SYMONS'S

MONTHLY

METEOROLOGICAL

MAGAZINE.

VOLUME THE SIXTEENTH.

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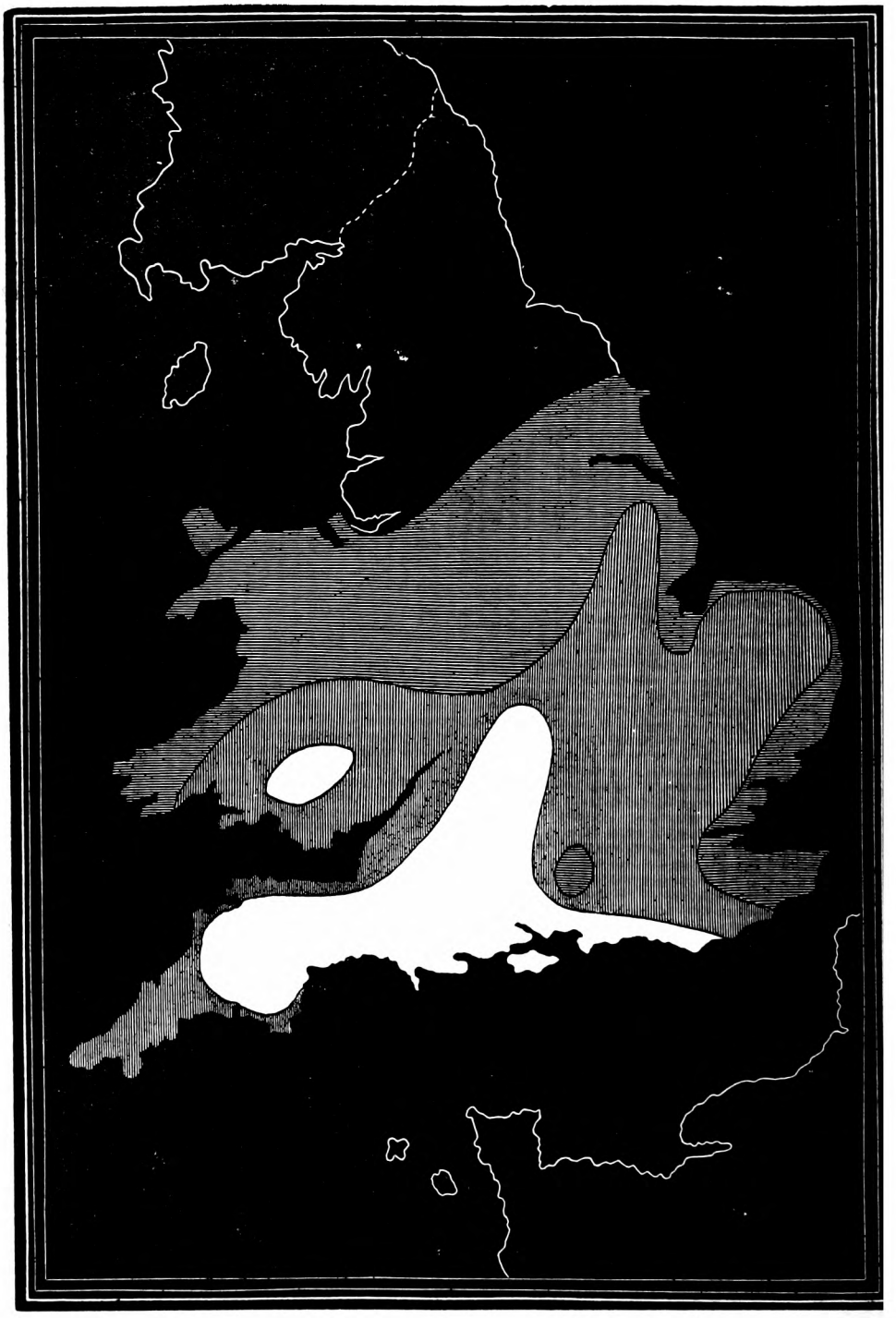
INDEX.

ILLUSTRATIONS.

DISTRIBUTION OF SNOW,
JANUARY 17TH TO 21ST, 1881.



[*For explanation see page 4.*

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CLXXXI.] FEBRUARY, 1881. [PRICE FOURPENCE. *or 5s. per ann. post free.*

EDITORIAL AND EXPLANATORY.

DURING the past fifteen years it has several times been our duty and our pleasure, by special enlargements, to present our readers with complete accounts of remarkable phenomena. But on no occasion has there been such a strain put upon us, as has resulted from the mass of details furnished respecting the frost and the snow of the past month, which have come in along with sadly too numerous enquiries, "How to measure the snow?" from observers who had neglected to read rule XV., which we reprint, in the hope that, with the recent snow-storm in their memory, all our correspondents will read it.

XV.—SNOW.—In snow three methods may be adopted—it is well to try them all. (1) Melt what is caught in the funnel by adding to the snow a previously ascertained quantity of warm water, and then deducting this quantity from the total measurement, enter the residue as rain. (2) Select a place where the snow has not drifted, invert the funnel, and turning it round, lift and melt what is inclosed. (3) Measure with a rule the average depth of snow, and take one-twelfth as the equivalent of water. This being a very rough method, is not to be adopted if it can be avoided. Some observers use in snowy weather a cylinder of the same diameter as the rain gauge, and of considerable depth. If the wind is at all rough, all the snow is blown out of a flat-funnelled rain gauge. Snowdon pattern gauges are much the best.

Very fortunately the Council Meeting of the Meteorological Society was held on the night after the snow, and it was then resolved that all the data respecting the frost which could be collected should be forwarded to the Assistant Secretary, Mr. Marriott, who should discuss them and report the results to the meeting of the Society on February 16th. An abstract of his report will be found on page 25, and of course the report in *extenso* will appear in the Society's *Quarterly Journal*. Hence it is that none of the many letters which we have received upon the subject will be found in our pages.

We undertook the investigation of the limits of the snow-storm; we applied specially to 150 of our observers and also to the managers or principal officers of the following railway companies, nearly all of whom have taken much trouble in the matter, and rendered most

valuable aid, as is sufficiently evident from the letters and tables printed at the end of Mr. Wallis's report.

List of Railways with the pages on which data respecting them will be found.

Although it has been a matter of considerable difficulty to get all this mass of material discussed in time for the regular date of publication we are satisfied that accuracy has not been sacrificed to speed, and that such subsequent material as may arrive will in no way invalidate the conclusions arrived at in the following article.

Owing to the very exceptional character of the snow-storm many of the monthly returns on pages 30 and 32 are obviously incorrect. All the figures to which the ? is attached are not necessarily wrong; but the observers are requested to report what they believe to have been the average depth of the snow in their neighbourhood, and the nearest possible approach to the truth will be obtained before the publication of the annual totals. Few rain-gauges will hold 5 inches of snow, many will not hold 3 inches; where, therefore, the fall has exceeded those amounts, it is evidently fallacious to report merely what was "found in the gauge." Rule XV., Sections (2) and (3), should have been generally followed, but even then some difficulty existed. It is neither easy nor pleasant to obtain accurate measurements of such a storm; we rejoice to notice the care which many of our observers paid to the matter; that which they have done will not merely render their own records perfect, but will help to check those of their neighbours, and in spite of all difficulties and a terrible addition to our ordinary work, we have no doubt that eventually few records will prove entirely spoilt.—G. J. S.

ON THE SNOW STORM OF JANUARY, 1881.

By H. Sowerby Wallis, F.M.S.

After the 9th of January snow fell daily on some portion of the British Isles, and on the 12th and 13th rather heavily over the greater part of them, so that by the 17th (on which day practically none fell), there was a considerable depth on the ground over the whole of the United Kingdom, the weather having been so cold that scarcely any had melted. This depth averaged three to four inches over the greater part of England, and rather more in Wales, the N. of England, and in Scotland. During the early morning of the 18th the wind, which was easterly, rapidly increased in force, and blew a strong easterly gale nearly all day, the wind falling again in the south at night, but in other parts of the country it lasted till about mid-day on the 19th. The gale was particularly severe on the

east coast, but the number of wrecks and casualties all round our shores was very great; reports from many seaports stating that it was the most severe gale that had been experienced for more than 30 years. Much damage was done to roofs, &c., and a very large number of trees were blown down in the eastern counties—*e.g.*, Lord Rendlesham reports over 1,500, most of them large ones, blown down on his estate, and there were many isolated cases of structural damage in other parts of the country. In London an extremely high tide, increased by the gale, overflowed the low-lying districts on the south of the Thames, causing great distress, augmented by the extreme severity of the weather, among the poorer classes.

The gale was accompanied by a heavy and steady fall of snow over all but the north of England, which lasted through the 18th and continued, though rather lighter, till about noon on the 19th. The amount of snow deposited over the whole of the southern portion of the country was very great, and was so drifted by the fierce wind, that communication both by rail and road was entirely disorganised, and it was more than a week before the railway and postal arrangements throughout the country recovered their usual regularity and punctuality; the interruption to business was further increased by the large number of telegraph wires which were broken by the gale or by contraction caused by the extreme cold.

Snow fell again on the 20th in the S. and S.W., very heavily in the Isle of Wight and neighbouring districts, blocking up many lines of railway that had with great difficulty been cleared from the fall of the 18th.

Among careful observers in all parts of the country where the snow fell with its full intensity, it appears to be the general opinion that to find anything like a parallel case we must go back to 1836 or to 1814; and it would appear that in most parts of the country the depth in those years was greater, but that the drifts were not so great. As regards the fall in the Isle of Wight and South Hampshire, it is believed to be altogether unprecedented in recent times.

One feature of the snow which appears to have been noticed nearly all over the country, was its extreme fineness and dryness, and the remarkable manner in which it penetrated in large quantities through roofs, the cracks of doors and windows, and even the most minute and almost imperceptible crevices.

The loss of life in England and Wales, entirely due to the snow, was very great, and probably an estimate of 100 persons would be very near the truth, and the amount of distress occasioned simply by the stoppage of the supplies of food and fuel to country districts from towns is almost incalculable.

Small birds died of starvation in vast numbers, their food being covered by the snow. At Littlehampton, in one shrubbery, more than 100 dead blackbirds and thrushes were found, and the following curious incident is reported in an Isle of Wight newspaper:—"A friend of ours looking from his window (in Shanklin) on Monday,

saw some larks hopping about on his lawn. Presently some rooks swooped down upon the birds, tore several to pieces, and ate them."

It is very difficult to realise the magnitude of the snowstorm and of the drifts; perhaps some of the men employed in clearing the railways had the best opportunity of doing so. Locomotive engines and trains, in spite of their size and power, were snowed up by the dozen; not merely stopped, but buried for days together, and in some cases so completely as to be quite hidden. From the Tring cutting on the L. & N. W. railway, 1,700 truck loads of snow were taken. A railway truck is about 15 ft. long, therefore 1,700 trucks would form a train nearly five miles long. A train five miles long to empty *one* cutting on *one* railway, what length of train would it require to remove the snow from all the cuttings on all the railways in England?

