PRICE ONE SHILLING.

ANEROID BAROMETERS

A DESCRIPTION OF THE CONSTRUCTION
AND VARIOUS USES EXPLAINED.

ALSO
A DESCRIPTION OF VARIOUS OTHER INSTRUMENTS
USED TO DETERMINE
THE MOST IMPORTANT POINTS IN

PRACTICAL METEOROLOGY.

BY

T. W. SHORT.

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10th THOUSAND.

1903.

(ENTERED AT STATIONERS' HALL).

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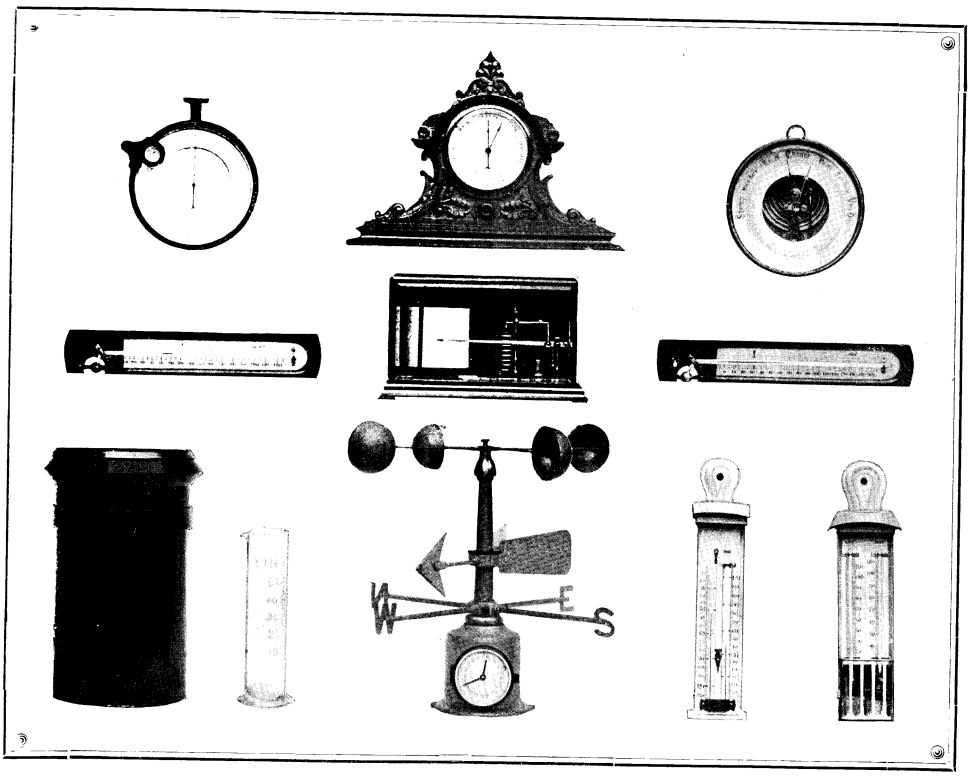

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PREFACE.

The great interest taken in Meteorological Observations and the importance of the subject to many whose occupation or vocation in life is dependent upon, or affected thereby, is fully borne out by the daily reports now being given in the Public Press, giving records of Barometric pressure, Thermometric Variations, Wind pressure and Direction, &c., &c., all of which tend to develop the taste for gaining a fore-knowledge of the weather, and keeping records of that which has passed away.

To the Agriculturist, the Horticulturist and those whose interests are centered in the growing of crops and flowers, and the various products of the Earth, by careful notice of the indications of Instruments, added to personal observation, much may be done to avert damage and loss.

To the Mariner, the importance cannot be overstated, and much loss of life is saved, as well as valuable ships and cargoes, by timely precautions being taken upon the Fore-Warnings given by instruments.

To the Engineer also, much of his success in works depends upon a careful consideration of the action of Temperature, the amount of Rainfall and the force of wind, and failures and accidents thereby averted.

Indirectly the whole community is affected by all these considerations, and it is therefore a great satisfaction, that the subject is now receiving such general interest.

The object of this pamphlet is to direct attention to several Meteorological Instruments needful for this purpose, and in particular, to the Aneroid Barometer, which fills an important part in this advancing science of Meteorology, as well as for other purposes for which it is used.

The description and the construction of this form of Barometer, which is given in the pamphlet, may be acceptable to those desiring to obtain one, and a guide to their selection of such a one as will fill their particular requirements.

LONDON,
January, 1903.

[Entered at Stationers' Hall].

A PAMPHLET OF GENERAL INFORMATION RESPECTING THE CONSTRUCTION AND USE OF INSTRUMENTS FOR INDICATING, MEASURING, AND RECORDING ATMOSPHERIC CHANGES.

ANEROID BAROMETERS.

These Barometers have now borne the test for many years of proof and trial, and their great merits and advantages over other kinds of Barometers, for many purposes, fully recognised.

As "Weather Barometers" the Aneroid has almost superseded the use of the Mercurial Barometer, for, its action being purely Mechanical, it cannot be easily deranged.

Originally, it was the invention of a French manufacturer, and may be regarded as one of the most ingenious instruments ever constructed for measuring the action of a "Natural law."

In recent years, it has been so much improved and perfected by English makers, that it may now be considered, in some forms in which it is made, the most sensitive Instrument to indicate the variations in Atmospheric pressure.

The Atmosphere surrounding the Earth may be regarded as an "Ocean" of air, extending upwards from the sea level of the earth's surface about ten miles; its greatest density is nearest to the earth's surface, by reason of having to support the weight of its whole depth, and gradually becoming less dense as the distance from the earth increases. This law of decrease in pressure being known, it is used as a means of measuring the heights of hills and mountains.

This great discovery of the weight and pressure of Air was first made by "Torricelli," in the year 1647, by his experiment of filling a glass tube about 36 inches long (closed at one end only) with Mercury, and then by inverting it and placing the open end in an open vessel of Mercury; when he found that, the pressure of the Air upon the surface of the Mercury in the open vessel, sustained and supported the column within the tube, to a height of about 30 inches.

From this experiment, which was elaborated by succeeding Scientists, all the various forms of Mercurial Barometers have subsequently been made, each and all demonstrating this beautiful "Law of Nature" which is now further developed and utilised by the "Aneroid" Barometer, which is the special subject of this pamphlet.

Aneroid Barometers—*continued.*

In order to convey a correct idea of the Mechanical and Physical structure of the Aneroid, an illustration of its movement and action is here given, and the detail of its construction explained by the reference letters.

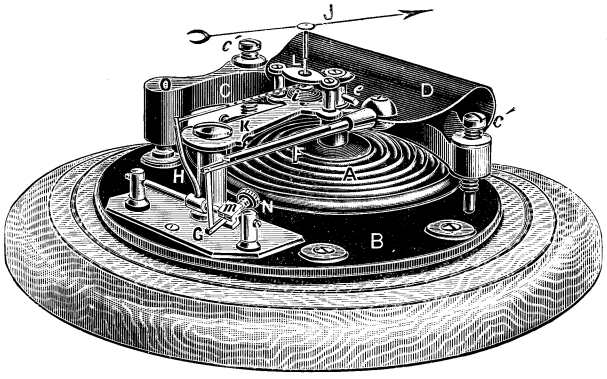

Fig. 1.

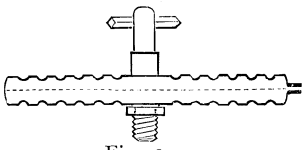

Fig. 2.

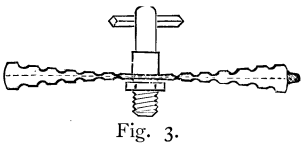

Fig. 3.

The word "Aneroid" is a Greek compound, expressing, "without fluid," and the illustration here given, Fig. 1, clearly shews the general construction of the movement with its elastic Metallic box, called the "Vacuum Chamber," *A*, upon which the pressure of the atmosphere produces the effect hereafter described.

This chamber is constructed with two circular discs of thin German silver, corrugated on each surface, and firmly soldered together at the edge, forming a close box shewn at Fig. 2; from the bottom a screwed centre piece projects, by which it is attached to the base plate, and from the top a central pillar, carrying a steel knife edge piece to rest upon the surface of the main-spring when under tension.

At the edge of the box a piece of soft metal pipe is inserted and soldered, through which the air from the chamber is exhausted by an Air-pump, and close sealed while the vacuum is maintained.

As will be seen by reference to Fig. 3, the effect of this exhaustion is, to cause the top and bottom discs to close together by the pressure of Air upon the outside surfaces, which, upon an ordinary size chamber, is equal to a force of about 60 lbs.

The base of the movement is a strong metal plate of circular form, *B*, to this plate the vacuum chamber *A* is firmly fixed by a screwed nut upon its centre projecting through the base plate.

An iron bridge or carriage piece, *C*, spans the chamber, resting upon the base plate by means of the two pointed screws, *c' c'*, the object of these screws being to finally regulate the tension upon the chamber *A*.

Aneroid Barometers—*continued.*

To the bridge *C* is fixed the main-spring *D*, which, being forced down by mechanical means sufficient to insert the knife-edge piece *E*, when released, lifts the upper part of the chamber drawing the two discs asunder, thus forming a perfect balance with the power of the main-spring, opposing the atmospheric pressure upon the vacuum chamber.

Any variation in Air-pressure will now be shown by a movement up or down of the elastic chamber, a decrease in pressure allows the main-spring to overcome the power of the vacuum, and the action is upwards, any increase of air pressure produces the contrary result.

