed down before the instrument is removed from the vertical position.

13.—DINES'S PATENT PRESSURE-TUBE ANEMOMETER, Recording Form.



TYPE OF HEAD USED WHEN FIXING TO A SOLID POLE OR FLAGSTAFF.



TYPE OF HEAD USED WHEN FIXING TO A HOLLOW TUBE.

No. 13.

This anemometer, designed by Mr. W. H. Dines, has been generally recognised as a most useful and reliable instrument, and is now to be found in many observatories and meteorological stations throughout the world. It is based on the same principle as the portable anemometer just described (No. 12), that is, the result obtained is due to the combined effect of suction and pressure.

The construction is of a simple kind, and not likely to get

The **receiving mechanism** may be at a considerable distance from the **recording mechanism** which is usually set up in a convenient position indoors; these two parts are connected with each other by two flexible metal tubes which can without difficulty be carried wherever desired.

The **receiver** consists of a vane formed of a horizontal piece of tube open at one end, and pivoted upon the top of a vertical tube into which it leads. Just below the vane this vertical tube is surrounded by another of much larger diameter, the exterior of which is perforated by four rings of holes placed close together around its circumference.

The **recorder** consists of a cylindrical copper vessel closed at one end, which is suspended, somewhat after the manner of a diving-bell, in a vessel partially filled with water and sealed from the air of the room in which it is placed.

By means of the vane the receiving tube is kept with its open end facing the wind, and every increase in the wind-pressure is transmitted through it down the vertical tube and through the flexible connecting pipe to the inside of the float, which it causes to rise. The outer perforated tube below the vane is connected by means of the second flexible pipe with the top of the closed vessel containing the float. As the wind blows across the perforations the air in the tube is sucked out, with the result that a reduction of pressure takes place in the vessel above the float simultaneously with the increase of pressure within it. The two forces thus act together, but in different ways, to produce the same result, namely, to raise the float in the water. As the wind-pressure decreases the float falls again by its own weight until an equilibrium is established between it and the diminished pressure.

To the top of the float is fixed a rod which passes through what is practically an air-tight collar in the cover of the water vessel; this rod carries a pen, the point of which rests against a sheet of paper attached to a drum which is rotated by a clock. With every upward

decrease of wind force, the pen leaves a trace upon the paper, and thus the amount of every variation in the strength of the wind is graphically registered together with the time of its occurrence.

Dines's Recording Pressure-Tube Anemometer possesses many advantages over other anemometers, which may be summarised, briefly, as follows:—

It records each variation in the pressure of the wind, as well as the average velocity in a given time.

The receiving mechanism need not be situated close to the recording mechanism; the former can be placed in the most exposed, the latter is in the most convenient, position.

There is no delicate or complicated machinery, and the anemometer does not require an expert or trained person to keep it in good order.

When this instrument is used at high altitudes or in very cold climates it is recommended that the following anti-freezing mixture be used instead of water, in the recording vessel:—

32 fl. oz. methylated spirit.

25 fl. oz. glycerin.

Sufficient water to bring the fluid up to the zero mark.

For ordinary climates, however, it is sufficient in winter to keep a small paraffin stove or lamp in the same room as the recording apparatus, to be used only when the temperature is so low that otherwise the water in the vessel would freeze.

Precautions to be observed in the use of Dines's Recording Pressure Anemometer.

(1) Before fixing see that all passages and suction holes are free from dirt and grit.

