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GREENWICH VISITATION DAY, 1881, AND SOME THOUGHTS SUGGESTED THEREBY.

WE do not know why the Astronomer Royal in his Annual Report presented on June 4th, was silent upon the very subject with which the minds of most of those who gathered within those venerable walls were full. It is widely reported—and certainly we are far from intending to contradict the report—that on August 1st of this year Sir George Biddell Airy will retire from the appointment of Astronomer Royal, which he has held with credit to himself and to the office, for the long period of forty-six years. Sir George does not promise himself an idle life when he lays down his official title; he has much hard astronomical work cut out, and long may it be ere it would be appropriate to attempt to estimate the position which posterity will assign to him.

But when there is a chance of an alteration in the head of such an establishment as Greenwich Observatory, one which is to a certain extent looked up to as typical of the perfect development of British Science, it is the duty of all who have the scientific credit of the country at heart, to put aside reserve, and to do everything in their power towards securing its perfect efficiency.

We, in these pages, are not concerned with the splendid astronomical work done at Greenwich, but solely with the meteorological observations, and we purpose considering the objects for which meteorological observations are made at Greenwich, and how far those objects are attained.

There are, we take it, two objects specially aimed at by the Greenwich observations:—the determining (1) the climate of the locality, and (2) the secular changes thereof. Although the Greenwich values are largely used by the Registrar-General, for comparison with the mortality of the Metropolis, this is such an unsatisfactory arrangement, that we can only attribute it to a dearth of proper information at the Registrar-General's office. Surely observations in the Quadrangle of Somerset House itself, would more accurately represent the air breathed by the millions of the Metropolis, than will observations made upon the top of the hill in the middle of Greenwich Park.

But we come back to (1) determining the climate of the locality and (2) the secular changes thereof. Now these are slightly contradictory, just sufficiently so to require care and consideration. As time advances improved instruments and improved modes of observing are discovered, and thus an equipment which was in advance of everyone else in 1835, may be wofully behind date in 1881; and yet there is nothing so fatal to the accurate determination of secular changes as such alterations as we have just pointed out to be necessary. This difficulty is easily surmounted, but hitherto we fear that in the Meteorological Department at Greenwich *continuity* has not been worshipped so heartily as we desire. One illustration is worth pages of vague talk. Years ago, in 1840 or thereabouts, Mr. Glaisher put up the first thermometer stand of his pattern; we have no desire to know when or by whose orders changes have been made in that stand; it is sufficient for us to know that the present pattern differs in several respects from the first. Why does it differ? it must be because those who ordered the alterations thought that they were improvements—be it so, though we doubt it. But admit that they are improvements, and what does that necessarily involve: the fact that the observations made since the alteration differ from those made before it by the amount of this improvement, and therefore, inasmuch as overlapping observations are never reported to have been made, it is impossible to say how much of any observed change in the temperature or humidity is due to secular change and how much to “improvements.”

The same difficulty attaches to most of the elements recorded at Greenwich.

Our object is, however, rather with the future than with the past. We trust that, in order that the question of secular changes may not be further complicated, at least the data required for the weekly returns of the Registrar-General may continue to be obtained from the old instruments in the old positions observed precisely in the same manner as hitherto.

But foreigners and some Englishmen, unable to understand that the Royal Observatory can be other than a first order Meteorological Station, as well as our best astronomical observatory, will carry away a poor idea of the present state of meteorology in this country if the Greenwich authorities do not arouse themselves and provide *in addition to*—by no means in substitution for—their present instruments about £100 worth of new ones, and mount them in a style worthy of the establishment.

When we have complained of the cramped space and the mass of trees allowed to surround the instruments, we have been told that the Government authorities will not allow trees to be cut. There is moderation in everything, no doubt, but we should rather like to hear the refusal of the Commissioners of Woods and Forests to allow reasonable clearing of the ground for the necessities of the observatory read in the House of Commons. The House would hardly be

likely to vote one department of Government money for taking observations, and to support another department in rendering those observations inaccurate.

Three courses are open to the Greenwich authorities :—

- (1). To pursue their present course ; this we contend is not abreast of the modern requirements of meteorology.
- (2.) To cut down their meteorological work to that point which will ensure the continuity of the various more important elements being kept up.
- (3.) To keep up their present system in its integrity, and side by side with it to start a fresh set as perfect in respect alike of instruments and position as is possible.

Need we add that we trust the third course will be adopted.

THE ORGANIZATION OF THE METEOROLOGICAL SERVICE IN SOME OF THE PRINCIPAL COUNTRIES OF EUROPE.

V.—RUSSIA (*Continued*).*

OWING to the extensive area of the Russian Empire and the careful attention bestowed upon the meteorological services there, we were unable to do justice to the subject in one short paper ; the following concluding portion, like the preceding articles, has been *chiefly* compiled from Dr. Hellmann's exhaustive reports to the Prussian Minister of Public Instruction.

In order to provide the stations of the Russian network with verified instruments, the Central Observatory has obtained a rich collection of standard instruments of excellent quality. They form the greatest treasure of the institution, and in this respect it compares favourably with other similar establishments. The Central Observatory undertakes the filling of the barometers intended for the various stations, and for this purpose employs Weinhold's mercury purifying apparatus described in Carl's *Repert. f. Experimental physik*, Bd. ix. At the more remote stations, the barometers are filled locally by a method explained by Prof. Wild in his *Repert. f. Met.*, Bd. ii. The anemometers are also compared with a normal instrument of Robinson's principle, or their constants are deduced by means of a Combe's rotary apparatus. Much information on this subject will be found in Dohrandt's *Determination of Anemometer Constants* (*Repert. f. Met.*, Bd. iv. and vi.), and in Wild's *Zustand der Anemometrie* (*Bulln. Acad., St. Petersburg, T. xxiii.*). The verification of magnetic instruments is now done at the Pawlowsk Observatory.

