

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Ballate, County of Shetland, in Lat. 59° 12' N., Long. 2° 12' W., Distance from Sea 43 miles.Height of Cistern of the Barometer above Mean Sea-level 1660 feet, above Ground 4 feet.During the MONTH of January 1871.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER. No. —				WIND.				RAIN.		CLOUDS.				SUNSHINE. Hours.	THERMOMETERS under Ground.			SEA. Temperature of surface, and Depth.	OZONE. 0—10.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.	Days of Month.				
		9 h. A.M.		9 h. P.M.		Protected in Shade, 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		No. of hours in which it fell.	Amount in inches.	9 A.M.		P.M.			9 h. A.M.										
		Barometer.	Attached Thermometer.	Barometer.	Attached Thermometer.	Max. No.	Min. No.	Max. No.	Min. No.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.			Readings of the H. Cup Anemometer. No. —	Velocity (0—10), and Direction.	Amount (0—10), and Species.	Velocity (0—10), and Direction.		Amount (0—10), and Species.	No. 8 inches.	No. 12 inches.					No. 22 inches.			
		* No.	inches.	°	inches.	°	°	°	°	°	°	°	°	°	°	°	°			°	°	°	°		°	°	°					°	°	°	°
	1	28.90034	28.90036	35	26.5					30	35			N	6	N	4			35	var.	5 W	10 east								A.M. very cold stormy	1			
	2	29.000363	29.00036	34.5	26					31	34										8 east											cloudy & quiet fresher	2		
	3	29.10034	29.150365	38	12.5						35											4 W	5 east									clear frosty blowing hard	3		
	4	29.10037	29.00039	40	30					36	34	38.5	37.5	N	4		2				5 W	5 east										soft chilly clear fine	4		
	5	28.70040	29.05040	40.5	29					38.5	36	35.5	33		1		0.5				2											over frosty	5		
	6	28.850395	28.600425	46	32					37.5	36.5	39	38		5	S.W.	2				6	10	25 W	10								blowing a gale off sea	6		
	7	28.45040	28.50041	40	31					37	35	33	32.5	N.E.	2	N	0.5				3	10	25 W	10								fresh fall from cold storm	7		
	8	28.650395	28.65041	33	21.5					33.5	32			S.W.	2						3.5 W											cloudy unrolled frosty	8		
	9	28.60038	28.80040	35	20					29	35	33.5		N	1	N	2				2	10	25 W	10								stormy looking frosty	9		
	10	28.800375	28.800385	37	21					29.5	34	33		N.W.	0.5	N.W.	2				2	10	25 W	10								very cold snowing	10		
	11	29.050395	29.25040	37	27.5					30.5	29	30	29		2	N.E.	1				30	3	10	25 W	10								stormy frosty quiet	11	
	12	29.350375	29.20039	34.5	24					30	34.5	33		S.W.	2	E	0.5				3.5 W	5											cloudy not bright sunshine	12	
	13	29.01440	28.90043	45.5	34					41.5	39	45.5	43	N	0.5	S.W.	4				2	10	25 W	10									do fresh cont. frost	13	
	14	28.65044	28.55044	45	39.5					43	42	43	40	S.W.	4	N	3				0.5	5 W	10	4	10								discovery very cold	14	
	15	28.30044	28.22443	44.5	35					41	39.5	36.5	34		3		2				7.5	var.	5	10									squally raining cloudy	15	
	16	27.70042	27.70041	39	33.5					38	36.5	37	34.5	S.E.	4	S.W.	3				0.4	5.5	10	25 W	10								very cold damp blizzard	16	
	17	27.750423	27.95041	39	33.5					38	35	38	36	S.W.	5	N	0.5				6	10	25 W	10									very cold wind cloudy & quiet	17	
	18	28.200385	28.100415	39.5	25.5					28.5	27.5	31.5	30	N	1																		clear frosty cont. frost	18	
	19	28.55039	28.70041	35.5	24					26	25.5	34.5	34	S.W.	2	N.W.	0.5				3.5	10	25 W	10									bright sunshine snowing	19	
	20	28.950375	29.00037	35.5	16.5									N.W.	2		0																clear frosty cont. d	20	
	21	28.900345	28.85038	33	15.5						33	32		1	N	0.5																		very cold fresh looking	21
	22	28.900375	29.050375	33	31							32.5	31.5	S.E.	0.5						2.5	10	25 W	10									very frosty snowing	22	
	23	29.20038	29.40038	35.5	17.5					32	32			N	0.5																			heavy fall from clear frosty	23
	24	29.35034	29.55036	27	4.5									1	N	2					2	10	25 W	10										very cold blizzard over sea cold	24
	25	29.400345	29.35034	31.5	10									0.5							2	5												very frosty stormy looking clear frosty	25
	26	29.300325	29.40034	30	9.5									N.W.	2	S.W.	1				2.5	3	10	25 W	10								very cold bright sunshine soft looking	26	
	27	29.45032	29.50035	31	12.5					30.5		30		S.W.	2		3				3.5	10	4	10										chilly cold wind hazy	27
	28	29.50034	29.42036	31	23					31		31		0.5			3				2	5	10	4	10									very frosty stormy morning	28
	29	29.450355	29.550365	34	29					32		33	32	E	1	S	2				2.5	5	10	25 W	10									cloudy quiet very cold soft looking	29
	30	29.60036	29.50038	35	30					34	33	32	31	S	0.5	S.E.	1				2.5	10	25 W	10										over chilly fresh	30
	31	29.45037	29.45039	35.5	30.5					34.5	33.5	34.5	34	var.		2																		very cold stormy var. chilly	31
Sums.		896.364	167.897	89.7394	1133.7585					945.660	104.75			58.5		46.0				174															
Means.		28.915376	28.915388	36.5245						33.7341	36.5381					1.48																			
† Total Corrections for Instrumental Errors.										+2	+2																								
‡ Corrections for Diurnal Range.																																			
“Corrected Means.”																																			
No. of Column.		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				

NOTATION USED IN GENERAL REMARKS.					
a.	denotes aurora.	m.	denotes meteor.		
ci.	„ cirrus.	ms.	„ meteors.		
ci-cu.	„ cirro-cumulus.	n.	„ nimbus.		
ci-s.	„ cirro-stratus.	r.	„ rain.		
cu.	„ cumulus.	h. r.	„ heavy rain.		
cu-s.	„ cumulo-stratus.	c. h. r.	„ continued heavy rain.		
d.	„ dew.	s.	„ stratus.		
f.	„ fog.	sc.	„ scud.		
fr.	„ frost.	sl.	„ sleet.		
h. fr.	„ hoar-frost.	sn.	„ snow.		
h.	„ haze.	so. h.	„ solar halo.		
h. d.	„ heavy dew.	sq.	„ squall.		
hl.	„ hail.	sq.	„ squalls.		
l.	„ lightning.	t.	„ thunder.		
li. cl.	„ light clouds.	t. s.	„ thunder storm.		
li. sh.	„ light showers.	w.	„ wind.		
li. co.	„ lunar corona.	g.	„ gale of wind.		
li. ha.	„ lunar halo.				

TABLE FOR ESTIMATING FORCE OF WIND.					
Estimated Force, 0—6.	Common Designation.	Estimated Force 0—6.	Common Designation.	Estimated Force, 0—6.	Common Designation.
0	Calm	1.5	Light breeze	4	Blowing hard
0.5	Very light air	2	Light breeze	5	Blowing fast
1	Light air	3	Very fresh	6	Violent gale

BAROMETER, “corrected Mean” at 9 A.M., minus the Correction †† for Temp. (Col. 2), = 28.915 — 0.0245 = 28.891

“Corrected Mean” of Barometer at 9 P.M., minus the Correction †† for Temp. (Col. 4), = 28.946 — 0.027 = 28.921

Mean at Station, corrected, and at 32°, = 28.906

Correction for height, feet above Mean Sea-level, = 738

Mean, reduced to 32°, and Sea-level, = 29.644

Highest Reading, corrected for Index error, on the 30th, 24., = 29.600

Lowest Do. Do. on the 16th, = 27.700

Difference, or Monthly Range, = 1.900

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 6th, = 46.0

Lowest in Month, corrected for Index errors, on the 26th, = 2.5

Difference, or Monthly Range, = 36.5

“Corrected Mean” of all the Highest, (Col. 5), = 36.5

“Corrected Mean” of all the Lowest, (Col. 6), = 24.5

Difference, or Mean Daily Range, = 12.0

Calculated Mean Temperature of Month, = 30.5

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the th, =

“Corrected Mean,” (Col. 7), of Black Bulb, Max. in Sun, =

Lowest at Night, Black Bulb, (corrected for Index errors), on the th, =

“Corrected Mean,” (Col. 8), of Black Bulb, Min. on grass, =

Difference of above Means or Range (“exposed”), =

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), =

Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), =

†† Computed Temperature of Dew-Point, =

†† Do. Elastic Force of Vapour, =

†† Do. Weight of Vapour in a Cubic Foot of Air, =

†† Relative Humidity, (Saturation = 100), =

RAIN fell on 8 Days; Amount in Inches, 4.48 = 1

WIND.												SUMMARY.	
Direction.	N	NE	E	SE	S	SW	W	NW	Calm or Variable.	Mean Force.	Mean Velocity in miles per day.		
A.M.		1	1	2	1	8	10	5	3				
P.M.		1	1	2	1	7	13	1	5		1.48		
Mean.		1	1	2	1	7	12	3	5		1.48		

N.B.—The Sums to be correctly added and the Means deduced. Returns from the “Principal Towns” should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

James W. Paterson
Ballate

(Signed)

James W. Paterson

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATION, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by *scrupulous attention* to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains they are involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some and once (morning or evening) for other instruments, as specified in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *Aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations, that is not supplied with such means of *adjustment or compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer's constructed by Mr. Aile of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-tubes* are not true tubes, but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the *index-line* on this little piston-rod is brought by the adjusting screw, to *form one straight line* with those of the ivory from the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary setting* must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *vernier*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg, must be screwed so as to form a tight plug to the cistern. Then *score up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern upmost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slanting top* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by fighting the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *light*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted; the observer must then be gently tapped and the cistern-adjustment carefully made. By rising and lowering the eye, it must be brought into the plane of the back and front of the index,—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from any local influences. The laths forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians.

Self-registering Thermometers.—Professor Phillips, and Negretti and Zambra's Patent "*Maximum*" Thermometers are recommended: printed directions for their use may be obtained with each instrument. The "*Minimum*" Thermometer of Rutherford is recommended when graduated on the glass stem and affixed to a frame separate from the "*Maximum*." This Thermometer is liable to two derangements, both of which must be granted against, and may be easily remedied by an observer. When the *columns* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense: in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "*Maximum*" should be freely exposed to the sun, and the "*Minimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are *not* graduated on the stem, but merely on an attached scale, (under repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*.) The self-registering wants to be used, without being *re-tested*. The self-registering and especially the "*Minimum*" Thermometers ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Society.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus specially vitiate the "Hygrometrical Deductions," Observers are requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered and placed to the side, and a little below the level of the wet bulb;—in no case under the bulbs—the mesh must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the mesh is always *clean* and *moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed, evaporation will proceed as from the moist cloth in ordinary circumstances. One form of "Hygrometer" is enclosed in a tin case, which also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the recommended requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or *column* of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—89.9, 40.0, or 40.1; or again, 40.4, 40.5, or 40.6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40½°, and 40¾°, more or less must be registered 40.2, or 40.3, and 40.7, or 40.8 respectively. In reading Rutherford's "*Max*," and "*Min*," Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observing Temperature.—The Hygrometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes vary even at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the *lid* are those of a series of phenomena commencing at 9 P.M. on the 24th, and extending till 9 P.M. on the 25th.

Wind.—A wind-gauge ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, &c.

Careful observations ought to be made on the changes in the direction of the wind; and during storms it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Rain-gauges.—Many causes conspire to produce anomalies in rain return, and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexpected position for the rain-gauge, but in all cases the gauge must be sunk in the ground till its glass is on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may, for convenience, be registered in the rain columns, under the following condition:—When a Snow shower occurs it must be noted in the "Remarks," and the latter S affected to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations only*; and nothing that partakes of the nature of deduction or inference.

Clouds—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (6, 6½, within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearances and changes ought to be noted among the "*Remarks*." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity 6, S. W." (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S. W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "Cloud" column, an entry of 4, ² ₄ (*eq*) will indicate that the higher regions are covered to the "amount" of 4-tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

Underground Thermometers.—As the temperature and health of crops and plants greatly depend on the temperature of the soil,—its amount and constancy,—the Council recommend that observations in this interesting department be made at 9 A.M. by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent from water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for other and greater depths, noting at various times the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of wells ought, when noted.

Geone.—Mention whether Schuchbein's or Moffat's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the winds, the time of observation, in the following manner:—Thus 6° 5', as an *even* entry in the schedule, will indicate that the ozone paper is turned 6° 5' on the scale, 0—6 is "4° + 4°," that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "*Remarks*" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned.

The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column. Besides special and extraordinary observations great prominence ought to be given in this column to prevalent diseases, differences in characters colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, &c. Remarks on remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of setting of wind attaining their maximum, as well as such notes on storms as have been hinted at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, or, if space be unoccupied, or in two ruled off for the purpose, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner or on the side-marginal. Additional remarks may be made on the margin.

"Observations in connection with the periodic return of the seasons" possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the printers.

The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

EDINBURGH, 19th November 1869.

(By Order) A. B.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings,

Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

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Ballantyne
Jan. 1871.

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Pallat, County of Aberdeen, in Lat. 57° 22' N. Long. 2° 12' W. Distance from Sea 43 miles.Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 4 feet.During the MONTH of February 1871.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER. No.				WIND.				RAIN.		CLOUDS.				THERMOMETERS under Ground.			SEA.	OZONE.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.	Days of Month.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		9 h. A.M.		9 h. P.M.		Protected in Shade, 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		No. of hours in which it fell.	Amount in inches.	9 A.M.		P.M.		9 h. A.M.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
		Barometer.	Attached Thermometer.	Barometer.	Attached Thermometer.	Max. No.	Min. No.	Max. in Sun-rays.	Min. on Grass.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.			Velocity (0-10), and Direction.	Amount (0-10), and Species.	Velocity (0-10), and Direction.	Amount (0-10), and Species.	No. 1.	No. 2.	No. 22 inches.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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BAROMETER, "corrected Mean" at 9 A.M., minus the Correction ++ for Temp. (Col. 2), = 29.998
"Corrected Mean" of Barometer at 9 P.M., minus the Correction ++ for Temp. (Col. 4), = 29.989
Mean at Station, corrected, and at 32°, = 28.994
Correction for height, feet above Mean Sea-level, = 724
Mean, reduced to 32°, and Sea-level, = 29.718
Highest Reading, corrected for Index error, on the 28th, = 29.600
Lowest Do. Do., on the 1st, = 28.500
Difference, or Monthly Range, = 1.100

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 1st, = 53.5
Lowest in Month, corrected for Index errors, on the 28th, = 26.0
Difference, or Monthly Range, = 27.5
"Corrected Mean" of all the Highest, (Col. 5), = 44.6
"Corrected Mean" of all the Lowest, (Col. 6), = 34.3
Difference, or Mean Daily Range, = 10.3
** Calculated Mean Temperature of Month, = 39.5

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the 1st, = 53.5
"Corrected Mean," (Col. 7), of Black Bulb, Max. in Sun, = 44.6
Lowest at Night, Black Bulb, (corrected for Index errors), on the 28th, = 26.0
"Corrected Mean," (Col. 8), of Black Bulb, Min. on grass, = 34.3
Difference of above Means or Range ("exposed"), = 10.3

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 40.3
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 39.0
Computed Temperature of Dew-Point, = 37.3
Do. Elastic Force of Vapour, = 2.23
Do. Weight of Vapour in a Cubic Foot of Air, = 80
Relative Humidity, (Saturation = 100), = 2.30

WIND.												SUMMARY.		
Direction.	N	NE	E	SE	S	SW	W	NW	Calm or Variable.	Mean Force.	Mean Velocity in miles per day.			
A.M.	1	1	4			6	5	8	2	1.9				
P.M.	1	1	2			3	13	2	1	1.6				
Mean.	1	1	3			10	5	9	5	1.75				

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N.B.—The Sums to be correctly added and the Means deduced. Returns from the "Principal Towns" should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and Return verified by

James M. Paterson
Coallata

(Signed)

J. M. Paterson

125
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INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified, in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to make opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Woolen glasses and aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. No can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment* or *compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council, if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-bulbs* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of peltide, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When *stem* passes freely through the lid and case of the cistern, the *index-line* on this little piston-rod is brought, by the adjusting screw, to *form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary* setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *vernier*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *seize up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slump top* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *shade*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first model: the tube must then be gently tapped and the observation adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index;—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from merely local influences. The laths forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians, Negretti and Zambra's Patent "Meteorological" Thermometers are recommended: printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Rutherford is recommended when graduated on the glass stem and affixed to a frame separate from the "Maximum." This Thermometer is liable to two drawbacks, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be discoloured from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or melted, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "Maximum" should be freely exposed to the sun, and the "Minimum" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used without being *re-tested*. The self-registering, and especially the "Maximum" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year in snow melting ice, for comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Society.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus seriously vitiate the "Hygrometrical Deductions," Observers are specially requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulb;—the muslin must be of medium fineness and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the muslin is always *clean and moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

One form of "Maxim's" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water-cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the recommended requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index, or *column* of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—58.3, 40.0, or 40.1; or again, 40.4, 40.5, or 40.6, according as it indicates a little under, an exact coincidence with, or a little over .40°, or .40°, respectively. So also .44°, and .40°, or .40.8, more or less must be registered 40.2, 40.3, and 40.7, or 40.8 respectively. In reading Rutherford's "Max" and "Min." Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observing Temperature.—The Hygrometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 2d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

Wind.—A wind-vane ought to be elevated 12 feet, at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, &c.

