METEOROLOGICAL INSTRUMENTS.

[Mr. Cassella, of London, has furnished us with a series of wood cuts to illustrate some late forms of instruments constructed by himself; and, as they may be interesting to meteorological observers, we have concluded to insert them in this Appendix to the Annual Report.—J. H.]

Fig. 1.

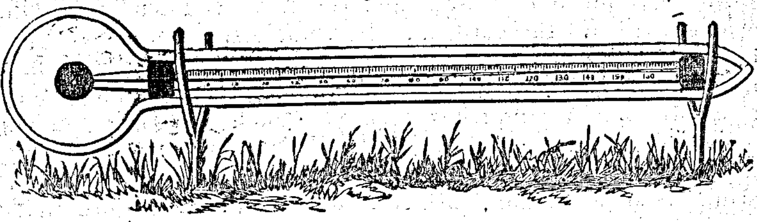


Fig. 1 represents a solar radiation thermometer, with blackened bulb, in a stout glass tube exhausted of air within one-tenth of an inch of the mercurial gauge, constructed agreeably to the suggestion of Sir John Herschel.

The instrument being thus protected from all external influences, gives uniformity of readings for comparison of solar radiation, which surpasses those obtained by the naked bulb exposed to contact with the air.

Fig. 2.

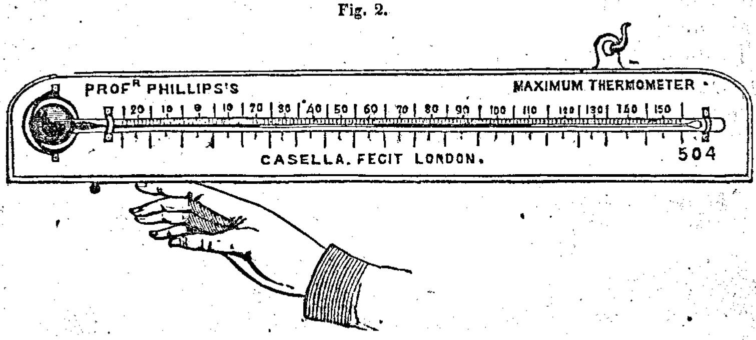


Fig. 2 represents a maximum thermometer constructed on the principle of Professor Phillips. The maximum point of temperature attained during the interval between two observations is indicated by a separation in the mercurial column. The end of a portion of the extremity of the column is left at the point of maximum, while the contraction takes place in the remainder of the column, as shown in the figure. To insure this separation, the bore of the tube is exceedingly fine, and a minute portion of air is left by the maker at the point where the separation takes place. This instrument is suspended horizontally on a hook at one end and on a pin at the other. In order to bring back the index to its proper place after the observation has been made, the pin is removed, the instrument is brought to a perpendicular position with the bulb downwards, when the detached mercury descends into near contact with the remaining portion of the column. The instrument is again brought back to its horizontal position and the pin restored to its place.

Thermometers constructed after this plan were first exhibited by Professor Phillips, accompanied by a description, at the Oxford meeting of the British Association for the advancement of science, in 1832. The principle of the instrument is, as we have stated, the employment of a certain portion of the column of mercury detached as a marker. The length of this is capable of a great range of adaptation to suit the objects of experiment; the instrument is independent of change by time or chemical action, and as delicate in operation as the best ordinary thermometer. Mr. Phillips constructed a number twenty-five years ago, some of which remain in an excellent state to the present time. The length of the marker may be varied at pleasure by means of a second hollow ball blown at the extremity opposite the ball containing the mercury. The longer this marker is left the more moveable it becomes. With *a certain small length* depending on the diameter of the tube it will remain, without moving, in any position, and requires strong shaking to change its place. Among the samples presented to the Association was one planned by Professor Phillips for special researches on limited sources, or areas of heat, with small bulb, fine bore, and *short detached marking column.* Thus constructed, the thermometer may be used in any position—vertical, inclined, or horizontal—and the short detached marking column will retain its place with such firmness that the instrument may be carried to a distance, or even agitated, without disturbing the registration.

Fig. 3.

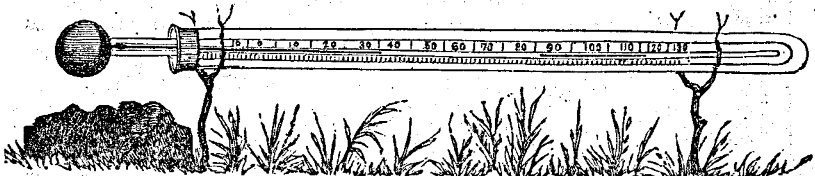


Fig. 3 represents an instrument of the same kind with black bulb for solar radiation.

Fig. 4.

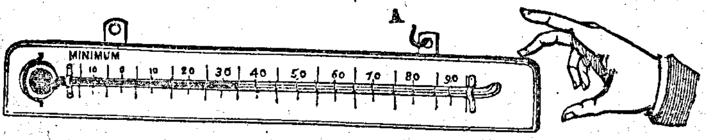


Fig. 4 represents the ordinary minimum thermometer in which the index is a small piece of enamel.