Department for Ocean Meteorology and Weather Telegraphy. The

* Continued from *Meteorological Magazine* for May.

first organization of a system of telegraphic weather reports in Russia was made by Kupffer (*Compte-rendu annuel*, 1864), but was limited to the reports from nine inland and two foreign stations in 1865, and no particular use was made of them. In 1872, with the co-operation of the Hydrographic Department, a lithographed meteorological bulletin was issued, containing reports from 55 stations and synoptic charts for Russia and a part of Asia. In the spring of 1874, storm warnings were commenced, and in July, 1876, a special department for Ocean Meteorology and Weather Telegraphy was established. Telegraphic reports are now received from 92 stations, including observations made as far as the Pacific Coast and in foreign countries. But owing to the observations being made according to local time, only about 35 per cent. of the reports arrive early enough to be included in the bulletin on the day of issue. The storm signals, like those in this country, refer to the next 48 hours. Books are kept giving the reasons for issuing the warnings and the weather actually experienced. The results attained in 1878 were as follows:—Successes, 70 per cent. ; failures, 26 per cent. ; late warnings, 4 per cent. The following useful papers have appeared as appendices to the weather bulletin:—

Maydell, Determination of Storm-paths according to changes of temperature.

Maydell, Storm-paths in Europe in the years 1872-4.

Spindler, do. do. in the years 1875-7.

Brownow, On the determination of the direction of the propagation of barometric minima.

The chief of this department is Captain Rykatchew, who is also charged with the branch for *Ocean Meteorology*. This branch is of very recent establishment, so that there is but little to be reported about it. The observations made at the Russian lighthouses are to be published in the *Annals* (those for 1877-8 contain the wind observations from 10 lighthouses on the Baltic Coast). A discussion of the wind observations has been made by Capt. Rykatchew (see the list of publications given in the preceding number). Instructions for keeping meteorological logs are prepared in accordance with the decisions of the London Maritime Conference of 1874.

The physical researches at the observatory are carried out almost entirely by Prof. Wild himself, as the staff is generally fully occupied in the other branches of the work. It is not our intention to enter into particulars about these researches ; some of them are published in the *Mémoires* and in the *Bulletin* of the St. Petersburg Academy. We avail ourselves, however, of this opportunity of testifying to the remarkable care and ability bestowed by Prof. Wild upon all the discussions undertaken in the various branches, whether magnetical, meteorological, or physical.

We must, however, here draw especial attention to the following publication:—

In 1877, Wild published part I., 4to, 267 pp., of his great work, "*Die*

Temperatur-Verhältnisse des russischen Reiches" as a supplement to the Repertorium. The Atlas (large folio) and part II. of the text have now been published (St. Petersburg, 1881, large quarto, 791 pp.).

The work is divided into four parts :—(1) Discussion of the daily period ; (2) calculation of corrections for the reduction of individual observations to the true daily mean ; (3) discussion of the yearly period, with monthly means ; (4) geographical distribution of temperature represented by isotherms. This is a magnificent contribution to the knowledge of the temperature of the globe ; the Atlas will render very important service in affording corrections to Dove's and Wojeikoff's *generalizations* for the area in question. The Atlas contains Isotherms and Isabnormals for the area embraced between latitude 30°–80° N. and longitude 10°–180° E. The charts are drawn for the meridian of Greenwich and based upon the data from 396 stations in Russia and 137 stations in adjoining countries, and for a period of 20 to 30 years. The observations were taken several times a day, and at many of the stations hourly observations were made both day and night. The isotherms are drawn for every degree centigrade in European Russia and for every two degrees in Asiatic Russia. A table is also given showing the decrease of temperature with elevation above the sea, for each month, which is intended to be used as a correction for the curves.

A very favourable notice of this work will be found at p. 217 of the *Zeitschrift* of the Austrian Meteorological Society (Band xvi. Mai-Heft), by Dr. J. Hann, who is a very high authority upon the subject.

The library of the observatory includes about 14,000 vols.

The funds voted by the State are given by Dr. Hellmann as follows :

For general purposes and maintenance of stations	£4,298
For Ocean Meteorology.....	450
For Weather Telegraphy	690
Total	<u>£5,438</u>

Postage is free within the Russian Empire.

The Director receives part of his salary from the Academy, the amount not being stated, and residence is provided in the Observatory for the Director and two employés. The number of persons employed is given as 18.

The Academy also pays for a large part of the printing.

The Magnetical and Meteorological Observatory at Pawlowsk, near St. Petersburg, owes its origin to the insufficient accommodation of the St. Petersburg Observatory for magnetic observations, and to the liberality of the Grand Duke Constantine Nicolajewitsch, who gave up a very favourable position in his park for this institution. The observatory commenced work on 1st January, 1878. The site is extremely suitable for magnetic observations, but as regards meteorology, the climate partakes of a mixed character, of half forest and half field climate. The observatory possesses an extensive

library, and in addition to the best magnetographs, is provided with one of Von Oettingen's wind-component-integrators (a specimen of which was at the South Kensington Loan Exhibition), electric registering barographs, a Beckley anemograph, thermographs, &c. Full particulars respecting the observatory will be found in the *Annals of the Central Physical Observatory*, and in Carl's *Repertorium f. Experimental Physik*, 1879.