Careful observations ought to be made on the changes in the direction of the wind; and during storms it is extremely recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer;—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Rain-gauges.—Many causes conspire to produce anomalies in rain returns. They arise partly from unfavourable situation for observation and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snow-falls may, for convenience, be registered in the rain columns, under the following conditions:—when a Snow shower occurs it must be noted in the "Remarks," and the letter S affixed to the depth of water received in gauges. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the rain-gauge. For windy, rainy, and snowy, as well as in every column, the observer cannot be too careful to register *observations* only; and nothing that partakes of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Laide Howard's

nomenclature of clouds will be found on the other side. The

amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearances and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is half covered by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity 6, S. W." (for example) will indicate that the

upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "Cloud" column, an entry of 2, *cu-st* (*cu-g*) will indicate that the higher regions are covered to the "amount" of 4-tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *gemulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

Underground Thermometers.—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and consistency,—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground, protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for other and greater depths, noting always the temperature of the air and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted.

Ozone.—Attention whether Schönbach's or Moffat's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—Thus 5.7, as an *ozone* entry in the schedule, will indicate that the ozone paper is tinted as "3" on the scale, that the wind is from the N.W., and that its force on the scale 0—6 is "4" i.e., that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "Remarks" column is too narrow, but unfortunately so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column.

Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, &c. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, fogs, storms, and remarkable falls of snow, hail, or rain, the hour of storms of wind retaining their maximum, as well as such notices on storms as have been hinted at above. When heavy fogs are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, otherwise unoccupied, or in two ruled off for the purposes, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner or on the side-marginal. Additional remarks may be made on the margin.

Observations in connection with the periodic return of the seasons, possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds, and in the case of crops, to specified sorts reaped from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers.

The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

EDINBURGH, 10th November 1859. (By Order) A. B.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Linne,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	FRUIT Ripe generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

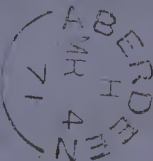
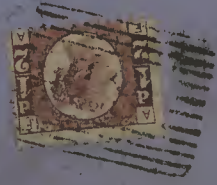
Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings,
Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

To



SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Ballate, County of Aberdeen, in Lat. 57° 41' Long. 3° 01', Distance from Sea 43 miles.Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 14 feet.During the MONTH of March 1871

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER. No.				WIND.				RAIN.		CLOUDS.				THERMOMETERS under Ground.	Temperature of WELL at each of feet, &c.	SEA.	OZONE.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.		Days of Month.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		9 h. A.M.		9 h. P.M.		Protected in Shade & Test above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		No. of hours in which it fell.	Amount in inches.	9 A.M.		P.M.									9 A.M.	9 P.M.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		Barometer. " No.	Atmos- phere thermometer	Barometer. No.	Atmos- phere thermometer	Max. No.	Min. No.	Max. in Sun-rays No.	Min. on Grass. No.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.			9 h. A.M.	Velocity (0-10), and Species.	Amount (0-10), and Species.	9 A.M.										Amount (0-10), and Species.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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BAROMETER, "corrected Mean" at 9 A.M., minus the Correction \pm = 29.050
for Temp. (Col. 2), = 29.099 - 0.049
"Corrected Mean" of Barometer at 9 P.M., minus the Correction \pm = 29.045
for Temp. (Col. 4), = 29.098 - 0.053
Mean at Station, corrected, and at 32°, = 29.048
Correction for height, feet above Mean Sea-level, = 716
Mean, reduced to 32°, and Sea-level, = 29.764
Highest Reading, corrected for Index error, on the 16th, = 29.870
Lowest Do. Do. on the 12th, = 28.330
Difference, or Monthly Range, = 1.450

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 16th, = 66.0
Lowest in Month, corrected for Index errors, on the 16th, = 18.5
Difference, or Monthly Range, = 47.5
"Corrected Mean" of all the Highest, (Col. 5), = 48.9
"Corrected Mean" of all the Lowest, (Col. 6), = 34.6
Difference, or Mean Daily Range, = 14.3
** Calculated Mean Temperature of Month, = 41.8

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the 16th, =
"Corrected Mean," (Col. 7), of Black Bulb, Max. in Sun, =
Lowest at Night, Black Bulb, (corrected for Index errors), on the 16th, =
"Corrected Mean," (Col. 8), of Black Bulb, Min. on grass, =
Difference of above Means or Range ("exposed"), =

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 42.3
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 41.9
†† Computed Temperature of Dew-Point, =
†† Do. Elastic Force of Vapour, =
†† Do. Weight of Vapour in a Cubic Foot of Air, ... =
†† Relative Humidity, (Saturation = 100), =
RAIN fell on 8 Days; Amount in Inches, = 1.00

WIND.		SUMMARY.									
Direction.	N	NE	E	SE	S	SW	W	NW	Calm or Variable.	Mean Force.	Mean Velocity in miles per day.
A.M.	1	1	2				9	5	4	1.42	
P.M.	1	2	1				4	5	5	1.60	
Mean.	1	1	2	0	0	7	12	4	4	1.51	2.28

N.B.—The Sums to be correctly added and the Means deduced. Returns from the "Principal Towns" should be in Edinburgh not later than the 3d; those from "Other Places," not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

James W. Paterson
Ballate

(Signed)

James W. Paterson

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified, in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *aneroids*, though admirably adapted for the latter certainly are to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. No can any Barometer be used for Meteorological Observations. That is not supplied with such means of *adjustment* or *compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-sized Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted for Meteorological purposes.

An excellent Barometer is constructed by Mr. Able of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-tubules* are not true indices but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather and thus by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; when stem passes freely through the lid and case of the cistern. When their coincidence being indicated by a little ivory float, whose *index-line* on this little piston-rod is brought, by the adjusting screw, to *form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary setting* must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *zenith*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *sew up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern unperforated. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *sharp tap* is produced. If this is prevented by air it may be removed to the cistern, and got rid of by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *light*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular and exposed to neither the sun's direct rays nor the heat of a fire.

In taking an *Observation*, the attached Thermometer is first noted: the tube must then be gently tapped and the cistern adjusted carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index,—usually the lower edge of the venturi, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from merely local influences. The laths forming the sides and doors of the Boxes are arranged so as to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians *Self-Registering Thermometers*.—Professor Phillips, and Negretti and Zamboni's Patent "*Maximum*" Thermometers, are recommended: printed directions for their use may be obtained from each instrument when graduated on the glass stem of Ruthvenford is recommended when graduated on the glass stem and attached to a frame separate from the "*Maximum*." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the spirit distils by high temperature, it will be found near the top of the tube and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "*Maximum*" should be freely exposed to the sun, and the "*Minimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the *Minimum* Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "*Minimum*" Thermometers ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested* form of this apparatus seriously vitiate the "*Hygrometric Deductions*," Observers are specially requested to attend to the following conditions:—The bulbs must *hang down* by a least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side and a little below the level of the wet bulb;—in no case under the bulbs;—the mesh must be of medium fineness and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the mesh is always *clean* and *moist*, and the water pure. In frosty weather observation is impossible of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 20 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

One form of "*Mason's*" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or *column* of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39.9, 40.0, or 40.1; or again, 40° 4, 40° 5, or 40° 6, according as it indicates a little less, an exact coincidence with or a little over 40°, or 40½, respectively. So also 40½, and 40¾, 40° more or less must be registered 40° 2 or 40° 3, and 40° 7 or 40° 8 respectively. In reading Rathbourn's "*Max*," and "*Min*," Thermometers, the indication of that end of the *index*, which is next to the surface of the mercury or alcohol is also noted. Readings of the Thermometers, especially of the wet and dry bulbs, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observing Temperature.—The Hygrometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremity occurs at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 2d are those of a series of observations commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When oscillates incessantly, the mean direction must be taken; at when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of winds overhead, and to the direction of smokes, etc.

Careful observations ought to be made on the changes in the direction of the wind; and during storms it is extremely recommended that extra observations be made at every hour of Greenwich time. Such a systematic simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical Cup anemometer—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained, for indicating the Force of the Wind, at any particular hour. Observations, Lind's Anemometer is also recommended; the method of *Distinguishing* Wind Force by such tables as that given the schedule is, to say the least, unsatisfactory.

Atmosphere. Many causes concur to produce anomalies in rain returns. They arise, partly from unfavourable situation for observation, and partly from defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge, in all cases the gauges must be sunk in the ground till its eye are on a level with the close cut grass around its mouth. A rain-gauge ought to be read daily, and the readings entered the returns on the day on which the rain falls.

Snowfalls may, for convenience registered in the rain columns, under the following conditions:—when a Snow shower occurs it must be noted in the "*marks*," and the letter S affixed to the depth of water received gauge. The depth of the snow must be measured in sunken place where no drift is observed, and registered in addition, and as a check upon the indications of the rain-gauge. If wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations* only; and noting that particles of the nature of delusion or inference.

Clouds.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky *overhead* (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearances and changes ought to be noted among the "*Remarks*." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky *overhead* is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "*Velocity* 6, S. W. W. (for example), will indicate that the and Direction, 2, W. (for example), will indicate that the upper strata of clouds travel with *extreme* velocity from S. W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "*Cloud*" column, an entry of —, (*eg.*) will indicate that the higher regions are covered to the "amount" of 4 tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2 tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the pen or column. *Underground Thermometers.*—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and consistency,—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks toward the coast, where it is not influenced by the heat of river waters. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for other and greater depths, indicating always the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted. *Crops.*—Mention whether Seiborn's or Moffat's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—Thus 9° as an *azone* entry in the schedule, will indicate that the ozone paper is tinted as 43° on the scale, 0—6 is "4°" i.e., that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "*Remarks*" column is too narrow, but unfortunately so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column.

Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of mists, aurora borealis, remarkable depressions and elevations of the barometer; thunder storms, and remarkable falls of snow, hail, or rain, the hour of on storms as have been hinted at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered either in two columns, otherwise unoccupied, or in two ruled off for the purpose, from that headed "*Remarks*." It is intended that observations by the Electrometer should be entered in this manner, or on the side-margin. Additional remarks may be made on the margin.

"*Observations* in connection with the periodic return of the seasons" possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena, that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *year* day observations be taken; viz., on the 21st days of March, June, September, and December. Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers. The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B. Examiners, 16th November 1852.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Cut or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bouree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gorseberry,			Lapwing,		
Hawthorn,		Peach,			Plover,		
Holly,		Pear,			Sand-Martin,		
Laburnum,		Plum,			Starling,		
Lilac,		Strawberry,			Swan,		
Mezerion,					Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings, Secretary of the Meteorological Society of Scotland.

MR ALEXANDER BUCHAN,

EDINBURGH

BALESTER

ABERDEEN

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Pallater, County of Meriden, in Lat. 57° 14', Long 2° 12' W., Distance from Sea 43 miles.
Height of Cistern of the Barometer above Mean Sea-level 600 feet, above Ground 4 feet. During the MONTH of April 1871.
The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER. No.				WIND.				RAIN.				CLOUDS.				THERMOMETERS under Ground.				SEA.	OZONE.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.	Days of Month.	
		9 h. A.M.		9 h. P.M.		Protected in Shade, 1 foot above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		Temperature of WELL at depth of feet. No.	Temperature at 1 inch, 2 inches, and Density.	9 A.M. 9 P.M.						
		Barometer. No.	Attached Thermometer	Barometer. No.	Attached Thermometer	Max. No.	Min. No.	Max. in Sunshade No.	Min. on Grass. No.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.	No. of hours in which it fell.	Amount in inches.	9 A.M. Velocity (0-10), and Direction.	9 P.M. Velocity (0-10), and Direction.	Amount (0-10), and Direction.	Amount (0-10), and Direction.	No. 3 inches.	No. 12 inches.				No. 22 inches.					
		inches.	°	inches.	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°				°					°
1	29.200445	29.150445	44.5	36.5	31					30.5	29	34.5	33.5	N	2	W	2				3 W	10 mi								A.M. over gloomy off rain	1			
2	28.950444	28.950446	46	46	32.5					41.5	40.5	32.5	32	N.W.	1			1.5		1 mi	10 mi	10 mi								very cold the showers	2			
3	29.050445	29.200444	47	37	31					33	33.5	35	34	E	0.5	N.E.	2			2 N.E.	8 mi	over								cloudy squint snowing	3			
4	29.150444	29.100446	46	49.5	31					41	39	42.5	40.5	W	0.5	W	2			2 W	5	3 W	10 mi							quiet mists	4			
5	29.250445	29.350446	44	43	25.5					35	33	27.5	27		1					10										cloudy squint fresh	5			
6	29.400440	29.400444	44	45.5	19					34		40.5	39		0.5	W	0.5				2 W	5 mi								clear frosty fresh	6			
7	29.450445	29.450448	48	54	37					45.5	44.4	38	37		1			0.7			2	8								mild quiet cont.	7			
8	29.400445	29.380449	49	52	26.5					45	43	44	42.5	W	0.5	W	0.5			1 W	5 mi	2	8							clear warm mild	8			
9	29.300447	29.350450	46	46	33					38.5	38	34.5	33		2					misty	2	5								close mist damp	9			
10	29.300446	29.300449	49	46.5	29.5					38.5	36.5	35	35	N.W.	0.5	N.W.	1			2 N.W.	10 mi	2 N.W.	10 mi							cloudy squint chilly	10			
11	29.250443	29.050449	49.5	52	22.5					46.5	43	41.5	41	N.W.	0.5	E	2			11		2 E	10 mi							clear warm cloudy squint	11			
12	28.850450	28.950455	51.5	61.5	31.5					39.5	37	39	38	W	0.5					1 W	5 mi									clear mists cont. then	12			
13	29.150453	29.300452	54.5	59.5	38.5					44.5	43	40	40		0.5	E	2			0.4	2	1 mi	2 E	10 mi						off rain cold	13			
14	29.200449	28.800449	44.5	45	21.5					39.5	38	41.5	41	N.E.	2					3 N.E.	10 mi	sear								very cold damp cold	14			
15	28.600450	28.400451	51	51	40					46	45	47.5	46.5	W	2	N.E.	0.5			0.7	misty	1 N.E.	10 mi							close mist damp cold	15			
16	28.550451	28.600450	49	49	38					45	43	39.5	39	N.W.	2	E	1			1.4	1 N.W.	10 mi	1 E	10 mi						cloudy gloomy off rain	16			
17	28.800449	29.000448	41	41	33.5					39	38.5	35	34	E	2		2				over	3	8							snowing cold damp strong	17			
18	29.050446	28.850449	49	40	21					35.5	34	36	35		0.5		3				2 E	10 mi	over							very sharp wind	18			
19	28.600445	28.450444	39	39	30.5					33.5	33	34.5	34		2	W	2			1.10	over	3 W	5 mi							stormy sleet off rain	19			
20	28.500445	28.600448	37	37	31					36	35	36	34	N.E.	1		0.5			0.3	2 N.E.	8 mi								quiet very strong fresh	20			
21	28.800445	28.950445	41.5	41.5	31					40	36	36.5	34	W	0.5								5 mi								clear quiet chilly	21		
22	28.950442	28.850444	39.5	39.5	25.5					35.5	33.5	33.5	33		0.5	E	2			1.70	2 W	8 mi	2 E	10 mi						cloudy squint wet	22			
23	28.950445	29.150445	38.5	38.5	31.5					36	35	35.5	34.5	E	1		0.5			0.8	over	2	8							over very wet cold	23			
24	29.200445	29.250445	41.5	41.5	26.5					38	37	40	39	N.E.	0.5						2 N.E.	8 mi									cloudy very cold fresh	24		
25	29.270446	29.250449	50	49.5	29.5					45	41.5	39	37	W	2					1.10		3 W	8 mi								clear fresh fresh breeze	25		
26	29.150446	29.050445	42	42	36					38	37.5	35.5	35	E	2	E	2			1.61	3 E	10 mi	over							cloudy mist very cold	26			
27	28.900446	28.900446	47	47	24					43	41.5	40	39.5	N.E.	0.5						2 N.E.	10 mi	8 mi								cloudy squint calm	27		
28	28.850447	28.900449	52.5	52.5	32					48.5	48.3	39	38	W	1	W	0.5				2 W	8	2 W	8							quiet mists cont. then	28		
29	28.850449	28.900453	58	58	31					50	46.5	45.5	44.5								8	3 E	10 mi								do off rain	29		
30	28.950452	29.100450	56.5	56.5	37					53	47.5	39	38	E	0.5	N.E.	2			0.4	2 E	8	3 N.E.	10 mi							quiet chilly very cold	30		
31																																		31
Sums.		870.6145	116	570.950	138	2185	140	152	157	165	145	148	143	245	360	324																NOTATION USED IN GENERAL REMARKS.		
Means.		29.029464	29.031476	29.031476	46.7306					40.6386	37.9370			1.8	12																			
Total Corrections for Instrumental Errors.																																		
Corrections for Diurnal Range.																																		
Corrected Means.																																		
No. of Column.		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			