Fig. 5.

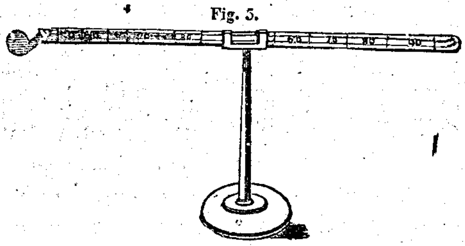


Fig. 5 represents a convenient form for mounting a thermometer for determining the temperature of grass due to radiation.

Fig. 6.

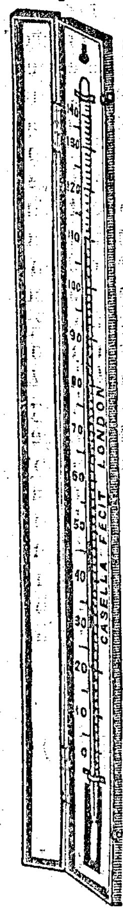


Fig. 7.

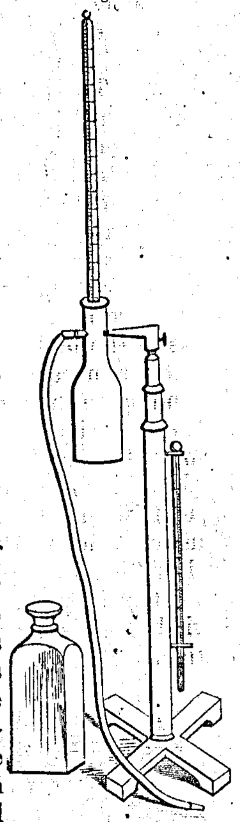


Fig. 6 represents one of a series of standard thermometers, extra sensitive, about 20 inches in length, each degree three-fourths of an inch, divided into tenths or twentieths.

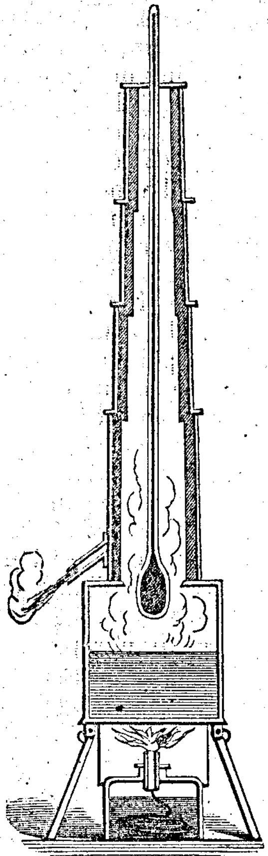
Sensitive thermometers for extremely low temperatures are also constructed of the same pattern, thirty-five inches long, with a range from 60° below to 80° above zero, filled with pure alcohol of the specific gravityof 720.

Fig. 7 represents Regnault's condensing dew-point hygrometer.

This instrument consists essentially of two sensitive thermometers, as shown in the figure, the lower exposed to the action of the atmosphere, the upper to the influence of a current of air passing through ether contained in a well-polished silver bottle, from the mouth of which the stem of the thermometer projects. This thermometer marks the exact temperature at which the aqueous vapor at the time in the atmosphere is condensed in the form of dew upon the bottle, and thus gives by direct observation the existing "*dew-point.*" The polished silver bottle is about one inch in diameter, the neck being contracted to about five-eighths. The thermometer inserted into this bottle is a sensitive one, divided on its stem to *half degrees*, the stem passing through an ivory stopper fitted with a cork which renders the bottle air-tight at the neck. On one side, and within the silver bottle, a small, slender silver tube descends to nearly the bottom; this tube passes outwards, and is connected with an India-rubber tube. Upon nearly filling the large part of the silver bottle with *ether*, and blowing through this tube, the air rises through the ether in bubbles and carries with it a portion of the ether in vapor. This evaporation of the ether causes such a degree of cold that the surface of the silver bottle is so reduced in temperature as to cause a precipitation of dew. The supporting stem of the instrument being *hollow* a ready means is provided for the egress of the air. The bottle at the foot of the stand is for containing a supply of ether.

Fig. 8 represents the hygrometrical apparatus or instrument for measuring altitudes by the boiling point of water. It consists first, of a strong sensitive enamelled thermometer, the scale of which ranges from 180° to 214° Fahrenheit, divided on the stem so as to show the tenth of a degree. Second, a copper boiler supported on a small tripod and surmounted by a telescopic draw-tube, which is again sur-

Fig. 8.



rounded by a second tube or steam jacket. The inner tube has perforations near the top which allow the steam readily to fill the intermediate space and freely to escape by a side tube, as shown in the figure. The thermometer is supported, at about one inch above the surface of the water in the boiler, by means of a cork or India-rubber washer on the upper part of the stem, and can be immersed in the steam to any required amount by sliding the telescope tube to any required height. Distilled water is used in this instrument, which is made to boil by means of a spirit lamp. The whole is packed in a leathern sling case, shown in Fig. 9.