The main lever *F*, attached to the main spring, is actuated by the movement of the chamber, which action is multiplied by the length of the lever. This is attached to a second short lever, *G*, and is again attached to a third long lever, *H*, from which a fine chain extends to the centre of the movement, passing around a central arbor or spindle, *I*, upon which the indicating hand *J* of the Barometer is fixed, having now a horizontal motion, and parallel to the dial, a projecting arm *K*, carrying two small pillars, with a cross piece, *L*, support the central arbor or spindle. The short lever *G* projects from a Regulator, *M*, and is provided with an adjusting screw, *N*, this being capable of lengthening or shortening the lever, provides an adjustment to the graduated scale on the dial, also, at the extremity of the Bridge at *O*, an adjusting screw passes through the base-plate, by which the indicating Hand of the Barometer can be set to the correct position upon the Dial.

The best made instruments are correctly compensated for alterations of Temperature. In that case, the main lever *G* is made of a composite bar of two metals, steel and brass, the quantity of *each* metal is then altered until the compensation is effected. The compensation of an Aneroid is of the greatest importance for all purposes, but especially so when used for measuring altitudes, as the passing from low to high regions is generally accompanied by a reduction in temperature, and any movement of the Hand by temperature would give erroneous results, but if perfectly compensated, this would not occur, and in that condition no allowance for Temperature, as in a Mercurial Barometer, is necessary in noting the inches of pressure.

The graduations upon the Dial of an Aneroid of this class, by good makers, are carefully compared with the readings of a Standard Barometer at each inch of pressure, in the same manner that they are tested at the Observatory of the National Physical Laboratory, Kew, this operation being done under the glass receiver of an Air-pump, the comparative readings can easily be seen. The following quotations from published opinions of eminent Meteorologists are worthy of repetition.

Aneroid Barometers —*continued.*

Admiral Fitzroy says: "The Aneroid is an excellent weather glass if well made, and in its improved condition of *compensation* is fit for measuring heights. I have had one now in use for ten years, and it appears as good now as at first."

Sir Leopold McClintock when engaged in his search for Sir John Franklin and his party, in the Arctic region, says that "The atmosphere changes were indicated *first* by the Aneroid, *next* by the Sympiesometer, and *lastly* by the Mercurial Barometer."

James Glaisher, Esq., F.R.S., testing Aneroids in Balloon ascents, says: "The Aneroid readings from all observations made in the several ascents, may be safely depended upon to pressures *below* twelve inches even to the second place of decimals."

Col. Sir H. James, R.E., in his "Instructions for taking Meteorological Observations," says, in speaking of the Aneroid: "This is a most valuable instrument; it is extremely portable. I have had one in use for upwards of ten years, and find it the best form of Barometer, as a weather glass, that has been made."

It is however necessary, whenever an opportunity offers, to compare the readings of an Aneroid with a Standard Mercurial Barometer, as there is sometimes a settlement of some of the metal parts and springs which alter the position of the indicating Hand. This can be easily set correct by turning the adjusting screw which passes through the bottom of the movement.

Having now given a general idea, as well as a description of the construction, attention will be directed to the various forms in which it is made and the particular uses these different forms are applied to.

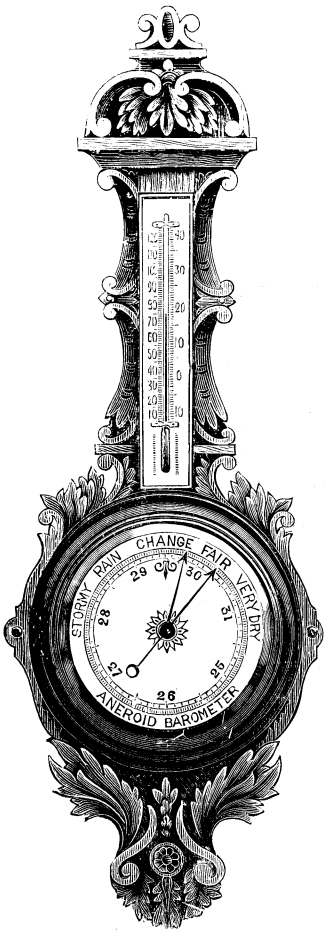

Fig. 4.

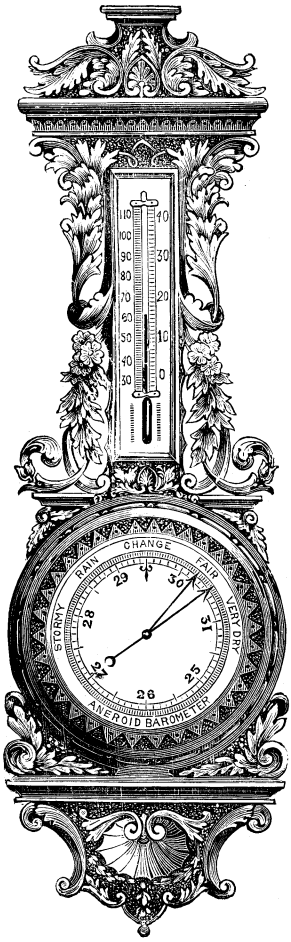

Fig. 5.

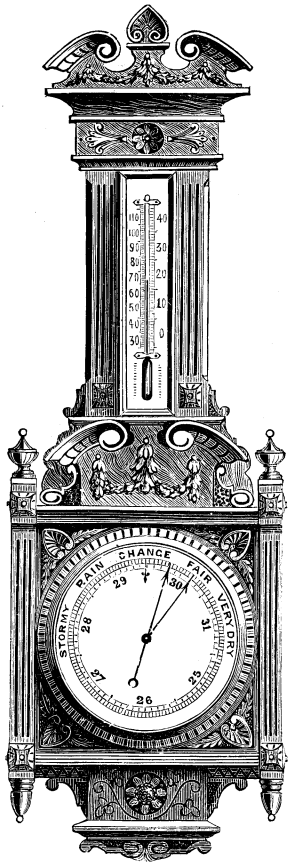

Fig. 6.

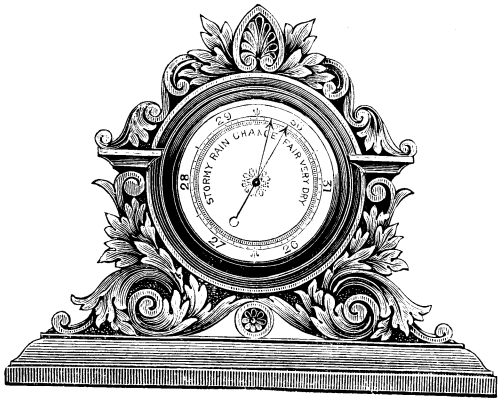

Fig. 7.

ANEROIDS

for use as

"WEATHER GLASSES."

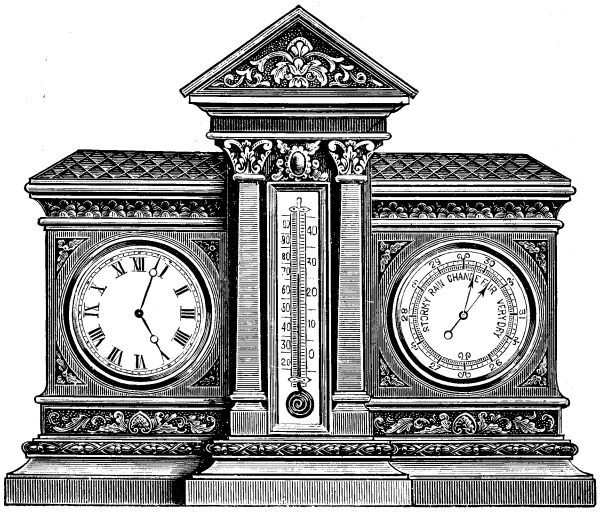

Fig. 8.

The illustrations here given are a few of the many forms and designs now produced, as they are made in all sizes, with dials varying from five to ten or twelve inches in diameter, with the frames in due proportion, and in every style. In carving and cabinet work, for use in Halls or Rooms of Houses, they are also made in artistic designs with combination of Thermometers and Clocks, and have the great advantage of not being liable to derange in handling and cleaning by inexperienced persons.

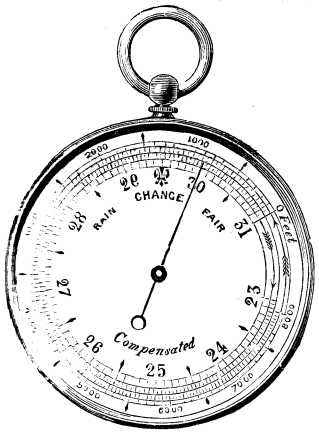

Fig. 9.

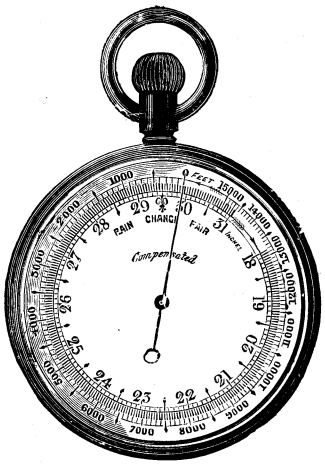

Fig. 10.

Fig. 11.

POCKET SIZE ANEROIDS.

To the traveller or tourist, these instruments have now become almost an indispensable companion, causing the greatest interest to those who possess them, by indicating the height of hills, mountains and gradients with great accuracy, as well as being useful as weather Barometers.