BAROMETER, "corrected Mean" at 9 A.M., minus the Correction^{††} for Temp. (Col. 2), = 28.983
"Corrected Mean" of Barometer at 9 P.M., minus the Correction^{††} for Temp. (Col. 4), = 28.980
Mean at Station, corrected, and at 32°, = 28.982
Correction for height, feet above Mean Sea-level, = 7.23
Mean, reduced to 32°, and Sea-level, = 28.705
Highest Reading, corrected for Index error, on the 7 th, = 29.450
Lowest Do. Do., on the 15 th, = 28.450
Difference, or Monthly Range, = 1.000

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 12 th, = 61.5
Lowest in Month, corrected for Index errors, on the 6 th, = 19.0
Difference, or Monthly Range, = 42.5
"Corrected Mean" of all the Highest, (Col. 5), = 46.7
"Corrected Mean" of all the Lowest, (Col. 6), = 30.6
Difference, or Mean Daily Range, = 16.1
** Calculated Mean Temperature of Month, = 38.6

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the th, =
"Corrected Mean," (Col. 7), of Black Bulb, Max. in Sun, =
Lowest at Night, Black Bulb, (corrected for Index errors), on the th, =
"Corrected Mean," (Col. 8), of Black Bulb, Min. on grass, =
Difference of above Means or Range ("exposed"), =

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 39.4
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 37.8
Computed Temperature of Dew-Point, = 35.7
Do. Elastic Force of Vapour, = 260
Do. Weight of Vapour in a Cubic Foot of Air, =
Relative Humidity, (Saturation = 100), = 87
RAIN fell on 13 Days; Amount in Inches, = 3.24

WIND.		SUMMARY.									
Direction.	N	NE	E.	SE	S	SW	W	NW	Calms or Variable.	Mean Force.	Mean Velocity in miles per day.
A.M.	1	4	7				1	10	2	5	0.82
P.M.		3	12				9	2	1	1.20	
Mean.	1	3	9	0	0	1	10	2	4	1.02	

Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S.," and a number to be entered in the Heading; or the Number and Initials of the Maker may be here given.
†† The Diurnal Range for Scotland is as yet unknown.
††† These "Hygrometric Relations" are calculated from Glaisher's Hygrometric Tables, Second Edition only.
†††† While the Diurnal Range is unknown, the Arithmetic Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any observations not taken under the conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. See over.

N.B.—The Sums to be correctly added and the Means deduced. Returns from the "Principal Towns" should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

David W. Paterson
Pallater

(Signed)

Dr. Paterson

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Reports from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) on other instruments as specified, in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—Weather glasses and *aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. For can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment or compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-inches* are not two inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the *bulb* from one *straight line* with those on its ivory frame, the *scale* is graduated. In taking an observation, this *preliminary setting* must be made with scrupulous accuracy; a *slight error* here will vitiate the readings from the *vernier*.

When a Barometer, having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *erect* up the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern upmost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slight tap* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *hull*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an observation*, the attached Thermometer is first noted; the tube must then be gently tapped and the cistern-adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index;—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box, painted white outside and inside, and fixed 4 feet above ground in an exposed position, free from nearly local influences. The hails forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers and to allow a complete ventilation of the interior. The instruments are suspended on cross-sticks, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians *Self-registering Thermometers*.—Professor Phillips, and Negretti and Zambra's Patent "*Maximum*" Thermometers are recommended; printed directions for their use may be obtained with each instrument. The "*Minimum*" Thermometer of Rutherford is recommended when graduated on the glass stem and affixed to a frame separate from the "*Maximum*." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand, when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or made, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "*Maximum*" should be freely exposed to the sun, and the "*Minimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Protection of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are *not* graduated on the stem, but merely on an attached scale, unceasing repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "*Minimum*" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus seriously vitiate the "Hygrometrical Deductions," Observers are specially requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulbs;—the mastin must be of medium fineness and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the mastin is always *clean and moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cold in ordinary circumstances.

One form of "Mason's Hygrometer is highly objectionable, also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the frame would requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the thermometer will be read—38°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, or 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½, respectively. So also 40½, and 40¾, more or less must be registered 40°·2 or 40°·3, and 40°·7 or 40°·8 respectively. In reading Rutherford's "*Max*" and "*Min*," Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observing Temperature.—The Hygrometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to note their occurrence to their proper meteorological day. In the Society's schedule, the indications registered on the 24 are those of a series of phenomena commencing at 9 P.M. on the 24, and extending till 9 P.M. on the 3d.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, etc.

Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer;—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Rain-gauges. Many causes conspire to produce anomalies in rain returns. They arise partly from unpropitious situation for observation, and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its top is on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfall may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow storm occurs it must be noted in the "Remarks," and the depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, as a check upon, the indications of the rain-gauge. For wind, rain, and snow as indicated in every column, the observer cannot be too careful to include *observations only*; and nothing that partakes of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Luke Howard's nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less observation of the sky overhead (i.e. within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearance and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on. Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity and Direction," 2 W. (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the (extreme) speed of the former. Again, in the second "Cloud" column, an entry of 2, c.s., (e.g.) will indicate that the higher regions are covered to the "amount" of 4-tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column.

Underground Thermometers.—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and constancy,—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by the tide of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for colder and greater depths, noting always the temperature of the air and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted.

Ozone.—Mention whether Schönbien's or Moir's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus 8°·3, as an ozone entry in the schedule, will indicate that the ozone paper is tinted as 8°·3 on the scale, that the wind is from the N.W., and that its force on the scale 0—6 is "4"; i.e., that it is *floating fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "Remarks" column is too narrow, but unfortunately so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column. Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of mists, mists, mists, mists, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms of wind attaching their maximum, as well as such notes on storms as have been hinted at above. When fog, fogs are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, otherwise unoccupied, or in two ruled off for the purpose, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner or on the side-margin. Additional remarks may be made on the margin.

"Observations in connection with the periodic return of the seasons" possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers.

The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Cut or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bountree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

General Post Office Buildings,
Secretary of the Meteorological Society of Scotland,



MR ALEXANDER BUCHAN,

C BALLATER
MY 8
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SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Ballater, County of Aberdeen, in Lat. 57° 12' N., Long. 2° 19' W., Distance from Sea 4.3 miles.Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 4 feet.During the MONTH of May 1871.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER.				WIND.				RAIN.		CLOUDS.		THERMOMETERS under Ground.			SEA.	OZONE.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.	Days of Month.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
		9 h. A.M.		9 h. P.M.		Protected in Shade, 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		No. of hours in which it fell.	Amount in inches.	9 A.M.		P.M.		No. 1 3 inches.					No. 12 inches.	No. 22 inches.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
		Barometer. No.	Attached Thermometer No.	Barometer. No.	Attached Thermometer No.	Max. No.	Min. No.	Max. in shade.	Min. on Grass.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.			Readings of the H. Cup Anemometer. No.	9 h. A.M.	Velocity (0-10), and Direction.	Amount (0-10), and Species.								Velocity (0-10), and Direction.	Amount (0-10), and Species.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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BAROMETER, "corrected Mean" at 9 A.M., minus the Correction†† = 29.246
for Temp. (Col. 2), = 29.317... - 0.71...
"Corrected Mean" of Barometer at 9 P.M., minus the Correction†† = 29.269
for Temp. (Col. 4), = 29.344... - 0.75...
Mean at Station, corrected, and at 32°, = 29.258
Correction for height, feet above Mean Sea-level, = 707
Mean, reduced to 32°, and Sea-level, = 29.065
Highest Reading, corrected for Index error, on the 28 th, = 29.750
Lowest Do. Do., on the 3 th, = 28.650
Difference, or Monthly Range, = 1.100

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 22 th, = 73.0
Lowest in Month, corrected for Index errors, on the 12 th, = 28.5
Difference, or Monthly Range, = 44.5
"Corrected Mean" of all the Highest, (Col. 5), = 59.1
"Corrected Mean" of all the Lowest, (Col. 6), = 38.6
Difference, or Mean Daily Range, = 20.5
* Calculated Mean Temperature of Month, = 48.8

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the th, =
"Corrected Mean," (Col. 7), of Black Bulb, Max. in Sun, =
Lowest at Night, Black Bulb, (corrected for Index errors), on the th, =
"Corrected Mean," (Col. 8), of Black Bulb, Min. on grass, =
Difference of above Means or Range ("exposed"), =

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 50.0
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 46.5
† Computed Temperature of Dew-Point, = 42.8
†† Do. Elastic Force of Vapour, = 0.275
†† Do. Weight of Vapour in a Cubic Foot of Air, =
†† Relative Humidity, (Saturation = 100), = 78
RAIN fell on 7 Days; Amount in Inches, = 0.95

WIND.		SUMMARY.									
Direction.	Force.	N	NE	E	SE	S	SW	W	NW	Calms or Variable.	Mean Force.
A.M.			3	3	3			2	10	5	1.13
P.M.			5	3				2	12	4	0.85
Mean.			0	4	3	2	0	2	11	4	0.99

† Each instrument tested at the Office in Edinburgh bears the stamp "S.M.S.," and a number to be entered in the Heading, or the Number and Initials of the Maker may be here given.
†† The Diurnal Range for Scotland is as yet unknown.
††† These "Hygrometrical Data" are calculated from Gish's Hygrometrical Tables, Second Edition only.
While the Diurnal Range is unknown, the Arithmetical Mean of Cols. 5 and 6 will be entered as the "Calculated Mean Temperature."
Any Observations not taken under the conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. See over.

N.B.—The Sums to be correctly added and the Means deduced. Returns from the "Principal Towns" should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

James W. Paterson
Ballater

(Signed)

James W. Paterson

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WITH REMARKS ON THE USE OF INSTRUMENTS

from radiation during night. The Thermometer is placed in a box, in which may easily be made, or provided, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes whose sides protect the bulbs from the wind. The "*Mazum*" should be freely exposed to the sun, and the "*Mimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are not graduated on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "*Mimum*" Thermometers ought frequently to be compared with the dry bulb of the Hygrometer. The

The *Hygrometers* consists of two *Thermometers* usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-secured form* of this apparatus seriously vitiate the "Hygrometrical predictions," Observers are specially requested to attend to the following conditions:—

The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulbs;—the muslin must be of medium fineness, and fastened at the neck of the bulb by a cord, which also supplies it with water. It must be seen to by

the observer. In frosty weather, observation is a matter of much value, pure. In frosty weather, observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed, evaporation will proceed as from the moist cloth in ordinary circumstances. One form of a "Kraus's" Hygrometer is highly objectionable. The frame of the Thermometer is enclosed in a tin case, which also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read, -39.2 , 40.0 , or 40.1 ; or again, 40.4 , 40.5 , or 40.6 , according as it indicates a little

ther, an exact coincidence with that of a true over- or less must be respectively. So, also $40\frac{1}{2}^{\circ}$ and $40\frac{1}{2}^{\circ}$ more or less must be registered $40^{\circ}2$ or $40^{\circ}3$, and $40^{\circ}7$ or $40^{\circ}8$ respectively. In reading Rutherford's " M_{max} " and " M_{min} " Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hours of observing Temperature.—The *Hygrometer* is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 2 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered at the *2d* are those of a series of phenomena commencing at

P. M. on 24, and extending till 9 P.M. on the 25.

Wind.—A wind-whirl ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, relevance must be made to the direction of the lower strata of clouds overhead, and to the direction of snaks, etc.

Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory to be furnished with a Hemispherical Cup anemometer—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force

Rain-gauges.—Many causes conspire to produce anomalies in rain returns. They arise partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may, for convenience, be registered in the rain columns, under the following conditions—When a Snow shower occurs it must be noted in the “Remarks,” and the letter S attached to the depth of water received in gauge. The depth of snow must be measured in some open place where no drift

Clouds.—Convenient abbreviations for Luke Howard's observations registered in addition to, and as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations* only; and nothing that partakes of the nature of deduction or inference.

[illegible]

Plants of leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appear- ance above Gro-
	Barley, . . .		
	Bere or Bigg, . .		
	Oats, . . .		
	Wheat, . . .		
	Beans, . . .		
	Pease, . . .		
	Potatoes, . . .		
	Turnips, . . .		
	Rye Grass, . .		

[illegible]

FOREST	
Alder, . . .	
Ash, . . .	
Beech, . . .	
Birch, . . .	
Elm, . . .	
Larch, . . .	
Lime, . . .	
Oak, . . .	
Sycamore	

FOREST TREES	In	Leaf Buds	In	Divested of	CROPS.	Sowing or	Appearing	In Ear	First C
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SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mexazon,		Strawberry,			Rail or Corn Crane,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

The Hours of Observation are of Greenwich Time.

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INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparably, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fall in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a day for some, and once (morning or evening) for other instruments, as specified in the following remarks or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *Anemoids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment* or *compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-inches* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory hair, whose stem passes freely through the lid and case of the cistern. When the *index-line* on this little piston-rod is brought, by the adjusting screw, *to form one straight line* with those on the ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary* setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *zenith*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *screw up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *sharp tap* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *light*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted; the tube must then be gently tapped and the cistern-adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index,—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from nearly local influences. The laths forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the box, and the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians, *Self-registering Thermometers*.—Professor Phillips, and Negretti and Zambra's Patent "*Maximum*" Thermometers are recommended: printed directions for their use may be obtained with each instrument. The "*Minimum*" Thermometer of Rutherford is recommended when graduated on the glass stem and affixed to a frame separate from the "*Maximum*." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or melted, by the application of a mixture of lamp black and printer's ink. They are placed in station blackened boxes, whose sides protect the bulbs from the wind. The "*Maximum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover the face of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are *not graduated* on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "*Minimum*" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus seriously vitiate the "Hygrometrical Deductions," Observers are specially requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any coverd, on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulb;—the muslin must be of medium fineness, and stretched at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the muslin is always *clean* and *moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

One form of "Mason's" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water-cup underneath. This arrangement must be immediately altered by putting the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with as far as possible. **Readings of the Thermometer.**—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite to the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39.9, 40.0, or 40.1; or again, 40° 4', 40° 5', or 40° 6', according as it indicates a little more, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 40½°, and 40½°, more or less must be registered 40° 2 or 40° 3, and 40° 7 or 40° 8 respectively. In reading Rutherford's "*Maximum*" and "*Minimum*" Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Mode of observing Temperature.—The Thermometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrences to their proper meteorological day. In the Society's schedules, the indications registered on the 2d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates necessarily, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, etc. Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is especially recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer,—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Atmospheres. Many causes conspire to produce anomalies in rain returns. They arise partly from an unfavourable situation for observation, and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauges must be sunk in the ground till its edge are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs it must be noted in the "Remarks," and the latter's affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations only*; and nothing that partakes of the nature of deduction or inference.

Cloudb.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearances and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on. Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity and Direction," 2, W., (for example,) will indicate that the upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "Cloud" column, an entry of 4½, (e.g.) will indicate that the higher 2, cu-st., regions are covered to the "amount" of 4-tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column. **Underground Thermometers.**—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and constancy,—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground, protected from the sun's rays, and fixed with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly 65 feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient extra sea observations might be taken for colder and greater depths, notwithstanding the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted. **Ozone.**—Mention whether Schönbach's or Moffet's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus 3½, as an ozone entry in the schedule, will indicate that the ozone paper is tinted as "3" on the scale 0—6 is "4"; i.e., that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory. **Remarks.**—The "Remarks" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no rules can be given nor forms assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column. Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of mists, mists, mists, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms, and remarkable falls of snow, hail, or rain, the hour of storms as have been hinted at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered either in two columns, otherwise unoccupied, or in two ruled off for the purposes from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner or on the side-margins. Additional remarks may be made on the margin. "Observations in connection with the periodic return of the seasons," possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December. Full directions for the use of the instruments mentioned above have been printed and may be had along with them from the makers.