In addition to the records of the self-registering instruments, eye observations are made at 7 a.m., 1 and 9 p.m., local time. Most of the self-registering instruments are on the Wild-Hasler system (described in Carl's *Repertorium*, vol. II., *et seq.*), and record by electricity every ten minutes.

Earth thermometers are sunk into pure yellow sand, in the same way as at the Central Physical Observatory, but as the underground water is high, the lowest thermometer at a depth of 10·6 feet reaches the water.

Two ordinary rain gauges, with a receiving area of one-twentieth square metre = ·5 square foot, and 8·2 feet above the ground, and two self-registering rain gauges are in use.

Wild's balance atmometer, and also a floating atmometer (when it is not freezing) are observed once a day.

Dr. Hellmann considers that the observatory erected for absolute and relative magnetic observations, is the most perfect that exists any where. It is built of wood, in the form of a cross, and is entirely free from iron. Complete details about all operations, and of the various instruments are given in the first part of the "*Annals*" for 1878.

The superintendent of the Pawlowsk Observatory is nominated by the director of the Central Physical Observatory, and the staff consists of four assistants and a mechanic. In 1879 the funds at the disposal of the observatory amounted to about £2,500. The cost of erection, furnishing, and partial outfit of instruments was nearly £22,000.

The observatories at Dorpat, Nicolaieff, Tiflis and Peking hold a prominent position in the Russian system, partaking of the nature of stations of the first order, and partially of central stations for their special districts.

1st. *Dorpat*.—Up to the year 1867, Dorpat was a station of the second order, taking observations three times a day only. After this time, owing to the exertions of Dr. von Oettingen, it took the rank of a station of the first order, eye observations being made from 7 a.m. till 10 p.m. With regard to the self-registering instruments, it may be mentioned that anemometry forms a special feature; the observatory possesses two of von Oettingen's wind component integrators (above mentioned), and two of Robinson's ordinary anemometers, all made by Schulze, of Dorpat. Regular magnetic observations have not yet been made. The present superintendent of the observatory is Dr. H. Weihrauch, Professor of Physical Geography and Meteorology at the University of Dorpat, who has the services

of an assistant, and an allowance of under £350 yearly for expenses. The observations are published in "*Meteorologische Beobachtungen, angestellt in Dorpat . . .*", 1867—75; also a volume containing the means of ten years, and hourly means for nine years. Phenological observations made at the Botanical Garden, and three times daily at Reo (Island of Oesel), and rainfall observations at six to eight stations in Livonia are contained in the above publications.

2nd. *Nicolaieff*.—The hydrographic department of the administration of the Black Sea fleet and ports has the immediate superintendence, both of the meteorological station at Nicolaieff itself, and of the observations taken on the ships, and at the lighthouses in the Black Sea. It inspects the regular stations, and sends the observations to the Central Physical Observatory at St. Petersburg. The department possesses a self-registering balance-barometer, and an English anemograph, but the observations are not regularly discussed. It issues a daily weather bulletin referring to the Black Sea stations. Further details respecting this institution will be found in the Inspector's Report, published in the Annual Report of the Central Physical Observatory for 1875-6.

3rd. *Tiflis*.—The duties of this establishment consist in taking regular meteorological and magnetical observations, with climatological and physical investigation of the district of the Caucasus, and the superintendence of the meteorological stations. The funds at the disposal of the superintendent amounted in 1867 to about £1,950, all the officials having free residence in the observatory. This service has recently been entirely re-organised, and placed under the superintendence of Dr. J. Mielberg. On the 1st January, 1880, a series of hourly eye observations of the various meteorological and magnetical elements was begun. Eight stations in the Caucasus send their observations to Tiflis. Observations made several times a-day for the years 1871—79 have been published in the *Materialen zu einer Klimatologie des Kaukasus, Tiflis*.

4th. *Peking*.—This observatory was founded in 1841, by the ecclesiastical diplomatic mission of Russia to Peking, but was separated from the mission in 1863, and placed under the Academy of Sciences of St. Petersburg. Since 1870, meteorological and magnetical observations taken three times daily, have been published in the Annals of the Central Physical Observatory. The superintendent, M. A. Fritsche, has published various papers in the *Repert. f. Meteorologie*, and makes a report yearly on the condition of the observatory and the stations in connection with it. His observations made during journeys between Peking and St. Petersburg, and printed in the *Repertorium*, are worthy of notice. The superintendent is assisted by two Chinese Christians; the funds at his disposal are £625 only, of which three-fourths are paid for his salary.

THE IMPERIAL RUSSIAN GEOGRAPHICAL SOCIETY.

After 60 years of its existence, this society commenced the publi-

cation of Kämtz's *Repertorium* (previously referred to), and in 1870 established a special meteorological section, which, among other things, started a number of rain and thunderstorm stations. The first yearly series of these observations (1871) was published by Wojeikoff in the journal of the society, vol. iv., 1875. Subsequently these stations diminished in number, and now seem wholly to have disappeared. The only further activity of this section appears to have been the publication of a paper entitled "*Travaux météorologiques*," containing various meteorological articles in the Russian language by Wojeikoff and Rykatchew, and referring principally to temperature and rainfall.