Mr. J. H. BELVILLE, of the Royal Observatory, Greenwich, says that, "its movements are always consistant, it was a delightful companion and highly useful, its indications preventing many an excursion which would have ended in disappointment."

In well made instruments, the action of the Aneroid is so sensitive, that the slight gradients on a railway can readily be observed by watching the Aneroid as the journey is being made, when they will at once be seen by the rising or falling of the indicating hand upon the dial.

It is advisable to hold the Aneroid in a horizontal position when reading for altitudes, and *all* readings taken in this position, as the position of the indicating hand is slightly different if held in the vertical position.

The dials of these Aneroids are graduated in concentric circles, the Inner circle giving the Barometer inches comparable with the inches of a mercurial column, and the Outer circle giving the scale of feet, shewing the different altitudes of one station to another. Many Aneroids are made with the Altitude scale moveable. This is a convenient form to use more particularly as a Weather Barometer, and by which the zero point can be moved until it coincides with the indicating hand, when, the rise or fall of the hand is at once seen, but, in measuring altitudes correctly, the zero of the scale should be set to coincide with the Barometer scale at 31 inches.

The explanation of this is, that the Barometric inches are equal in length throughout, and the altitude scale is gradually diminishing as the ascent is greater, it will therefore be seen that, if this scale is moved from its coincident position at 31 inches to a lower point, the equivalent value of the scale of feet would be incorrect. It is, however, convenient to be able to move it slightly, so that the indicating hand coincides with any one of the graduations indicating 100 feet, but *not* moving it far from its proper position of 31 inches, any error would then be so slight as to be scarcely appreciable, and, when the ascent was made, the reading of the number of feet would be more easily seen when starting from an *even* number.

Special Surveying Aneroid Barometers.

Reading to Single Feet of Altitude Scale. Compensated for Temperature.

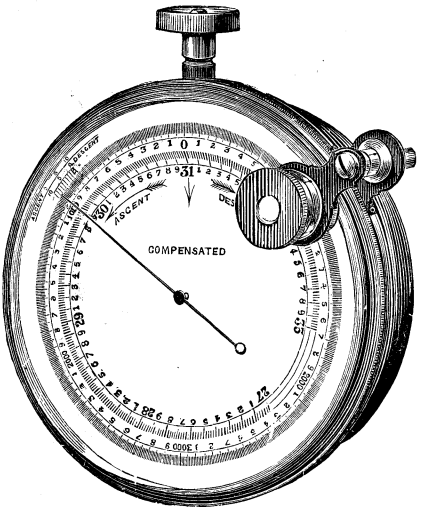

Fig. 12.

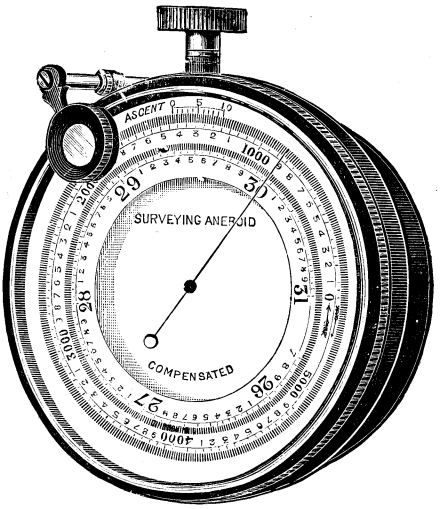

Fig. 13.

These instruments have been designed and constructed specially for the purpose of readily ascertaining slight variations in gradients, levels, etc. For approximate surveys and levellings, for roads, railways, canals, water course and mines, it is invaluable, as its readings can be easily and rapidly taken.

Besides extreme sensitiveness, the specialty claimed for the instrument is an arrangement of the scale of altitudes which admits of sub-divisions by a Vernier, hitherto impracticable owing to the altitude scale in ordinary use being a gradually diminishing one, to which a Vernier cannot be applied.

In the present instrument, the action has been so arranged as to give accurate readings upon a regular scale of altitudes; the barometrical scale of inches having been made progressive, to afford the correct relative readings with the scale of altitudes, this arrangement, therefore, in no way interferes with its use as an ordinary barometer.

For mining purposes (Fig. 12), the entire circle of the dial is graduated to represent six inches of the mercurial Column, i.e., from 27 to 33 inches. This scale will register about 2,000 feet below sea level, to 4,000 feet above. The divisions of the altitude scale represent 10 feet measurements, which can again be sub-divided by the Vernier to single feet,—the Vernier scale is moved by a rackwork adjustment, and a magnifying lens which rotates upon the outer circumference of the instrument facilitates the reading of minute quantities.

For surveying purposes, where it is not required to be used below sea level (Fig. 13), the instrument is made with the scale divided from 25 to 31 inches, thus giving an altitude scale of 6,000 feet above sea level only, and with this open scale, and the assistance of the Vernier, the same minute readings can be easily taken.

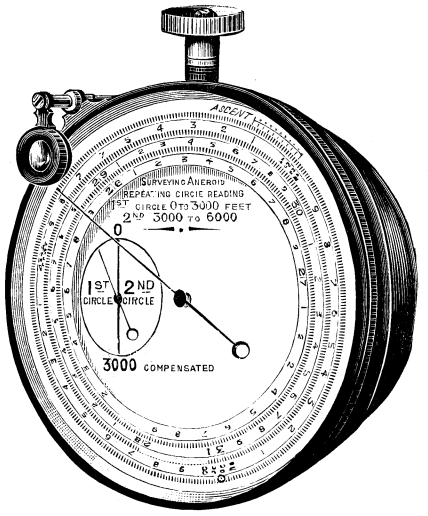

Fig. 14.

At figure 14 another form is shown, in which a much more extended scale is given upon the dial, the pressure scale being shown by a repeating or second concentric circle of division, and the altitude scale reads from the outer circle, which agrees at coincident points with either of the circles of pressure scale.

The instruments are also constructed for measuring much greater altitudes, i. e., 10,000 to 15,000 or 20,000 feet, but with these scales the measurements cannot be made quite so minute as in the more open scales.

In using the surveying Aneroid to obtain the difference of level of any two stations or positions, it is only necessary to place it horizontally at one of the two stations, adjust (by means of the rack motion) the zero of the Vernier, until it coincides with the point of the Indicating Hand, and read off the number of feet indicated by the Altitude Scale and Vernier; then remove the instrument to the other station and place it in the same position; adjust the zero of Vernier as before, and the difference of the two readings gives the difference of level.

EXAMPLE.

Reading of scale at upper station . . .	1027 feet.
Reading of scale at lower station . . .	785 feet.
Difference of level . . .	242 feet.

The following Table of Altitudes is adopted as the standard scale, and was determined by PROFESSOR AIREY, the Astronomer-Royal of England.

TABLE OF ALTITUDES

at mean Temperature of Atmosphere of 50° Fahrenheit.

Aneroid or Corrected Barometer	Height in Feet	Aneroid or Corrected Barometer	Height in Feet	Aneroid or Corrected Barometer	Height in Feet	Aneroid or Corrected Barometer	Height in Feet	Aneroid or Corrected Barometer	Height in Feet
in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.
31.00	0	28.28	2500	25.80	5000	23.54	7500	21.47	10000
30.94	50	28.23	2550	25.75	5050	23.50	7550	21.44	10050
30.88	100	28.18	2600	25.71	5100	23.45	7600	21.40	10100
30.83	150	28.12	2650	25.66	5150	23.41	7650	21.36	10150
30.77	200	28.07	2700	25.61	5200	23.37	7700	21.32	10200
30.71	250	28.02	2750	25.56	5250	23.32	7750	21.28	10250
30.66	300	27.97	2800	25.52	5300	23.28	7800	21.24	10300
30.60	350	27.92	2850	25.47	5350	23.24	7850	21.20	10350
30.54	400	27.87	2900	25.42	5400	23.20	7900	21.16	10400
30.49	450	27.82	2950	25.38	5450	23.15	7950	21.12	10450
30.43	500	27.76	3000	25.33	5500	23.11	8000	21.08	10500
30.38	550	27.71	3050	25.28	5550	23.07	8050	21.05	10550
30.32	600	27.66	3100	25.24	5600	23.03	8100	21.01	10600
30.26	650	27.61	3150	25.19	5650	22.98	8150	20.97	10650
30.21	700	27.56	3200	25.15	5700	22.94	8200	20.93	10700
30.15	750	27.51	3250	25.10	5750	22.90	8250	20.89	10750
30.10	800	27.46	3300	25.05	5800	22.86	8300	20.85	10800
30.04	850	27.41	3350	25.01	5850	22.82	8350	20.82	10850
29.99	900	27.36	3400	24.96	5900	22.77	8400	20.78	10900
29.93	950	27.31	3450	24.92	5950	22.73	8450	20.74	10950
29.88	1000	27.26	3500	24.87	6000	22.69	8500	20.70	11000
29.82	1050	27.21	3550	24.82	6050	22.65	8550	20.66	11050
29.77	1100	27.16	3600	24.78	6100	22.61	8600	20.63	11100
29-71	1150	27.11	3650	24.73	6150	22.57	8650	20.59	11150
29.66	1200	27.06	3700	24.69	6200	22.52	8700	20.55	11200
29.61	1250	27.01	3750	24.64	6250	22.48	8750	20.51	11250
29.55	1300	26.96	3800	24.60	6300	22.44	8800	20.47	11300
29.50	1350	26.91	3850	24.55	6350	22.40	8850	20.44	11350
29.44	1400	26.86	3900	24.51	6400	22.36	8900	20.40	11400
29.39	1450	26.81	3950	24.46	6450	22.32	8950	20.36	11450
29.34	1500	26.76	4000	24.42	6500	22.28	9000	20.32	11500
29.28	1550	26.72	4050	24.37	6550	22.24	9050	20.29	11550
29.23	1600	26.67	4100	24.33	6600	22.20	9100	20.25	11600
29.17	1650	26.62	4150	24.28	6650	22.16	9150	20.21	11650
29.12	1700	26.57	4200	24.24	6700	22.11	9200	20.18	11700
29.07	1750	26.52	4250	24.20	6750	22.07	9250	20.14	11750
29.01	1800	26.47	4300	24.15	6800	22.03	9300	20.10	11800
28.96	1850	26.42	4350	24.11	6850	21.99	9350	20.07	11850
28.91	1900	26.37	4400	24.06	6900	21.95	9400	20.03	11900
28.86	1950	26.33	4450	24.02	6950	21.91	9450	19.99	11950
28.80	2000	26.28	4500	23.97	7000	21.87	9500	19.95	12000
28.75	2050	26.23	4550	23.93	7050	21.83	9550	19.241	13000
28.70	2100	26.18	4600	23.89	7100	21.79	9600	18.548	14000
28.64	2150	26.13	4650	23.84	7150	21.75	9650	17.880	15000
28.59	2200	26.09	4700	23.80	7200	21.71	9700	17.235	16000
28.54	2250	26.04	4750	23.76	7250	21.67	9750	16.615	17000
28.49	2300	25.99	4800	23.71	7300	21.63	9800	16.016	18000
28.43	2350	25.94	4850	23.67	7350	21.59	9850	15.439	19000
28.38	2400	25.89	4900	23.62	7400	21.55	9900	14.883	20000
28.33	2450	25.85	4950	23.58	7450	21.51	9950		