The Council recommend that observers before purchasing new instruments, should communicate with the Meteorological Secretary, and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

Edinburgh, 10th November 1870.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Boutree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezerion,		Strawberry,			Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

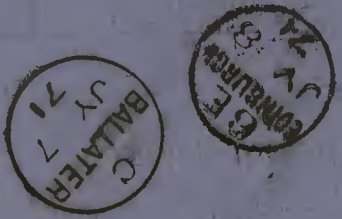
Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings,
Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

Revalate
June 1871-



_____ miles.

During the MONTH of July 1877

July

1	fresh breeze raining	1
2	gyg rain li showers chilly	2
3	damp hazy & dull raining	3
4	quiet mild wet	4
5	mild warm heavy rain	5
6	very cold wind	6
7	drizzle rain chilly	7
8	fresh breeze raining	8
9	blowing very fresh	9
10	fine warm dry cont.	10
11	clear warm quiet mild	11
12	dull warm	12
13	very d ^r & cold	13
14	fine raining	14
15	quiet mild li showers	15
16	warm cont? mild	16
17	fresh breeze & cold wind	17
18	warm fine cont ^d	18
19	li showers hazy wet	19
20	chilly mild	20
21	very cold wind	21
22	fine mild warm	22
23	gloomy gyg rain	23
24	calm damp wet	24
25	raining very cold	25
26	cold gyg rain raining	26
27	mild warm	27
28	chilly li shower	28
29	clear warm raining	29
30	heavy rain	30
31	clear fine chilly	31

S.-R. THERMOMETER , (in shade, etc.), Highest in Month , (corrected for Index Errors), on the 17 th.....	=	72.5
Lowest in Month , corrected for Index errors, on the 12 th,	=	38.0
Difference, or Monthly Range ,	=	34.5
"Corrected Mean " of all the Highest , (Col. 5),	=	65.8
"Corrected Mean " of all the Lowest , (Col. 6),	=	46.9
Difference, or Mean Daily Range ,	=	18.9
** Calculated Mean Temperature of Month,	=	55.3
 S.-R. THERMOMETER, Black Bulb in Sun, Highest , (corrected for Index Errors), on the th,		
"Corrected Mean ," (Col. 7), of Black Bulb, Max. in Sun ,.....	=	
Lowest at Night , Black Bulb, (corrected for Index errors), on the th, ...	=	
"Corrected Mean ," (Col. 8), of Black Bulb, Min. on grass,	=	
Difference of above Means or Range ("exposed"),	=	

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb , (Cols. 9 and 11),	=	57.4
Mean (corrected) A.M. and P.M. Reading of Wet Bulb , (Cols. 10 and 12),	=	54.5
## Computed Temperature of Dew-Point ,	=	51.9
## Do. Elastic Force of Vapour ,	=	356
## Do. Weight of Vapour in a Cubic Foot of Air , ...	=	
## Relative Humidity , (Saturation = 100),	=	82
RAIN fell on 15 Days ; Amount in Inches,	=	3.13

[illegible]

Observations made and
Return verified by } James W. Paterson
Bell, Jr.

(Signed) John H. Peterson

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which, the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *Anemoids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment* or *compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr A. de la Roche, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-tubes* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the *scale-tube* on this little piston-rod is brought, by the adjusting screw, *to form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *spontaneous* setting must be made with scrupulous accuracy; a slight error here will vitiate the readings from the register.

When a Barometer, having adjustable surfaces, has to be removed from its fastenings, the ivory peg must be secured so as to form a tight plug to the cistern. Then *keep up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *sharp tap* is produced. If this is prevented by air it may be removed to the cistern and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a *good light*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted; the tube must then be gently tapped, and the cistern-adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index—usually the lower edge of the venturi, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from merely local influences. The laths forming the sides and floors of the Boxes are arranged so as at once to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians, Messrs. Rogers and Sons, 15, Abchurch Lane, London, E.C. 4.

Self-registering Thermometers.—Professor Phillips, and Messrs. Negretti and Zambra's Patent "Maximum" Thermometers are recommended; printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Mr. Rutherford is recommended when graduated on the glass stem, and affixed to a frame separate from the "Maximum." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the column of spirit breaks, it may be re-joined by striking the instrument repeatedly against the palm of the hand; when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate, and again condense in contact with the body of the liquid. These derangements should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "Maximum" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover the sides of these Thermometers; nor must heat be allowed to affect the Minimum Thermometer by distillation.

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One form of "Mason's" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water-cup underneath. This arrangement must be immediately altered by putting the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, or 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½° respectively. So also 40½°, and 40½°, more or less must be registered 40°·2 or 40°·3, and 40°·7 or 40°·8 respectively. In reading Rutherford's "Max." and "Min." Thermometers, the indication of that end of the index which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry bulbs, must be promptly taken, being so readily affected by heat from the person of the observer.

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Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of snobs, etc.

Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical Cup Anemometer;—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

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Snowfalls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs it must be noted in the "Remarks," and the letter S affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indeed in every column, the observer cannot be too careful to register *observations* only; and nothing that partakes of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 90° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearances and changes ought to be noted among the "Remarks." The amount of cloud is entered on a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity and Direction," 2, W., (for example,) will indicate that the upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "Cloud" column, an entry of 2, cu-st., (*etc.*) will indicate that the higher regions are covered to the "amount" of 4 tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column. **Underground Thermometers.**—As the germination and health of crops and plants greatly depend on the temperature of the soil.—its amount and constancy.—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground, protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for other and greater depths, noting always the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted. **Ozone.**—Mention whether Schönbien's or Moffat's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus 3²⁵, as an ozone entry in the schedule, will indicate that the ozone paper is tinted as "3" on the scale 0-6; i.e., that it is *blewing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "Remarks" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no table can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such, as are recognised and in use at Greenwich and Southampton, are given at the foot of the column. Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms of wind attaining their maximum, as well as such notes on storms as have been hinted at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, otherwise unoccupied, or in two ruled off for the purpose, from that headed "Remarks." It is intimated that observations by the Diectometer should be entered in this manner on the side margin. Additional remarks may be made on the margin.

Seasons' interest not only great scientific value, but are of considerable attention of Observers to the registration of such phenomena; that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the publishers.

The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, 19th November 1875.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning Variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Chickoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crane,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings,

Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Ballater, County of Aberdeen, in Lat. 57° 24', Long. 2° 42' W, Distance from Sea 43 miles.Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 4 feet.During the MONTH of August 1871.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER. No. —				WIND.				RAIN.		CLOUDS.				THERMOMETERS under Ground.			SEA.	OZONE.	GENERAL REMARKS.		Days of Month.				
		9 h. A.M.		9 h. P.M.		Protected in Shade 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 A.M.		P.M.		9 h. A.M.			0—10.				As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc.						
		Barometer.	Atmos- phere	Barometer.	Atmos- phere	Max. No.	Min. No.	Max. in Sun's rays	Min. on Grass.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.	No. of hours in which it fell.	Amount in inches.	Velocity (0—6), and Direction.	Amount (0—10), and Species.	Velocity (0—6), and Direction.	Amount (0—10), and Species.	No. 3 inches.	No. 12 inches.	No. 22 inches.			Temperature of Water at depth of 1 foot, 2 feet, 3 feet, &c.	Temperature of air and humidity.		9 A.M.	9 P.M.	Mention the hour at which Storms, including Thunder and Lightning, began and ended.	
		* No.	inches.	°	inches.	°	°	°	°	°	°	°	°																						
	1	29.15062	29.20066	66	42.3					65.58	58.54	57	71	2					2.71	scat	3.71	scat										St. clear fine	1		
	2	29.10063	28.85067	72	49					63.58	61.59	59	71	2																		fresh breeze mild	2		
	3	28.75065	28.70063	64	46					60.55	56.56	56		3	71	2			2.71	scat	2.71	scat										blow hard heavy rain	3		
	4	28.65063	29.00063	61.5	42					60.55	58.55	55	53	71	2					2.71	scat	2.71	scat									clear warm	4		
	5	29.100605	29.15066	69	42					62.56	61.57	57	57	71	2					2.71	scat	2.71	scat									dull damp fine	5		
	6	29.25066	29.40064	73	54					71.56	60.54	54	57	71	2																		very warm	6	
	7	29.40068	29.25067	76	48					71.56	62.56	60			71	2																	7		
	8	29.400695	29.35069	73.5	56					71.56	63.56	60			71	2																	fresh breeze sultry	8	
	9	29.30071	29.35070	75	52					73.58	66.53	63	58	71	2					2.71	scat	2.71	scat										clear warm	9	
	10	29.40071	29.25068	75	55					71.58	65.56	62	60	71	2					2.71	scat	2.71	scat										clear very warm	10	
	11	29.25071	29.35070	78.5	36.5					68.58	62.56	58																					dull	11	
	12	29.30070	29.32071	76.5	47					68.58	64.56	58	59	71	2																		fine mild	12	
	13	29.30068	29.45070	74.5	50					69.58	64.55	58	57	71	2																		calm warm	13	
	14	29.300655	29.25066	74	39.5					68.58	63.56	57	57	71	2					2.71	scat	2.71	scat										clear warm chilly	14	
	15	29.20063	29.20063	70	43.5					61.58	62.56	60	60	71	2					2.71	scat	2.71	scat										fine mild cold mist	15	
	16	29.25064	29.20067	65	50					63.58	61.57	58	57	71	2					3.71	scat	3.71	scat										clear fine	16	
	17	29.05066	28.90065	69	52					58.58	56.53	53	53	71	2					2.71	scat	2.71	scat										dull mild	17	
	18	28.75064	28.800645	66.5	52.3					57.58	56.54	53			71	2																	raining cool	18	
	19	28.900625	29.10065	64.5	47					56.58	50.48	47	57	71	2					2.71	scat	2.71	scat										fine warm very cool	19	
	20	29.150615	29.85062	56.3	36.5					57.58	56.55	53	53	71	2					7.62	thick	2.71	scat										gloomy quiet	20	
	21	29.000605	29.10060	66.4	40					57.58	48.57	49	49	71	2					2.71	scat	2.71	scat										very cold stormy	21	
	22	29.20059	29.00060	65.4	41					57.58	49.52	50	50	71	2					2.71	scat	3.71	scat										fresh breeze gloomy	22	
	23	28.80061	28.850625	63.4	45					56.58	54.53	57	57	71	2																		cold wind fine	23	
	24	28.80062	28.750629	62.5	47					56.58	53.50	48	48	71	2					3.71		4.71	scat										mild heavy rain	24	
	25	28.70060	28.85062	61.4	42					57.58	49.52	47	47	71	4					1.0													blow hard	25	
	26	28.80060	29.250605	59.4	41					52.58	57.55	46	45	71	2																		raining cold heavy rain	26	
	27	29.30061	29.20064	66.5	48.5					55.58	53.48	47	47	71	2																			fine mild chilly	27
	28	29.60063	29.55063	70.5	53					62.58	57.55	53	53																					clear warm mild	28
	29	29.40063	29.35063	68.5	40.5					60.58	57.55	57	57	71	2					2.71	scat	2.71	scat											fine mild	29
	30	29.25063	29.25064	73.4	45					61.58	59.57	57	57	71	2					1.09		2.71	scat											calm warm cool	30
	31	29.20070	29.10070	71.4	43.5					62.58	61.55	59	59	71	2					2.71	scat	2.71	scat											gloomy clear fine	31
	Sums.	903.08093	903.701525	43.12						127.146	135.141	141	142	243					1.98															NOTATION USED IN GENERAL REMARKS.	
	Means.	29.123	29.135	64.9						62.0578	56.9546	15	16																					a. denotes aurora.	
	† Total Corrections for Instrumental Errors.																																		m. denotes meteor.
	‡ Corrections for Diurnal Range.																																		ms. " meteors.
	“Corrected Means.”																																		n. " nimbus.
	No. of Column.	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			ci. " cirrus.	
																																			ci. " cirro-stratus.
																																			ci. " cirro-stratus.
																																			ci. " cumulus.
																																			ci. " cumulo-stratus.
																																			d. " dew.
																																			f. " fog.
																																			fr. " frost.
																																			h. " hoar-frost.
																																			h. " haze.
																																			h. " heavy dew.
																																			h. " hail.
																																			l. " lightning.
																																			li. " light clouds.
																																			li. " light showers.
																																			lu. " lunar corona.
																																			lu. " lunar halo.
																																			g. " gale of wind.
																</																			

BAROMETER, “corrected Mean” at 9 A.M., minus the Correction†† = 29.030
for Temp. (Col. 2), = 29.123... - 0.093...
“Corrected Mean” of Barometer at 9 P.M., minus the Correction†† = 29.040
for Temp. (Col. 4), = 29.135... - 0.095...
Mean at Station, corrected, and at 32°, = 29.035
Correction for height, feet above Mean Sea-level, = 710
Mean, reduced to 32°, and Sea-level, = 29.745
Highest Reading, corrected for Index error, on the 18th, = 29.600
Lowest Do. Do., on the 4th, = 28.650
Difference, or Monthly Range, = 0.950

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 12th, = 76.5
Lowest in Month, corrected for Index errors, on the 20th, = 36.5
Difference, or Monthly Range, = 40.0
“Corrected Mean” of all the Highest, (Col. 5), = 68.4
“Corrected Mean” of all the Lowest, (Col. 6), = 46.5
Difference, or Mean Daily Range, = 21.9
** Calculated Mean Temperature of Month, = 57.5

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the 12th, = 76.5
“Corrected Mean,” (Col. 7), of Black Bulb, Max. in Sun, = 68.4
Lowest at Night, Black Bulb, (corrected for Index errors), on the 12th, = 36.5
“Corrected Mean,” (Col. 8), of Black Bulb, Min. on grass, = 46.5
Difference of above Means or Range (“exposed”), = 21.9

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 59.6
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 56.2
†† Computed Temperature of Dew-Point, = 53.2
†† Do. Elastic Force of Vapour, = 406
†† Do. Weight of Vapour in a Cubic Foot of Air, = 80
†† Relative Humidity, (Saturation = 100), = 80
RAIN fell on 7 Days; Amount in Inches, = 1.98

WIND.		SUMMARY.									
Direction.		N	NE	E	SE	S	SW	W	NW	Calm or Variable.	Mean Force.
A.M.								3	16	5	1.50
P.M.								2	7	6	1.60
Mean.		0	0	0	1	0	2	11	6		1.55

Each instrument tested at the Office in Edinburgh bears the stamp “S.M.S.” and a number to be entered in the Heading; or the Number and Initials of the Maker may be given.
† Excluding corrections for both capillary and Index Errors.
†† The Diurnal Range for Scotland is as yet unknown.
‡ These “Hygrometric Deductions” are calculated from Thacker’s Hygrometric Tables, Second Edition 1870.
‡‡ While the Diurnal Range is unknown, the Artificial Mean of Cols. 9 and 10 will be entered as the “Calculated Mean Temperature.”
Any Observations not taken under the conditions specified in the Directions on the other side, or noted at the Top of each column, must be marked as such by the observer, in each Schedule. See over.

N.B.—The Sums to be correctly added and the Means deduced. Returns from the “Principal Towns” should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gummed or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

Jas W. Paterson
Ballater

(Signed)

Jas W. Paterson

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hours of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some key cases, may find it impossible in such instances, they are specially requested to mark opposite their reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Wet-thermometer glasses* and *aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment* or *compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-inches* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the *water-line* on this little piston-rod is brought by the adjusting screw, to *join one exactly line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary* setting must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the cistern.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be covered so as to form a tight plug to the cistern. Then *step up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slump* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *level*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted: the tube must then be gently tapped and the *disen-* adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box, painted to the outside and inside and fixed 4 feet above grass in an exposed position, free from nearby local influences. The bulbs forming the sides and doors of the Boxes are arranged so as to be "protected" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-sticks, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians, *Self-registering Thermometers*.—Professor Phillips, and Negretti and Zambra's Patent "Maximum" Thermometers are recommended: printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Rothford is recommended when graduated on the glass stem and affixed to a frame separate from the "Maximum." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by stirring. When the column of spirit breaks it may be re-united by stirring the instrument repeatedly against the palm of the hand; when part of the spirit disals by high temperature, it will be found near the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "Maximum" should be freely exposed to the sun, and the "Minimum" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Registration of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers are *not* graduated on the stem, but merely on an attached scale, under repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "Minimum" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested* form of this apparatus seriously vitiate the "Hygrometrical Predictions," Observers are specially requested to attend to the following conditions:—The bulbs must *not* hang down by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulbs—the mesh must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the mesh is always *clean* and *moist*, and the water pure. In frosty weather, observation is unobtainable of delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances. One form of "Nelson's" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water-cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39°·9, 40°·0, or 40°·1; or again, 40°·4, 40°·5, or 40°·6, according as it indicates a little under, an exact coincidence with, or a little over 40°; or 40½° respectively. So also 40½°, and 40¾°, more or less must be registered 40°·2 or 40°·3, and 40°·7 or 40°·8 respectively. In reading Ruthford's "Max" and "Min" Thermometers, the indication of that end of the index which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry bulbs, must be rapidly taken, being so readily affected by heat from the person of the observer, being so readily affected by heat from the person of the observer.