(2) Place a little vaseline in the cup supporting the vane. No lubricant must be on the stem round which the vane revolves, as it

(3) **Connecting Tubes.**—The gun-metal unions must be first soldered firmly to the ends of the compo. tubes, and then made secure to the head by means of the union nuts provided for that purpose. Lead the compo. pipe down to the recording apparatus by gentle and easy curves, avoiding as much as possible sharp bends, and being especially careful not to allow any **U** shaped loop, or kink, to exist, in which water from condensed moisture could accumulate. This is most important, for if there is any place left in the tubes in which water can accumulate, the accuracy of the record is utterly destroyed. It is desirable for purposes of comparison that all instruments should have the same length of tube between the head and the recording apparatus, and 40 feet is suggested as a suitable length. Ten feet more or less will not make an appreciable difference, but if the length were greatly increased the effect would be to retard somewhat the movements of the float, and very transient gusts might pass away before being fully registered, owing to the friction of the air in the pipes. When the distance between the head and the recording apparatus exceeds 50 feet a larger pipe should be used. Departure from this rule does not interfere with the values given for mean velocities, but prevents the possibility of comparison of the maxima obtained with those of the many instruments already in use.

(4) **Water for Charging the Water-cylinder.**—The water used for charging the water-cylinder must be either filtered rain water or distilled water. Hard water will cause an incrustation on the central air tube, and prevent the free movement of the float.

(5) **Water-cylinder.**—After unpacking the float, remove carefully any dust which may have collected, and then place the instrument on its stand, which should be about eighteen inches in height. Now place the float inside the cylinder and fill up with clean water, avoiding splashing as much as possible, until the water can be seen level with the centre of the sight-holes in the gauge-glass tube. The float must be kept on the bottom of the cylinder whilst the water-

down, inserting at the same time the guide, which prevents the float from rotating, and which must be screwed in its place. Now connect the compo. tubes with the cylinder, taking care that the *pressure* tube is joined to the stop-cock at the bottom of the cylinder, and that the *suction* tube is connected to the stop-cock attached to the cover of the cylinder.

(6) **Adjustment of Float.**—The pen attachment should now be placed temporarily upon the top of the rod projecting through the centre of the cover, and the cylinder is to be levelled by means of the screws at the bottom until the rod floats exactly central in the hole; in doing this, make sure that the float is off the bottom of the cylinder. The pen is now to be removed, and the guide collar placed over the rod and fastened in its place; after which the pen may be replaced, and shot placed in the cup at the top until the float just, and only just, sinks to the bottom on being tapped gently. Place a chart upon the clock cylinder and fix this in its place; adjust the pen to the zero of the chart; open the stop-cocks of the *pressure* and *suction* tubes, and the instrument will begin to record.

(7) **Changing Charts.**—In changing the charts both stop-cocks should be turned off so as to connect the inside of the water-cylinder with the air of the room, the balance of the float should then be examined, and, if necessary, re-adjusted by means of the shot in the cup before restarting. The amount of shot should be such that the float, when raised one-quarter of an inch, just fails to fall back to the bottom without tapping. The level of the water in the glass tube should also be examined occasionally (the float being kept upon the bottom of the cylinder), as the accuracy of the record depends upon the correct height of the water.

(8) **Glass Shade.**—The glass shade should be kept over the clock cylinder, and in dry weather a small shallow vessel of water, about one inch in diameter, kept under the shade, will suffice to keep the air moist and prevent the ink from drying on the pen. It is a good plan to let the shade rest upon a ring cut out of two or three

The anemometer registers the actual pressure, and hence, when the barometer is low and the temperature high the air is less dense, and must therefore have a greater velocity to raise the pen to the same height. The scale is constructed for a temperature of 50° Fahrenheit, and a barometric height of 30 inches of mercury. The corrections for ordinary purposes are small, being approximately 0·1 per cent. for a change of one degree Fahrenheit, and 1·6 per cent. for a change of one inch in the barometer. But for high altitudes a correction is necessary. Taking into account that the air becomes colder as we ascend, a correction of 1½ per cent. for every 1,000 feet is sufficiently accurate for any height at which an anemometer could be fixed.

No correction for altitude is needed when the charts are ruled for recording the pressure of the wind only.

The following charts can be supplied, viz.:—

ENGLISH.

1.	To indicate wind velocity in miles per hour ...	Max. 120 miles.
2.	To indicate wind velocity in feet per second ...	Max. 175 feet.
3.	To indicate wind pressure in lbs. per square foot ...	Max. 43 lbs.

METRIC.