VI.—THE METEOROLOGICAL SERVICE IN FINLAND.

Finland has hitherto maintained, meteorologically, its independence of Russia; it possesses a system of observing stations, and a magnetical and meteorological observatory at Helsingfors, and at present each service is independent of the other. The Observatory was founded in 1844 by M. J. Nervander, and on his death in 1848, M. Borenus took the superintendence. The unifilar and bifilar magnetometers were read every ten minutes from 1st July, 1844, to 1st May, 1856, then for 13 months every twenty minutes; from the 1st June, 1857, until the present time they are read hourly. The variations of vertical intensity were observed hourly until the 1st November, 1851. Observations of magnetic variation are made hourly up to the present time, but are not reduced. The meteorological observations form a very valuable series, for although the exposure of the instruments does not correspond in all respects to the requirements of the present day, the continuity of the observations is unbroken, and they have been made with the same instruments from the 1st July, 1844. Two thermometers are used for the observations of air temperature—one on the east and one on the west side of the Observatory—so that the observations may be always taken in the shade. The lower portions of the thermometers are protected by metal screens, with holes to allow free passage to the air. With these thermometers, observations were taken every twenty minutes from 1st July, 1844, to 1st June, 1857, and from that time every hour.

The barometer is on Fortin's principle. Until 1st March, 1853, readings were taken every twenty minutes, and from that time, hourly.

Wind observations, by a Robinson's anemometer with simple counting apparatus, were made every twenty minutes until 1st July, 1857, and from that time every hour. The rain gauge is read twice daily, and has a receiver of 1 foot in diameter. The amount of cloud, &c., has been recorded with the other observations.

Of these rich materials, Nervander published the observations for the years 1844-8 in four volumes ("*Observations faites à l'observatoire . . . de Helsingfors*." 4 vols., 4to). The publication of a fifth

volume (Helsingfors, 1873) at the expense of the *Finska Vetenskaps-Societet*," containing the temperature observations from 1844--56, has been made under the care of Prof. Nordenskjöld. The amount of funds at the disposal of the observatory is only about £450.

The meteorological stations of the "*Finska Vetenskaps-Societet*," the first meteorological stations in Finland (five in number), were established by this Society in 1846, at the instigation of Nervander. In 1875, the number of stations had increased to 22; the most northerly being Kittilä, in $67^{\circ} 40'$ N. lat. The instruments are compared at the Helsingfors Observatory, and the observations are taken at 7 a.m., 2 and 9 p.m., all the observers being volunteers. Prof. Nordenskjöld has published the temperature observations for the years 1846-65 in pentades in *Bidrag till Finlands officiella Statistik, V. Helsingfors*, 1869; and since 1873 the Society has published yearly the barometer and thermometer observations for all stations, and the humidity for three stations, in *Observations météorologiques publiées par la Société des Sciences, de Finlande*, 1873--5. This Society, in connection with the Agricultural Society, organized in 1845 an extensive network of climatological stations, the most northerly station being Utsjocki, in $69^{\circ} 51'$ N. lat. The observers are all volunteers, and the registers are sent yearly to the Society at Helsingfors. From want of funds the Society has been unable to give a definite organization to the system, and above all to properly discuss and publish the materials; consequently the number of observers gradually diminished, for the zeal of the observers can only be maintained by showing them that the observations on which they have spent time and trouble are published and utilized. The number of observers, which amounted to 105 in 1846, had dwindled to 23 in 1854. Subsequently the Society has published the observations from 1846--55, without any attempt at discussion, in *Klimatologiska Jakttagelser i Finland 1846--55*. (Helsingfors, 1860 and 1871.)

J. S. HARDING.

RESEARCHES IN THERMOMETRY.

The Transactions of the Royal Society of Edinburgh for 1880 contain a memoir, entitled "Researches in Thermometry," by Edmund J. Mills, D.Sc., F.R.S., the principal results of which it is proposed to notice here. The memoir might have been written with greater perspicuity of style and more explanatory symbolical treatment. Several properties of mercurial thermometers are discussed, and in a physical point of view the work, no doubt, is of considerable value and much interest, though it contains very little of essential importance to meteorology.

Dr. Mills shows that in calibrating thermometer tubes there is no necessity to use precision in placing the extremes of the small index

of mercury, which is made to assume different positions all along the bore. Time will be saved by adjusting the index so as to have a slight error, and then immediately correcting for this error. Suppose the first position of the index to be from 0 to 26.9 millimetres; the second from 29.6 to 54.9. Here the error made is 2.7 mm.; the second position corrected is therefore 26.9 to 52.2. Thus the lengths of the index in these two positions are 26.9 and 25.3 successively; and so on.

The correction for a thermometer only partially immersed in a medium, whose temperature it is intended to exhibit, will be \pm according as the temperature of the air is below or above that of the medium. It is generally found by Regnault's formula

$$y = .0001545 (T - t) N, \text{ centigrade,}$$

where y is the correction, .0001545 is the difference between the co-efficients of cubical expansion of mercury and of glass; T , the reading of the principal thermometer; t , that of a subordinate thermometer whose bulb is placed half-way up the exposed stem of the principal thermometer; and N the total number of scale degrees exposed. Dr. Mills concludes that .000135 would be a more accurate constant.