This Table is intended more particularly for the graduation of Aneroids with a circle of Measures in Feet concentric with the ordinary circle of Barometric Height measured in Inches. The circle of feet is to be read off, at the upper and lower stations, by the Index; and the rule for measuring the height will be:—Subtract the reading at the lower station from the reading at the upper station; the difference is the height in feet.

EXAMPLE { Barometer at Upper Station, 23.50 .. ... 7550 feet.
,, Lower ,, 24.20 ... ... 6750 ,,
Actual Height ... 800 ,,

There is no correction for temperature required with Aneroids which are "Compensated."

ALTITUDE BAROMETERS.

For the very accurate measurement of altitudes, Aneroids of larger sizes are generally used, and these, 4 inches or 5 inches in diameter, by which a very slight movement of the indicating hand is more readily seen. In the construction of the movement also, greater accuracy can be attained than in the very small instruments, where the mechanism is of necessity compressed.

At page 10 is given the example for taking Altitudes correctly. In very accurate Surveys, which are likely to occupy a considerable time, it is usual to employ two Aneroids, one of them being placed at the lower station with an observer to record at intervals of time any change, which takes place at that station, of atmospheric pressure. When the survey is completed, these changes, if any, are added to, or deducted from the observed readings of the Aneroid used in the ascent, and the corrections accordingly made.

As mentioned on page 12, a *Recording* Aneroid, Fig. 15, (which is not a very portable instrument), is now sometimes used, being placed at the *lower* station, this plan avoids the necessity of a second observer.

It has previously been explained that Aneroids are compensated for any change of temperature; this is correct in all well-made instruments, but, although the Aneroid itself is not affected by change of temperature, the atmosphere itself is affected thereby, and the following rule for correction should be applied.

RULE.

The table of altitude assumes a mean atmospheric temperature of 50° Fah^{t}., for other temperatures the following correction to be applied :—

Add together the temperatures of the upper and lower stations, if this sum in degrees is greater than 100° Fahrenheit, increase the height by $\frac{1}{1000}$ part for every degree in excess of 100°. If the sum be lower than 100°, diminish the height by $\frac{1}{1000}$ part.

EXAMPLE :—

Barometer reading at lower station, 30,146 = 500 ft. by the scale
Do. do. upper do., 21,019 = 10,500 ft. do.

Reading by the scale 10,000 ft.

Temperature at lower station	60°
Do. upper do.	30°
Total	90°

This temperature being 10° less than 100°, the deduction would be 10 ft., therefore 10° × 10 ft. = 100, deducted from reading of 10,000 ft. = correct height, 9,900 ft.

The best form and sizes of Aneroids for these purposes will be recommended by the different well-known makers of them. A very fine instrument is made for Observatory uses with a diameter of about 6 inches with which, by means of a vernier scale, the variations of $\frac{1}{1000}$ part of inch can be distinctly seen.

BAROGRAPHS.

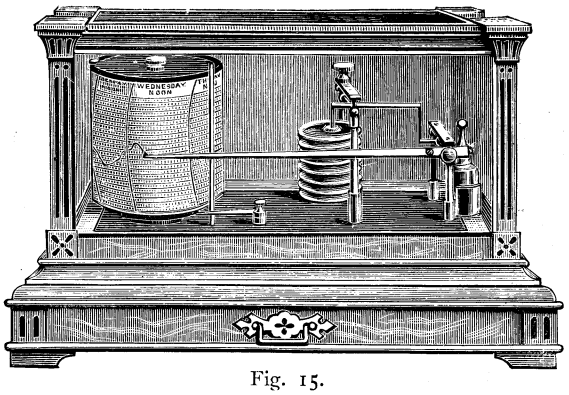

Fig. 15.

These instruments are most interesting, as they show, at a glance, the exact height and reading of the Barometer, as well as Recording the same by a pen upon a printed chart, which is placed around the cylindrical case of a clock, rotating a complete circle in one week, the exact reading can therefore be seen for any time during the week, and the charts being renewed each week, can be retained as a Record for the entire year. They are also of great use in the measurement of Altitudes, one being retained at the *base* of a mountain, which is to be measured. This is more fully explained under the description of Altitude Barometers.

The Recording *Pen* is made with a reservoir sufficiently large to carry ink for one entire week, and the *Ink* is specially prepared, so that it does not dry until marked on the paper of the chart.

In using and setting the Barograph, first throw the pen off the Cylinder carrying the Chart, by turning the lever in the base plate.

Wind the Clock by the attached key, holding the Cylinder firmly in position in the left hand.

To place a Chart in position, turn the milled-head nut at the top of the retaining spring band (which is hinged at the bottom), the catch at the upper end being released it will fall downwards—remove the used Chart (if there is one on the Cylinder), and put a new one into position, being careful that its edge rests on the projecting rim at the bottom of the Cylinder, one end of the Chart should over-lap the other, and the junction come where the retaining spring band, when replaced, will hold the paper firmly to the Cylinder.

Another form is made (patented), by which the Chart is secured to the Cylinder by a gummed end, and perforated to permit the removal easily. With this form no spring band is required.

Fill the pen with the prepared ink, draw a piece of paper lightly and carefully across the nibs to see that the ink will flow.

Turn the lever in the base plate and allow the return of the pen to the face of the Chart. The pressure of the pen upon the Chart should be as light as possible, only sufficient to ensure the pen marking distinctly with the ink. This pressure can be regulated by turning the milled-head screw at the other end of arm which carries the pen.

The Cylinder with Chart must then be turned upon its centre, until the pen points to the correct time.

To set the pen to the correct reading of a Standard, turn very gently, the milled-head screw which is placed on top of the central bridge, and the arm carrying the pen will be depressed or elevated accordingly.

The change of Chart should be made on Monday morning between the hours of seven and twelve—this period being duplicated on the Chart for the purpose.

ANEROIDS for Use in Ships and Yachts.

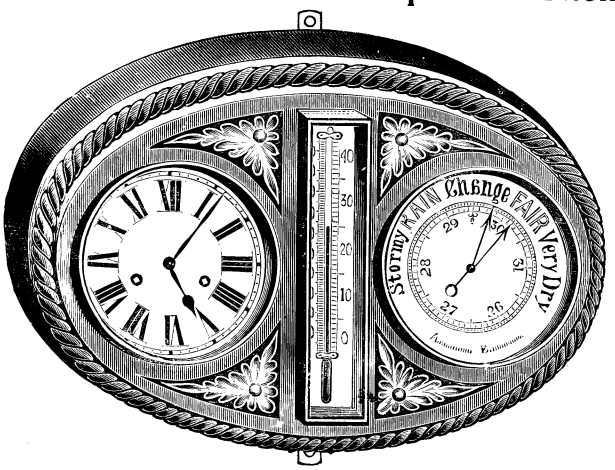

Fig. 16.

Fig. 17.

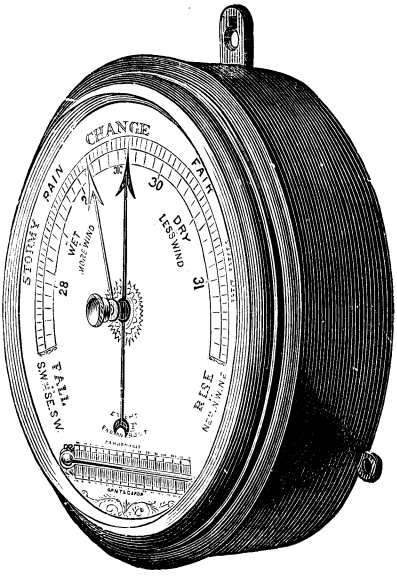

Fig. 18.