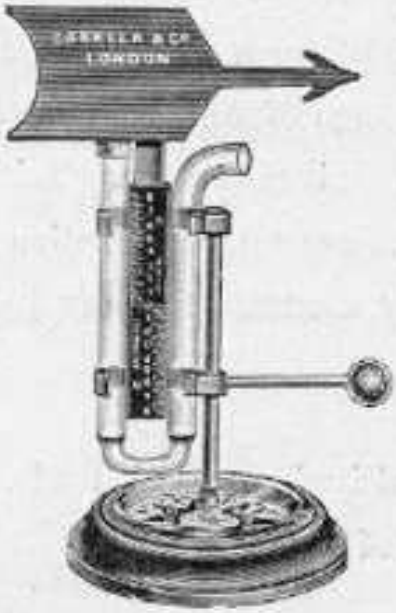
4.	To indicate wind velocity in kilometers per hour ...	Max. 190 kilometres.
5.	To indicate wind velocity in metres per second ...	Max. 53 metres.
6.	To indicate wind pressure in kilogrammes per sq. metre	Max. 210 kilogrammes.

PRICES on application.

*** *When ordering please state whether the vane head is intended to be fixed to iron gas piping or to be mounted on a solid pole or*

14.—LIND'S ANEMOMETER,

Improved by Sir W. SNOW HARRIS.



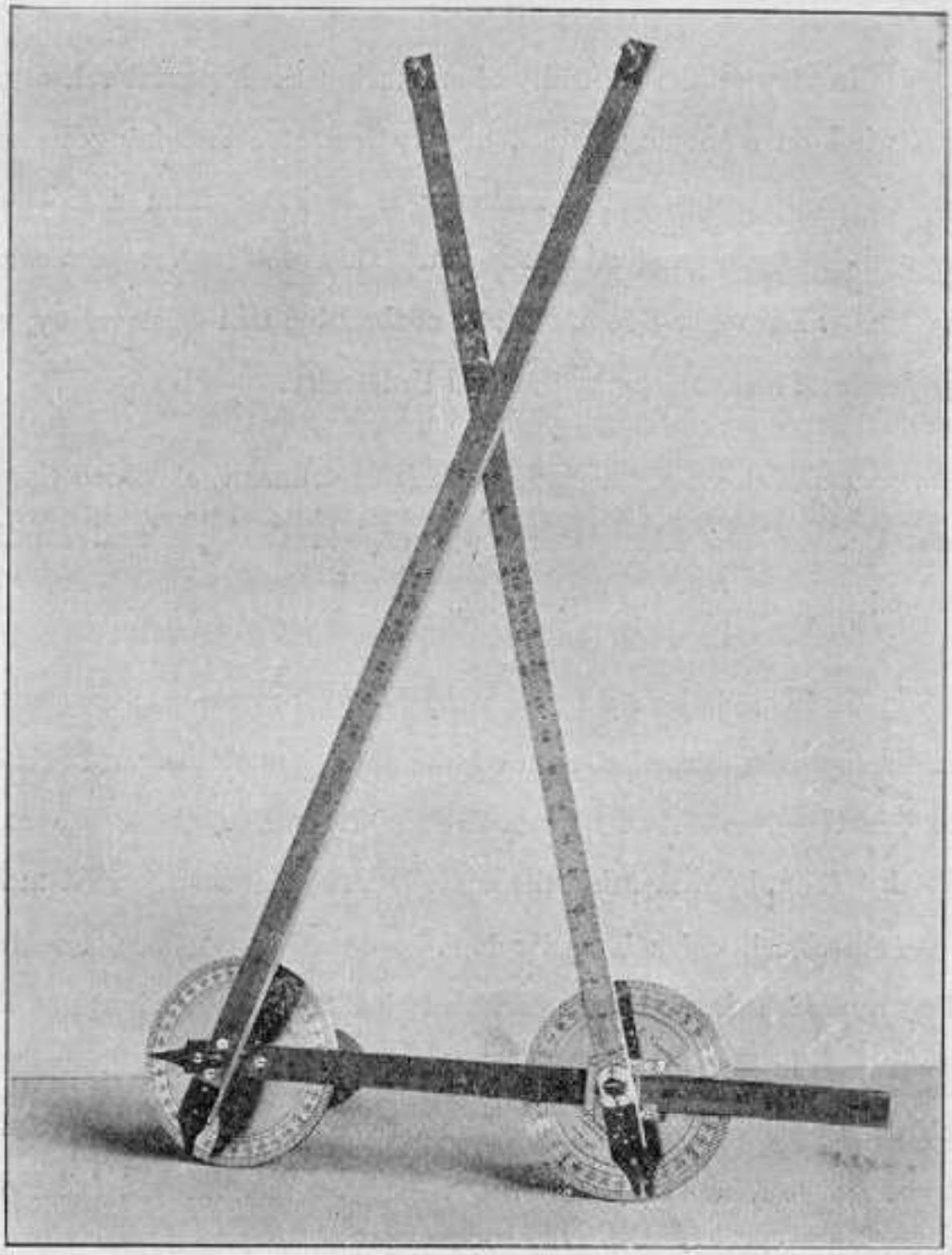
No. 14.