"The movements in the zero of a thermometer, when the pressure upon it is constant, are due primarily to a difference of temperature between some given initial state and some state brought about thereafter. The bulb of a thermometer consists of glass, that is, of a mixture in various proportions of more fusible, less crystalline, basic silicates with less fusible, more crystalline acid silicates. During the operations of blowing it becomes richer in silica, and hence of a more crystalline nature. The crystalline portion, in all probability, takes many years to complete its separation—however rapid at first—from the amorphous constituents; and this separation should be attended with some slight contraction of volume. The mixture is also especially sensitive to the influence of temperature, more particularly soon after its manufacture; and thus it exhibits—after heating, for example—a 'set,' the recovery from which is comparatively slow. Movements in the zero of a thermometer may be investigated in two ways, according as we make (1) time or (2) an immediate temperature disturbance the leading feature of our study." Meteorological thermometers are not subject to such extreme and sudden contractions and expansions as thermometers employed in chemical and physical researches often are; and on this account, if on no other, the line of research pursued by Dr. Mills in examining the change of zero of thermometers is probably not altogether applicable to meteorological thermometers. Those who wish to follow up this subject cannot do better than take Dr. Mills as their guide.

Dr. Mills does not appear to have succeeded in effecting comparisons between the air thermometer and the mercurial thermometer with greater accuracy than preceding investigators. He concludes

that the maximum difference between the two lies at $34^{\circ}47'$, where it amounts to 0.198 of a degree.

"The stem of an ordinary thermometer may be regarded for all practical purposes as incompressible. The bulb, however, is always thin, and has yielding sides; it is therefore affected by external pressure." Dr. Mills concludes from his experiments that the effect of atmospheric pressure may account for about $0^{\circ}2$ in the zero's ascent; and that up to about 134 atmospheres the ascent of the mercury in a thermometer's bulb is proportional to the pressure applied, and does not at the higher limit show any indication of a change of law.

R. STRACHAN.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday, the 18th instant, at the Institution of Civil Engineers; Mr. G. J. Symons, F.R.S., President, in the chair. D. W. Barker, B. Jumeaux, W. Oelrichs, H. Porter, W. Roper, and Rev. G. R. Wynne were balloted for and elected Fellows of the Society.

The following papers were read:—(1) "Comparison of Robinson's and Osler's Anemometers, with remarks on Anemometry in general," by Richard H. Curtis, F.M.S. The author in this paper gives a very clear statement of the present state of anemometry, and points out the defects in Osler's and Robinson's Anemometers, which are the chief forms of recording instruments used in this country. (2) "Notes on Waterspouts observed at Cannes in January or February, 1872," by the Hon. F. A. Rollo Russell, M.A., F.M.S. (3) "On some Swedish Meteorological Observations in connection with the return of the seasons." by Alexander Beazley, M. Inst. C.E.

ERRATA IN THE *METEOROLOGICAL MAGAZINE* FOR 1880.

In discussing the Annual Returns of Rainfall for 1880, the following errors have been detected in the Tables of the *Meteorological Magazine* for that year.

REGULAR TABLE.

Edenfel (Omagh)	January	1.90 in.	should be	2.10 in.
Inverness (Culloden)	February ...	1.58	„ „	1.59 „
„ („)	June	1.00	„ „	1.14 „
Manchester (Ardwick).....	July	5.32	„ „	5.36 „
Cirencester.....	August	1.82	„ „	1.60 „
Leicester (Town Museum) ...	November ...	1.67	„ „	1.69 „
Inverness (Culloden)	December ...	2.00	„ „	2.30 „

SUPPLEMENTARY TABLE.

Dowra	April	4.05 in.	should be	3.97 in.
Tipperary, Henry Street	May	1.20	„ „	2.40 „
Dowra	October .....	.71	„ „	.79 „
Kilrush	December	3.89	„ „	3.93 „

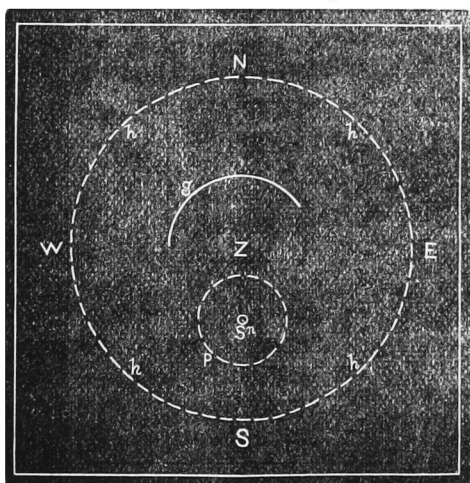
ZENITHAL HALO.

To the Editor of the Meteorological Magazine.

SIR,—The somewhat rare phenomenon of a brilliant, though imperfect, “zenithal halo” was seen here to-day. Cirrus had been moving rapidly from North-East during the morning, covering more than half of the sky. From 11.55 a.m. till 0.10 p.m. I had been watching an ordinary prismatic solar halo of rather uncommon brilliancy, when my attention was called by a companion to a bright arc of white light extending from West through North to North-East, forming in short very nearly a semi-circle. The centre of this great halo was in the zenith, and its radius was 37° . The arc was not continued to the points where it would intersect the $22\frac{1}{2}^\circ$ halo, and no special brightness was discernible at these points. From the time I had my attention called to the great halo until its final disappearance ten minutes elapsed. It then slowly faded, the ordinary halo remaining, though faint, for fifteen minutes more. From 3 to 3.30 p.m. there was again an ordinary solar halo, and there is now (10.20 p.m.) a lunar halo.—Yours truly, W. CLEMENT LEY.