The Aneroid Barometer for Marine use is, without doubt, the best that can be devised, not only for its extreme sensitiveness in indicating change of weather, but by reason of its not being affected by the motion and rolling of a vessel at sea; and in all well appointed vessels is now recognised as a necessity for the Mariner.

For use in Yachts, it is made in many compact forms, occupying very little space, which is an important point in vessels of small size.

An important Testimonial of their excellence for Mariners, is given in the very generous action of the Life Boat Institution of Great Britain, whereby they will provide the Master of any Fishing Smack with an Aneroid at half its cost, in order to promote its use, and thereby prevent the loss of life amongst this fine class of Fishermen, in addition to this, they most generously award many prizes of the same kind for bravery, in efforts made by Fishermen to save life, in times of storms and trouble, and it is a notable tribute to their generosity that the same action is taking place in other Countries.

EXPLANATORY DIRECTIONS

BY THE LATE ADMIRAL FITZROY, F.R.S.

For use with Weather Barometers.

THE BAROMETER RISES for Northerly wind (including from North-west, by the *North*, to the Eastward) for dry, or less wet weather,—for less wind,—or for more than one of these changes :—

EXCEPT on a few occasions when rain, hail, or snow comes from the Northward with *strong* wind.

THE BAROMETER FALLS for Southerly wind (including from South-east, by the *South*, to the Westward), for wet weather,—for stronger wind,—or for more than one of these changes :—

EXCEPT on a few occasions when *moderate* wind with rain (or snow) comes from the Northward.

For change of wind towards Northerly directions,—

A THERMOMETER FALLS.

For change of wind towards Southerly directions,—

A THERMOMETER RISES.

Moisture or dampness in the air (shown by a hygrometer) increases BEFORE rain, fog, or dew.

On barometer scales the following contractions may be useful :—

RISE	FALL
FOR	FOR
NORTH	SOUTH
N.W.—N.—E.	S.E.—S.—W.
DRY	WET
OR	OR
LESS	MORE
WIND.	WIND.
——	——
EXCEPT	EXCEPT
WET FROM	WET FROM
NORTH.	NORTH.

And the following summary may be useful generally in any latitude :

RISE	FALL
FOR	FOR
COLD	WARM
DRY	WET
OR	OR
LESS	MORE
WIND.	WIND.
——	——
EXCEPT	EXCEPT
WET FROM	WET FROM
COOLER	COOLER
SIDE.	SIDE.

In SOUTH LATITUDES substitute SOUTH or SOUTHERLY for NORTH OR NORTHERLY.

Add one-tenth of an inch to the observed height for each hundred feet the barometer is above the half-tide level.

The *average* height of the barometer in England, at the sea-level, is about 29.94 inches ; and the *average* temperature of air is nearly 50 degrees (London latitude).

The Thermometer falls about one degree for each three hundred feet of elevation from the ground, but varies with wind.

"When the wind shifts against the sun,
Trust it not for back it will run."

First rise after very low
Indicates a stronger blow.

Long foretold—long last,
Short notice—soon past.

Various Meteorological Instruments.

Having now given a general exposition of the Barometer and its varied forms and uses, attention is directed to the other kinds of instruments which, in addition to the Barometer, are necessary to establish a record of statistics of the most important points in Meteorology, i.e., Temperature, Hygrometry, Rainfall, Wind Pressure, and Sunshine Record, to do which but few simple and inexpensive instruments are required for ordinary purposes. For higher objects, such as investigations of a purely scientific character, and the general duties of a regular observatory, extremely delicate, correct, and consequently expensive instruments, with modern mechanical appliances, are indispensible. These can be obtained from any of the different makers of repute, some of whom have devoted many years of their lives to the practical development and perfection of such instruments by which the greater efficiency is obtained.

TEMPERATURE.

The remarks upon temperature in this pamphlet apply particularly to the atmosphere and to general surroundings by which the conditions of life are regulated, and the Thermometer is the *measure* by which such conditions are ascertained and (if necessary) regulated.

Thermometers are made in great variety of forms and sizes, but for Meteorological pursuits, the forms as shewn in the illustrations here given are those proved to be the best for the purpose. The different graduation of Thermometers are comprised in three scales, i.e., Fahrenheit, Centigrade, and Reaumur. Fahrenheit is generally used in England, her Colonies and America, Reaumur is principally used in the Northern part of Europe, and Centigrade on the Continent of Europe generally, but amongst scientists is now becoming very general in use, and, as it establishes the scale of 0° as the *freezing* point of water to 100° the *boiling* point of water, it would appear to be the best adapted for a world-adopted universal scale, if such an adoption is ever effected.

To convert the reading of one Thermometer Scale into those of another, observe the following rules:

1.—To convert Fahrenheit degrees into those of Centigrade, subtract 32, divide by 9, and multiply by 5.

For example, take the boiling point Fahrenheit, 212°:

$$212 - 32 \div 9 \times 5 = 100.$$

The boiling point Centigrade.

2.—To Convert Fahrenheit degrees into those of Reaumur, subtract 32, divide by 9 and multiply by 4.

3.—To convert Centigrade degrees into those of Fahrenheit, divide by 5, multiply by 9, and add 32.

4.—To convert Reaumur degrees into those of Fahrenheit, divide by 4, multiply by 9, and add 32.

5.—To convert Centigrade degrees into those of Reaumur, divide by 5, and multiply the quotient by 4.

6.—To convert Reaumur degrees into those of Centigrade, divide by 4, and multiply the quotient by 5.

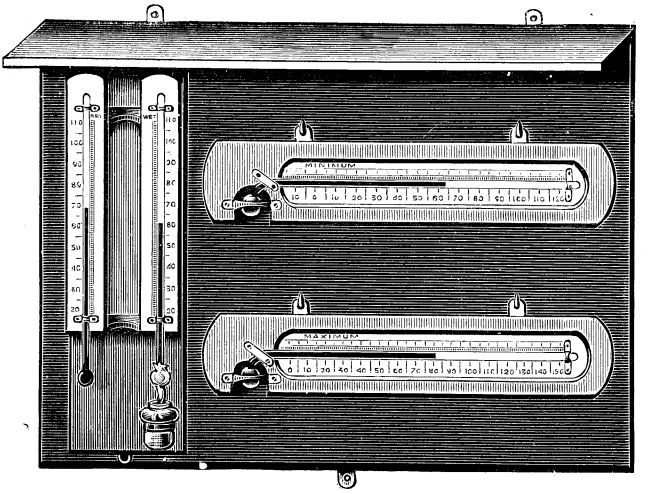

Fig. 19.

Fig. 19 represents a screen or frame, upon which Thermometers can be hung. This should be fixed in a shaded place, where direct rays of the sun cannot affect the instruments.

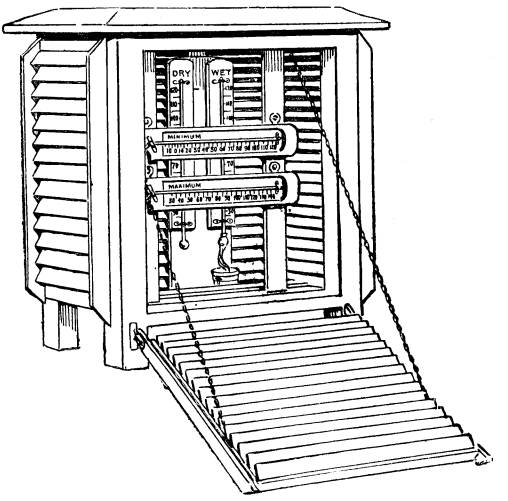

Fig. 20.

Fig. 20 represents a Thermometer Screen, or stand, known as "Stephenson's Screen." This is intended to stand in an open and exposed position, as by its structure the direct rays of the sun do not affect the instruments, and free circulation of the surrounding air is ensured.

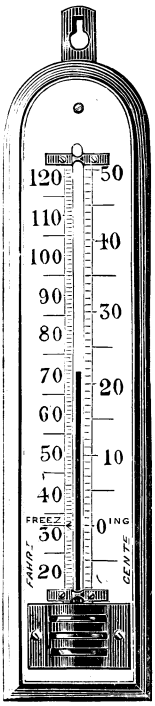

Fig. 21.

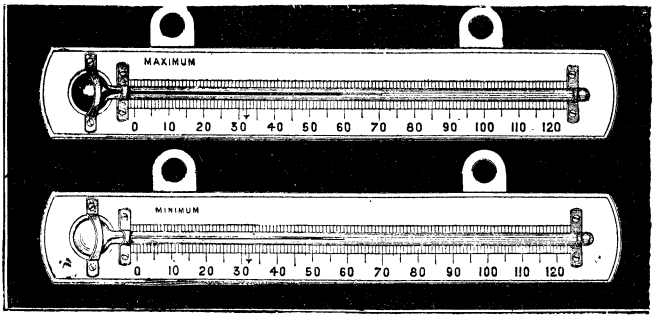

Fig. 22.

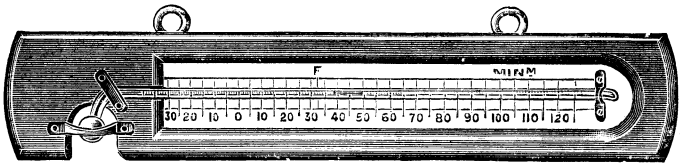

Fig. 23.

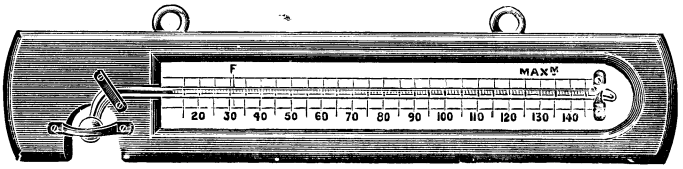

Fig. 24.