The loss to the country was enormous; over more than half England business was practically stopped for one day at least, and the cost of clearing not only the railways but almost all the roads in the country, is incalculable, not to mention the more or less serious suffering and discomfort. Plymouth was deprived of water for nearly a week. Public and private meetings of all kinds had to be postponed; in short, that intercourse between man and man, on which the whole business and pleasure of life depend, was interrupted.

The accompanying map and following summaries for the different counties are founded on special returns from about 200 regular meteorological observers, and on the reports furnished by nearly all the great railway companies, which are especially valuable, as they are based on statistics furnished by the engineers and traffic superintendents of the various lines, who not only had special opportunities of ascertaining the various depths, but who are in the habit of dealing with accurate measurements, and are, therefore, less likely to be led into unconscious exaggeration than amateurs of all classes.

The depths of snow in the various cases must be understood to represent the greatest depth to which the ground was covered at any time between the 17th and 21st of January, as it was impossible to deal with it in any other way; but except in the extreme S. and S.W., by far the greater portion of it fell during the one continuous storm of the 18th-19th.

The map shows at a glance where the greatest amount fell. Over the white portion the depth exceeded 12 inches, and the part left black is where no appreciable amount fell on the 18th and 19th; the shaded portions represent respectively where the depth was less than 6 inches, and where it was between 6 and 12 inches.

There was also snow on the ground over almost the whole of Scotland and Ireland, which drifted considerably, and in some cases caused delay to traffic; but it has no interest in connection with the abnormally heavy fall of the 18th and 19th over the southern portion of England, and therefore needs no further notice. The special feature

being that the heaviest falls occurred in those parts of the United Kingdom where ordinarily such falls are most rare.

In the neighbourhood of *London* snow began to fall soon after 9 a.m. on Tuesday, January 18th, while a violent gale was blowing, gradually increasing in quantity till night, continuing all night, and ceasing about mid-day on Wednesday the 19th, about which time 9 inches had fallen over the whole of *Middlesex*. In the London streets traffic was almost entirely discontinued during Tuesday afternoon, and nearly, if not quite all the suburban lines of railway were blocked, and remained so till various times on Wednesday. Drifts 3 feet in depth were common in the streets, and in the country lanes 4 feet was occasionally reached.

In *Surrey* conditions were much the same as those prevailing in Middlesex, the depth of snow being if anything rather less. Communication by rail with London and other places was stopped from about mid-day on Tuesday till the same time on Wednesday, the mails of course being delayed to the same extent.

The fall in *Kent* was considerably less, being only 3 to 4 inches along the coast, 4 to 6 inches over the greater part of the county, increasing to about 7 inches in the N.W. near London. Drifts up to 5 feet in depth were frequent, others were 6 to 8, 9, and 10 feet, and in the Isle of Thanet, where they appear to have beeu remarkably deep, 12 to 14 feet is reported in a Margate newspaper, and confirmed by the observer at Acol. The roads in many parts were not rendered passable till the 22nd, and in some cases not till the 24th. Communication with all parts any distance from London stopped for periods varying from 4 to 29 hours. The Judges leaving London on the 18th to open the Maidstone Assizes found the line blocked at Shoreham, near Sevenoaks, and were obliged to return to London.

The fall commenced earlier in *Sussex* than in London, snow being first observed in the night of 17th-18th, and the depth all along the coast was very great, reports of the average depth being, Worthing, 18 in. to 24 inches; Brighton, 18 inches; St. Leonard's, 12 inches; Littlehampton, 12 to 9 inches. The fall appears to have diminished gradually from the coast northwards, the depth on the borders of Surrey being not more than 7 or 8 inches. The snow ceased about 4 or 5 p.m., when the drifts varied from 4 to 8 feet. Railway traffic was of course stopped, and two or three trains and several locomotives were so imbedded in the drifts that they had to remain till gangs of labourers were collected to dig them out. A considerable amount of inconvenience and distress was occasioned in the villages and country districts by the want of food and fuel, the snow-drifts rendering it impossible for them to receive their usual supplies from the towns.

In the *Isle of Wight* and the south of *Hampshire* matters were very serious, for the fall of the 18th—which was greater there than in any

other part of the country—was followed by another, equally heavy on the 20th. At Newport the first fall averaged 16 inches, and the second 18 inches; total 2 ft. 10 in. At St. Lawrence the two falls gave 22 inches; at Ventnor, 18 inches; at Osborne, 18 inches; and at Cowes it is stated that the depth was 5 feet, but this is certainly an exaggeration. At Ryde the fall was 18 inches to 2 feet, and many of the roads are said to have been filled nearly half-way up the lamp-posts, and the lamps were left alight the greater part of the day on account of the difficulty of getting to them. No shops were open, the drifts in some cases being above the tops of the doors and shutters. All the towns in the Island seem to have been in much the same state. At Cowes there were drifts in the streets 12 feet deep, and in the west of the Island there were blocks in the roads 12 feet deep extending for a quarter of a mile at a stretch. At Shorwell the school-house was buried, and to rescue the master and his family a tunnel was dug from the road to his door. The roads in the Undercliff were impassable from the 18th to the 26th. Here, also, the distress occasioned in the rural districts by the stoppage of supplies was very great; and it is stated that at Chale there was no bread from Tuesday, the 18th, to Tuesday, the 25th, when a waggon load of flour was dragged in with great difficulty. All the railway lines on the Island were of course blocked, and, though large gangs of men were kept at work, it was impossible to resume traffic on any of them till mid-day on Saturday, and the Ryde Direct was not re-opened till Wednesday, the 26th. All over the south of Hampshire the fall was almost, if not quite, as bad as in the Isle of Wight, the depth being reported at from 8 inches to 4 feet; but the latter amount is undoubtedly too great, the true fall probably ranging from 12 to 18 inches, or perhaps in special cases to 2 feet or 2ft. 6in. In the N.W. of the county the fall was considerably less, being about 8 in., while in the N.E. it was remarkably small, it being a well-authenticated fact that in a large district surrounding Basingstoke the depth did not exceed 4 inches, nevertheless there were drifts 8 feet deep in the neighbourhood. The greatest drifts appear to have been in the neighbourhood of Havant, where they were 10 to 14 feet, and Portsmouth, 3 to 8 feet. The rail to Portsmouth was blocked for 17 hours on 18th–19th, and 21 hours on 20th–21st. A hall at Portsmouth is reported to have fallen to the ground from the weight of snow on the roof.

In *Berkshire* the average depth ranged from 9 inches to about 15, the fall being greatest to the west of the county and smaller in the east. The roads in most parts were completely blocked and remained so for several days till the drifts were cut through, and in one road near Lambourn a tunnel several yards in length was cut for foot passengers. No mails were received at Lambourn from Tuesday, 18th, morning, till Saturday, 22nd, afternoon.* The drifts on the Great Western Railway were considerable.

* Near Hungerford a mail cart driver and two assistants were frozen to death.

The fall was rather smaller in *Hertfordshire*, the reports varying from 6 in. to 9 in., the fall being greatest in the west. The average for the whole county was about 7 or 8 inches.

In *Buckinghamshire* the fall averaged about 7 inches, which, though large, is small in comparison with other parts of the country, and the drifts were not so deep, the greatest reported being 6 ft. 6 in., but even with this fall the difficulty of establishing communication was very considerable, for the surveyor of the borough of Buckingham states that he had 14 miles of road to clear on which the average depth of snow was 3 ft.

The amount of snow in *Oxfordshire* was very great, reports from all parts giving the fall as 12 to 13 inches. In Oxford on Wednesday the drifts in the principal streets were knee-deep, and all traffic was suspended. No letters or newspapers from London or the north were received from Tuesday to Thursday, and Oxford was isolated from the rest of England; the local traffic by the Great Western Railway was suspended from Tuesday afternoon till Thursday afternoon. The 3.30 p.m., 3.50 p.m., and 4.45 p.m. trains from Paddington were snowed up between Reading, Didcot, and Radley; passengers by the 2.15 p.m. train from Reading on Tuesday were snowed up at Radley until 9 a.m. on Wednesday, when they were released and taken to the station, and finally reached Oxford (4 miles) about 7.15 p.m., after a captivity of 26 hours. The down line from Didcot was cleared about 6 or 7 o'clock on Wednesday evening. The block was not so complete on the L. & N. W. Railway; only two trains left Oxford for Bletchley on Wednesday and reached their destination very late, all communication south of Bletchley being cut off. On Tuesday night the only passenger train which left Oxford was snowed up about 1½ miles out, and brought back with much difficulty, after several hours delay. Careful measurement taken in several places show the fall in Oxford to have been from 12 to 13 inches, and the drifts were of all depths, from knee-deep to 13 feet. At Banbury snow began to fall soon after noon on the 18th, and by the next morning the depth averaged 9 inches, and during the 19th another 4 inches fell; the drifts in the streets at one side of the way were 3 ft. deep; about a mile from the town a drift nearly covering the road was 7 ft. deep, and in other roads it is said to have been as deep or deeper. Four men lost their lives near Banbury, and there were several narrow escapes. There was no communication with London or Birmingham for two days, and mails both going out and coming in were delayed for the same time.

Over almost the whole of *Northamptonshire* there was an evenly distributed fall of six inches, the exception being the S.W. where it gradually increased to 12 inches near Banbury. The lines all over the county were blocked with drifts of an average depth of 6 feet.

In *Huntingdon* the depth ranged from about 5 inches in the N.E. to 8 inches in the S., the average probably being between 6 and 7 inches; the drifts all along the Great Northern Railway, which runs

in almost a straight line from N. to S. through the county, were very considerable, and were some of the worst on that system, ranging from 3 to 10 feet.

The fall in *Bedfordshire* averaged about 7½ inches, the amount being slightly larger in the S. than in the N. The drifts on the different railways ranged from 6 to 10 feet, and traffic was much interrupted, the Hertford, Luton and Dunstable line being blocked for two days, and the North Western line to Bedford for the same period.

The depth did not vary much in *Cambridgeshire*, and averaged about 7 inches, all reports stating it at from 6 to 8 inches. The Spalding and March Railway, and part of the Cambridge branch of the G. N. R., were blocked for two days, and the Cambridge branch of the L. and N. W. for twelve hours.

There was considerable variation in the amounts of snow which fell in different parts of *Essex* but the average was about 8 inches, the deposit was slightest in the S.E. and on the coast, where it was just below six inches, 8 inches fell over the central portion of the county, and 9 inches in the W. and S.W. The drifts were considerable and five or six persons are reported to have lost their lives in the snow.

The fall in *Suffolk* was curiously small, not averaging more than 6 inches and very diversified, not more than 2 or 3 inches falling on the southern portion of the coast, and four or five on the northern part, inland the fall was 6 inches, increasing to 7 in the extreme west. Drifts of 7 feet and upwards are reported, a luggage train was buried near Ingham station and the traffic was suspended for three days. The mail cart from Thetford was snowed up and the driver had some difficulty in removing the horse.

Over the greater part of *Norfolk* the fall was large, the average for the whole county being about 9 inches, dividing the county by a straight line from Lynn to Harleston, the deposit on the N. of the line was 10 inches and S. 6 to 7 inches. Drifts were very considerable, the roads nearly all over the county being blocked. In the neighbourhood of Swaffham drifts were 12 feet deep and the mail cart from Swaffham to Brandon was stopped for more than a week, and the rail to Watton was closed for three days. At Hindringham the mails were stopped from Tuesday to Friday, and the Attleborough mail cart was abandoned and buried.