Hours of observing Temperature.—The Thermometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 2d are those of a series of phenomena commencing at 9 P.M. on the 2d, and extending till 9 P.M. on the 3d.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, etc. Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is especially recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, *Lind's* Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Remarks.—Many causes conspire to produce anomalies in rain returns. They arise, partly, from uniform estimation for observation, and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass round its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may, for convenience, be registered in the rain columns, under the following conditions:—When a Snow shower occurs it must be noted in the "Remarks," and the letter S affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations* only; and nothing that particles of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the *clouds* column, though their appearance and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 A.M. and sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity and Direction," 6 S. W. (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S. W., and those in the lower regions from W., with one-third the (*extreme*) speed of the former. Again, in the second "Cloud" column, an entry of 4, st., (*eg.*) will indicate that the higher regions are covered to the "amount" of 4 tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2 tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column. **Underground Thermometers.**—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and consistency,—the Council recommend that observations in this interesting department be made at 9 A.M., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council, therefore, recommend that the temperature of the sea be carefully taken, by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When conveniently extra sea observations might be taken for other and generally judiciously, adding always the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted. **Ozone.**—Mention whether Schönbren's or Mofett's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—Thus 8½%, as an *ozone* entry in the schedule, will indicate that the ozone paper is tinted as 8½% on the scale, that the wind is as 4½%, and that its force on the scale 0—6 is as 4½%, that it is *blowing fresh*.

Electricity.Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "Remarks" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognized and in use at Greenwich, and Southampton, are given at the foot of the column. Besides special and extraordinary observations, great preference ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms of wind attaining their maximum, as well as such notes on storms as have been limited at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, otherwise unoccupied, or in two ruled off for the purpose, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner, or on the side-margin. Additional remarks may be made on the margin.

Observations in connection with the periodic return of the seasons, possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on selected pieces of ground or farm.

The Council recommend that *ten day* observations be taken; viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers. The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary, and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

Edinburgh, 20th November 1870.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Farch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

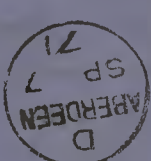
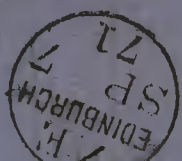
SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bouquet or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crake,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

EDINBURGH.

General Post Office Buildings, Secretary of the Meteorological Society of Scotland

MR ALEXANDER BUCHAN,



Book-Post.
August 1871

The Hours of Observation are of Greenwich Time.

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb , (Cols. 9 and 11), = 50.3									
Mean (corrected) A.M. and P.M. Reading of Wet Bulb , (Cols. 10 and 12), = 47.9									
‡ Computed Temperature of Dew-Point , = 45.6									
‡ Do. Elastic Force of Vapour , = 3.04									
‡ Do. Weight of Vapour in a Cubic Foot of Air , ... =									
‡ Relative Humidity , (Saturation = 100), = 84									
RAIN fell on 10 Days ; Amount in Inches, = 3.46									

WIND.		SUMMARY.									
Direction.	N	NE	E	SE	S	SW	W	NW	Chimn or Variable.	Mean Force.	Mean Velocity in miles per day.
A.M.		2	5				13	3		1.10	
P.M.		2	7			2	3	3	1	1.20	
Mean.	0	2	6	0	0	1	8	3	1	1.15	13.2

115
17

459

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS.

WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Returns from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will, by their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Table published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a day for some, and once (morning or evening) for other instruments, as specified in the following remarks. It is hoped that the instruments will be punctually in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses and Anemoids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment or compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Aitch of London, the use of which is attended with the great convenience of requiring no *adjustment* of the cistern. Its *scale-sticks* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of lead, and this, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes *frankly* into the piston-rod is brought, by the adjusting screw, to *form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary setting* must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *vernier*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *serve up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern uppermost. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slight top* is produced. If this is prevented by air, it may be removed to the cistern, and got rid of by inverting the Barometer (once being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *level*, which may be improved by putting a piece of white paper *behind* the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted: the tube must then be gently tapped, and the cistern adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the *vernier*, which must be index;—usually the lower edge of the *vernier*, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a Box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from every local influence. The laths forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the Box, and face the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians, *Self-registering Thermometers*.—Professor Phillips, and Negretti and Zamboni's Patent "Maximum" Thermometers are recommended: printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Rutherford is recommended when graduated on the glass stem and attached to a frame separate from the "Maximum." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand, when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "Maximum" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; nor the sun's heat to affect the Minimum Thermometer by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers as are *not graduated* on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "Minimum" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Society.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and well-tested form of this apparatus seriously vitiate the "Hygrometrical Deductions" Observers are specially requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulb;—the mistin must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the mistin is always *clean and moist*, and that the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances. One form of "Hasson's" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water cup underneath. This arrangement it is to be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the forementioned requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index, or *column* of mercury. The reading site the Thermometer will be $28^{\circ} 23' 24''$ $28^{\circ} 24' 24''$ $28^{\circ} 25' 24''$ $28^{\circ} 26' 24''$ $28^{\circ} 27' 24''$ $28^{\circ} 28' 24''$ $28^{\circ} 29' 24''$ $28^{\circ} 30' 24''$ $28^{\circ} 31' 24''$ $28^{\circ} 32' 24''$ $28^{\circ} 33' 24''$ $28^{\circ} 34' 24''$ $28^{\circ} 35' 24''$ $28^{\circ} 36' 24''$ $28^{\circ} 37' 24''$ $28^{\circ} 38' 24''$ $28^{\circ} 39' 24''$ $28^{\circ} 40' 24''$ $28^{\circ} 41' 24''$ $28^{\circ} 42' 24''$ $28^{\circ} 43' 24''$ $28^{\circ} 44' 24''$ $28^{\circ} 45' 24''$ $28^{\circ} 46' 24''$ $28^{\circ} 47' 24''$ $28^{\circ} 48' 24''$ $28^{\circ} 49' 24''$ $28^{\circ} 50' 24''$ $28^{\circ} 51' 24''$ $28^{\circ} 52' 24''$ $28^{\circ} 53' 24''$ $28^{\circ} 54' 24''$ $28^{\circ} 55' 24''$ $28^{\circ} 56' 24''$ $28^{\circ} 57' 24''$ $28^{\circ} 58' 24''$ $28^{\circ} 59' 24''$ $28^{\circ} 60' 24''$ $28^{\circ} 61' 24''$ $28^{\circ} 62' 24''$ $28^{\circ} 63' 24''$ $28^{\circ} 64' 24''$ $28^{\circ} 65' 24''$ $28^{\circ} 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SCOTT
Ballater

Aberdeen

During the MONTH of October 1871

The Hours of Observation are of Greenwich Time.

BAROMETER, "corrected Mean" at 9 A.M., <i>minus</i> the Correction $\uparrow \uparrow$	=	29.031
for Temp. (Col. 2), = 29.093 - 0.062		
"Corrected Mean" of Barometer at 9 P.M., <i>minus</i> the Correction $\uparrow \uparrow$	=	29.053
for Temp. (Col. 4), = 29.117 - 0.064		
Mean at Station, corrected, and at 32°,.....	=	29.042
Correction for height, feet above Mean Sea-level,.....	=	715
Mean, reduced to 32°, and Sea-level,.....	=	29.757
Highest Reading, corrected for Index error, on the 10th,.....	=	29.620
Lowest Do. Do., on the 1 th,.....	=	28.450
Difference, or Monthly Range,	=	1.220

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb , (Cols. 9 and 11),	=	46.3
Mean (corrected) A.M. and P.M. Reading of Wet Bulb , (Cols. 10 and 12),	=	43.8
†† Computed Temperature of Dew-Point ,	=	40.9
†† Do. Elastic Force of Vapour ,	=	256
†† Do. Weight of Vapour in a Cubic Foot of Air , ...	=	
†† Relative Humidity , (Saturation = 100),	=	83
RAIN fell on 12 Days ; Amount in Inches,	=	5.22

Observations made and
Return verified by

Jas. W. Paterson
Ballantyne

J. A. Petersen

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

One of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarities in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hour of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified, in the following remarks, or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite in their reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *Aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment or compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-inches* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their case being freely through the lid and case of the cistern. When seen pass freely through the lid and case of the cistern. When the *index-tube* on this little piston-rod is brought, by the adjusting screw, *to form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, this *preliminary setting* must be made with scrupulous accuracy; as a slight error here will vitiate the readings from the *vernier*.

When a Barometer, having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. The *index* must be removed to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern upright. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on bringing the instrument so that the mercury strikes the top of the tube, a *slight tap* is produced. If this is prevented by air it may be removed to the cistern, and got rid of by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *light*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted; the tube must then be gently tapped and the cistern-adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly; so as to prevent heat from the observer's hands and person from affecting the instrument and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that self-registering Thermometers and Hygrometers be enclosed in a box, painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from merely local influences. The lids forming the sides and doors of the Boxes are arranged so as at once to "protect" the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-laths, in the centre of the box, and the door opening to the north. No accommodative door hinged set open to the south. These Boxes may be had from the Principals, Negretti and Zambra's Patent "Maximum" Thermometers, and recommended; printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Rutherford is recommended when graduated on the glass stem and affixed to a frame separate from the "Maximum." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the spirit distils by high temperature, it will be found near the top of the tube, and must be discoloured from thence by heating that part over a lamp; the alcohol will evaporate, and the spirit condense in contact with the body of the liquid.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes whose sides protect the bulbs from the wind. The "*Maximum*" should be freely exposed to the sun, and the "*Minimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; for the sun's heat to affect the Minimum Thermometer by radiation.

Position of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers as are *not graduated* on the stem, but merely on an attached scale, undergo repairs they are very liable to be moved from their position on the Scales, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "*Minimum*" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice, for comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The *Hygrometer* consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested* form of this apparatus specially vitiate the "Hygrometrical Deductions," Observers are specially requested to attend to the following conditions:—

The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side and a little below the level of the wet bulb;—in no case under the bulbs;—the machine must be of medium fineness, and fastened at the neck of the bulb by the cotton, which also supplies it with water. It must be seen to by the observer that the machine is always *clean and moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be immersed by immersion from 15 to 30 minutes before the hour of observation. From the fit cloth in ordinary circumstances, will proceed as from the fit cloth in ordinary circumstances.

One form of "Minimum" Hygrometer is highly objectionable. The frame of the Thermometers is enclosed in a tin case, which also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the recommended requirements shall be complied with, as far as possible.

Reading of the Thermometer.—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals, again, 40° 4, 40° 5, or 40° 6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40° 5 respectively. So also 40½°, and 40¾°, more or less must be registered 40° 2 or 40° 3, and 40° 7 or 40° 8 respectively. In reading Rutherford's "*Max*," and "*Min*," Thermometers, the indication of that end of the *index* which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry *bulbs*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observing Temperature.—The Hygrometer is read at 9 A.M. and 9 P.M. The self-registering Thermometers are read at 9 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their concurrence to their proper meteorological day. In the Society's schedules, the indications registered on the 24 are those of a series of phenomena commencing at 9 P.M. on the 24, and extending till 9 P.M. on the 24.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, &c.

Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical Cup Anemometer—a self-registering instrument which shows the amount of Wind that passes it per day; from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Rain-gauges.—Many causes conspire to produce anomalies in rain returns. They arise, partly from unfavorable situation for observation and partly from the defective nature of the instruments used. It is, indeed, difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may be measured, he registered in the rain columns, under the following conditions:—When a Snow shower occurs it must be noted in the "Remarks," and the letter S affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot too carefully register *observations only*; and nothing that partakes of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the cloud column, though their appearance and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 A.M. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity 6, S. W." (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the (extreme) speed of the former. Again, in the second "Cloud" column, an entry of 2, on-st., (eq.) will indicate that the higher regions are covered to the "amount" of 4-tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2-tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column. Under *pendulum Thermometers*, As the germination and health of crops and plants greatly depend on the temperature of the soil—its amount and consistency—the Council recommend that observations in this interesting department be made at 9 A.M. by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with stopping iron collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relation to that of our island, a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus from the ends of piers and rocks round the coast, where it is not influenced by that of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient, extra sea observations might be taken for other and greater depths, noting always the temperature of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well noted. *Crops.*—Mention whether Schimper's or Board's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indications registered at 9 A.M. and 9 P.M. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—thus 8½", as an *average* entry in the schedule, will indicate that the ozone paper is fired as "3" on the scale, 0-6 is "4 1/2", that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory.

Remarks.—The "Remarks" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column.

Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, &c. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms of wind attaining their maximum, as well as such notes on storms as have been hinted at above. When lofty hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, otherwise unoccupied, or in a note off for the purpose, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner on the side-marginal. Additional remarks may be made on the margin of the seasons' possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena; that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *ten day* observations be taken;—viz., on the 21st days of March, June, September, and December. Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers.

The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary; and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

Edinburgh, 10th November 1870. (By Order) A. B.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Disseal of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Out or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crane,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

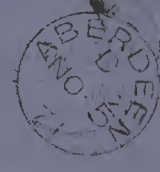
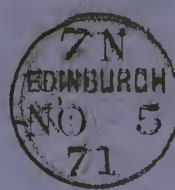
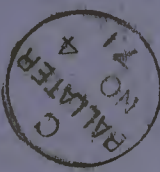
EDINBURGH.

General Post Office Buildings,

Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

To.



Ballater
Oct. 1871-

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Salisbury, County of Wiltshire, in Lat. 51° 12' N, Long. 2° 22' W, Distance from Sea 43 miles.
Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 4 feet.