Ashby Parva, Lutterworth, May 11th.

Sketch Map taken with Altazimuth at time of Halos seen May 11, 1881.



h, h, h, h. Horizon.

Sn. Sun.

p. Prismatic halo.

Z. Zenith.

g. Arc of great halo.

SOLAR HALO.

To the Editor of the Meteorological Magazine.

SIR,—A very bright solar halo was seen here yesterday (29th May), and remained visible from 10.15 a.m. till 2.15 p.m. The vertical diameter of the halo was 45° and the horizontal diameter 47° . At 11 o'clock fragments of a secondary circle, more highly coloured than the principal circle, and outside of it, were visible to the South-East and South-West of the sun.—Yours truly, J. M. DU PORT.

Mattishall, Norfolk, 30th May, 1881.

SUPPLEMENTARY TABLE OF RAINFALL IN MAY, 1881.

[For the Counties, Latitudes, and Longitudes of most of these Stations,
see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain. in.	Div.	STATION.	Total Rain. in.
II.	Dorking, Abinger	1.49	XI.	Carno, Tybrite	4.91
„	Margate, Acol	1.08	„	Corwen, Rhug	3.98
„	Littlehampton	1.05	„	Port Madoc	4.68
„	St. Leonards	1.09	„	Douglas	2.97
„	Hailsham .....	.89	XII.	Carsphairn	3.80
„	I. of W., St. Lawrence.	1.21	„	Melrose, Abbey Gate	3.36
„	Alton, Ashdell	1.16	XIV.	Glasgow, Queen's Park.	3.46
III.	Great Missenden	1.57	XV.	Islay, Gruinart School..	2.26
„	Winslow, Addington ...	1.15	XVI.	Cupar, Kembach	1.36
„	Oxford, Magdalen Col...	1.44	„	Aberfeldy H.R.S.	1.67
„	Northampton .....	.57	„	Dalnaspidal	3.87
„	Cambridge, Merton Vil.	2.05	XVII.	Tomintoul	2.12
IV.	Harlow, Sheering .....	.91	„	Keith H.R.S.	2.39
„	Diss	2.59	XVIII.	Forres H.R.S.	1.78
„	Swaffham .....	.97	„	Strome Ferry H.R.S. ...	3.29
„	Hindringham	1.11	„	Lochbroom	2.85
V.	Salisbury, Alderbury ...	.98	„	Tain, Springfield	2.29
„	Calne, Compton Bassett	1.56	„	Loch Shiel, Glenfinnan.	4.48
„	Beaminster Vicarage ...	1.02	XIX.	Lairg H.R.S.	2.12
„	Ashburton, Holne Vic..	2.09	„	Altnabreac H.R.S. ....	...
„	Langtree Wick	2.38	„	Watten H.R.S.	1.89
„	Lynmouth, Glenthorne.	2.04	XX.	Fermoy, Glenville	2.72
„	St. Austell, Cosgarne...	1.21	„	Tralee, Castlemorris ...	2.13
„	Ilebrewers, Walrond Pk.	...	„	Cahir, Tubrid	1.23
VI.	Bristol, Ashleydown ...	...	„	Tipperary, Henry St...	1.74
„	Ross	2.15	„	Newcastle West	2.43
„	Wem, Sansaw Hall	2.40	„	Kilrush	2.18
„	Cheadle, The Heath Ho.	2.01	„	Corofin	2.90
„	Bickenhill Vicarage ...	...	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston .....	.74	„	Carlów, Browne's Hill..	2.19
„	Horncastle, Bucknall ...	1.14	„	Kilsallaghan .....	...
VIII.	Macclesfield Park	2.47	„	Navan, Balrath	2.96
„	Walton-on-the-Hill ...	3.09	„	Athlone, Twyford	2.66
„	Broughton-in-Furness ...	5.96	„	Mullingar, Belvedere ...	2.58
IX.	Wakefield, Stanley Vic.	.74	XXII.	Ballinasloe	2.53
„	Ripon, Mickley	1.64	„	Clifden, Kylemore	4.26
„	Scarborough	1.17	„	Crossmolina, Enniscoc..	2.31
„	Mickleton	5.02	„	Carrick-on-Shannon ...	2.37
X.	Haltwhistle, Unthank..	2.52	XXIII.	Dowra	2.21
„	Shap, Copy Hill	4.50	„	Rockcorry	2.82
XI.	Llanfrechfa Grange	2.82	„	Warrenpoint	3.30
„	Llandovery	3.71	„	Newtownards	2.31
„	Solva .....	.83	„	Carnlough	2.94
„	Castle Malgwyn	1.91	„	Bushmills	2.09
„	Rhayader, Nantgwillt..	5.37	„	Buncrana	2.23