Fig. 10.

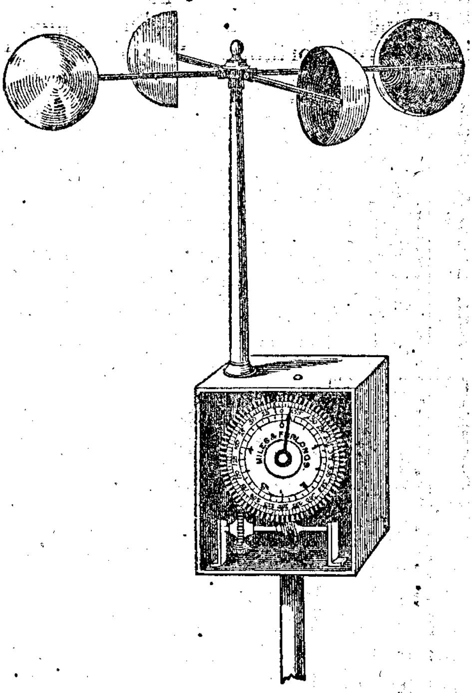


Fig. 9.

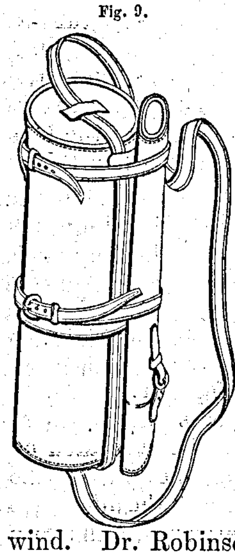


Fig. 10 represents a portable anemometer for registering the velocity of the wind in miles and furlongs.

This instrument is a modification of the anemometer devised by Dr. Robinson, of Armagh, which consists essentially of four hemispherical cups, having their diametrical planes exposed to a passing current of air; they are carried by four folding horizontal arms attached to a vertical shaft or axis, which is caused to rotate by the motion 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. A simple arrangement of wheels and screws is appended to the instrument, which, by means of two indices, shows, on inspection, the space traversed by the wind. The outer or front wheel, one revolution of which is equal to the transit of five miles of wind, is furnished with two graduated circles, the interior being divided to the eighth part of a mile, so that each division is equal to a furlong, while the exterior is divided into one hundred parts, each being equal to five miles. The stationary index at the top of the dial marks the number of miles (under five) and furlongs that the wind may have traversed, in addition to the miles shown by the traversing index, which revolves with the dial and indicates the transit of every five miles. The graduation is to five hundred. The traversing index is furnished with a milled-headed screw at the back of the instrument, which is employed for bringing its extremity to the zero point when the instrument is set, which consists in merely turning it by means of the milled-headed screw and bringing the end of the index to point to zero.

By means of the folding arms which carry the cups this anemometer is rendered portable. When in use it may be screwed on a shaft or the ordinary piece of gas-pipe which accompanies it and elevated to any desirable altitude. It is particularly adapted for occasional observations on shore, and is suitable for measuring the force of the wind at sea. It may readily be set up on the highest part of a building or elevated on board a vessel. When inspected it will show alike the wind's present velocity as well as the rate at which it was passed since it was set or last read. This instrument may also be used for showing the ventilation of public buildings or dwellings, by an inspection of its dial in combination with a watch or clock, by which the rate of the progress of ventilation may be seen.

Fig. 11.

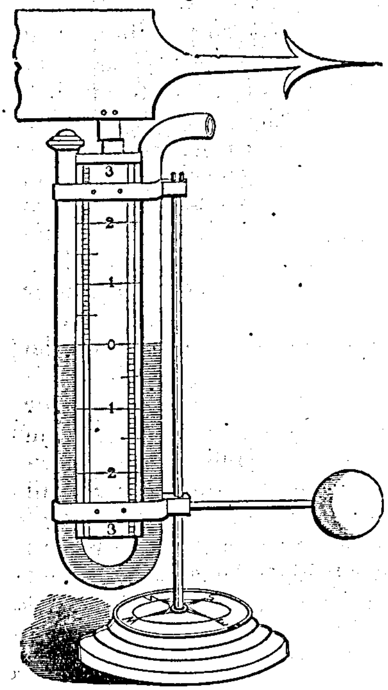


Fig. 11 represents a convenient form of Lind's anemometer for showing the direction and force of the wind. This consists essentially of a glass tube of half an inch bore, bent into the form of a U, as shown in the figure, the lower half of which is filled with mercury; the upper end of one of the legs is bent horizontally, and when this is directed toward the wind the mercury is driven down by the pressure in one leg and caused to rise in the other, the difference in level gives the pressure of the wind in inches of mercury from which the velocity may be calculated. For observing very high winds the straight leg may be closed at the top, in which case the pressure on the open end will be indicated by the condensation of the air in the other leg, combined with the difference of level of the mercury in the two legs.