During the MONTH of November 1871.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS.				HYGROMETER.				WIND.				RAIN.		CLOUDS.				SUNSHINE.	THERMOMETERS under Ground.			SEA.	OZONE.	GENERAL REMARKS.	Days of Month.		
		9 h. A.M.		9 h. P.M.		Protected in Shade, 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 h. A.M.											
		Barometer.	Attached Ther- mometer.	Barometer.	Attached Ther- mometer.	Max.	Min.	Max.	Min.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.	Velocity (0-10), and Direction.	Amount, and Species.	Velocity (0-10), and Direction.	Amount, and Species.	No. 1 inches.	No. 2 inches.		No. 3 inches.								
		* No.	°	No.	°	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.		No.	No.							
	1	29.50052	29.50052	47.539	47.539			46	43	42.5	41	71	1.5					27	10.00										Atm. chilly damp				
	2	29.60052	29.60052	44.38	44.38			43.5	42	41	40			77	0.5			27	10.00										fine mist cont.	1			
	3	29.55051	29.55051	44.375	44.375			41	40	39.5	38	87	0.5																chilly cold	2			
	4	29.55049	29.57049	42.365	42.365			40	38.5	37.5	37		2																very cold wind	3			
	5	29.55048	29.45049	41.5345	41.5345			40	39	39	38	88	2					27	10.00												5		
	6	29.20047	29.05049	44.35	44.35			39	38.5	42	40	80	0.5	88	1.5			27	10.00	27	10.00								dull damp	5			
	7	28.85047	28.55048	43.537	43.537			41	40	40.5	39	77	0.5					27	10.00										one rain	6			
	8	28.60047	28.65045	44.32	44.32			39	36	38	36	87	2					27	10.00										very cold misty frosty	7			
	9	28.70042	28.60042	45.32	45.32			35	34.5	35	34	77	1.5	77	2			27	10.00	27	10.00								snow on ground	8			
	10	28.65043	28.80042	41.5308	41.5308			37.5	36	34	33		2																slight dull	9			
	11	29.00042	29.05043	40.5315	40.5315			38.5	37.5	38	36																		quiet very cold	10			
	12	29.10042	29.32042	39.526	39.526			34.5	33	29.5	28							27	10.00										dull chilly snowing	11			
	13	29.45041	29.25041	40.215	40.215			27.5	39.5	37			0.71	2															clear frosty	12			
	14	28.95044	28.80044	50.526	50.526			47	45.5	40.5	39	87	4					27	10.00										blowing very hard mist	13			
	15	28.98046	29.20046	46.29	46.29			43.5	41	36	34.5	82	2					38	10.00										cold damp frosty	14			
	16	29.30043	29.15044	42.29	42.29			37	35	36	34	87	1.5	82	2			27	10.00										dull chilly snowing	15			
	17	29.30042	29.40042	42.27	42.27			31		33								27	10.00										quiet very cold frosty	16			
	18	29.40042	29.48042	43.21	43.21			33																						calm frosty	17		
	19	29.40042	29.38042	43.22	43.22			39	37	42	41	0.71	2	87	3			27	10.00	27	10.00								fresh breeze soft chilly	18			
	20	29.20045	29.20046	46.305	46.305			46	43.5	42.5	41		3					27	10.00										one thaw but no rain	19			
	21	29.15046	29.15044	45.5305	45.5305			39.5	38	35.5	33.5	82	0.5																	very cold	20		
	22	29.12043	29.15043	40.525	40.525			36	35	29	28		1.5					27	10.00											snowing cold frosty	21		
	23	29.20042	29.20038	40.26	40.26			24		28		77	0.5	77	0.5			27	10.00											very hard frost	22		
	24	29.20036	29.25038	40.523	40.523			27		30			1.5					27	10.00											misty frost clear cold	23		
	25	29.35039	29.40040	37.529	37.529			33		32.5			8	2				27	10.00											cloudy fresh looking	24		
	26	29.45042	29.50042	40.35	40.35			38.5	37.5	36.5	35.5	88	0.5																	drizzle	25		
	27	29.50042	29.50041	39.533	39.533			37	35	35	34	81						27	10.00											cold wind clearing	26		
	28	29.45042	29.40044	41.532	41.532			39	38	39	37.5							27	10.00											glowing dull snowing	27		
	29	29.35042	29.40043	42.33	42.33			49.5	37	36.5	34	88	1.5					27	10.00											chilly	28		
	30	29.45041	29.50042	40.31	40.31			38.5	36	37.5	36		1.5					27	10.00											frosty	29		
	31																																30
Sums.		29.55042	29.55042	42.21	42.21			16.5	12.5	18.5	12.5			32.5	15.5			2.22															
Means.		29.23542	29.23542	42.130	42.130			37.638	36.736	1.55	1.55																						
† Total Corrections for Instrumental Errors.																																	
‡ Corrections for Diurnal Range.																																	
“Corrected Means.”																																	
No. of Column.		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		

NOTATION USED IN GENERAL REMARKS.

a.	aurora.	m.	meteor.
ci.	cirrus.	ms.	meteors.
ci-cu.	cirro-cumulus.	n.	nebulae.
cu.	cumulus.	r.	rain.
cu-s.	cumulo-stratus.	h.r.	heavy rain.
d.	dew.	c.h.r.	continued heavy rain.
f.	fog.	s.	stratus.
fr.	frost.	sc.	scud.
h.	haze.	sl.	sleet.
h-fr.	hoar-frost.	sn.	snow.
h.d.	heavy dew.	so. ha.	solar halo.
hl.	hail.	sq.	squall.
li.	light.	sq.s.	squalls.
li-cl.	light clouds.	t.	thunder.
li.sh.	light showers.	t.s.	thunder storm.
lu. co.	lunar corona.	w.	wind.
lu. ha.	lunar halo.	g.	gale of wind.

TABLE FOR ESTIMATING FORCE OF WIND.

Estimated Force, 0-6.	Common Designation.	Estimated Force, 0-6.	Common Designation.	Estimated Force, 0-6.	Common Designation.
0	Calm	1.5	Light breeze	4	Blowing hard
0.5	Very light air	2	Fresh breeze	5	Blowing a gale
1	Light air	3	Very fresh	6	Violent gale

BAROMETER, “corrected Mean” at 9 A.M., minus the Correction†† = 29.194
for Temp. (Col. 2), = 29.235 — 0.041
“Corrected Mean” of Barometer at 9 P.M., minus the Correction†† = 29.191
for Temp. (Col. 4), = 29.231 — 0.041
Mean at Station, corrected, and at 32° = 29.192
Correction for height, feet above Mean Sea-level, = 7.1
Mean, reduced to 32°, and Sea-level, = 29.224
Highest Reading, corrected for Index error, on the 2. th, = 29.600
Lowest Do. Do. on the 8. th, = 28.600
Difference, or Monthly Range, = 1.000

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 14. th, = 50.5
Lowest in Month, corrected for Index errors, on the 18. th, = 21.0
Difference, or Monthly Range, = 29.5
“Corrected Mean” of all the Highest, (Col. 5), = 42.4
“Corrected Mean” of all the Lowest, (Col. 6), = 30.4
Difference, or Mean Daily Range, = 12.0
** Calculated Mean Temperature of Month, = 26.4
S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the . th, =
“Corrected Mean,” (Col. 7), of Black Bulb, Max. in Sun, =
Lowest at Night, Black Bulb, (corrected for Index errors), on the . th, =
“Corrected Mean,” (Col. 8), of Black Bulb, Min. on grass, =
Difference of above Means or Range (“exposed”), =

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 37.2
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), =
†† Computed Temperature of Dew-Point, =
†† Do. Elastic Force of Vapour, =
†† Do. Weight of Vapour in a Cubic Foot of Air, =
†† Relative Humidity, (Saturation = 100), =
RAIN fell on 9 Days; Amount in Inches, = 1.02
WIND. SUMMARY.
Direction. N NE E SE S SW W NW Calm or Variable. Mean Force. Mean Velocity in miles per day.
A.M. 1 1 2 3 2 1 1 55
P.M. 3 3 4 2 5 4 1 55
Means 7 2 5 0 0 3 4 3 0

N.B.—The Sums to be correctly added and the Means deduced. Returns from the “Principal Towns” should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Grammed or Fastened, and Forwarded by Book Post, prepaid.

Observations made and Return verified by James Watson
Salisbury

(Signed)

WITH REMARKS ON THE USE OF INSTRUMENTS.

from radiation during night. The thermometer outside is a *Thermometer* which may easily be made, or, maintained, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "*Maximum*" should be freely exposed to the sun, and the "*Minimum*" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Show must not be allowed to cover either of these *Thermometers*. The sun's heat to affect the *Minimum Thermometer* by distillation.

Verification of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully used for comparison with a *Standard Thermometer*. When such *Thermometers* are not graduated on the stem, or, merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-Checked*. The self-registering, and especially the "*Minimum*" *Thermometers*, ought frequently to be compared with the dry bulb of the *Hygrometer*. On freezing-point of each *Thermometer* (marked by a scratch on

The *Hygrometer* consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus seriously vitiate the "Hygrometrical Deductions," Observers are specially requested to attend to the following conditions:

The built must *hang down* by at least an inch from both sides of the frame. The built must be made of a material that is not so soft as to be deformed by the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, must be so board on which it may be supported; the water-cup must be covered, and placed to the side, and a little below the level of the built;—in no case under the built;—the mshin must be of a medium fineness, and fastened at the neck of the built by the cotton, which also supplies it with water. It must be seen to by the observer that the mshin is always *clean* and *moist*; and that

water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion from 15 to 30 minutes before the hour

of observation. From the film of ice thus formed evaporation

The frame of the water cup underneath. This arrangement must also immediately altered by pulling the boxwood frame out of the cases, and hanging them side by side, so that the aforementioned requirements shall be complied with as far as possible.

Radix of the Theorem—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The readings ought to be taken to tenths of a degree and noted in decimals. The thermometer will be read—89.9°, 40.0° or 40.1°, 40.2°, 40.3°, 40.4°, 40.5°, 40.6°, 40.7°, 40.8°, 40.9°, 41.0°, 41.1°, 41.2°, 41.3°, 41.4°, 41.5°, 41.6°, 41.7°, 41.8°, 41.9°, 42.0°, 42.1°, 42.2°, 42.3°, 42.4°, 42.5°, 42.6°, 42.7°, 42.8°, 42.9°, 43.0°, 43.1°, 43.2°, 43.3°, 43.4°, 43.5°, 43.6°, 43.7°, 43.8°, 43.9°, 44.0°, 44.1°, 44.2°, 44.3°, 44.4°, 44.5°, 44.6°, 44.7°, 44.8°, 44.9°, 45.0°, 45.1°, 45.2°, 45.3°, 45.4°, 45.5°, 45.6°, 45.7°, 45.8°, 45.9°, 46.0°, 46.1°, 46.2°, 46.3°, 46.4°, 46.5°, 46.6°, 46.7°, 46.8°, 46.9°, 47.0°, 47.1°, 47.2°, 47.3°, 47.4°, 47.5°, 47.6°, 47.7°, 47.8°, 47.9°, 48.0°, 48.1°, 48.2°, 48.3°, 48.4°, 48.5°, 48.6°, 48.7°, 48.8°, 48.9°, 49.0°, 49.1°, 49.2°, 49.3°, 49.4°, 49.5°, 49.6°, 49.7°, 49.8°, 49.9°, 50.0°, 50.1°, 50.2°, 50.3°, 50.4°, 50.5°, 50.6°, 50.7°, 50.8°, 50.9°, 51.0°, 51.1°, 51.2°, 51.3°, 51.4°, 51.5°, 51.6°, 51.7°, 51.8°, 51.9°, 52.0°, 52.1°, 52.2°, 52.3°, 52.4°, 52.5°, 52.6°, 52.7°, 52.8°, 52.9°, 53.0°, 53.1°, 53.2°, 53.3°, 53.4°, 53.5°, 53.6°, 53.7°, 53.8°, 53.9°, 54.0°, 54.1°, 54.2°, 54.3°, 54.4°, 54.5°, 54.6°, 54.7°, 54.8°, 54.9°, 55.0°, 55.1°, 55.2°, 55.3°, 55.4°, 55.5°, 55.6°, 55.7°, 55.8°, 55.9°, 56.0°, 56.1°, 56.2°, 56.3°, 56.4°, 56.5°, 56.6°, 56.7°, 56.8°, 56.9°, 57.0°, 57.1°, 57.2°, 57.3°, 57.4°, 57.5°, 57.6°, 57.7°, 57.8°, 57.9°, 58.0°, 58.1°, 58.2°, 58.3°, 58.4°, 58.5°, 58.6°, 58.7°, 58.8°, 58.9°, 59.0°, 59.1°, 59.2°, 59.3°, 59.4°, 59.5°, 59.6°, 59.7°, 59.8°, 59.9°, 60.0°, 60.1°, 60.2°, 60.3°, 60.4°, 60.5°, 60.6°, 60.7°, 60.8°, 60.9°, 61.0°, 61.1°, 61.2°, 61.3°, 61.4°, 61.5°, 61.6°, 61.7°, 61.8°, 61.9°, 62.0°, 62.1°, 62.2°, 62.3°, 62.4°, 62.5°, 62.6°, 62.7°, 62.8°, 62.9°, 63.0°, 63.1°, 63.2°, 63.3°, 63.4°, 63.5°, 63.6°, 63.7°, 63.8°, 63.9°, 64.0°, 64.1°, 64.2°, 64.3°, 64.4°, 64.5°, 64.6°, 64.7°, 64.8°, 64.9°, 65.0°, 65.1°, 65.2°, 65.3°, 65.4°, 65.5°, 65.6°, 65.7°, 65.8°, 65.9°, 66.0°, 66.1°, 66.2°, 66.3°, 66.4°, 66.5°, 66.6°, 66.7°, 66.8°, 66.9°, 67.0°, 67.1°, 67.2°, 67.3°, 67.4°, 67.5°, 67.6°, 67.7°, 67.8°, 67.9°, 68.0°, 68.1°, 68.2°, 68.3°, 68.4°, 68.5°, 68.6°, 68.7°, 68.8°, 68.9°, 69.0°, 69.1°, 69.2°, 69.3°, 69.4°, 69.5°, 69.6°, 69.7°, 69.8°, 69.9°, 70.0°, 70.1°, 70.2°, 70.3°, 70.4°, 70.5°, 70.6°, 70.7°, 70.8°, 70.9°, 71.0°, 71.1°, 71.2°, 71.3°, 71.4°, 71.5°, 71.6°, 71.7°, 71.8°, 71.9°, 72.0°, 72.1°, 72.2°, 72.3°, 72.4°, 72.5°, 72.6°, 72.7°, 72.8°, 72.9°, 73.0°, 73.1°, 73.2°, 73.3°, 73.4°, 73.5°, 73.6°, 73.7°, 73.8°, 73.9°, 74.0°, 74.1°, 74.2°, 74.3°, 74.4°, 74.5°, 74.6°, 74.7°, 74.8°, 74.9°, 75.0°, 75.1°, 75.2°, 75.3°, 75.4°, 75.5°, 75.6°, 75.7°, 75.8°, 75.9°, 76.0°, 76.1°, 76.2°, 76.3°, 76.4°, 76.5°, 76.6°, 76.7°, 76.8°, 76.9°, 77.0°, 77.1°, 77.2°, 77.3°, 77.4°, 77.5°, 77.6°, 77.7°, 77.8°, 77.9°, 78.0°, 78.1°, 78.2°, 78.3°, 78.4°, 78.5°, 78.6°, 78.7°, 78.8°, 78.9°, 79.0°, 79.1°, 79.2°, 79.3°, 79.4°, 79.5°, 79.6°, 79.7°, 79.8°, 79.9°, 80.0°, 80.1°, 80.2°, 80.3°, 80.4°, 80.5°, 80.6°, 80.7°, 80.8°, 80.9°, 81.0°, 81.1°, 81.2°, 81.3°, 81.4°, 81.5°, 81.6°, 81.7°, 81.8°, 81.9°, 82.0°, 82.1°, 82.2°, 82.3°, 82.4°, 82.5°, 82.6°, 82.7°, 82.8°, 82.9°, 83.0°, 83.1°, 83.2°, 83.3°, 83.4°, 83.5°, 83.6°, 83.7°, 83.8°, 83.9°, 84.0°, 84.1°, 84.2°, 84.3°, 84.4°, 84.5°, 84.6°, 84.7°, 84.8°, 84.9°, 85.0°, 85.1°, 85.2°, 85.3°, 85.4°, 85.5°, 85.6°, 85.7°, 85.8°, 85.9°, 86.0°, 86.1°, 86.2°, 86.3°, 86.4°, 86.5°, 86.6°, 86.7°, 86.8°, 86.9°, 87.0°, 87.1°, 87.2°, 87.3°, 87.4°, 87.5°, 87.6°, 87.7°, 87.8°, 87.9°, 88.0°, 88.1°, 88.2°, 88.3°, 88.4°, 88.5°, 88.6°, 88.7°, 88.8°, 88.9°, 89.0°, 89.1°, 89.2°, 89.3°, 89.4°, 89.5°, 89.6°, 89.7°, 89.8°, 89.9°, 90.0°, 90.1°, 90.2°, 90.3°, 90.4°, 90.5°, 90.6°, 90.7°, 90.8°, 90.9°, 91.0°, 91.1°, 91.2°, 91.3°, 91.4°, 91.5°, 91.6°, 91.7°, 91.8°, 91.9°, 92.0°, 92.1°, 92.2°, 92.3°, 92.4°, 92.5°, 92.6°, 92.7°, 92.8°, 92.9°, 93.0°, 93.1°, 93.2°, 93.3°, 93.4°, 93.5°, 93.6°, 93.7°, 93.8°, 93.9°, 94.0°, 94.1°, 94.2°, 94.3°, 94.4°, 94.5°, 94.6°, 94.7°, 94.8°, 94.9°, 95.0°, 95.1°, 95.2°, 95.3°, 95.4°, 95.5°, 95.6°, 95.7°, 95.8°, 95.9°, 96.0°, 96.1°, 96.2°, 96.3°, 96.4°, 96.5°, 96.6°, 96.7°, 96.8°, 96.9°, 97.0°, 97.1°, 97.2°, 97.3°, 97.4°, 97.5°, 97.6°, 97.7°, 97.8°, 97.9°, 98.0°, 98.1°, 98.2°, 98.3°, 98.4°, 98.5°, 98.6°, 98.7°, 98.8°, 98.9°, 99.0°, 99.1°, 99.2°, 99.3°, 99.4°, 99.5°, 99.6°, 99.7°, 99.8°, 99.9°, 100.0°, 100.1°, 100.2°, 100.3°, 100.4°, 100.5°, 100.6°, 100.7°, 100.8°, 100.9°, 101.0°, 101.1°, 101.2°, 101.3°, 101.4°, 101.5°, 101.6°, 101.7°, 101.8°, 101.9°, 102.0°, 102.1°, 102.2°, 102.3°, 102.4°, 102.5°, 102.6°, 102.7°, 102.8°, 102.9°, 103.0°, 103.1°, 103.2°, 103.3°, 103.4°, 103.5°, 103.6°, 103.7°, 103.8°, 103.9°, 104.0°, 104.1°, 104.2°, 104.3°, 104.4°, 104.5°, 104.6°, 104.7°, 104.8°, 104.9°, 105.0°, 105.1°, 105.2°, 105.3°, 105.4°, 105.5°, 105.6°, 105.7°, 105.8°, 105.9°, 106

indication that end on the *32* and *34* are alone noted. Readings of the mercury or alcohol in the thermometers, especially of the new and *Reinhold's*, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hour of observation.—Thermometer.—The Hygrometer is read at 9 A.M. and at 3 P.M. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the thermes may occur at any hour; and it is necessary to effect their occurrence to their proper meteorological place in the Society's schedules, the indications registered on the *2d*, *3d* and *4th* extending till 9 P.M. on the *32*.