MAY, 1881.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.						Days on which "01 or more fell.	TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Difference from average 1870-9	Greatest Fall in 24 hours.		Max.	Min.							
				Dpth	Date.				Deg.	Date.				
		inches	inches.	in.				Deg.	Date.	Deg.	Date.	In shade.	On grass	
I.	Camden Square.....	1.52	— .40	.57	28	11	80.7	31	31.2	11	1	4		
II.	Maidstone (Hunton Court)...	.57	— 1.45	.24	28	9	...	...	...	...	...	...
III.	Strathfield Turgiss .....	.97	— .71	.32	17	12	80.9	31	27.9	11	2	12	
IV.	Hitchin .....	.65	— 1.34	.16	18	11	74.0	31	26.0	10	2	...	
	Banbury	1.04	— 1.09	.31	17	9	78.0	31	26.5	11	3	...		
	Bury St. Edmunds (Culford)...	1.09	— .81	.23	18	12	77.0	26	24.0	3, 10	3	...		
	Norwich (Cossey).....	.64	— 1.17	.21	18	9	80.0	26	27.0	4	2	3		
V.	Bridport .....	.88	...	.26	17	9	72.0	30	33.0	9	0	...
"	Barnstaple.....	2.05	— .05	1.05	17	7	82.0	31	36.0	11	0	...		
"	Bodmin	1.72	— 1.12	.60	17	10	71.0	31	37.0	11	0	2		
VI.	Cirencester	1.37	— .81	.38	17	10	...	...	...	...	...	...
"	Church Stretton (Woolstaston	2.15	— .24	.78	17	15	76.0	31	35.0	10	0	...		
"	Tenbury (Orleton)	1.34	— 1.09	.44	17	15	81.2	31	26.5	11	2	6		
VII.	Leicester (Town Museum) ...	.98	...	.28	17	7	77.9	31	29.1	11	1	17
"	Boston .....	.76	— 1.01	.26	26	10	85.0	31	30.0	4	1	...	
"	Grimsby (Killingholme) .....	.76	— .89	.15	17	10	75.0	31	33.0	4	0	...	
"	Mansfield	1.57	— .75	.77	26	12	79.8	31	28.7	11	1	3		
VIII.	Manchester (Ardwick).....	4.02	+ 1.79	.88	18*	16	80.0	30	35.0	11	0	0		
IX.	Wetherby (Ribstone)	1.57	— .25	.61	27	7	85.0	31	34.0	31	0	...		
"	Skipton (Arnccliffe)	5.89	+ 2.77	1.56	17	13	79.0	29	31.0	10	1	...		
X.	North Shields	1.65	— .20	.89	24	11	...	...	...	...	...	...
XI.	Borrowdale (Seathwaite).....	13.31	+ 6.33	4.00	5	16	...	...	...	...	...	...
"	Cardiff (Ely)	2.83	+ .23	1.67	18	10	...	...	...	...	...	...
"	Haverfordwest	2.06	— .63	.88	17	7	77.7	31	31.0	10	1	5		
"	Aberystwith Goginan .....	...	...	...	...	...	...	...	...	...	...	...
"	Llandudno.....	3.74	+ 2.12	1.62	26	13	71.8	31	38.0	11	0	...		
XII.	Cargen	3.70	+ 1.17	.81	15	12	79.0	29	33.0	3	0	0		
"	Hawick (Silverbut Hall)...	2.65	+ .51	.68	1	13	...	...	...	...	...	...
XIV.	Douglas Castle (Newmains)..	1.72	— .62	.28	25	15	...	...	...	...	...	...
XV.	Loch Long (Arddaroch) .....	...	...	...	...	...	...	...	...	...	...	...
"	Kilmory	2.57	— .19	.63	17	15	...	...	27.0	3	1	...
"	Mull (Quinish)	2.60	...	.81	17	15	...	...	...	...	...	...
XVI.	Loch Leven	2.30	+ .01	.40	16+	9	...	...	...	...	...	...
"	Arbroath	1.67	— .10	.49	15	8	69.0	11	33.0	10	0	...		
XVII.	Braemar	2.05	— .37	.44	15	14	74.0	30	30.0	10	6	19		
"	Aberdeen	2.63	...	.62	15	12	74.0	31	30.0	9	1	...
XVIII.	Portree	3.97	— .18	.76	15+	11	...	...	...	...	...	...
"	Inverness (Culloden)	1.64	— .14	.37	19	13	72.0	31	31.3	3	2	9		
XIX.	Dunrobin	2.64	...	.68	19	13	70.5	31	32.0	3	1	...
"	Sandwick	1.56	— .31	.43	15	11	64.3	23	33.8	3	0	6		
XX.	Cork (Blackrock).....	1.92	— .24	.75	28	12	85.0	31	30.0	10	...	...
"	Darrynane Abbey.....	...	...	...	...	...	...	...	...	...	...	...
"	Waterford (Brook Lodge) ...	1.51	...	.41	14	14	75.0	31	30.0	10	...	...
"	Killaloe	4.12	...	.80	16	12	85.0	31	32.0	11	1	...
XXI.	Portarlington	2.14	+ .29	.35	16	16	73.5	26	35.0	10	0	...		
"	Monkstown	1.65	...	.31	1	13	75.0	11	29.0	11	...	...
XXII.	Galway	2.71	+ .04	.67	16	11	77.0	24||	43.0	12||	0	...		
XXIII.	Waringstown	3.24	+ 1.13	.47	5	15	82.0	31	33.0	10	0	2		
"	Londonderry.....	1.76	...	.30	14	12	77.0	31	39.0	3	0	1
"	Edenfel (Omagh)	2.20	— .15	.33	15	15	82.0	31	30.0	2	1	...		

* And 27.

† And 18.

‡ And 17.

§ And 31.

|| And 10, 21.

¶ And 13, 23, 24.

+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON MAY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; TS for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The weather during the month was most favourable for agriculture, and the welcome rains had a most beneficial effect on the grass and other crops; wheat plant satisfactory although short. The character of the season seems becoming decided for dryness and sunshine, such as makes a good bread year.