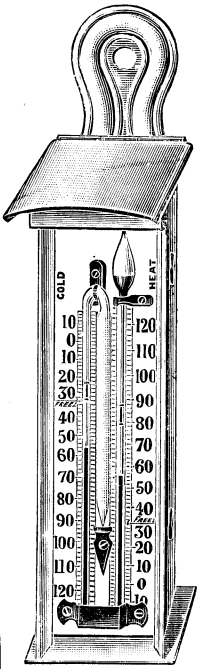

Fig. 25.

Of the illustrations here given, Fig. 21 represents a good form of an ordinary thermometer, having a plain legible scale, and should be graduated with the scales of Fahrenheit and Centigrade, being the two mostly used.

Fig. 22 represents the simple and least expensive form of Maximum and Minimum Self-registering Thermometer. At Fig. 23 and 24 a higher grade of Maximum and Minimum Registering Thermometer is shown. The graduation of single degrees are made upon the stem of the tube, the flat scale showing only the extended points of 5° and 10°, and the figures at each 10°. At Fig. 25 is shewn the Maximum and Minimum Registering Thermometer known as the Six's form. This is an excellent form, the indices within the tube are drawn down by a magnet to each end of the column of mercury, which is acted upon by the expansion or contraction of the spirit contained within the central tube, and causes by expansion the mercury to rise on the right hand side, and by contraction to rise on the left hand side, in either case lifting the index to the highest point attained, where it remains showing the register.

HYGROMETRY

Relates to the amount of moisture contained in the atmosphere, and the Hygrometer is the instrument devised for determining the amount, and ascertaining the relative humidity by comparison of the wet and dry bulbs of the Thermometer.

The form shown at Figs. 26 and 27 is known as Mason's Hygrometer, and commends itself by its simplicity. The construction consists of two Thermometers as nearly alike as possible, and mounted on a scale sufficiently wide apart as not to affect each other. The one marked DRY is exposed to the air, the other marked WET has its bulb surrounded by a piece of muslin, from which a cotton wick descends, passing into the opening of the glass cistern, which should be kept filled with water. The conducting wick conveys the water to the bulb, keeping its surroundings quite wet, and as evaporation causes loss of heat, the wet bulb Thermometer will read lower than the other relatively under the condition of the atmosphere.

When air is very dry, the difference of the readings will be greater; if moist proportionately less.

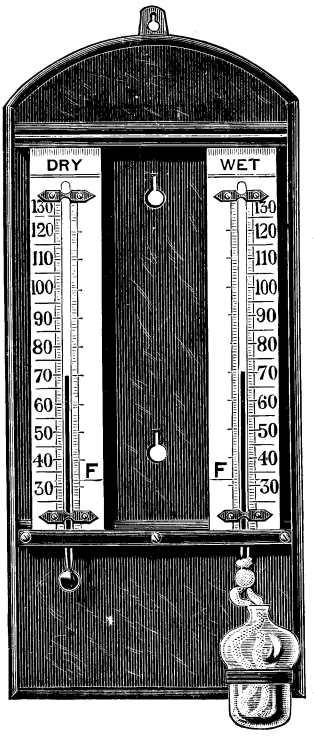

Fig. 26.

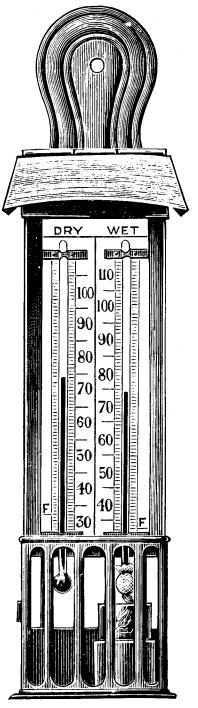

Fig. 27.

Dew is formed by the radiation of heat from the surface of trees, plants, &c., consequently, reducing the temperature of the air near the immediate surface of such objects to the point of complete saturation, causing moisture to be deposited. The Hygrometer, therefore, becomes of the greatest value to the Farmer and Florist, as, in the hands of an intelligent observer the formation of frost can be foretold with certainty, enabling him to take steps to prevent damage to delicate plants exposed to the air.

In the Greenhouse it is most useful, as also in the household, for maintaining a degree of healthful humidity.

RAINFALL.

The capacity of air to retain moisture, or the quantity of moisture, which a given volume of air will hold, increases with temperature until saturation is obtained, hence it follows, that with any reduction of temperature, from whatever cause, precipitation must take place from the inability of the air to sustain the amount of aqueous vapour it has absorbed, the result is the rain which we receive upon the earth, first being formed in small globules and falling to the earth by gravitation, formed into larger drops as one unites with another, their increase of weight causing the more rapid fall and overtaking in their descent other small drops, so that from the greater height of clouds, rain-drops fall larger to the earth.

The average quantity of rain which falls in a year at any given place, depends upon a great variety of circumstances, as, latitude, proximity to the sea, elevation of the region, configuration of the Country, Mountain ranges, exposure to the prevailing wind and in general on the different local causes which influence Climate.

The Average yearly depth of rain-fall for places in Great Britain, deduced from a series of observations, is—

London	24,900	inches
Manchester	36,140	,,
Lancaster	39,714	,,
Liverpool	34,118	,,
Kendal	53,944	,,
York	25,700	,,
Dumfries	36,918	,,
Glasgow	21,331	,,
Edinburgh	25,000	,,

The equivalent in weight of one inch upon the surface, is one-hundred tons to the acre.

To measure the amount of rain-fall, recourse is had to the Rain Gauge, these are made in different forms, as shewn in the illustrations here given, one and all registering by the same principle, but some forms possessing advantages over others.

A Rain Gauge should *not* be set on a roof, a slope or a terrace, but upon a level piece of ground and in a clear space, so that it will not be sheltered by trees, shrubs or buildings, the Gauge should be placed as near level as possible, and fixed in such a way that it would not be overturned by strong wind.

In using the Measuring Glass, it should be held quite level, so that the surface of the water is level and a true reading obtained from the graduation on the glass to which it is in contact.

When very heavy rains occur, it is desirable to measure at once on their termination, and return the water to the Gauge, unless there is a doubt as to the Gauge holding all there may fall before the hour of the day at which the amount is measured—in that case, the quantity of water measured from the Gauge should be written down, and that amount added to the subsequent measurement.

The amount of rain measured, should always be written down before the water is thrown away.

Snow. The best way to measure the rain-fall by the depth of snow, is to select a place where the snow has not drifted, invert the Funnel of the Gauge, press it down through the snow to the surface of the ground, give the Funnel a turn and it will lift up the snow within its circumference, this should then be melted into the Gauge and measured. Some Gauges (as in Fig. 30) are fitted with a snow receptacle, when this is provided, the foregoing directions do not apply.

ILLUSTRATIONS OF RAIN GAUGES.

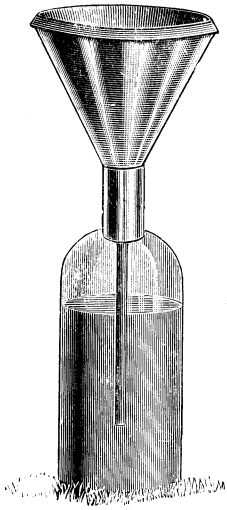

Fig. 28.

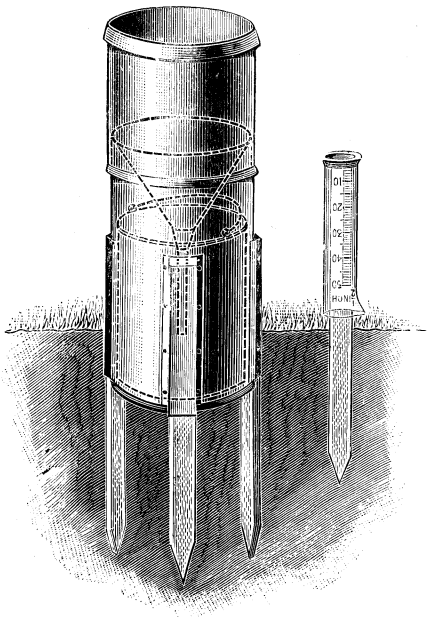

Fig. 30.

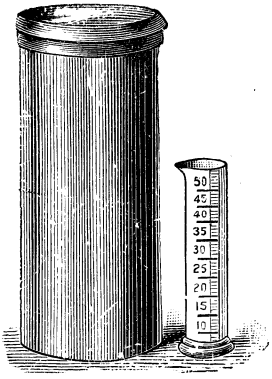

Fig. 29.

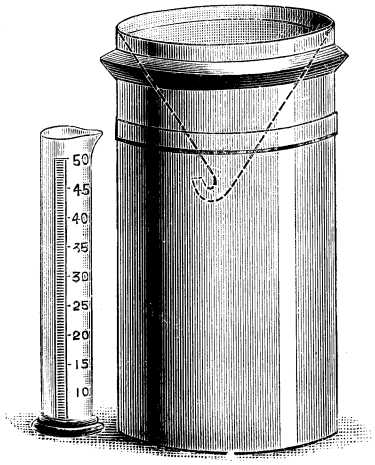

Fig. 31.

Description

of

Rain-Gauges.