As the illustration shows, this instrument consists of a balanced Pitot's U-tube, swinging freely on a vertical spindle, the mouth of the tube being kept facing the wind by means of the brass vane attached to it. The difference of level between the liquid in one limb and that in the other is a measure of the **force** of the wind, and the **direction** is obtained by reading the large compass which forms the base of the anemometer.

PRICE, with English or metric graduations, complete ... ... **£2 5s. 0d.**

Various modified forms of Lind's Anemometer have been made

ROTCH'S WIND INSTRUMENT.



No. 15.

15.—ROTCH'S INSTRUMENT FOR DETERMINING THE TRUE DIRECTION AND VELOCITY OF THE WIND AT SEA.

In view of the difficulty of measuring the apparent velocity of the wind on a moving vessel, any method of ascertaining its true velocity with considerable accuracy is desirable from a scientific as well as from a practical standpoint. This problem has been solved by Mr. A. Lawrence Rotch, director of the Blue Hill Observatory, and professor of meteorology in Harvard University.

The following description of his instrument, of which Casella and Co. are the sole makers, will explain the graphical solution ingeniously devised by Mr. Rotch.

In Fig. 15a let AB be the wind due to the motion of the steamer in the opposite direction, and AC the direction of the wind relative to the vessel as shown by the drift of its smoke, giving the angle BAC. Then, by measuring the angle DBA that the true wind makes with the vessel, which is easily done by watching the wave crests as they approach it, we obtain the third side, BC, of the triangle. This represents in direction, and also in length, on the scale used in setting off the speed of the ship, the true direction of the wind relative to the vessel, and also its true velocity. The method fails when the wind direction coincides with the ship's course, and becomes inaccurate when the angle between them is small ; but in other cases, since the course and speed of the ship are always accurately known, and the two angles, BAC and DBA, can be measured