Wiltshire was one of the counties where the fall was greatest, and over the whole county it probably averaged 18 inches, reports varying from 6 inches at Calne to 36 inches at Warminster. These appear to err one on each side of the truth, though there was an exceptionally small deposit in the neighbourhood of Calne and Devizes, and an exceptionally large one about Warminster, near which place the drifts on the railway were 12 feet deep, and near Severnake 9 feet. The lines between Salisbury and Dounton and betweed Salisbury and Warminster were blocked for three days, and the roads were blocked in some places for four days.

Dorset, like all counties on the southern coast, was severely visited, the average for the whole county being about 15 inches, 12 to 14 inches inland and 18 to 20 inches or perhaps more on the coast. The drifts on the S. W. Railway were 5 to 12 feet deep, and the line was partially blocked on the 18th, 19th, and 20th, and completely for a short time on the 21st. Roads in the neighbourhood were blocked from 18th to 22nd. On the Somerset and Dorset line, between Stalbridge and Sturminster Newton, there was 5 to 6 feet of snow on the rails for a considerable portion of the way, and similar but shorter drifts S. of Blandford. At Beaminster the streets were stopped by drifts 3 feet deep, and on the country roads there were drifts of 6 to 12 feet; no mail carts could run between Beaminster and Ilminster, or between Beaminster, Bridport, and Dorchester. Two public conveyances which started from Beaminster to Crewkerne on Tuesday morning (18th) remained buried in a drift till Saturday, 22nd.

Over *Devonshire* the fall was pretty evenly distributed about 12 to 14 inches, except round the greater part of the coast, where it was rather less, and on Dartmoor, where it may have averaged anything up to 3 feet. The drifts on the railways were in many places 15 feet deep, and parts of the lines were entirely blocked for 2 and 3 days, and the line to Holsworthy was blocked for 7 days. The roads in the same neighbourhood were stopped for 4 days, the drifts in many cases being 10, 12, and 15 ft. deep, and the observer at Holsworthy says that "at the age of over sixty years I do not remember such severe weather; birds may be seen dead in considerable numbers." Perhaps one of the most serious results of the snow in any part of the country was the entire stoppage of the water supply to Plymouth, the open channel from the reservoirs and gathering ground on Dartmoor becoming completely choked by the drifting snow. The channel is about 20 miles long, and the drifts were in places from 12 to 20 feet deep, so that although 1,000 men were employed in clearing it they did not succeed in getting it open till the evening of Sunday, the 23rd.

In *Cornwall* the fall was about 12 inches in the extreme E., and decreased considerably towards the W., the deposit over the greater part of the county being about 7 inches, though it appears to have been heavier again in the neighbourhood of Penzance; the drifts, though very considerable, were not so bad as might have been expected in such a hilly country.

Twelve to 13 inches of snow fell in the S. and E. of *Somersetshire*, and 8 to 10 inches in the W. and N. The Bristol and Exeter line was not much blocked, but all along the Cheddar Valley line, and indeed from Yatton to Witham, there was almost one continuous drift, the average depth being 10 feet. The Somerset and Dorset line was much blocked, and traffic stopped for two days.

In *Gloucester* the fall appears to have decreased gradually from S. to N., the average depth in the S. being about 9 or 10 inches, and in the N. 6 or 7 inches; drifts 7 to 10 feet deep.

The fall in *Hereford* was 10 or 11 inches in the S., diminishing to about 6 inches in the north. Drifts on the rail in the neighbourhood of Ross averaged 6 feet. The 10 p.m. mail on Tuesday from London did not arrive at Hereford till Thursday.

Shropshire escaped all serious inconvenience from the storm, the fall being very small, not exceeding 5 inches in the south and 3 in the N. The drifts were only sufficient to make locomotion slow and disagreeable, and horses, if not overweighted, would have drawn a carriage anywhere.

In *Stafford* also the fall was unimportant, the reports varying from 1 to 4 inches; the drifts did not exceed 3 feet.

The average fall in *Worcestershire* was apparently about 5 to 6 inches, the fall being greatest in the east and N.E., where it was about 8 inches, and the drifts were considerable.

The snow was very unevenly distributed over *Warwick*, the depth in the central portion being about 7 or 8 inches, decreasing to about 4 inches in the N. and increasing to 12 inches in the S.E.

The fall appears to have been very equable over the whole of *Leicestershire*, and to have averaged about 6 inches; drifts of 6 feet were common on the railways.

Over the whole of *Lincolnshire* the fall averaged about 6 or 7 inches, being rather smaller along the coast. All the Lincolnshire section of the M. S. & L. R. was very much blocked, the traffic in some cases being suspended for 20 hours, and one passenger train became so embedded in a drift that it was only extricated with considerable difficulty.

On the 18th the fall of snow in *Notts* was not very great, but with what had previously fallen there were 5 or 6 inches on the ground, which drifted considerably, but there was no stoppage of traffic.

In *Derby*, *Cheshire*, and the *Northern Counties* there was no snow on the 18th or 19th, or so little as not to call for remark, though there was previously fallen snow over almost the whole of the remainder of England and the greater part of Scotland, and in many cases considerable drifts, but these were altogether of a normal character and are therefore outside the scope of this article.

The quantity of snow which actually fell on the 18th and 19th in *South Wales* was not great, probably not being so much as 6 inches anywhere, unless in the neighbourhood of Abergavenny, but there was a depth of 5 or 6 inches on the ground from previous falls, which was so blown about by the gale that it was impossible to ascertain how much fell and how much only altered its position. In *Monmouthshire*, however, the fall was considerably greater, ranging from about 7 to 9 inches. It is reported that in Monmouth on the 18th there were 4 feet of snow in the streets, no trains arrived, and business was totally suspended. The drifts in the mountainous country were, of course, very great, particularly in the district N. and W. of Abergavenny.

In *North Wales* very little snow fell, but that on the ground drifted

very much and caused some delay to traffic, especially in Anglesea and between Conway and Bangor.

THE GREAT NORTHERN RAILWAY,

General Manager's Office, King's Cross Station,
London, N., Feb. 9th, 1881.

DEAR SIR,—Referring to your letter of the 3rd inst., I think I cannot do better than send you copy of communication which has been addressed to me by Mr. Johnson, our Engineer, giving his experience of the effects of the late snow storm upon the Great Northern line.—Yours faithfully, H. OAKLEY.

G. J. Symons, Esq.

[Copy.] Engineer's Office, King's Cross, N.,
February 7th, 1881.

DEAR SIR,—Herewith I return Mr. G. J. Symons's letter of the 3rd inst., referring to the late snow storm.

So far as this railway is concerned the following particulars may be useful to Mr. Symons :—

The storm commenced on Tuesday morning, 18th January, wind north-east, and the whole of our railway from Grimsby on the east, to Boston, Sleaford, Grantham and Nottingham was covered with about 6 inches of snow. This extended southwards to Stamford, Peterborough, Cambridge and Hitchin, at which point there were about 9 inches of snow on the level, and this continued southward as far as Hatfield, Luton, and Hertford.

From Hatfield to London there was rather less snow, averaging only about 6 inches in depth.

As regards the drift, it was very bad on the whole of the area from Grimsby to Boston, Sleaford, Grantham, Peterborough, Cambridge, and Luton. The average depth of the drift was about 3 feet; but in many of our shallow cuttings, from 8 ft. to 10 ft. in depth, one side of the railway was completely blocked with snow.

The East Lincolnshire Railway, the Spalding and March Railway, part of the main line between Grantham and Peterborough, the Ramsey branch; part of the Cambridge branch between Cambridge, and Hitchin; and the Hertford, Luton, and Dunstable branches were blocked with snow for two days.

The east side of the railway between Hatfield and Potters Bar was also blocked with the snow drifts.

We have not had so serious a block on this railway since February, 1854, and January, 1861.—Yours faithfully,

H. Oakley, Esq. (Signed) RICHD. JOHNSON.

LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

London Bridge Terminus, S.E.,
February 9th, 1881.

DEAR SIR,—I beg to acknowledge the receipt of your communication of the 3rd inst., asking for certain particulars respecting the

depth of snow on various parts of our system, its average depth, its depth in drifts, and the obstruction of traffic therefrom.

I need scarcely say that I should be happy to give you all the information in my power in respect to this, but, necessarily owing to the exceptionally erratic nature of the storm and of the winds prevailing at the time, I am afraid the information I can give can only be of a general character differing as the storm did upon various parts of our line.

I may say that in cuttings and places exposed to exceptional drifts we have had the snow, in some instances, from 15 to 20 feet deep, and our traffic was temporarily suspended in consequence. This applied particularly to the *western* part of our system, in the direction of Portsmouth and the Isle of Wight, and where such snowstorm appears to have been most felt; and you may take it that the average depth of snow alone in this locality was not less than 4 feet. We had also some heavy drifts upon our *eastern* line in the vicinity of Eastbourne and Lewes; and our traffic generally would have been suspended in consequence for a much longer period than it was, but we have made use of the snow ploughs fixed upon the front of our engines, constructed by our Locomotive Superintendent, Mr. Stroudley, and which were of great advantage to us in clearing the roads and resuming the ordinary working of the traffic much earlier than we otherwise could have done.

I am, dear Sir, yours faithfully,

J. P. KNIGHT,

G. J. Symons, Esq., F.R.S. General Manager.

LONDON, CHATHAM AND DOVER RAILWAY,

Engineer's Office, Victoria Station, Pimlico, S.W.,
9th February, 1881.

DEAR SIR,—Mr. Forbes having handed to me your letter of the 3rd inst., I send, as requested, the best details I have been able to obtain of the result of the snow-storm, and its effect in obstructing the traffic on this railway.

I shall be most happy to forward to you, to the best of my abillty, any further information you may require.—Yours faithfully,

WILLIAM MILLS.

G. J. Symons, Esq., F.R.S.

LONDON, CHATHAM, AND DOVER RAILWAY.

Snow Storm, 18th January, 1881.

Suburban Lines.—Estimated fall, 3½ to 5 inches; greatest drift, 18 inches, Loughborough to Elephant and Castle. Very little hindrance to traffic.

London to Rochester.—Estimated fall, 5 inches; greatest drift, 15 inches, Bromley and Bickley. Very little hindrance to traffic.

Sevenoaks and Maidstone Branches.—Estimated fall, 3 to 4 inches;

greatest drift, 2 ft. 6 in. to 4 ft., Eynsford and Shoreham. Line completely blocked for 5 hours.

Rochester to Canterbury.—Estimated fall, 3 to 4 inches; average drift, 2 ft.; greatest drift, 5 to 6 ft., at Teynham, and 8 ft. near Selling. Down line blocked for 27 hours, up line for 4 hours.

Sittingbourne and Sheerness Branch.—Estimated fall, 5 to 6 inches; average drift on line, over 2 feet; greatest drift in cutting near Milton. Line completely blocked for 29 hours.

Canterbury to Dover.—Estimated fall, 3 to 4 inches; average drift, 3 ft. 6 in.; greatest drift, 9 to 10 ft., near Shepherd's Well. Down line blocked for 24 hours; up line traffic delayed.