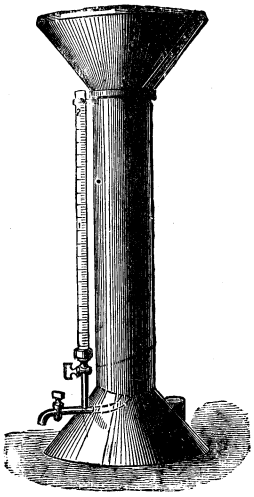

Fig. 32.

Fig. 28.—The "Howard" Gauge, 5 inches diameter.

Fig. 29.—The "British Association" Gauge, 5 inches diameter.

Fig. 30.—The "BA." Gauge, with snow receiver, 5 inches diameter.

Fig. 31.—The "Glaisher" Gauge, 5 and 8 inches diameter.

Fig. 32.—The Pedestal Gauge, with graduated tube attached, to shew amount of rain-fall at a glance.

Registering and Recording Rain-Gauges.

These rain-gauges are more expensive than those enumerated on the preceeding pages, but, with the advantages they offer, are greatly to be desired, as no measurement is required. The rain falls upon the surface of the collecting funnel and passes down through a small pipe, falling into a balanced bucket known as "Tilting Bucket." When a given amount has fallen, the balance tilts over on the laden side, discharging the rain into a receiver. The continuing rain then passes into the opposite side of the bucket, which again tilts when the same quantity has passed into it, and this action is continued while the rain is falling.

The motion of the bucket is made to operate a mechanical arrangement by which the Indicating Hand upon the Dial registers the correct amount. The action is perfectly automatic, the rain passing through the gauge is directed to a discharge pipe which can be conveyed in any direction.

Fig. 33 illustrates the Registering gauge, the outer circle of the dial registering one inch of rain-fall for the entire circle, subdivided into $\frac{1}{100}$ of an inch, the second dial counting onward to any number of inches.

Fig. 34 illustrates the Recording gauge. This instrument is constructed upon the same principle as Fig. 33, but in addition has the recording chart fixed upon a cylinder with clockwork mechanism and recording pen as described for the Barograph. The chart is constructed to show one inch of rain for its entire depths ; the recording pen commences its mark at the top of the chart, and moves downwards as the rain falls. When the pen reaches the mark of the one inch it is automatically released and rises at once to the top line of the chart, this being subdivided into $\frac{1}{100}$ parts, the exact amount of rain and the exact time it occurred is recorded.

An advantage also which applies to either of these gauges is that the collecting funnel can be placed at a distance from the gauge, and connected to it by a small pipe, the instrument being placed within a house or shelter.

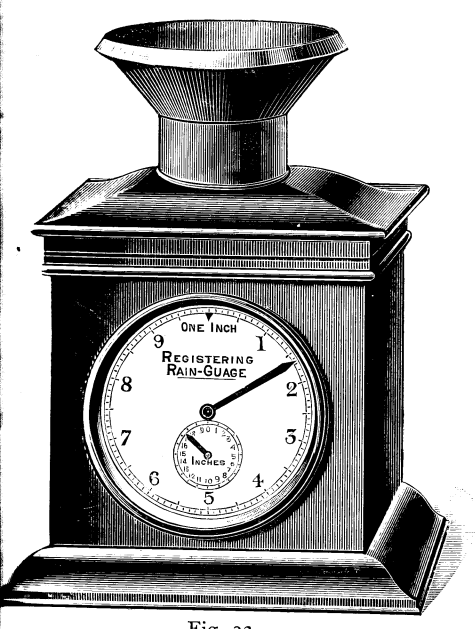

Fig. 33.

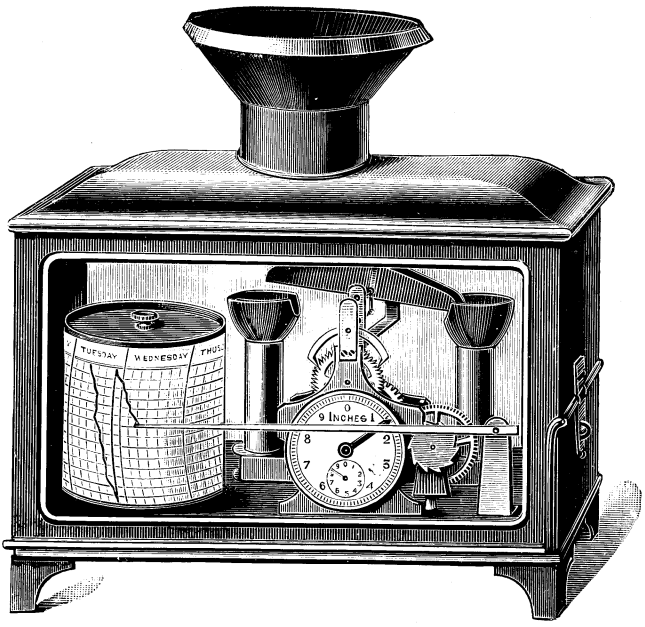

Fig. 34.

WIND PRESSURE.—Anemometry.

Many forms of wind-gauges have been invented and tried. The Anemometer of "Lind," one of the earliest form, consists of a glass syphon tube, one end bent outwards at right angles to the syphon, the tube being filled up half-way with water, a graduated scale being fixed between the tubes of the syphon, with the zero point set at the level of the water, the whole of it supported on a vane and rotating on pivots. The open end of the bent tube is by the vane brought round to face the wind. The pressure is then shown upon the water column, which falls on one side of the syphon and rises on the other side, the quantity being shown on the graduated scale.

The principle of a suspended pressure plate has also been used, but the more recent and as yet the most perfect form is that of Dr. Robinson, of Armagh, who introduced the principle of four hollow hemispherical cups fixed horizontally to arms attached to a vertical spindle. By this arrangement the velocity of the wind is ascertained, and the force, according to the velocity, is given in the tables of pressure following.

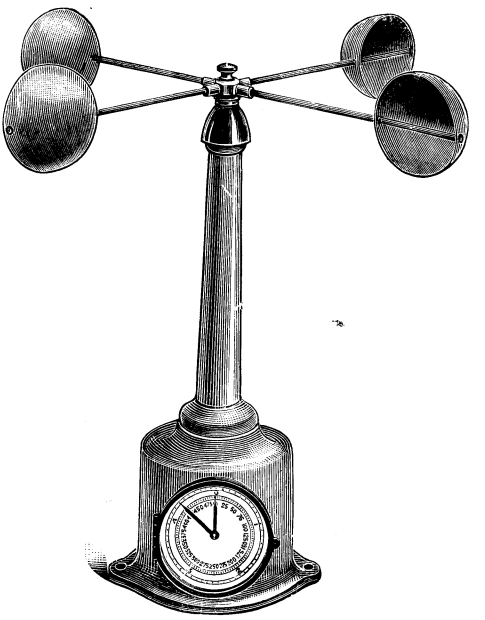

Fig. 35.

The most improved form of Robinson Anemometer is here shown by Fig. 35, one improvement being the facility for setting the hands on the dial to the Zero point before the commencement of any observations so that the result in a given time can be read off the dial at once.

TABLE, showing the number of Miles per Hour, and pressure in Pounds per Square foot, at velocities per Minute.

Feet per minute	Miles per hour	Pressure in lbs. per square foot	Feet per minute	Miles per hour	Pressure in lbs. per square foot	Feet per minute	Miles per hour	Pressure in lbs. per square foot
20	·227	·0002	500	5·681	·1596	4,500	51·131	12·9375
30	·340	·0006	600	6·818	·2300	5,000	56·818	15·9709
40	·454	·0010	700	7·954	·3125	5,500	62·499	19·2982
50	·568	·0016	800	9·090	·4087	6,000	68·181	22·9954
60	·681	·0023	900	10·227	·5175	6,500	73·861	26·9764
70	·795	·0031	1,000	11·363	·6384	7,000	79·545	31·3020
80	·909	·0041	1,500	17·405	1·4375	7,500	85·225	35·9375
90	1·022	·0051	2,000	22·727	2·5553	8,000	90·909	40·8868
100	1·136	·0063	2,500	28·407	3·9918	8,500	96·589	46·1554
150	1·704	·0143	3,000	34·090	5·7500	9,000	102·272	51·7500
200	2·272	·0255	3,500	39·772	7·8255	9,500	107·952	57·7447
300	3·409	·0575	4,000	45·454	10·2202	10,000	113·636	63 8837
400	4·545	·1021						

SUNSHINE RECORDER.

Fig. 36.

This instrument was originally designed in a rough form by J. P. CAMPBELL, Esq., of Kensington, in 1853; the present form of zodiacal belt being the introduction of PROFESSOR STOKES, of Cambridge. This belt is divided into three zones of equal width, by two planes, parallel to, and equidistant from, the plane of the Equator. Each of these zones is constructed to receive a strip of flat card, which, following the curve, may without appreciable error be taken to represent the respective zone of spherical surface. The middle zone receiving a straight card serves for about a month at each Equinox. The upper and lower zones answer the same purpose for summer and winter months respectively. When the cards are properly placed within the the grooves, their surfaces are always well within the burning power of the sphere. The cards are divided into half-hour spaces, and figured every three hours, and when set to accord with the noon-mark on the belt constitute the instrument an accurate sun-dial.

The recorder should be fixed in the true North direction, with its Polar axis adjusted to the latitude of the place.

The following

Extracts from Weather Book by Admiral Fitzroy,

will be useful to guide in a Forecast of Weather.