Wind.—A wind-vane ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feeble, reference must be made to the

direction of the lower strata of clouds overhead, and to the direction of smokes, etc.

Careful observations ought to be made on the changes in the direction of the wind; and during storms, it is earnestly recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation pursued at different Stations would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a *Hertschfeld-Gun Anemometer*—a self-registering

ing instrument which shows the amount of Wind that passes over a certain area in a certain period; from which also the Velocity of the Wind as the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, manifestly false.

Many causes conspire to produce anomalies in *Barometrical* Theory arise partly from unfavorable situations for observation and partly from the defective nature of the instruments used. It is indeed, difficult to obtain an exact—

tionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day

Snowfalls may, *for convenience*, be registered in the rain columns, under the following conditions:—When a Snow shower occurs it must be noted in the “Remarks,” and the letter S affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift

is observed, and registered in addition to, and as a check upon, the observations of the rain-gauge. For wind, rain, and snow, as the indications of the rain-gauge. The observer cannot be too careful to record in every column, the observer cannot be too careful to register *observations only*; and nothing that partakes of the nature of *deduction or inference*.

Clouds.—Convenient abbreviations for Luke Howard's

amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (*z*), within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, you ought not to take them into account in the clouds' column, though their appearances and changes ought to be noted among the *ci* *Parasels*. The amount of cloud is inferred from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on. Observations of the clouds are made at 9 A.M. and at sunset.

as illustrating the condition and currents of the upper strata of the atmosphere. The entries in the table are to be read in the following manner:—In the column "Velocity and Direction," $\frac{2}{3}$ S. W.; (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S. W. to N. E. at the rate of $\frac{2}{3}$ of the velocity of the wind, and those in the lower regions from W. with one-third the $\frac{2}{3}$ (*extreme*) speed of the former. Again, in the second column, an entry of $\frac{2}{3}$ S. (*eq.*) will indicate that the higher $\frac{2}{3}$ of clouds are covered to the "amount" of 4-thirds with *stratus* clouds; and that the sky is further observed to the extent of 1-third to be covered with *stratus* clouds.

2-genius bryoflorous of the *temnocalyx* group. *Arctia* *Stenobothrus*.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the 'proy-ctum' and 'health' columns.

Underground Nomenclature.—As the germination of the seeds of crops and plants greatly depend on the temperature of the soil,—its amount and consistency,—the Council has adopted the following observations in this interesting department.

Thermometers placed in the earth, their bulbs being sunk 3, 6, 9, 12, and 22 inches, and the stems above ground, will present with the sun's rays, and fitted with stoping tin collars, to prevent frost-water being conveyed to the bulbs by the stems or pollen fringes.

Mention must be made of the geological formation and agricultural condition of the soil in which these thermometers are placed.

Table 1.—A new table of the thermometer of Fahrenheit's

Temperature of the Sea.—It is now, less of the temperature of the sea is not only in itself, but in its relations to that of climate, and therefore a very important branch of Meteorology. The Council, therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the existence of which, and from the observations of the surface currents, of waters and rocks round the coast, where it is not influenced by the wind of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes elapsed, drawn up and read. When convenient, extra sea observations might be taken, and the temperature of the surface of the water, and of the air, and the hour of observation; and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted.

Zones.—Mention whether the *zozones* of Meibitt's papers are used. The paper is affixed by a pin to a board in the meteorometer box, and the indications registered at 9 A.M. and 9 P.M.

It is desired that these indications be registered in connection with the force and direction of the wind, at the time of observation, in the following manner:—thus 2 N.W. , as an *ozone* entry in the schedule, will indicate that the *ozone* paper is turned 45° on the scale, that the wind is from the N.W., and that its force on the scale, that the wind is from the N.W., and that its force on the scale $0-6$ is $4 \frac{1}{2}$; that it is blowing fresh.

Electricity.—Too much importance cannot be attached to

Hermanns—The “*Hermanns*” column is too narrow, but not avoidably so. Some of the most valuable observations that can be taken are those for which no notes can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton are given at the foot of the column. Besides special and extraordinary observations, great prominence ought to be given in this column to prevent disease, differences of column velocity in different directions between the lower

in various colours, and the appearance of the sky, the position and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, hurricanes, storms, and remarkable falls of snow, hail, or rain, the hour of storms, and the direction of the wind, as well as such local disturbances of wind attaining their maximum, as well as such local storms as have been hinted at above. When July hills are noted on storms as have been hinted at above. When July hills are noted in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 A.M. and 9 P.M. ought to be registered, either in two columns, either twice unoccupied, or in two single for the purpose, from that which the following is intended. It is intended that observations by the

Electrometer art should be effected in such manner as to manage the instrument in the most judicious manner, and to make the most advantage of the instrument. Additional remarks may be made on the various parts of the instrument. "Observations in connection with the hydrologic return of the seasons" possess not only great scientific value, but also a high degree of detectable interest to the Agriculturist. The Council could direct the special attention of the Agriculturists to the registration of such phenomena; that the published Summaries may be sufficiently representative of the whole of Scotland. Observation ought to be confined to individual trees and shrubs, to particular species of birds; and, in the case of crops, to specified crops traced from year to year on a selected piece of ground or farm.

The Council recommend that *sem diu* observations be taken, viz., on the 1st days of March, June, September, and December.

Full attention to the use of the instrument should be given before it is allowed to be printed, and any that had along with them from the Meteorological Office should be sent to the Meteorological Office. The Meteorological Office should communicate with the Meteorological Office, and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. D.

Ensignment, 1916, November 1892.

Out-
ed.

Signature.

[illegible]

THE PERIODICAL RET		
	CROPS, mentioning variety.	Sowing or Planting.
	Barley,	
	Bere or Bigg, .	
	Oats,	
	Wheat,	
	Beans,	
	Pease,	
	Potatoes, . . .	
	Turnips,	
	Rye Grass, . . .	

[illegible]

OBSERVATIONS	
FOREST TREES.	
Allder,	
Ash,	
Beech,	
Birch,	
Elm,	
Larch,	
Lime,	
Oak,	
Sycamore or Plane,	

SHRUBS, ETC.

94

General Post Office Buildings,

MR ALEXANDER BOCHAN,

	In	Last Year		Directed of	CROPS	Sowing or	Annealing	In Ear	First C
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SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bountree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crane,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

DE 71
BALATER

SCOTTISH METEOROLOGICAL SOCIETY.

Observations taken at Railton, County of Aberdeen, in Lat. 57°12'N, Long. 2°12'W, Distance from Sea 40 miles.Height of Cistern of the Barometer above Mean Sea-level 660 feet, above Ground 4 feet.During the MONTH of December 1874.

The Hours of Observation are of Greenwich Time.

ELECTRICITY.	Days of Month.	BAROMETER.				SELF-REGISTERING THERMOMETERS. Read Daily, at 9 P.M.				HYGROMETER.				WIND.				RAIN.		CLOUDS.				THERMOMETERS under Ground.			SEA.	OZONE.	GENERAL REMARKS. As to occurrence of Thunder, Lightning, Storms, Hail, Meteors, Remarkable Depression or Elevation of Barometer, Prevalent Diseases, etc. Mention the hour at which Storms, including Thunder and Lightning, began and ended.	Days of Month.	
		9 h. A.M.		9 h. P.M.		Protected in Shade, 4 feet above Ground.		Exposed Black Bulbs.		9 h. A.M.		9 h. P.M.		9 h. A.M.		9 h. P.M.		9 A.M.		P.M.		9 h. A.M.									
		Barometer. No.	Attached Ther- mometer	Barometer. No.	Attached Ther- mometer	Max. No.	Min. No.	Max. in Sun's rays	Min. on Grass.	Dry bulb.	Wet bulb.	Dry bulb.	Wet bulb.	Direction.	Force.	Direction.	Force.	No. of hours in which it fell.	Amount in inches.	Velocity (0-10), and Direction.	Amount (0-10), and Direction.	Amount (0-10), and Direction.	No. 3 inches.	No. 12 inches.	No. 22 inches.						
		Inches.		Inches.																											
	1	29.550	41.5	29.600	42	38	33			39	33	35	33	8	0.5					2.8	5.0						a.m. cloudy & dull	1			
	2	29.400	40	29.350	41.5	39.5	29			38.5	35	34.5	33		8	0.5				6	10						" quite chilly	2			
	3	29.400	41	29.470	40.5	37	29			33	32	32	31.5						2.5								" very stormy	3			
	4	29.550	38	29.500	36	33.5	22			29		25		8	1.5	8	0.5				2.8	8	2.8				" very cold frosty	4			
	5	29.350	37	29.370	40	34.5	19			27		36	34	8	1.5				5.0								" softer	5			
	6	29.400	39	29.450	38	36	20			30		34.5	33			8.5	0.5				1.8	10					" hard frost	6			
	7	29.450	40	29.500	38	36	18.5			35.5	33	29		8	1.5												" overcast	7			
	8	29.550	34	29.500	39	37	14.5			28		34.5	33.5				1.5				2.8	8					" very hard frost	8			
	9	29.450	39.5	29.450	40	37.5	28			36.5	34	34.5	33			7	1.5			2.8	10						" quiet stormy	9			
	10	29.430	37	29.400	39.5	38.5	22			34.5	33	38	37	8.5	1.5												" cloudy softer	10			
	11	29.500	38	29.450	46	44.5	24			30		44	42		1.5	8	2		0.5	2.8	8	3	10				" very frosty snowing	11			
	12	29.450	41.5	29.450	48	46.5	35			40.5	39	41	39			8	2				2	10					" overcast	12			
	13	29.600	43	29.500	44	46	32			36	32	44.5	33			8	1.5			2.8	10						" quiet chilly	13			
	14	29.500	45.5	29.450	42	42.5	30.5			34.5	33	40.5	39	8	1.5												" overcast	14			
	15	29.350	42.5	29.400	42	44.5	31.5			39	37	38	34			8	0.5		2	8	10						" very cold wind	15			
	16	29.500	42.5	29.400	43	41	31			34.5	33	39	37			8	1.5	8	2								" fresh breeze	16			
	17	29.150	44.5	29.000	47	47	38			41.5	40	44.5	42			8	1.5			4.0	10						" gloomy clear cold	17			
	18	28.650	45	28.500	49	52	47			37		48.5	50.5	47			2		1.5	3							" chilly & dull	18			
	19	28.900	46.5	28.850	53	52	35			38.5	36	48	46			8	0.5	8	2								" sharp wind	19			
	20	28.700	52	28.750	49	43	31			39	36	38	35			8	1.5			2.8	10						" snowing heavy	20			
	21	28.900	41	29.000	40	40	19			35.5	35	32															" calm & fresh	21			
	22	29.200	39.5	29.400	40	40	23			30		42				8	2										" very gloomy & snow	22			
	23	29.050	38	29.020	42	43	14.5			31		43	41.5					8	2								" fine quiet clear	23			
	24	28.950	42	28.650	47	49.5	34			41.5	38	48	45			8	1.5										" frosty & gloomy	24			
	25	28.800	44	28.750	42.5	44.5	34			40	39	35	34							2.8	10						" gloomy fine	25			
	26	28.800	43	28.550	42	44.5	38.5			37.5	36	40.5	38			8	1.5		0.5								" snowing heavy	26			
	27	28.450	44.5	28.400	42.5	43	35			39	37	41.5	38				1.5		0.5								" very frosty	27			
	28	28.450	44.5	28.500	46	43	37			42	40	39	38.5			8	2		0.8	2.5		2.8					" light showers	28			
	29	28.650	43.5	28.700	44	43	30.5			34.5	33	42.5	40			8	1.5			2.8	10						" frosty quiet & cold	29			
	30	28.500	46	28.600	45.5	49	34			44	47	34	34.5			8	2										" overcast & rain	30			
	31	28.950	42	28.870	46	45	33			36.5	34	42.5	40.5	8	2				2.0	2.8							" frosty light showers	31			
Sums.		902.570	545.902	902.570	545.902	7	27			2080.155	2280.462			330					78												
Means.		29.145	41.8	29.122	43.1	42.5	29.0			36.7	36.5	37.4	37.5			1.3	1.3														
+ Total Corrections for Instrumental Errors.																															
+ Corrections for Diurnal Range.																															
"Corrected Means."																															
No. of Column.		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

BAROMETER, "corrected Mean" at 9 A.M., minus the Correction^{††} for Temp. (Col. 2), = 29.111
"Corrected Mean" of Barometer at 9 P.M., minus the Correction^{††} for Temp. (Col. 4), = 29.087
Mean at Station, corrected, and at 32°, = 29.099
Correction for height, feet above Mean Sea-level, = 731
Mean, reduced to 32°, and Sea-Level, = 29.830
Highest Reading, corrected for Index error, on the 1st th., = 29.650
Lowest Do. Do., on the 27th th., = 28.400
Difference, or Monthly Range, = 1.250

S.-R. THERMOMETER, (in shade, etc.), Highest in Month, (corrected for Index Errors), on the 18th th., = 52.0
Lowest in Month, corrected for Index errors, on the 8th th., = 14.5
Difference, or Monthly Range, = 37.5
"Corrected Mean" of all the Highest, (Col. 5), = 42.5
"Corrected Mean" of all the Lowest, (Col. 6), = 29.0
Difference, or Mean Daily Range, = 13.5
** Calculated Mean Temperature of Month, = 35.8

S.-R. THERMOMETER, Black Bulb in Sun, Highest, (corrected for Index Errors), on the 1st th., = 52.0
"Corrected Mean," (Col. 7), of Black Bulb, Max. in Sun, = 42.5
Lowest at Night, Black Bulb, (corrected for Index errors), on the 8th th., = 14.5
"Corrected Mean," (Col. 8), of Black Bulb, Min. on grass, = 29.0
Difference of above Means or Range ("exposed"), = 37.5

HYGROMETER, Mean (corrected) A.M. and P.M. Reading of Dry Bulb, (Cols. 9 and 11), = 37.2
Mean (corrected) A.M. and P.M. Reading of Wet Bulb, (Cols. 10 and 12), = 37.2
Computed Temperature of Dew-Point, = 37.2
Do. Elastic Force of Vapour, = 37.2
Do. Weight of Vapour in a Cubic Foot of Air, = 37.2
Relative Humidity, (Saturation = 100), = 37.2
RAIN fell on 6 Days; Amount in Inches, = 7.8

WIND.		SUMMARY.									
Direction.	N	NE	E	SE	S	SW	W	NW	Variable.	Mean Force.	Mean Velocity in miles per day.
A.M.	2	2	1			1	7	7	5	1.3	
P.M.	1	2	1			3					
Mean.											

N.B.—The Sums to be correctly added and the Means deduced. Returns from the "Principal Towns" should be in Edinburgh not later than the 3d; those from Other Places, not later if possible than the 6th. This Schedule not to be Gunned or Fastened, and Forwarded by Book Post, prepaid.

Observations made and
Return verified by

(Signed)

INSTRUCTIONS FOR TAKING METEOROLOGICAL OBSERVATIONS, WITH REMARKS ON THE USE OF INSTRUMENTS.

ONE of the objects of immediate importance that the Scottish Meteorological Society has proposed to itself, is to secure a *perfect uniformity* in the system of observation pursued at all its Stations. A certain degree of uniformity is absolutely necessary to justify the publication of Monthly Results from different observations; and it is found that differences between the Returns from any two Stations, so very considerable as to render them quite incomparable, may arise from dissimilarity in the position or shelter of instruments, different hours of observation, or even from the use of differently constructed instruments. It is therefore hoped, that those persons who kindly furnish Reports to the Society will by a scrupulous attention to the following Directions, secure for their Monthly Returns, an accuracy and value commensurate with the labour and pains involved in making them; and, for the Tables published by the Society, an entire comparableness among the several Returns, without which the Society's Reports must inevitably fail in achieving one of the main objects of Meteorological Observation.