Ramsgate and Margate Branch.—Estimated fall, 4 inches; average drift, 2 ft. 6 in.; greatest drift, 6 to 8 ft., Margate to Broadstairs. Up line blocked for 54 hours between Ramsgate and Margate; down line traffic delayed.

WILLIAM MILLS, Engineer.

LONDON AND SOUTH WESTERN RAILWAY,

General Manager's Office, Waterloo Bridge Station, S.E.,
London, 9th February, 1881.

SIR,—I beg now to send you, in answer to your letter of the 3rd instant, some particulars of the late snow-storm, and its effects upon the lines of this Company.

The whole of our lines were, more or less, seriously affected by the snow-storm; and on some portions the traffic was entirely suspended for some days, more especially in the vicinity of Dartmoor and on branches.

I trust the information is what you required.—I am, Sir, your most obedient servant,

ARCHIBALD SCOTT, General Manager.

G. J. Symons, Esq., F.R.S.

LONDON AND SOUTH-WESTERN RAILWAY.

Snow Storm, January, 1881.

District.	Depth in open Country. in.	Depth in Drifts. ft.	Obstruction to Traffic and General Remarks.
Andover	12	5 to 15	Single line worked where drifts very deep; but no serious delays to trains. Highways blocked from 3 to 10 days before they were fit for traffic.
Basingstoke..	4	3 to 8	Lines pretty clear, trains delayed at Micheldever about 8 hours through snowdrift. Roads in some cases entirely blocked. Villagers crossed the fields.
Barnstaple ...	36	10 to 16	Line to Ilfracombe blocked for several days, traffic greatly obstructed on North Devon line. Roads in all directions impassable.
Dorchester ...	36	5 to 12	Partial block on rail on 18th, 19th, and 20th. Complete block for about 10 hours on 21st. Roads all blocked round this neighbourhood from 18th to 22nd, inclusive.

District.	Depth in open Country. in.	Depth in Drifts. ft.	Obstruction to Traffic and General Remarks.
Exeter.....	12	5 to 25	The whole of the railway and road traffic was very seriously interrupted (and at times quite stopped) from 18th to 24th, both inclusive.
Fareham.....	30	6	Roads in the neighbourhood blocked for days. Railway to Gosport blocked from 18th to 20th, for 48 hours, and from 21st to 22nd, about 40 hours entirely.
Guildford ...	8	5 to 10	Railway not obstructed, but some of the roads impassable for vehicles.
Havant	36	10 to 14	No train to Portsmouth on 18th inst. after 9.30 a.m., both lines blocked, worked single line on 19th inst. ; 20th both lines open again ; 21st, both lines blocked again by further fall of snow, but cleared in evening.
Lidford	15	about 15	Line blocked from 18th to 19th then cleared, again blocked from Friday 21st 9 a.m. till Saturday 11 a.m. Turnpikes blocked for 14 days.
Okehampton.	36	10 to 15	All traffic by road stopped for 4 days entirely, and by rail at intervals of 2 to 3 days. Holsworthy line blocked for seven days.
Plymouth ...	18	3 to 5	Traffic by rail not suspended within 10 miles of Plymouth, and by road only partially.
Portsmouth..	30	3 to 8	Railway traffic delayed 18th and 19th about 17 hours and on 20th and 21st about 21 hours. Street traffic stopped practically for 6 days.
Ringwood ...	36	15	All trains delayed about 3 or 4 hours. Bournemouth East line blocked one day. Road traffic completely blocked for 3 days.
Salisbury ...	9	3 to 15	Line between Salisbury and Downton and between Salisbury and Warminster blocked for 3 days ; other lines for 10 miles east and west partially blocked. Roads blocked for 4 days.
Southampton	12	4 to 6	Trains running fairly well, no serious delays. Roads blocked for nearly a fortnight.
Templecombe	30	6 to 20	Somerset and Dorset line blocked for 2 days. Turnpike roads obstructed in every direction.

SOUTH-WESTERN AND MIDLAND RAILWAY COMPANIES' SOMERSET AND DORSET JOINT LINE.

Office of Superintendent of the Line,
Bath, 9th February, 1881.

SIR,—In reply to your favor of the 3rd instant, I have pleasure in furnishing the information you ask for, so far as the "Somerset and Dorset" Line is concerned.

The snow storm commenced about 8.0 a.m. on Tuesday, the 18th ultimo. The snow was exceedingly fine, fell very fast, and was accompanied by a very strong wind from the south-west. It continued almost without ceasing throughout Tuesday, Tuesday night, and, at the Bath end, until about 5.0 p.m. on Wednesday (19th), at which time it ceased on the north side of the Mendips ; but at Shepton Mallet, on the south side of the Mendips, and south of that place, the

snow continued until about 1.30 a.m. on Thursday morning (20th), after which there was a very slight fall.

From Bath to the summit of the Mendips, I should consider the average depth was about 10 inches, this depth increasing on the south of the Mendips, being probably a foot or a little more at Shepton Mallet and as far as the foot of the hills at Evercreech Junction. From thence to Temple Combe there appeared to be a considerably less quantity, but southward of Temple Combe, and through to Wimborne, there was again a very considerable depth of snow, which, at Wimborne, is said to have reaced 18 inches on the level. The drifts were, of course, to a very great extent controlled by the particular formation of the line at various points.

So far as the railway was concerned, the heaviest drifts on the north side of the Mendips were near Bath, again at Chilcompton, and on the actual summit, near Binegar; these drifts being from 3 ft. 6 in. to 4 ft. 6 in. in depth. The deepest drifts we had were on the southern slope of the Mendips, between the summit and Shepton Mallet, where in more than one place the drifts were 13 feet deep, and there were also other places where they ranged up to 6 feet for a distance of between 500 and 600 yards.

Between the foot of the hills at Evercreech Junction and Temple Combe the drifts were comparatively slight, but between Temple Combe and Wimborne we had several heavy interruptions, the principal ones being drifts of about 5 and 6 feet for a considerable portion of the way between Stalbridge and Sturminster Newton, and similar ones for shorter distances south of Blandford.

On the branch from Evercreech Junction to Highbridge the depth of snow was much the same as on the Bath end of the line, the principal drifts being near the terminal stations on the branch, which extended for nearly a mile, with a depth of at least 5 feet. There was also on the Wells branch a heavy drift, about half-way between Wells and Glastonbury.

The interruptions to traffic commenced about noon on Tuesday, after which time trains were very much delayed, and the later trains were not run at all. The line was wholly closed on Wednesday and Thursday, but the passenger train service was resumed on Friday morning (21st), though we were unable to re-commence goods working until Saturday night (22nd), owing to the station yards being thoroughly snowed up.—I am, Sir, your obedient servant,

ROBERT A. DYKES,
Traffic Superintendent.

G. J. Symons, Esq., F.R.S.,

GREAT WESTERN RAILWAY,
General Manager's Office, Paddington Station,
London, W., 10th Feb., 1881.

DEAR SIR,—In reference to your letter of the 3rd instant, I have the pleasure to enclose a copy of a statement which was prepared for

the information of the Directors, at their meeting last week, together with a plan shewing the position of each drift, and a memorandum giving the average depth.

If I can be of any further assistance to you, I shall, on hearing from you, be pleased to supply you with any other particulars in my possession.—Yours faithfully, J. GRIERSON.

G. J. Symons, Esq., F.R.S.

Average Depth of Drifts on the GREAT WESTERN RAILWAY.

	Depth in feet.
Buckinghamshire—	
Wycombe to Aylesbury	6½
Bourne End to Great Marlow	5
Berkshire—	
Maidenhead to Cookham	5
Reading to Mortimer	4
Reading to Thatcham	4
Reading to Challow	6
Moulsford to Wallingford	1½
Didcot to Kennington Junc.	8
Radley to Abingdon	5
Uffington to Faringdon	5½
Brecknockshire—	
Hirwain Yard	4
Cornwall—	
Victoria to New Quay	6
Menheniot to Liskeard	6
Devonshire—	
Venn Cross to South Molton	9
Wellington to Collumpton	3
Tiverton Junction to Hemyock	5
Tiverton Junction to Tiverton.	6
Torquay to Charston	5
Totness to Plymyton	13
Bickleigh to Coryton	6
Dorsetshire—	
Yetminster to Weymouth	10
Maiden Newton to Bridport	8
Glamorganshire—	
Llwydcoed to Merthy Tydvil.	4
Llancaiach to Aberdare	8
Hendreforgan to Gilfach	15
Brynmenin to Blackmill	3
Llanharran to Tondu	4
Gloucestershire—	
Lechlade to Fairford	6
Chipping Norton to Bourton	6
Stapleton Road to Montpellier.	3
Narraways Hill to New Passage	5
Kemble to Brimscombe	5
Bullo Pill to Churchway	15
Awre Junction to Howbeach	6
Hampshire—	
Mortimer to Basingstoke	4
Herefordshire—	
Hereford to Mitcheldean Road.	4½
Ross to Kerne Bridge	6
Hereford to Tram Inn	4
Lyons Hall to Almeley	6
Monmouthshire—	
Monmouth to Chepstow	5
Monmouth to Lydbrook	4
Monmouth to Usk	4
Pontypool Road to Nantyderry.	4
Newport to Llantarnam	4
Pontypool Road to Crumlin	4
Radnorshire—	
Dolyhir to Radnor	7
Oxfordshire—	
Twyford to Henley	3
Thame to Wheatley	5
South Leigh to Alvescott	5
Chipping Norton Junction to Chipping Norton	3½
Somersetshire—	
Langport to Martock	6
Witham to Yatton	10
Yatton to Clevedon	4
Weston Junc. to Weston-super-Mare	4
Brent Knoll to Highbridge	5
Norton Junction to Williton	5
Warwickshire—	
Fennycompton to Southam Rd.	6
Stratford-on-Avon to Milcote	6
Wiltshire—	
Swindon to Purton	3
Swindon to Dauntsey	4
Dauntsey to Somerford	5
Chippenham to Calne	5
Thingley Junction to Melksham	5
Holt Junction to Seend	4
Savernake to Bedwyn	9
Savernake to Marlboro	3
Westbury to Salisbury	12
Worcestershire—	
Long Marston to Honeybourne	6

Interruptions to Traffic on the GREAT WESTERN RAILWAY.

Total number of places where blocks occurred ...	141		
	Miles.	Chns.	Yds.
Total length of drifts	111	30	6
Shortest length of drift (between Lidford and Coryton)	—	—	30
Longest length of drift (between Tiverton Junction and Hemyock)	7	20	—
	Days.	hrs.	mins.
Total time of stoppage of lines through drifts equal to	190	2	56
Shortest time any length was blocked (between Lidford and Coryton)	—	—	12
Longest time any length was blocked (between Wallingford and Moulsford)	6	3	—
Total number of Passenger trains snowed up over the system	51		
	Days.	hrs.	mins.
Total time delayed equal to	25	12	43
Shortest time a train was delayed (between Savernake and Marlboro')	—	—	10
Longest time a train was detained (between Wallingford and Moulsford)	4	22	—
Number of Goods trains snowed up	13		
	Days.	hrs.	mins.
Total time delayed equal to	7	4	55
Shortest time a Goods train was detained (between Paignton and Torquay)	—	—	45
Longest time a Goods train was detained (between Highbridge and Brentknoll)	2	4	45

GREAT WESTERN RAILWAY,
General Manager's Office, Paddington Station,
London, W., 12th February, 1881.