"It should always be remembered that the state of the air foretells coming weather, rather than indicates weather that is present (an invaluable fact too often overlooked)—that, the longer the time between the signs and the change foretold by them, the longer such altered weather will last; and, on the contrary, the less the time between a warning and a change, the shorter will be the continuance of such predicted weather.

To know the state of the atmosphere, not only barometers and thermometers should be watched, but appearances of the sky should be vigilantly noticed, invariably.

If a barometer has been about its ordinary height (say near thirty inches at the sea level), and is steady, or rising—while the thermometer falls, and dampness becomes less, north-westerly, northerly, or north-easterly wind, or less wind, less rain or snow may be expected.

On the contrary, if a fall takes place, with a rising thermometer and increased dampness, wind and rain may be expected from the south-eastward, southward or south-westward.

In winter a considerable fall with rather low thermometer (from 30° to 40°) foretells snow.

Exceptions to these rules occur when northerly winds with wet (rain, hail, or snow) are impending, before which the barometer often rises (on account of the direction of the coming wind alone), and deceives persons who, from that sign only (the rising), expect fair weather immediately.

When the barometer is rather below its ordinary height (say down to near twenty-nine inches and a half at the sea level), a rise may foretell less wind, or a change in its direction, toward the northward, or less wet; but when it has been very low, say about twenty-nine inches, the first rising usually precedes or indicates strong wind, at times heavy squalls, from the north-westward, northward, or north-eastward, after which violence a gradually rising glass foretells improving weather, if the thermometer falls. But if warmth continue, probably the wind will back (shift against the sun), and more Southerly or South-westerly wind will follow; especially if the barometer rise has been sudden and considerable, or if it is unsteady.

The most dangerous shifts of wind, or the heaviest northerly gales, happen soon after the barometer first rises from a very low point; or, if the wind veers gradually, at some short time afterwards, although with a rising glass.

Indications of approaching change of weather, and the direction and force of winds, are shown much less by the height of the barometer than by its falling or rising, yet, a height of more than thirty (30.0) inches (at the level of the sea), if the rise has been gradual and not a sudden "jump," is indicative of fine weather and moderate winds; except from east to north, occasionally whence it may blow strongly, even with a high glass for a time. At the beginning of a south-west gale, the barometer is sometimes high, but it falls as the wind increases.

A rapid rise of the barometer indicates unsettled weather; a slow movement of some duration, the contrary; as does likewise a steady barometer, which, when continued, and with dryness, foretell very fine weather, lasting for some time.

A rapid and considerable fall is a sign of very stormy weather and rain (or snow). Alternate rising and sinking or oscilliation, accompanied by changes of temperature, always indicate unsettled and disagreeable weather.

The greatest depressions of the barometers are with gales from S.E., S., or S.W., ; the greatest elevations with wind from N.W., N., or N.E., or with calm.

Though the barometer generally falls for southerly, and rises for a northerly wind, the contrary sometimes occurs, in which case the southerly wind is usually dry with fine weather, or the northerly wind is violent, and accompanied by rain, snow, or hail; sometimes with lightning, which is always a bad sign.

When the barometer sinks considerably, much wind, rain (perhaps with hail), or snow, will follow, with or without lightning. The wind will be from the northward if the thermometer is high.

Occasionally a low glass is followed or attended by lightning only; while a storm is beyond the horizon.

A sudden fall of the barometer, with a westerly wind, is occasionally followed by a violent storm from N.W. or N. to N.E., indicated also by the thermometer.

If a gale sets in from the eastward, and the wind veers by the S., the barometer will continue falling until a marked change is near, when a lull may occur; after which the gale will soon be renewed, perhaps suddenly and violently, and the veering of the wind towards the N.W., N. or N.E. will be indicated by a rising of the barometer with a fall of temperature.

Another remarkable peculiarity is—that the wind usually appears to veer, shift, or go round with the sun (right-handed or from left to right), and that when it does not do so, or backs, more wind or bad weather may be expected, instead of improvement, after a short interval.

A few more marked signs of weather useful alike to seamen, farmers, and gardeners, are the following:—

Whether clear or cloudy, a rosy sky at sunset presages fine weather; a sickly-looking greenish hue, wind and rain; a dark or (or Indian) red, rain; a red sky in the morning, bad weather or much wind (perhaps rain); a grey sky in the morning, fine weather; a high dawn, wind; a low dawn, fair weather.

Soft-looking or delicate clouds foretell fine weather, with moderate or light breezes; hard-edged oily-looking clouds, wind; a dark gloomy blue sky indicates fine weather. Generally the softer clouds look, the less wind (but perhaps more rain) may be expected, and the harder, more "greasy" rolled, tufted, or ragged, the stronger the coming wind prove. Also a bright yellow sky at sunset presages wind, a pale yellow, wet; therefore by the prevalence and kind of red, yellow, or other tints, the coming weather may be foretold very nearly; indeed, if aided by instruments, almost exactly.

Small inky-looking clouds foretell rain; light scud clouds driving across heavy masses show rain and wind; but if alone, may indicate wind only.

High upper clouds crossing the sun, moon, or stars, in a direction different from that of the lower clouds, or the wind then felt below, foretell a change of wind towards their direction.

After fine clear weather, the first signs in the sky of a coming change, are usually light streaks, curls, wisps, or mottled patches of white distant clouds, which increase, and are followed by an overcasting of murky vapour that grows into cloudiness. This appearance, more or less oily or watery, as wind or rain will prevail, is an infallible sign.

Usually, the higher and more distant such clouds seem to be the more gradual, but general, the coming change of the weather will prove.

Light delicate, quiet tints or colours, with soft undefined forms of clouds, indicate and accompany fine weather; but unusual or gaudy hues, with hard definitely outlined clouds, foretell rain, and probably strong wind.

Misty clouds forming, or hanging on heights, show wind and rain coming, if they remain, increase, or descend. If they rise, or disperse, the weather will improve or become fine.

When the sea birds fly out early and far to seaward, moderate wind and fair weather may be expected. When they hang about the land or over it, sometimes flying inland, expect a strong wind with stormy weather. As many creatures besides birds are affected by the approach of rain or wind, such indications should not be slighted by an observer who wishes to foresee weather, or compare its variation.

There are other signs of a coming change in the weather known less generally than may be desirable, and therefore worth notice; such as, when birds of long flight—rooks, swallows or others, hang about home, and fly up and down, or low, rain or wind may be expected. Also when animals seek sheltered places, instead of spreading over their usual range—when pigs carry straw to their sties, when smoke from the chimneys does not ascend readily during calm, an unfavourable change is probable.

Dew is an indication of fine weather, so is fog.

Neither of these two formations occurs under an overcast sky, or when there is much wind. One sees fog occasionally rolled away as it were, by wind, but seldom or never formed while it is blowing.

Remarkable clearness of atmosphere near the horizon—distant objects such as hills, unusually visible, or raised (by refraction), and what is called a good hearing day, may be mentioned among signs of wet, if not wind, to be expected.

More than usual twinkling of the stars, indistinctness or apparent multiplication of the moon's horns; haloes, wind-dogs, and the rainbow, are more or less significant of increasing wind, if not approaching rain, with or without wind.

CLOUDS.

Clouds were divided by "Howard" into four classes called: CIRRUS, STRATUS, NIMBUS, and CUMULUS.

CIRRUS is the first cloud that forms in the sky after fine clear weather. It is very light and delicate in its appearance, and generally curling or waving, like feathers, hair, or horses' tails (commonly called 'mares' tails'). It may also be called the "Curl Cloud."

STRATUS is the shapeless smoke-like cloud that is most common, and of all sizes: sometimes it is small and at a distance, like spots of inky or dirty water; its edges appearing faint or ill-defined; sometimes it overspreads and hides the sky. Rain does not fall from it. Its exact resemblance cannot be traced upon paper, because the edges are so ill-defined.

NIMBUS is the heavy-looking, soft, shapeless cloud, from which rain is falling. Whatever shape a cloud may have retained previous to rain falling from it, at the moment of its change, from vapour to water, it softens in appearance, and becomes the Nimbus or Rain Cloud.

CUMULUS is the hard-edged cloud with well-defined edges, whose resemblance can be accurately traced on paper. This cloud is not, generally speaking, so large as the Stratus or Nimbus.

These four classifications will not, however, suffice to describe exactly the appearance of the clouds at all times. More minute distinctions are required, for which the following may be used:—

CIRRO-STRATUS, signifying a mixture of Cirrus and Stratus.
CIRRO-CUMULUS, Cirrus and Cumulus.
CUMULUS-STRATUS, a mixture of Cumulus and Stratus.

Which terms may be rendered more explanatory of the precise kind of cloud by using the augmentative termination *onus* or the diminutive, *itus*. Thus: Cirronus, Cirrito; Cirrono-stratus, Cirrito-stratus; Cirrono-cumulus, Cirrito-cumulus; Stratonus, Stratitus; Cumulonus, Cumulitus; Cumulono-stratus, Cumulito-stratus; which are sufficient to convey distinct ideas of every variety of clouds.

MONTHLY RECORDS.

A Convenient Record Calendar can be obtained, for keeping complete registers. A copy is shown herewith.

METEOROLOGICAL REGISTER.

KEPT AT _____ MONTH _____ 190

BAROMETER CHART.

DAYS OF THE MONTH.

In.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	*In.*
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DATE	DIRECTION OF WIND.	RAIN FALL	THERMOMETER. MAX.	MIN.	WET.	DRY.
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DATE	DIRECTION OF WIND.	RAIN FALL	THERMOMETER. MAX.	MIN.	WET.	DRY.
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