BANBURY.—T and L on 11th and 26th; sharp frost on 11th, doing much injury to potatoes.

CULFORD.—There were some unusually severe frosts at the beginning of the month, but the last few days were very warm, more like August than May; T and L on 4th; T on 26th, 27th, and 28th.

COSSEY.—A very dry month, and a poor prospect for the hay crop; solar halo, with all the prismatic colours, lasting several hours on the 29th.

BODMIN.—Mean temp. of month $57^{\circ}2$.

CIRENCESTER.—A dry month; mild, genial weather in the latter half.

WOOLSTASTON.—Mean temp. of month $52^{\circ}4$.

ORLETON.—A very brilliant month, with a mean temp. nearly 2° above the average of last 20 years. The first six days were generally cloudy, with light falls of R at intervals, the sky then became clear, with cold nights and bright sunny days till the end of the month, and the bar. was very high and steady. On the morning of the 11th the shade temp. fell to $26^{\circ}5$, destroying nearly all early fruit in the valleys. On the 28th a TS with H passed a few miles to S.E., the H doing much damage in places.

KILLINGHOLME.—The month was very dry; easterly winds prevailing; towards the close the weather became fine and warm, but rain was much wanted; L on 26th.

MANSFIELD.—The first part of May was dry, cold nights; warmer weather succeeded about the middle of the month with genial showers, which caused vegetation—previously very backward—to make rapid progress; TS at 11 p.m. on 26th; lilac, horse chestnut, laburnum, and hawthorn in flower during the last week.

MANCHESTER.—The month opened with gloomy, wet weather and low temp. but soon became fine; there were some genial rains in the middle, though the accompanying weather was somewhat boisterous, but towards the end it was finer, and the temp. rose considerably, the month closing with splendid weather and high temp; TS in early morning of 27th.

NORTH SHIELDS.—TS on 4th.

WALES.

HAVERFORDWEST.—A remarkably fine month; the driest and warmest May since 1852; only one night frost, a most unusual occurrence; white thorn in blossom on the 22nd, remarkably early for this county; oak in leaf at least a week before the ash; corn looking splendid, and although we could have borne more R, the hay, except on dry light ground, promises well. Mean temp. $52^{\circ}6$.

LLANDUDNO.—On the whole a month of grand weather; mean temp. nearly 1° above the average; rainfall more than double the average; and we had over 226 hours of bright sunshine, consequently crops of all kinds look promising, though rather later than usual. A most violent TS occurred between 6 and 7 p.m. of the 26th, the most severe I have known to occur here in a period of 22 years; the rainfall was 1.18 in, falling in 25 minutes—from 6 to 6.25 p.m. A man driving a carriage was killed by lightning, but the horse, though knocked down, escaped.

SCOTLAND.

CARGEN.—T and L on 29th, and T on the 4th, 25th, and 28th. A gale on 15th.

HAWICK.—The first half of the month was colder, and the latter half much warmer than usual ; vegetation of all kinds fully three weeks late, though it made rapid progress during the warm weather at the end of the month ; all kinds of fruit promising.

NEWMAINS.—Distant T on 28th, 29th, and 30th.

QUINISH.—Exceedingly warm weather from the 22nd to the end of the month.

BRAËMAR.—Although a cold month, vegetation made excellent progress. T on 18th and 30th.

ABERDEEN.—Fine genial weather, during the month vegetation advanced rapidly ; rainfall above the average, but falling on a small number of days ; T and L on 20th.

PORTREE.—A fine month ; vegetation made rapid progress ; sheep and cattle healthy and thriving well on the pastures.

SANDWICK.—May continued unusually cold till the 22nd, but after that date it was warm and pleasant, with fog on the 29th and 30th ; no rain fell after the 19th. There was a gale of 50 miles an hour, from 7 to 8 a.m. on the 16th ; and on the 27th a fine sun pillar was visible for 45 minutes at sunset. Vegetation very backward.

IRELAND.

WATERFORD.—Sharp frost on 10th, injuring potatoes ; S.W. gale on 15th, 16th, and 17th ; distant T on 19th ; the last few days of the month were very warm. Cuckoo first heard on the 1st, later than for the last nine years at least.

KILLALOE.—Midsummer heat during the last week of the month ; the days brilliant and calm, and heavy dews at night.

MONKSTOWN.—By far the finest and most genial May for many years ; soft showers and warm sunshine. The bar. ranged very high. Frost on morning of 11th.

WARINGSTOWN.—A most genial and charming month, the last few days very hot.

LONDONDERRY.—A very striking feature of the weather of the month was the regular alternation of sunshine and showers, hastening the growth of every description of crop ; potato crop looking remarkably well. Wind principally S.W.

MAY FROST.

To the Editor of the Meteorological Magazine.

SIR,—I have not seen any notice taken of the severe frost on the morning of the 11th of May. At midnight on Tuesday, the 10th, the thermometer had fallen to 35°, and at five o'clock on Wednesday morning, the 11th, it was standing just a little above 22° ; the grass thermometer at 20°. A very great deal of damage was done to the gooseberry and currant crop. Of early potatoes, which were well up, not a vestige was left above the ground ; I never saw a cleaner sweep ; the young leaves on many of the beech trees were completely blackened. The nights have been cold since, but without much frost. Now it looks as if we should have a little rain, which is rather wanted, if accompanied with heat.

I am, Sir, yours truly,

JOHN MATHISON.

Addington, Winslow, 17th May, 1881.