DEAR SIR,—In reply to your letter of the 10th instant, I have to state that I have obtained from the local officers statements giving, as far as they can, the average depth of the snow in undrifted localities in their respective divisions.

Of course there was not a district where the snow did not drift more or less, so that it has been rather a difficult task even to estimate what the depth would have been under ordinary circumstances; but the enclosed memorandum shows, as near as it is possible to judge, the depth of snow in the districts adjacent to the railway in the several counties through which the line passes.

Yours truly,

G. J. Symons, Esq. J. GRIERSON.

Estimated depth of the snow in undrifted localities adjacent to the Great Western Railway in the several counties through which the line passes.

	ft.	in.		ft.	in.
Berks	0	6	to 2	0	
Brecknock			0	6	
Carmarthen			0	6	
Cornwall	0	6	to 1	0	
Denbigh			0	6	
Devon	1	0	to 1	6	
Dorset			1	0	
Flint			0	8	
Gloucester	0	10	to 1	6	
Glamorgan			0	6	
Hampshire	0	10	to 1	0	
Hereford	0	10	to 1	6	
Merioneth	0	6	to 0	9	
Middlesex			0	10	
Monmouth			1	6	
Pembroke			0	6	
Radnor			1	3	
Salop			0	6	
Somerset			1	0	
Stafford			0	3	
Warwick	0	6	to 0	8	
Wiltshire			1	0	
Worcester	0	5	to 1	2	

METROPOLITAN RAILWAY,

General Manager's Office, 32, Westbourne Terrace,
London, W., 10th February, 1881.

SIR,—In compliance with your application of the 3rd instant, I have pleasure in forwarding details of the extent to which this line was affected by the recent snow storm.

Owing to a considerable portion of our system being underground and protected from the downfall, we were able to continue the traffic on the line, and branch lines, without interruption, though the trains were prevented from maintaining their usual punctuality in consequence of the additional friction created by the snow on the wheels of the carriages and engines, which materially impeded their progress; and further detention was caused by the exceptional increase in the number of passengers who took advantage of our line during the complete interruption of vehicular traffic and train services in London and the suburbs.

On the exposed portions of our line the uniform depth of snow was estimated at from 8 to 9 inches, and in certain places the drifts were 2 feet deep. From three stations alone, we removed in one night 80 wagon loads of snow (equivalent to 560 cubic yards) from the space between the platforms.

We had no casualty of any kind, either to passengers or to our rolling stock, during this severe weather.

I am, Sir, your obedient servant,
JNO. BELL.

G. J. Symons, Esq., F.R.S.

GREAT EASTERN RAILWAY,

General Manager's Office, Liverpool-street Station,
London, E.C., 11th February, 1881.

SIR,—In answer to your letter of the 3rd inst., I beg to enclose you some papers which may perhaps give you the information you want.—I am, Sir, your obedient servant, WM. BIRT.

G. J. Symons, Esq.

Return shewing portions of GREAT EASTERN LINES *blocked by Snow Storms of January 18th and 19th,* 1881.

Between what Stations.	Average depth on the level. inches.	Average depth in drift. ft. in.	Obstructions and Remarks.
Tottenham and Park ...	8	3 0	From 12.30 p.m. 18th to 2.10 a.m. 19th ; up line.
Broxbourne & Roydon...	8	3 6	From 8.30 p.m. 18th to 1.30 p.m. 19th ; up line.
Angel Road and Edmonton	8	2 0	From 12.30 a.m. 18th to 12 p.m. 19th! single line.
St. James's Street	8	3 0	From 8.30 p.m. 18th to 7 a.m. 19th ; up line.
Theydon and Epping ...	8	2 0	Jan. 18th and 19th, 3 hours each day ; single line.
Stanstead and Great Chesterford	8	3 0	From 2 p.m. 18th to 2.3 p.m. 19th ; up line. More or less, and trains delayed, snow having to be cut away. Engine working to keep line clear.
Hadham and Standon and Buntingford	8	3 0	From 9.50 p.m. 18th to 2 p.m. 20th.
Rye House and Broxbourne	8	1 3	From 8 p.m. 18th to 1 p.m. 19th.
Oakington and Chesterton Junction	...	4 to 5	From 6 a.m. 19th to 1.50 p.m. 20th, for about 2 miles in length.
Snailwell Junction and Fordham	...	3 to 4	From 8 a.m. 19th to 9 a.m. 19th, for about 300 yards (single line).
Stretham & Haddenham	...	2 to 4	From 6 a.m. 19th to 7 a.m. 19th, for about 1000 yards (single line).
Saxham and Kennett ...	...	4 to 5	From 9.30 a.m. 19th to 11 a.m. 19th, for about 300 yards.
The average depth on other parts of the Cambridge district, where no drifts, was from 6in. to 8in.			
Harling Road & Norwich	12	2 0	Traffic delayed, but not stopped.
Wymondham & Dereham	12	5 0	Light engine and a passenger train blocked in snow 23 hours.
Dereham and Wells.....	12	5 0	Passr. train blocked in snow 46 hrs.
Heacham and Wells.....	12	5 0	Traffic stopped 26 hours.
Norwich and Yarmouth.	12	5 0	Passr. train blocked in snow 8 hours.
Reedham and Lowestoft	12	2 0	Traffic delayed, but not stopped.
Whitlingham and Wroxham	12	5 0	Passr. train blocked in snow 38 hrs.
Wroxham and Cromer...	12	5 0	2 do. trains blocked in snow 70 hrs.
Wroxham and Cawston..	12	4 0	Passr. train blocked in snow 3 hours. Traffic stopped 70 hours.
Bures and Sudbury	6	2 0	Goods train delayed ½-hour ; blocked about ½-mile.
Cockfield and Lavenham	6	2 0	Passr. train delayed 25 minutes ; blocked about 300 yards.
Hythe and Wyvenhoe...	6	2 to 4	Line blocked from 0.30 till 8.15 a.m. 20th.
Wyvenhoe and Brightlingsea	6	5 0	Line blocked from 0 a.m. till 1.0 p.m. 20th.
Bentley	6	2 6	Train delayed ½-hour ; blocked 500 yards.
Mistley	6	2 0	No delays ; blocked 100 yards.
Dovercourt and Harwich	6	1 0	,, , 50 ,,

Between what Stations.	Average depth on the level. inches.	Average depth in drift. ft. in.	Obstructions and Remarks.
Claydon and Needham..	6	3 0	No delays; blocked 300 yards.
Haughley & Stowmarket	6	3 0	,, ,, ¼ mile.
Thurston and Bury	6	4 0	,, ,, 200 yards.
Walton	6	4 0	,, ,, 100 ,,
Ipswich and Saxmundham	2	...	,, up line blocked 200 yds.
Saxmundham and Darsham	...	3 0	,, ,, ,, ½ mile.
Darsham & Halesworth..	...	2 0	,, ,, ,, 1 ,,
Halesworth & Brampton	...	3 0	Line blocked 18th and 19th; up line blocked ¼-mile.
Brampton and Beccles...	...	1 6	Line blocked 18th and 19th; up line blocked ¾-mile.
Beccles and Aldeby.....	...	5 0	Line blocked 18th and 19th; up line blocked ½-mile up and ½-mile down.
Aldeby and St. Olave's..	...	3 6	Line blocked 18th and 19th: up line blocked ¼-mile, and down ½-mile.
St. Olave's and Yarmouth	5	...	No delays.
Felixstowe line	3	2 6	,, single line.
Aldeburgh branch	3	2 6	,,
Harleston and Tivetshall	5	5 0	Line blocked 18th, 19th, and 20th; single line.
Harleston and Beccles...	4	3 0	No delays; single line.
Lowestoft Branch.....	4	...	,, ,,
Haughley and Norwich.	5	2 0	,, up line.
Brandon.....	4	3 to 4	Blocked from 1 a.m. to 2.30 a.m. 18th
Harling Road	6	2 to 3	No delays.
Ingham	6	1 to 3	Line blocked from 1 p.m. 18th to 2 p.m. 20th for 1000 yards.
Seven Hills	9	6 9	Line blocked from 1 p.m. 18th to 5.30 p.m. 19th for 1000 yards.
ditto	15	Drifted sand.	
Barnham	9	1 to 3	Blocked 1600 yards from 1 p.m. 18th to 5.30 p.m. 19th.
Thetford Bridge	6	2 to 5	Blocked 440 yards from 12 noon 18th to 11 a.m. 19th.
Roundham Junction.....	6	1 to 2	Blocked 880 yards from 4 p.m. 18th to 10 p.m. 19th.
Wretham and Watton...	6	1 to 4	Blocked 2½ miles from 4 p.m. 18th to 1 p.m. 19th.
Watton	6	3 to 4	Blocked 2 miles from 4 p.m. 18th to 5.30 p.m. 19th.
Watton and Swaffham..	6	1 6	Blocked 1½ miles from 4 p.m. 18th to 10 a.m. 19th.
Dereham and Swaffham.	6 to 9	1 0	No delay.
Narboro and Lynn	6 to 9	2 to 6	Blocked 1¾ miles from 8.30 a.m. to 12 noon 19th.
Lynn and Snettisham ...	6 to 9	1 to 4	Blocked 4½ miles from 2 a.m. to 9 a.m. 19th.
Snettisham and Hunstanton	9 to 12	2 to 6	Blocked 1¾ miles from 2 a.m. to 3.45 p.m. 18th.
Magdalen Road and Littleport	4 to 6	3 to 4	Blocked ½-mile from 7.30 a.m. to 9 a.m. 18th.
Ely and Littleport	4	...	
Chittisham and March...	4 to 6	...	
March and Peterboro'...	3 to 4	no drift.	

Between what Stations.	Average depth on the level. inches.	Average depth in drift. ft. in.	Obstructions and Remarks.
Wisbech and March.....	3	2 to 3	
Emneth & Middle Drove	3	no drift.	
Stratford Market and Canning Town	8	3 0	Blocked from 3 p.m. 18th to 8 a.m. 19th.
Canning Town and Woolwich	8	3 0	Blocked from 3 p.m. 18th to 2.35 p.m. 19th.
Blackwall line	8	3 0	No delays.
Stratford to Mark's Tey	8	2 6	,,
Witham to Bishop's Stortford	10	4 0	Blocked from 8 p.m. 18th to 12 a.m. 19th.
Ditto to Maldon	12	6 0	Blocked from 3.37 p.m. 18th to 2.40 p.m. 19th.

ALFD. LANGLEY.

Engineer's Office, Great Eastern Railway, Liverpool-street, E.C., 11th February, 1881.

MANCHESTER, SHEFFIELD, & LINCOLNSHIRE RAILWAY,
General Manager's Office,
Manchester, 11th February, 1881.

DEAR SIR,—With reference to your letter of the 3rd instant, in which you intimate that you are collecting all the information you can, in conjunction with the Meteorological Society, in regard to the depth of snow during the recent storm in various parts of the country; and asking for particulars so far as the neighbourhood of this Company's lines is concerned.