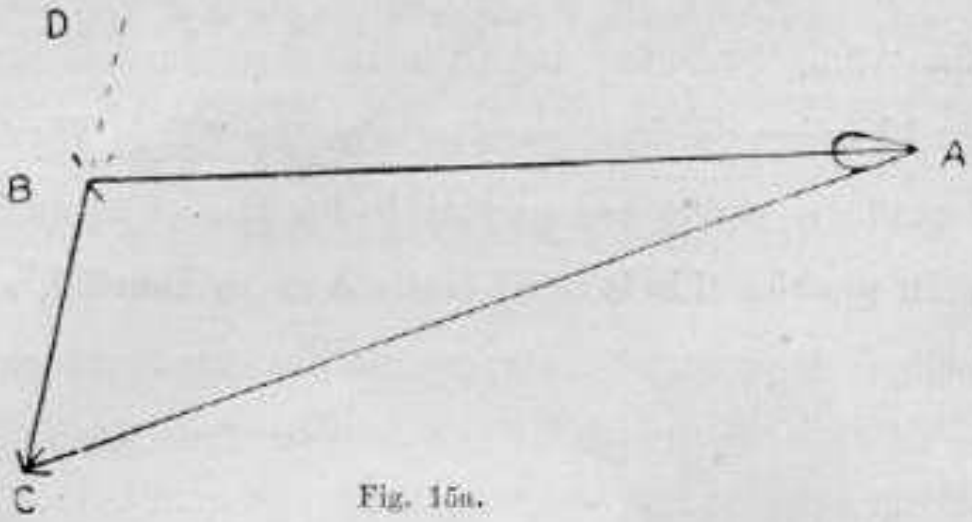


Fig. 15a.

To avoid the inconvenience of plotting these data, Mr. Rotch devised, in 1903, the instrument illustrated in the accompanying cut. The apparatus has two brass discs, 3 ins. in diameter, marked with the cardinal points of the compass, each quadrant being divided into 90°, beginning at North and proceeding in a right and left-handed direction to East and West respectively. One of these discs is pivoted near the end of a boxwood rule, 10 ins. long, having 30 divisions, and bearing the legend "Ship Moving," with an arrow pointing away from the pivot. On this pivot there is also mounted, near one end, a similar rule about 17 ins. long, containing 60 of the above divisions, and marked "True Wind," with an arrow directed away from the pivot. A brass slide upon the short rule carries the other moveable disc and also another pivoted boxwood rule, likewise divided into 60 parts and marked "Resultant Wind," with an arrow head away from its pivot. Sights are attached to the pivots and to the outer ends of the long rules, and a handle screws into the back of the disc that does not slide. The instrument folds together so as to pack away into a small box.

It is used as follows:—After rotating both discs until the divisions on their circumferences indicate at the middle of the "Ship"

representing its actual speed in miles per hour. Then, sighting along the "Ship" rule fore and aft in the direction indicated by the arrow, and holding the instrument steady, the "True Wind" rule is turned until its sights are normal to the line of advancing wave crests. In practice this is most easily done by standing amidships and holding the "Ship" rule against the windward rail, then, sighting as described, the short end of the "True Wind" rule will indicate on its graduated disc the direction from which this wind comes. The reading is noted, or the rule is clamped fast, and the observer stands to leeward of the funnel. It being certain that the "Ship" rule is again exactly fore and aft, and the "True Wind"

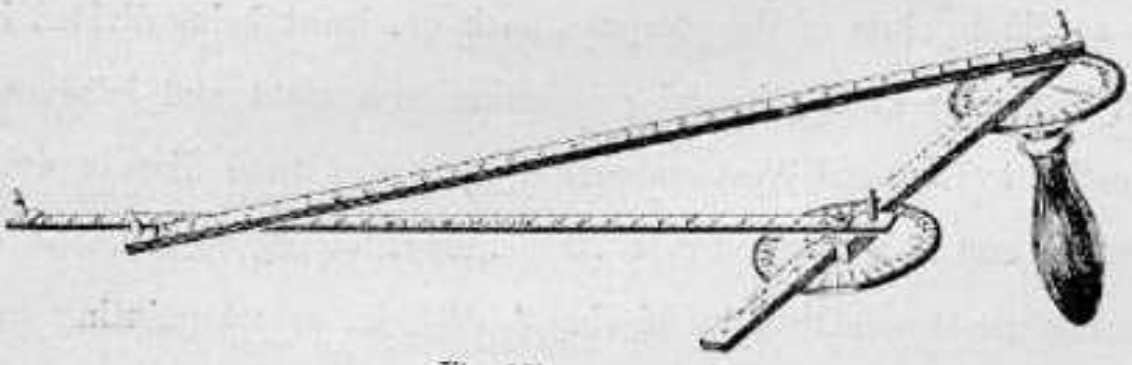
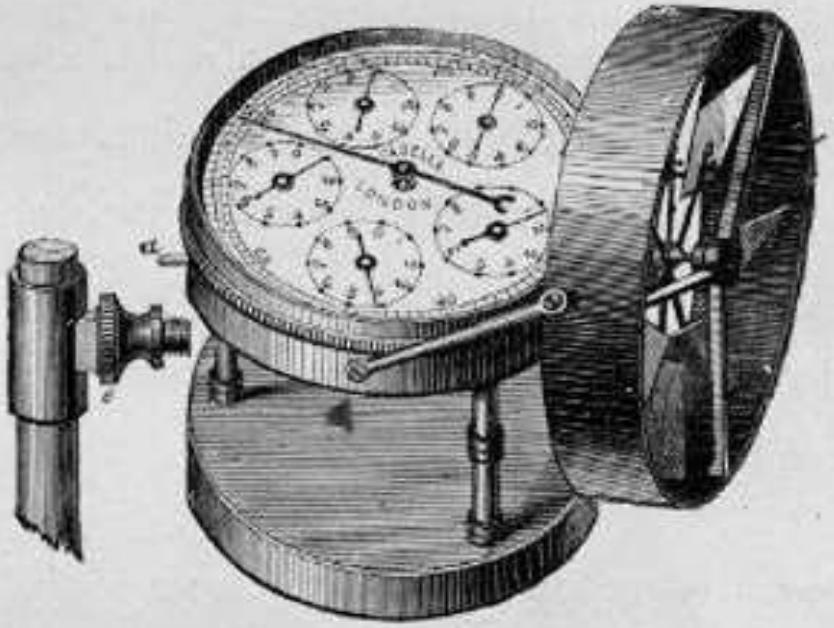