Hours of Observation.—The Council recommend that Observations be made precisely at 9 o'clock (Greenwich or Railway Time only) twice a-day for some, and once (morning or evening) for other instruments, as specified, in the following remarks or at the top of the schedule. It is hoped that the utmost punctuality in the time of reading the instruments will be observed. Observers, in some few cases, may find this impossible; in such instances, they are specially requested to mark opposite every reading at what time it was taken, if not at 9 o'clock.

Barometer.—*Weather glasses* and *aneroids*, though admirably adapted, as the latter certainly are, to indicate variations of atmospheric pressure, are not well fitted for scientific purposes. Nor can any Barometer be used for Meteorological Observations that is not supplied with such means of *adjustment or compensation* as will secure the height of the mercury in the tube being accurately measured from the fluctuating surface of the mercury in the cistern. It is also necessary that every Barometer shall have been compared with a *Standard*.

Two moderate-priced Barometers have been approved of by the Council; if properly tested and attended to, they are both well adapted to Meteorological purposes.

An excellent Barometer is constructed by Mr. Adie of London, the use of which is attended with the great convenience of requiring *no adjustment* of the cistern. Its *scale-inches* are not true inches but so much shorter as to *compensate* the error that would otherwise arise from the fluctuations of the surface of mercury in the cistern. This form of instrument has been adopted by the Board of Trade, and has received the approval of the Meteorological Committee of the British Association. In another form of the Barometer, the sides of the *cistern* are of leather, and thus, by aid of a screw acting on the bottom, the surface of the contained mercury can be adjusted to the *zero-point* of the fixed scale; their coincidence being indicated by a little ivory float, whose stem passes freely through the lid and case of the cistern. When the *index-line* on this little piston-rod is brought by the adjusting screw to *form one straight line* with those on its ivory frame, the surface of the mercury is then at the exact height from which the scale is graduated. In taking an observation, as a slight error here will vitiate the readings from the *aneroid*.

When a Barometer having adjustable surfaces has to be removed from its fastenings, the ivory peg must be screwed so as to form a tight plug to the cistern. Then *screw up* the mercury to within a quarter of an inch of the top of the tube, and take down the instrument; it may then be carried with the cistern upperside. Before suspending the Barometer for use, it must be ascertained whether the space above the mercury in the tube is a complete vacuum; this is the case when, on inclining the instrument so that the mercury strikes the top of the tube, a *slight tap* is produced. If this is prevented by air it may be removed to the cistern, and got rid of, by inverting the Barometer (care being taken to prevent the loss of mercury by tightening the ivory peg), and gently tapping it; and if this plan fails, the instrument must be repaired.

The Barometer should be suspended in a good *shade*, which may be improved by putting a piece of white paper behind the tube. It must be perfectly perpendicular, and exposed to neither the sun's direct rays nor the heat of a fire.

In *taking an Observation*, the attached Thermometer is first noted: the tube must then be gently tapped and the cistern-adjustment carefully made. By raising and lowering the eye, it must be brought into the plane of the back and front of the index;—usually the lower edge of the vernier, which must be carefully adjusted to form exactly a tangent to the convex surface of the mercury in the tube. Observations must be taken quickly, so as to prevent heat from the observer's hands and person from affecting the mercury. The use of a lens will greatly facilitate an accurate adjustment and reading of the Barometer.

Protection of Thermometers.—The Council of the Society recommend that Self-registering Thermometers and Hygrometers be enclosed in a box painted white outside and inside, and fixed 4 feet above grass in an exposed position, free from merely local influences. The laths forming the sides and doors of the Boxes are arranged so as to ones to *protect* the Thermometers, and to allow a complete ventilation of the interior. The instruments are suspended on cross-sticks, in the centre of the Box, and five the door opening to the north. To accommodate a duplicate set of instruments, which is most desirable, doors are also made to open to the south. These Boxes may be had from the opticians *Self-registering Thermometers*—Frost & Co. Phillips, and Negretti & Zambra's Patent "Maximum" Thermometers, and recommended: printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer is recommended: printed directions for their use may be obtained with each instrument. The "Minimum" Thermometer of Ruthenford is recommended when graduated on the glass stem and affixed to a frame separate from the "Maximum." This Thermometer is liable to two derangements, both of which must be guarded against, and may be easily remedied by an observer. When the *column* of spirit breaks, it may be re-united by striking the instrument repeatedly against the palm of the hand; when part of the top of the tube, and must be dislodged from thence by heating that part over a lamp; the alcohol will evaporate and again condense in contact with the body of the liquid. These instruments should be hung horizontally.

The above remarks apply equally to the Thermometers for registering the greatest heat from the sun's rays, and the least

from radiation during night. Their bulbs have a black coating, which may easily be made, or mended, by the application of a mixture of lamp black and printer's ink. They are placed in shallow blackened boxes, whose sides protect the bulbs from the wind. The "Maximum" should be freely exposed to the sun, and the "Minimum" should rest on wooden supports a few inches from the surface of the grass, in an open situation. Snow must not be allowed to cover either of these Thermometers; for the sun's heat to effect the Minimum Thermometer by distillation.

Protection of Thermometers.—No instrument ought to be used for Meteorological purposes till it has been carefully tested by comparison with a *Standard Thermometer*. When such Thermometers as are *not graduated* on the stem, but merely on an attached scale, undergo repairs, they are very liable to be moved from their position on the Scale, and ought never afterwards to be used, without being *re-tested*. The self-registering, and especially the "Minimum" Thermometers, ought frequently to be compared with the dry bulb of the Hygrometer. The freezing-point of each Thermometer (marked by a scratch on the tube) ought to be tested once a year, in snow or melting ice. For comparison of Thermometers, a properly tested Thermometer may be had, on loan, by any observer, from the Meteorological Secretary.

The Hygrometer consists of two Thermometers usually, but not necessarily, mounted on one frame. As apparently slight deviations from the approved and *well-tested form* of this apparatus specially vitiate the "Hygrometrical Deductions," Observers are requested to attend to the following conditions:—The bulbs must *hang down* by at least an inch free from the scales and frame to which they are attached;—the frame must be such as will bring the tubes forward by an inch, from any board on which it may be suspended; the water-cup must be covered, and placed to the side, and a little below the level of the wet bulb;—in no case under the bulbs;—the mastin must be of medium fineness, and fastened at the neck of the bulb by the action, which also supplies it with water. It must be seen to by the observer that the mastin is always *clean and moist*, and the water pure. In frosty weather observation is a matter of much delicacy, and must be made with great care. The bulb must be moistened by immersion for 15 or 30 minutes before the hour of observation. From the film of ice thus formed evaporation will proceed as from the moist cloth in ordinary circumstances.

One form of the Hygrometer is highly objectionable, the frame of the Thermometers is enclosed in a tin case, which also supports the water cup underneath. This arrangement must be immediately altered by pulling the boxwood frame out of the tin case, and hanging them side by side, so that the frame-rod of requirements shall be complied with, as far as possible. **Reading of the Thermometer.**—Great care must be taken to avoid the effects of refraction, by bringing the eye exactly opposite the tip of the index or column of mercury. The reading ought to be taken to tenths of a degree, and noted in decimals. Thus the Thermometer will be read—39.2, 39.0, or 40.1; or again, 40.4, 40.5, or 40.6, according as it indicates a little under, an exact coincidence with, or a little over 40°, or 40½°, respectively. So also 44½, and 44¾, and 44¾, more or less must be registered 44° 2, or 40° 3, and 40° 7, or 40° 8 respectively. In reading Ruthenford's "Max" and "Min" Thermometers, the indication of that end of the index which is next to the surface of the mercury or alcohol is alone noted. Readings of the Thermometers, especially of the wet and dry bulbs, must be rapidly taken, being so readily affected by heat from the person of the observer.

Hours of observing Temperature.—The Hygrometer is read at 9 a.m. and 9 p.m. The self-registering Thermometers are read at 9 p.m. only, as indicating the greatest and least degrees of temperature in the 24 hours preceding. It is not a matter of indifference when the self-registering Thermometers are read, since, in winter at least, the extremes may occur at any hour; and it is necessary to refer their occurrence to their proper meteorological day. In the Society's schedules, the indications registered on the *lid* are those of a series of thermometers commencing at 9 p.m. on the 24th, and extending all 9 p.m. on the 31st.

Wind.—A wind-gauge ought to be elevated 12 feet at least above surrounding objects. When it oscillates incessantly, the mean direction must be taken; and when it is stationary, and always when the wind is feebly, reference must be made to the direction of the lower strata of clouds overhead, and to the direction of smoke, etc. Careful observations ought to be made on the changes in the direction of the wind; and during storms it is extremely recommended that extra observations be made at every hour of Greenwich time. Such a system of simultaneous observation, pursued at different Stations, would be likely to give highly interesting and important results.

The Council recommend that every observatory be furnished with a Hemispherical-Cup Anemometer;—a self-registering instrument which shows the amount of Wind that passes it per day, from which also the Velocity of the Wind at the time of observation may be ascertained. For indicating the Force of the Wind, at any particular hour of observation, Lind's Anemometer is also recommended; the method of *Estimating* Wind Force by such tables as that given in the schedule is, to say the least, unsatisfactory.

Rain-gauges.—Many causes conspire to produce anomalies in rain returns. They arise, partly, from unfavourable situation for observation, and partly from the defective nature of the instruments used. It is indeed difficult to obtain an unexceptionable position for the rain-gauge; but in all cases the gauge must be sunk in the ground till its edges are on a level with the close cut grass around its mouth. The rain-gauge ought to be read daily, and the readings entered in the returns on the day on which the rain fell.

Snowfalls may, for convenience, be registered in the rain columns, under the following conditions:—When a snow shower occurs it must be noted in the "Remarks," and the letter S affixed to the depth of water received in gauge. The depth of the snow must be measured in some open place where no drift is observed, and registered in addition to, and as a check upon, the indications of the rain-gauge. For wind, rain, and snow, as indicated in every column, the observer cannot be too careful to register *observations only*; and nothing that partakes of the nature of deduction or inference.

Clouds.—Convenient abbreviations for Luke Howard's

nomenclature of clouds will be found on the other side. The amount of cloud in the atmosphere ought to be estimated from the greater or less obscuration of the sky overhead (i.e., within 20° or 30° of the zenith). The strata of clouds that appear near the horizon are viewed obliquely; and thus, being unable to judge of their amount, we ought not to take them into account in the clouds column, though their appearances and changes ought to be noted among the "Remarks." The amount of cloud is entered from a scale of 0 to 10; thus, when the sky overhead is *half covered* by clouds, 5 is entered as the *observation*, and so on.

Observations of the clouds are made at 9 a.m. and at sunset, as illustrating the condition and currents of the upper and lower regions of the atmosphere. The entries in the schedule are to be made in the following manner:—In the column "Velocity and Direction," 2 W. (for example) will indicate that the upper strata of clouds travel with *extreme* velocity from S.W., and those in the lower regions from W., with one-third the *extreme* speed of the former. Again, in the second "Cloud" column, an entry of 2, east, (e.g.) will indicate that the higher regions are covered to the "amount" of 4 tenths with *stratus* clouds; and that the sky is further obscured to the extent of 2 tenths by lower clouds of the *cumulo-stratus* kind.

Sunshine.—The number of hours in which objects in the sun's rays cast shadows, should be entered in the proper column. **Underground Thermometers.**—As the germination and health of crops and plants greatly depend on the temperature of the soil,—its amount and consistency,—the Council recommend that thermometers in this interesting department be made at 9 a.m., by thermometers placed in the earth, their bulbs being sunk to 3, 12, and 22 inches, and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain-water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geologic formation and agricultural condition of the soil in which these Thermometers are placed.

Temperature of the Sea.—A knowledge of the temperature of the sea is not only in itself, but in its relations to that of our island, a very important branch of Meteorology. The Council therefore recommend that the temperature of the sea be carefully taken by a properly constructed apparatus, from the ends of piers and rocks round the coast, where it is not influenced by the heat of river water. At or near the time of high water, on the 5th, 15th, and 25th of each month, the thermometer ought to be sunk exactly six feet (one fathom), and after ten minutes have elapsed, drawn up and read. When convenient extra sea observations might be taken for other and greater depths, noting always the temperature of the day, and the hour of observation, and continuing to observe for particular depths.

Temperature of Wells.—The temperature of the water at the bottoms of wells ought, when practicable, to be taken, and the depth of the well and of the water noted. **Ozone.**—Mention whether Schönbien's or Mofat's papers are used. The paper is affixed by a pin to a board in the thermometer box, and the indication registered at 9 a.m. and 9 p.m. It is desired that these indications be registered in connection with the force and direction of the wind at the time of observation, in the following manner:—Thus 8° 3' as an ozone entry in the schedule, will indicate that the ozone paper is tinted as 3° on the scale, that the wind is from the N.W., and that its force on the scale 0—6 is "4" i.e., that it is *blowing fresh*.

Electricity.—Too much importance cannot be attached to electric condition of the atmosphere in connection with terrestrial magnetism, and as a meteorological phenomenon. A proper Electrometer is necessary to every complete meteorological observatory. **Remarks.**—The "Remarks" column is too narrow, but unavoidably so. Some of the most valuable observations that can be taken are those for which no rules can be given nor hours assigned. The use of contractions ought, therefore, to be taken every advantage of, and a list of such as are recognised and in use at Greenwich and Southampton, are given at the foot of the column. Besides special and extraordinary observations, great prominence ought to be given in this column to prevalent diseases, differences in character, colour, velocity, and direction between the lower and upper strata of clouds, the colour of the sky, etc. Remarks ought to be made on the occurrence of meteors, aurora borealis, remarkable depressions and elevations of the barometer, thunder storms, and remarkable falls of snow, hail, or rain, the hour of storms, and wind attending their maximum, as well as such localities on storms as have been hinted at above. When long hills are in the vicinity of an Observatory, the height of clouds and of the snow-line in winter ought to be recorded.

By the use of abbreviations, the state of the weather at 9 a.m. and 9 p.m. ought to be registered, either in two columns, otherwise unoccupied, or in two ruled off for the purpose, from that headed "Remarks." It is intended that observations by the Electrometer should be entered in this manner or on the side-margin. Additional remarks may be made on the margin. "Observations in connection with the periodic return of the seasons" possess not only great scientific value, but are of considerable interest to the Agriculturist. The Council would direct the special attention of Observers to the registration of such phenomena, that the published Summaries may fairly represent the whole of Scotland. Observation ought to be confined to individual trees and shrubs; to particular species of birds; and, in the case of crops, to specified sorts reared from year to year on a selected piece of ground or farm.

The Council recommend that *term day* observations be taken;—viz., on the 21st days of March, June, September, and December.

Full directions for the use of the instruments mentioned above have been printed, and may be had along with them from the makers. The Council recommend that observers, before purchasing new instruments, should communicate with the Meteorological Secretary, and they consider it desirable that he should have full power to reject any instrument which, on being presented for comparison, does not afford him satisfaction.

(By Order) A. B.

EDINBURGH, 20th November 1872.

OBSERVATIONS IN CONNECTION WITH THE PERIODICAL RETURN OF THE SEASONS.

FOREST TREES.	In Flower.	Leaf Buds First appear.	In Leaf.	Divested of Leaves.	CROPS, mentioning variety.	Sowing or Planting.	Appearing above Ground.	In Ear or Flower.	First Cut or Raised.
Alder,					Barley,				
Ash,					Bere or Bigg,				
Beech,					Oats,				
Birch,					Wheat,				
Elm,					Beans,				
Larch,					Pease,				
Lime,					Potatoes,				
Oak,					Turnips,				
Sycamore or Plane,					Rye Grass,				

SHRUBS, ETC.	First in Blossom.	FRUITS.	First in Blossom.	Fruit Ripe, generally.	MIGRATORY BIRDS.	First Arrival.	Departure.
Barberry,		Apple,			Cuckoo,		
Bourtree or Elder,		Black Currant,			Curlew,		
Broom,		Cherry,			House-Swallow,		
Hazel,		Gean,			Lapwing,		
Hawthorn,		Gooseberry,			Plover,		
Holly,		Peach,			Sand-Martin,		
Laburnum,		Pear,			Starling,		
Lilac,		Plum,			Swan,		
Mezereon,		Strawberry,			Rail or Corn Crane,		
Mountain Ash or Rowan,							
Red Flowering Currant,							
Rhododendron Ponticum,							
Whin,							

Have the goodness also to state any information you may be able to collect relative to the Crops of Grain, Hay, Potatoes, Turnips, Fruits, etc., whether plentiful, or in perfection; whether any have suffered from blight, disease, etc. Whether Epizootic disease prevails among cattle; and the Agricultural condition of the district generally.

General Post Office Buildings, Secretary of the Meteorological Society of Scotland,

MR ALEXANDER BUCHAN,

Decr 1871