In reply I have to state that the average depth of snow in the several districts through which our lines of railway and canal pass, would be about six inches, but in some places where it had drifted the depth varied from one to nine feet, as you will see from the following instances :—

Usselby	9	feet.	Congleton	4	feet.
Thornton.....	9	,,	Macclesfield	4	,,
Oldham	6	,,	Crowden	3	,,
Chapel-en-le-frith ...	6	,,	Dunford Bridge	3	,,
Manchester.....	5	,,	Attercliffe	3	,,
Marple.....	5	,,	Frodingham	1½	,,

The working of the traffic was, of course, very seriously impeded, and in several instances we were compelled to suspend the train service, particularly on the Lincoln and Barnetby section of our line, and also on the main line between Ulceby and New Holland ;—indeed in several places between the points named large drafts of men were employed in removing the obstruction caused by the drifted snow, and in some cases they were thus engaged for a period of about 20 hours.

I may mention that a very melancholy accident occurred on the branch line between Lincoln and Barnetby, near to Usselby, on the night of the 18th January, whereby four of our servants were run over and killed by a passing engine whilst endeavouring with the aid

of a snow-plough to clear the line, and to extricate a train of passengers which had become embedded in the snow.

From the 13th January to the 2nd February, the whole of our Macclesfield Canal, extending from Marple to Hall Green, and the greater portion of the Peak Forest and Ashton Canals, extending from Manchester to Whaley Bridge, were frozen over and traffic was entirely suspended.

If you wish for any further information on the subject, generally, and will let me know what it is, I shall have pleasure in furnishing it, so far as our records will enable me to do so.

Yours faithfully,

R. G. UNDERDOWN,

G. J. Symons, Esq., General Manager.

LONDON AND NORTH WESTERN RAILWAY,

Office of the Superintendent of the Line, Euston Station,
London, February 12th, 1881.

DEAR SIR,—I have the pleasure to enclose you herewith, as requested in your favour of 3rd inst., the particulars I have been able to gather respecting the general effect of the snow-storm on the 18th January—the average depth of the snow, and in drifts, and the obstruction caused to traffic thereby—as far as this company's system is concerned.—Yours faithfully, G. P. NEELE.

G. J. Symons, Esq.

District Superintendent's Office, Euston Station,
February 12th, 1881.

DEAR SIR,—The effects of the snow-storm on Tuesday, 18th ult., began to be seriously felt on the traffic in the afternoon. The last train from Euston that got through to Stafford on that day was the 5.0 p.m. for Liverpool, which lost about 60 minutes travelling 133 miles.

The first train that got through to Rugby on the 19th left Euston at 9.15 a.m., about which time the local suburban service from Euston commenced to run with a fair degree of regularity. A train conveying the whole of the night and morning mails, was started from Euston at 10.35 a.m. The local service throughout Wednesnorth of Watford was only partially resumed over the main line.

About 18 of the up express and long distance passenger trains starting on the 18th were seriously impeded and arrived at Euston from 2h. 30m. to 14h. 30m. behind their due time.

The first train into Euston on the 19th was a local passenger train from Willesden, which arrived at 9.12 a.m. The first express passenger train arrived at 10.3 a.m.

Before the main lines became obstructed on the 18th very seriou difficulties were encountered in the making up and shunting of trains in consequence of the character of the snow and the high wind, which caused the points to be clogged and prevented them being used, even although men were constantly employed cleaning them

out; the axle boxes of the vehicles also became clogged with snow, preventing the axles from revolving. This necessitated one of the local suburban services in connexion with Willesden Junction being suspended between 3 and 4 o'clock, and later on the whole of these services had to be stopped. These trains could not resume running until the 20th.

The undermentioned branch lines between London and Stafford were blocked on the 18th, and traffic on them was resumed on the dates named :—

St. Alban's Branch.....	19th
Rickmansworth	19th (partially)
Aylesbury	20th
Dunstable.....	21st
Oxford	20th (one train went through late on the 19th).
Banbury	20th
Cambridge	19th

Although practically two sets of rails on the main line were opened on the Wednesday, the storm raged with considerable violence throughout the day and especially towards evening, some distance down the line, causing frequent temporary blockages, but as a very large staff of men was employed at all points, the difficulties were got through with only occasional delays of about 60 minutes.

The coal and goods traffic of course had to be suspended until the accumulation of passenger trains had been worked off. The goods were released on the Wednesday night, and on Friday some of the coal traffic was allowed to come forward, We had to work throughout the whole of Sunday in order to get away some of the accumulation of the latter traffic; and no fewer than 75 specials were started on Sunday in the direction of London from Rugby, Nottingham, South Wales, &c.

To give some idea of the quantity of snow that obstructed the line I may mention that at Tring cutting alone, at which place the drift principally affected the slow lines, no fewer than 1700 wagons had to be loaded and conveyed to a convenient place for nnloading.

Yours truly, E. M. G. EDDY.

G. P. Neele, Esq.

Abstract of data furnished by the Engineers and Superintendents, LONDON AND NORTH WESTERN RAILWAY.

District.	Average depth. inches.	Drifts. feet.	Obstruction.
London to Bletchley	7	6 to 8	Lines more or less blocked, and several trains had to be dug out.
Buckinghamshire	7	6 to 8	Blocked 8 p.m. 18th to 8 a m. 20th.
Leighton to Dunstable ...	7	3 to 5	Blocked 8 p.m. 8 p.m. 18th to noon on 21st.
Cambridge line	6	3 to 4	Blocked for 12 hours on 19th, about 5 miles W. of Cambridge.
Bletchley to Rugby	5		
Northampton to Market Harboro'	6 to 10	6 to 12	Blocked in three places from 9 p.m. 18th to 7 p.m. 20th.

District.	Average depth. inches.	Drifts. feet.	Obstruction.
Northampton to Peterboro'	6	6	Blocked near both termini.
Rugby to Birmingham.....	5 to 10	2 to 6	None.
Rugby to Stamford	6	6	Blocked near Rugby.
Market Harboro' to Melton	6	6	Blocked in two places.
Rugby to Leamington and Coventry	12 to 13	3 to 6	Men out all night, and no actual stoppage.
Shrewsbury to Manchester	...	under 5	Nothing serious.
Between Shrewsburg, Stafford, Buxton, Stockport, Warrington, and Chester	4 to 6	under 3	
Trent Valley—South end..	4	2 to 4	None.
,, ,, North end..	2½	,,	None.
Manchester to Huddersfield	6	2 to 3	None.
Manchester to Liverpool...	4 to 6	2 to 4	Slight block about 10 miles W. of Manchester.
Wigan to Preston.....	6	5	Considerable interruption; several goods trains ran into drifts, some as early as 11 a.m. on 18th.
Preston to Carlisle	3	under 1	None.
Whitehaven to Keswick...	4	none	None.
Near Swansea	2	2	None.
Llandovery to Knighton...	7	5 to 10	None.
Abergavenny to Merthyr..	19	10 to 13	Earliest block 5 p.m. on 18th; generally clear 9 a.m. 20th; last block, that at Dowlais, cleared 9 a.m. 21st.
Chester to Conway	12	2 to 10	
Llandudno branch	12	4 to 6	More than a mile; blocked 48 hours.
Conway to Bangor	12	5	One-and-a-half miles near Aber; blocked about 12 hours.
Anglesey Central	...	6½ to 10	Blocked 24 hours.

THE FROST OF JANUARY, 1881.

FROM January 7th to 26th an intensely severe frost prevailed over the whole of the United Kingdom, which for severity has not been equalled since the winter of 1814; but that was more remarkable for its long continuance, than for its extreme severity. On every day from the 7th to the 12th the temperature fell below 10° at several places in the south of Scotland, and readings below 20° prevailed over the greater part of Scotland, the north-west of England, and the central part of Ireland, and frost occurred all over the United Kingdom except at a few of the extreme sea coast stations. On the 13th the lowest reading registered was —2° at Cardigan. Temperatures below 20° prevailed over almost the whole of Scotland, the western half of England, and the greater part of Ireland. On the 14th readings below zero occurred in several parts of the country, the lowest being —4° at Corwen, —3° at Cardigan, and —1° at Achonachie, Alston, Ketton, and Lauder, while temperatures below 20° prevailed at all places except at some of the extreme sea-coast stations and the west of Ireland. On the 15th the frost became more intense all over the country, readings below 10° prevailing over the south of Scotland, the whole of the inland districts of England and Wales, and several parts of Ireland. On the 16th the frost was more intense than on the preceding day, temperatures below zero being registered in the south of Scotland and the north and north-west of England. The lowest readings were —12° at Blackadder, —10° at Stobo, —8° at Kelso and Corwen, —7° at Scaleby and Alston, —1° at Blackpool, and 0° at Chester. Temperatures below 10° were registered over the greater part of Scotland, England, Wales and Ireland, while readings below 20° prevailed all over the United Kingdom, except at the extreme sea-coast stations. On the 17th the temperature fell below zero over the south of Scotland and north of England, the lowest readings being —22° at Blackadder, —16° at Kelso, —15° at Stobo, —11° at Lauder, and —10° at Melrose. Readings below 10° degrees prevailed over the greater part of Scotland, England, Wales, and Ireland, while the temperature fell below 20° at all stations, except at the extreme sea-coast stations. On the 18th the lowest readings registered were, —15° at Stobo, —12° at Blackadder and Kelso, —10° at Melrose and —4° at Wick. The temperature fell below 10° over the greater part of Scotland and the north, east and west of England, while readings below 20° prevailed all over the United Kingdom. On the 19th the frost was not so severe, but still temperatures below 20° prevailed over the whole of Scotland and the central part of Ireland, while readings below 32° were registered at all places in the British Isles. On the 20th the frost became more intense, the region of greatest cold having travelled further south. The lowest readings were —4° at Ketton, —3° at Cheltenham, and 0° and Haltwhistle and Stokesay. Readings below 10° were registered over the southern half of Scotland, the north-west

and central parts of England and Wales and several parts of Ireland, while the temperature fell below 20° over almost the whole of the United Kingdom. On the 21st the lowest readings were, —10° at Haydon Bridge, —5° at Cardigan, —3° at King's Sutton, and —1° at Stokesay. Readings below 10° were registered in the south of Scotland, the greater part of England and Wales and the central part of Ireland, while the temperature fell below 20° at all places, except a few of the extreme sea-coast stations. On the 22nd readings below 10° were registered in the south of Scotland, the north-west, southern, and central parts of England, and the central part of Ireland, while the temperature fell below 20° at all places except in the eastern part of Scotland, the north-east of England, and at a few of the sea-coast stations. On the 23rd, the temperature at all places was much higher than on the previous day, and was not much below the freezing point except in the north-east of Scotland. On the 24th the temperature had fallen considerably, readings below zero being registered in the south-east of Scotland; the lowest reported were: —10° at Blackadder, —7° at Stobo, —4° at Lauder, and —1° at Melrose. The temperature fell below 10° over the southern part of Scotland, the greater part of England, and the north-west of Ireland; and frost occurred at all places except Sandwick, Falmouth, Penzance, and Scilly. On the 25th the lowest readings were: —7° at Bury St. Edmunds, —6° at Cardigan and Stobo, —4° at Corwen, and —2° at Arncliffe. Readings below 10° were registered in the south of Scotland, the greater part of England and Wales, and the north-west of Ireland. Frost occurred at all places except at Valentia, Scilly, and the extreme north of Scotland. On the 26th the cold was more intense in several parts than on the previous day. The lowest readings were: —16° at Blackadder, —9° at Sorrel Sykes, —8° at Melrose and Raby Castle, —3° at Aysgarth, and —1° at Churchstoke. Readings below 10° were registered in the central and south-eastern parts of Scotland; the north, north-west, east, and south-west of England; the central part of Wales; and the north of Ireland. Temperatures of 20° prevailed over the greater part of Scotland, nearly the whole of England and Wales, and the greater part of Ireland; while readings above 32° were registered only at Sumburgh Head, Sandwick, Scourie, and Roches Point.