Fig. 15b.

rule in its former position, the "Resultant Wind" rule is turned until its sights coincide with the direction taken by the receding line of smoke, or with the mast-head pennant, should there be no smoke. The short end of this rule then indicates on its disc the real direction from which the resultant wind comes, and at the intersection of the two long rules there may be read off on their respective scales the velocities of the true wind, and of the wind experienced on board.

AIR METERS.

CASELLA'S AIR METER, OR POCKET ANEMOMETER,



No. 16.

For use in Mines, Factories, Hospitals, and Public Buildings.

The object of this little instrument is to give a correct means of measuring the velocity of currents of air passing through coal and other mines, and the ventilating spaces or shafts of hospitals and other public buildings. Although now generally copied by the 'trade,' it was *originally* arranged and constructed by L. Casella for Dr. Parkes, of the Royal Victoria Hospital, Netley, for measuring the state of ventilation in that large military establishment, and was declared to be the most perfect and sensitive instrument of the kind in use. Since then it has been adopted in our Houses of Parliament, the United States Senate, in many of the leading prisons and hospitals throughout the country, and ordered to be used in every coal mine. The graduations

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. On the large dial the low velocity of 50 feet per minute may be measured, and by the smaller ones continuous registration is extended up to 10,000,000 feet, or 1894 miles.

It is also admirably suited for use as a pocket anemometer for travellers. The fan is made of thin aluminium, and is almost frictionless. A small catch is fitted to the side of the dial for putting the instrument in or out of use. With each air meter is furnished a correction factor, which is to be added to or subtracted from the mean velocity of the current per minute.

If the result is required in miles per hour, instead of feet per minute, diride by 88.

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16. **PORTABLE AIR METER, best quality,** registering on six dials, 10,000,000 feet, or the equivalent in metres if desired.

PRICE ... ... **£3 15s. 0d.**

17. **PORTABLE AIR METER,** as above, **second quality,**

PRICE ... ... **£2 15s. 0d.**

18. **PORTABLE AIR METER,** similar to No. 16, but only registering 10,000 feet.

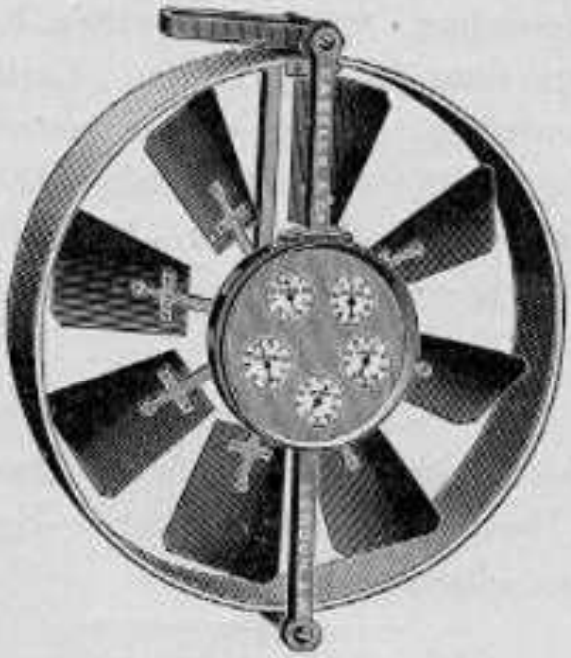
PRICE ... ... **£3 0s. 0d.**

19. **PORTABLE AIR METER,** fitted with "set to zero" mechanism, which obviates the necessity for noting the last reading, as the hand on each dial can be instantly set back to zero. Registering up to 1,000 feet.

PRICE ... ... **£3 3s. 0d.**

20. Ditto. Registering up to 10,000 feet ... ... **£3 7s. 6d.**

BIRAM'S PORTABLE AIR METER,



No. 21.

21. **COLLIERY PATTERN**, Fig. 21, fitted with 6-inch fan, reading to 1,000 feet.

PRICE ... ... **£3 10s. 0d.**

22. Ditto, to 100,000 feet.

PRICE ... ... **£4 7s. 6d.**

*** *All the above air meters, as is the case with the majority of* CASELLA & Co.'S *instruments, will be supplied with metric scales,*

Other Instruments manufactured by Casella & Co.

Engineering and Surveying. Transit Theodolites and Theodolites—Tacheometers—Dumpy and other Levels—Pocket Altazimuths—Azimuth Compasses—Repeating Circles—Tide Gauges—Current Meters—Mountain Barometers—Hypsometers—Aneroids (Field's and others)—Circumferentors—Miner's Dials—Levelling Staves—Chains—Pentagraphs—Planimeters—Station Pointers—Protractors—Computing Scales—Plotting Scales—Drawing Instruments—Parallel Rulers—Architects and Engineer's Curves—Steam and Pressure Gauges—Richards' and other Indicators—Gun and Torpedo Directors.

Meteorological. Barometers (Standard, Photographically Recording, King's Recording, Aneroids, Fortin's, Kew pattern, Long-range—Thermometers (Standard, Max., Min., Earth, Sun, Radiation, Photographically Recording, Pocket)—Hygrometers (Dry and Wet, Daniel's, Regnault's, Dines's)—Anemometers (Dines's, Robinson's, Beckley's, Embossing)—Helio-Pyrometer—Rain Gauges (Ordinary, Engineering, Recording) — Actinometers — Sunshine Recorders — Cathetometers.

Nautical. For Ships and Yachts — Sextants — Marine Barometers—Aneroids—Compasses—Artificial Horizons—Quadrants — Logs — Deep-sea Thermometers — Sounders — Hydrometers — Telescopes—Chronometers—Binoculars.

Electrical and Physical Apparatus. Galvanometers—Electrometers—Resistance Coils—Keys—Batteries—Mechanical and Mercurial High Vacuum Pumps, &c., &c.

Magnetic. Magnetographs—Magnetometers—Dip Circles—Fox's Circles—Goolden-Casella Dipping Needle Instrument, &c., &c.

Astronomical. Telescopes—Equatorials—Transit Circles—Chronographs—Sun Dials—Spectroscopes.

Medical. Clinical Thermometers—Air Meters—Spirometers—Microscopes and accessories.

*** *This list is naturally far from complete, but it illustrates the chief classes of instruments made by Messrs. Casella & Co., who will be happy to answer any enquiries concerning the above or any other apparatus or instruments.*