During the day the temperature began to rise, and ultimately a thaw set in.

THE FUTURE OF WEATHER FORETELLING.

ATLANTIC MONTHLY.

IN no other part of her wide realm has Science done so little for the good of man or her own fame as in the department of meteorology. In the solid earth her prophecies have long had a high value, in the far-off heavens her empire is affirmed, but in the unstable air between these two well-possessed provinces there is a region that is not yet subjugated. Around the border of the domain of meteorology some

gains to the cause of law and order have indeed been made: we control the lightning, we are able to track a clearly-defined storm for days on its path, and can help the sailor to knowledge that often enables him to escape its clutches when it assails him on the deep sea; but as for foretelling the weather in any proper sense, we have not yet attained to it. Is it attainable? Can we hope to compass the conditions of our days so that we may sow and reap, travel, feast, or make war in weather of our choice?

It is desirable that the work should be supplemented by a set of studies of the extra Gulf Stream—that little-known division of it that passes outside of the West Indian Archipelago. This could only be accomplished by an untried system of buoys, or by steamers cruising in those waters. This system of observations should occupy as many vessels as could be afforded for a few years: in a decade it should be possible to learn the laws of flow of the Gulf Stream in the Antillan and Floridian regions so well that thenceforth three cruising steamers would probably accomplish all the result sought for. It might be found useful to extend the observations by a system of studies on the course of the Gulf Stream north of the Straits of Florida; but while these inquiries would have a general scientific interest, and would serve to supplement the excellent observations made by the United States Coast Survey, it is not likely that they would throw much additional light upon the problem we are now considering. It is probable that the rate of flow and volume of the Gulf Stream when it passes the Straits of Florida, with the observations on the varying force and direction of the winds of the North Atlantic,—which latter point could be determined by the logs of the transatlantic steamers,—would suffice for determining the volume and heat-carrying power of this current. The effects of the Gulf Stream are greatly intermingled with that of the Japan current, its twin stream in the Pacific Ocean. It is certain that the Japan current has much less influence on the temperature of the lands about the boreal pole than the Gulf Stream has, yet the effects it has cannot be neglected if we would get an adequate idea of the possibilities of predicting the seasons in the northern parts of Europe and America. The study of this stream would be far more perplexing than that of the Gulf Stream. We know as yet much less of its general structure than we do of its Atlantic equivalent, and the acquisition of this knowledge will be a more difficult task. At no point does the Japan stream pass through such a gate-like channel as the Gulf Stream when it traverses the Straits of Florida. Its history must be sought in the open regions of the western part of the Pacific Ocean, where it finds its devious way among the coral islands of the great archipelagoes with which that sea is studded. It would probably require at least four times as many observers to trace the movements of the Pacific stream as we should need for the Atlantic current, and it would be necessary to have a careful system of weather reports from Oregon and the coast to the northward as far as Behring's Straits.

We should also need current observations on Behring's Straits, to determine the amount of Pacific water that enters the Polar Sea through that gate-way, if any part whatever passes that gate.

It is likely that next after the action of these ocean currents, the most powerful agent of climatic change is to be found in the relative amount of solar heat received on the earth during different years. It now seems probable that the sun's heat does vary in its power from one series of years to another. The actual value of this element of solar radiation would have been much better known were it not for the fact that our meteorological stations have been very badly placed for obervations on this matter. Almost all our stations where observations on the radiant power of the sun are made are accumulated in the regions where frequent clouds and a great variation in the heat transmitting power of the atmosphere have made it impossible to obtain very accurate results. We need a number of stations chosen solely for the measurement of the sun's radiant energy, and placed in those regions where the most perfectly cloudless skies could be found. There are several regions where the skies are practically without clouds for from three to six months each year, and by comparing the observations of several stations together we could probably get a close reckoning of the value of the sun's heat for each day in the year. With such a system of observation we could hope to have the basis for approximately predicting the heat and rainfall of the lands around the North Atlantic Ocean. It would doubtless require some years of careful study before the relations between the facts observed and the subsequent climatic conditions could be clearly discerned, but as soon as the matter was well in hand we could hope for forecasts of a very valuable nature concerning the economic weather that the growing season would be likely to bring to the several lands. Predictions of this sort, even if fulfilled only in general terms, would have a very great value. In all our husbandry there is more or less choice between several crops which suit different sorts of weather. A farmer may make sure of a crop of oats in just such weather as that in which he would lose his crop of maize, and forage plants do well in conditions that are much against wheat. There can be no doubt that as a whole, such predictions would be more generally profitable than any extension of the present system of brief forecasts of weather can be. To carry out such a scheme would require great continuity of labour, and probably a great degree of patience under failure that is hardly to be expected from any one government. It seems to me that the risk could be better taken and the work better done by a commission that should be appointed by several maritime States of the Atlantic. The United States, England, France and Germany, could divide the cost of such a work without feeling the burden, and a board of experts could be easily chosen from among their scientific men, who would direct the researches. Supposing that the half dozen or so of steamers could be loaned and maintained by the

several governments from their naval forces, the total cost of the inquiry, including a sufficiency of stations to observe the Gulf Stream, the Pacific currents, and the solar radiation, should not exceed £100,000, less, indeed, than is required to maintain a regiment in a field or a war ship on the seas. Even if the results of this inquiry should be to show that the unobserved and at present unobservable forces that enter into the making of our several climates so far perturb the action of these great factors which it is proposed to study that we could not use them for forecasts, still the inquiry would not be in vain. We should have gained in a few years, and with a completeness we could secure in no other way, a knowledge of the facts concerning some of the most momentous phenomena of climate, and should have a better chance for making effective our further inquiries into its problems. It is not reasonable to suppose, however, that the inquiry would meet with a complete check; there can be no tenable doubt of a certain measure of success; and, as in all great inquiries, the elements of failure will themselves be the germs of successes by pointing the way to supplementary inquiries which will narrow the limits of the unknown. In connection with this scheme an international commission could doubtless do very much to extend our general knowledge of thalassography, or the physical geography of the sea, by recommending to their several governments a system of observations at sea, to be made by their merchant marines. The United States have already won an enviable prominence for their surveys of the wild countries that fall to their lot. They are, moreover, peculiarly well placed for this inquiry, as they constitute the only State that lies upon the two great climate-making seas of the earth. There seems a certain fitness in their undertaking to lead in this inquiry. The work could best be done as a joint work, but if the other States which should feel a peculiar interest in this task should neglect it, it would be fit that our own Government should itself take up the burden. It is surely many times more promising of results to science and to the more immediate interests of humanity than all the schemes for attaining the north and south poles that now vex the spirit of adventurous peoples. Our Government made the first adequate beginnings in the work of forecasting the weather, and it did the first good work that was done in the study of the marine currents. It can well afford to follow up these lines of inquiry, which are clearly adapted to the genius of its people.

JANUARY, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	1·85	— ·50	1·08	18	8	48·4	30	11·8	17	20	27
II.		Maidstone (Hunton Court)	1·03	— 1·54	·23	26	15	...	...	...	...	...	...
,,		Strathfield Turgiss	1·02	— 1·53	·29	18	10	49·1	31	3·9	22	21	26
III.		Hitchin	?1·05	— 1·17	·24	29	12	42·0	2†	5·0	20	25	...
,,		Banbury	1·34	— 1·04	·49	19	11	44·0	30‡	6·0	15	26	...
IV.		Bury St. Edmunds (Culford)	?·93	— ·91	·20	26	12	47·0	30	1·0	21‖	23	...
,,		Norwich (Cossey)	?1·15	— ·55	·17	27	16	47·0	30‡	1·0	26	23	24
V.		Bridport	3·20	...	...	...	...	48·0	30	6·0	22	21	...
,,		Barnstaple	1·74	— 2·52	·33	30	11	52·0	31	8·0	26	...	...
,,		Bodmin	2·24	— 4·27	·42	28	17	48·0	31	12·0	6	20	25
VI.		Cirencester	1·50	— 1·88	·42	18	8	...	...	...	...	...	...
,,		Church Stretton (Woolstaston	...	...	...	...	...	...	...	...	..	...	...
,,		Tenbury (Orleton)	·65	— 2·34	·20	18	11	47·5	31	4·3	22	22	25
VII.		Leicester (Town Museum)	·59	...	·18	18	10	47·0	31	5·2	15	12	19
,,		Boston	·77	— ·95	·21	27	8	45·0	31	2·0	15	22	...
,,		Grimsby (Killingholme)	·92	— ·84	·32	12	15	42·0	5§	9·0	15¶	19	...
,,		Mansfield	·69	— 1·74	·32	12	9	45·2	1	6·0	15	23	27
VIII.		Manchester (Ardwick)	?·71	— 2·53	·17	17	9	52·0	31	10·0	17**	23	...
IX.		Skipton (Arncliffe)	·92	— 6·00	·22	30	11	46·0	2	—2·0	25	21	...
,,		Malton	...	...	...	...	...	...	...	...	..	...	...
X.		North Shields	1·65	— ·19	·42	13	15	46·0	2	6·0	26	23	25
,,		Borrowdale (Seathwaite)	1·26	—17·49	·56	30	10	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·91	— 3·36	·64	20	12	48·5	30	1·0	20	23	26
,,		Aberystwith Goginan	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	1·79	— 1·17	·62	15	10	48·2	29	14·5	26	20	...
XII.	SCOTLAND.	Cargen	·61	— 5·50	·18	27*	8	47·6	2	7·0	17	21	...
,,		Hawick (Silverbut Hall)	?·61	— 2·63	·20	12	6	...	...	...	...	...	...
XIV.		Douglas Castle (Newmains)	1·72	— 3·72	·65	18	12	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	....	...	...	...	...	...	...	...	...
,,		Kilmory	·80	— 7·17	...	...	...	...	...	10·0	16	24	...
,,		Mull (Quinish)	1·02	...	·24	25	14	...	...	...	...	...	...
XVI.		Loch Leven	·70	— 3·12	·20	21	6	...	...	...	...	...	...
,,		Arbroath	·93	— 1·52	·18	18	8	45·0	3	8·0	17	25	...
XVII.		Braemar	·63	— 2·15	·29	19	9	49·5	29	—4·0	17	25	30
,,		Aberdeen	1·90	...	·41	19	16	46·0	2	4·0	17	25	...
XVIII		Portree	2·21	— 6·94	·67	14	15	...	...	...	...	...	...
,,		Inverness (Culloden)	·64	— 1·11	...	...	..	48·0	2	4·0	14	24	29
XIX.		Dunrobin	1·29	...	·35	14	10	49·0	4	13·0	17	25	...
,,		Sandwick	2·57	— ·77	·39	18	21	48·6	2	7·8	18	15	21
XX.	IRELAND.	Cork (Blackrock)	1·52	— 4·50	·74	26	9	51·0	29	8·0	15	21	...
,,		Darrynane Abbey	1·56	— 5·10	·80	25	9	...	...	...	...	...	...
,,		Waterford	1·99	...	·67	17	14	50·0	29	10·0	17	22	...
,,		Killaloe	·64	...	·27	26	6	52·0	28	7·0	16††	25	...
XXI.		Portarlington	1·21	— 1·85	·67	17	14	47·0	30	11·0	21	22	...
,,		Monkstown	·79	...	·33	17	11	49·3	28	11·0	17	14	...
XXII.		Galway	·27	...	·13	4	5	50·0	1, 2	13·0	17‡‡	21	...
XXIII		Waringstown	·78	— 2·63	·26	17	14	49·0	30	—1·0	21	23	26
,,		Londonderry	·72	...	·20	11	14	53·0	2	14·0	22‖	20	27
,,		Edenfel (Omagh)	?·43	— 3·34	·16	19	9	46·0	1, 2	—3·0	23	25	...

* And 30. † And 29, 30 & 31. ‡ And 31. § And 6, 30 & 31. ‖ And 25.
¶ And 21. ** And 26. †† And 17. ‡‡ And 20 & 22.
+ Shows that the fall was above the average; — that it was below it.

METEOROLOGICAL NOTES ON JANUARY.

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

ENGLAND.

BANBURY.—Mean temp. 28°·5, min. temp. 6°; the lowest registered since Christmas Eve, 1860. Magnificent aurora on 31st.

CULFORD.—The weather throughout the month was very severe.

BODMIN.—The severest January recorded; mean temp., 33°·4.

CIRENCESTER.—The coldest month for many years.

ORLETON.—The temp. of the first six days was not lower than the average, but on the 7th frost set in and continued with unexampled severity till the 27th, when a gentle thaw commenced with fog and a cloudy sky. The mean temp. of the month was about 10°·5 below the average, and was the lowest recorded for a period of more than 50 years. On the 25th the ther. never rose above 19°, and on 7 nights it registered a minimum varying from 4°·3 to 9°·5 The rivers were all frozen over about the 15th. Bright aurora on 31st.

BOSTON.—Mean temp. of month 10° below the average; for 15 days the mean day temp. averaged 21°. The ice on the river was 6½ in. thick, and the drift ice in the haven accumulated in blocks from 10 to 12 feet in thickness.

KILLINGHOLME,—Quite an arctic month; temp. never reached 40° from 5th to 30th. Navigation of the Humber from 24th to 29th more difficult and dangerous from ice and fog than was ever remembered.

MANCHESTER.—A comparatively dry month; frost set in on the 7th, and continued with varying intensity until the 27th, when a thaw set in. Mean temp. unusually low.

WALES.

HAVERFORDWEST.—The severe frost of this January far exceeds anything I have recorded during 36 years. Minima in shade as low as 1°, 2°, 5°, 6°, and 7° were registered, and on the 20th, the coldest day, the max. was 18°. River Cleddan so frozen as to quite obstruct navigation. Fine aurora on 31st.

LLANDUDNO.—The month is memorable for the intensity and persistency of frost and amount of S, in both respects far exceeding anything within my experience of this place, which dates from 1858. The mean temp. (34°·6) was about 10° below the average of 20 years. Fine aurora on 31st.

SCOTLAND.

CARGEN.—The month was an unusually calm one; sunshine and pressure above the average. Mean temp. 9°·1 below it.

HAWICK.—The first six days were mild; frost set in on the 6th and was very severe; garden produce nearly all reduced to pulp, and many shrubs killed; the severest winter remembered; fine aurora on 31st.

BRAEMAR.—A very cold month but calm; quantity of S not at all unusual. Very brilliant aurora on 31st.

ABERDEEN.—An intensely cold month throughout; brilliant aurora on 31st.

PORTREE.—A very cold month with extremely hard frost and S; a grand display of northern lights on 31st.

CULLODEN.—The month will be long remembered for the continued intensity of the frost and the exceedingly low temps., which are without parallel in the last 40 years.

SANDWICK.—One of the coldest Januaries we have ever had, the temp. being 5°·6 below the mean of 54 years. On the 1st there was a thaw, which cleared the S off the ground, but on the 10th another set in, one of the most severe we have ever had. On the 18th, the exposed ther. registered —1°·3, the lowest during 20 years. Aurora on 31st.

IRELAND.

DARRYNANE.—A remarkably dry, but cold month; continuous frost from 2nd to 25th, very severe for the last ten days.

KILLALOE.—Frost very severe, a large portion of Lough Derg frozen over, and all traffic suspended for a fortnight. Aurora on 31st.

MONKSTOWN.—The month commenced somewhat mild; frost set in on 8th

and continued with varying intensity till 26th, excepting a slight thaw on 23rd. Brilliant aurora on 31st.

WARINGSTOWN.—Very severe frost set in on 10th and continued till 26th. Min. temp. on 21st the lowest recorded since observations commenced in 1860.

LONDONDERRY.—Frost the most severe for 15 or 16 years ; ice in some places 12 to 18 inches thick.

SUPPLEMENTARY TABLE OF RAINFALL IN JAN., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	...	XI.	Corwen, Rhug	·63
,,	Margate, Acol	1·24	,,	Port Madoc	1·46
,,	Littlehampton	1·98	,,	Douglas.....	...
,,	St. Leonards	1·17?	XII.	Carsphairn	1·09
,,	Hailsham	·56?	,,	Melrose, Abbey Gate...	2·43
,,	I. of W., St. Lawrence.	2·78	XIV.	Glasgow, Queen's Park.	·40
,,	Alton, Ashdell.....	...	XV.	Islay, Gruinart School..	1·07
III.	Great Missenden.....	1·17	XVI.	Cupar, Kembach.....	·80
,,	Winslow, Addington ...	1·54	,,	Aberfeldy H.R.S.	·27?
,,	Oxford, Magdalen Col...	1·19?	,,	Dalnaspidal	...
,,	Northampton	·73?	XVII.	Tomintoul.....	1·77
,,	Cambridge, Merton Vil.	1·11	,,	Keith H.R.S.	1·40
IV.	Harlow, Sheering	1·37	XVIII.	Forres H.R.S.	...
,,	Diss	1·26	,,	Strome Ferry H.R.S....	1·28
,,	Swaffham	1·02?	,,	Lochbroom	·50
,,	Hindringham	1·22	,,	Tain, Springfield.....	·47
V.	Salisbury, Alderbury...	·95?	,,	Loch Shiel, Glenfinnan.	1·76?
,,	Calne, Compton Bassett	1·84	XIX.	Lairg H.R.S.	4·88
,,	Beaminster Vicarage ...	3·30	,,	Altnabreac H.R.S.	...
,,	Ashburton, Holme Vic.	3·50?	,,	Watten H.R.S.	1·31
,,	Langtree Wick	1·82?	XX.	Fermoy, Glenville	1·48
,,	Lynmouth, Glenthorne.	1·31	,,	Tralee, Castlemorris ...	1·30
,,	St. Austell, Cosgarne...	2·54?	,,	Cahir, Tubrid	1·11
,,	Taunton	...	,,	Tipperary, Henry St....	·65
VI.	Bristol, Ashleydown ...	1·89	,,	Newcastle West	...
,,	Ross	1·65	,,	Kilrush	·84
,,	Wem, Sansaw Hall.....	·50	,,	Corofin	1·07
,,	Cheadle, The Heath Ho.	·39	XXI.	Kilkenny, Butler House	...
,,	Bickenhill Vicarage ...	1·14	,,	Carlow, Browne's Hill..	2·00
VII.	Melton Mowbray	1·19	,,	Kilsallaghan.....	...
,,	Horncastle, Bucknall...	·71	,,	Navan, Balrath	1·00
VIII.	Walton-on-the-Hill.....	...	,,	Athlone, Twyford	1·13
,,	Broughton-in-Furness ..	1·04	,,	Mullingar, Belvedere ...	..
IX.	Wakefield, Stanley Vic.	·31	XXII.	Ballinasloe	·82
,,	Ripon, Mickley	·50	,,	Clifden, Kylemore	2·73
,,	Scarborough.....	1·38	,,	Crossmolina, Enniscoe..	2·07
X.	Mickleton.....	·54	,,	Carrick-on-Shannon ...	·88
,,	Haltwhistle, Unthank..	·54	XXIII.	Dowra	·58
,,	Shap, Copy Hill	·51	,,	Rockcorry.....	·45
XI.	Llanfrechfa Grange	2·32	,,	Warrenpoint	1·19
,,	Llandovery	1·65	,,	Newtownards	·66
,,	Solva	2·27	,,	Carnlough.....	·75
,,	Castle Malgwyn	1·28	,,	Bushmills	1·36
,,	Rhayader, Nantgwillt..	1·46	,,	Buncrana	·95
,,	Carno, Tybritle	·68			

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

I. FRANCE.

THE following article has been almost entirely compiled, in a very condensed form, from one of a series of elaborate reports made, about two years ago, to the Prussian Ministry of Education by Dr. Gustav Hellmann, of the Statistical Office, Berlin. Some changes have recently taken place in the various services, especially in France; we have, however, taken cognizance of these as far as they are known to us.

SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE.

We commence this memoir with a brief notice of one of the oldest French meteorological organizations. In 1849 MM. Bérigny, C. Martins and Haeghens joined in the publication of a work entitled the *Annuaire Météorologique de France*. Four volumes (1849-52), containing observations and papers were published, but, as the cost was too much for private means, they established the Meteorological Society in December, 1852, of which the number of members is now about 300. A volume of the *Annuaire de la Société Météorologique de France* has been published yearly from 1852, and from 1868-76 the *Nouvelles Météorologiques*, containing detailed observations at about 60 stations up to the year 1872, and subsequently monthly *résumés*. From the year 1880 the *Annuaire* has been re-arranged, and is divided into three sections:—A *résumé* of the proceedings of the meetings of the society, (2) papers communicated by the members, and (3) monthly *résumés* of observations made at stations both in France and abroad. In May, 1877, the *Quinzaine Météorologique* was begun under the auspices of the society, and contained original observations from about 20 stations, a chronicle of the weather, and plates of curves; but the publication was given up after a very short time.

The Montsouris Observatory (Paris.)

This was established in 1871, through the influence of some of the leading scientific men, *e.g.*, A. Dumas and C. Sainte-Claire Deville. In 1872 it was affiliated to the National (Astronomical) Observatory, the meteorological work of the latter being transferred to Montsouris. But on Le Verrier's re-appointment to the Paris Observatory in February, 1873, Montsouris again became separated. This observatory is on the extreme south side of Paris, and the building was originally an oriental coffee-house attached to the Universal Exhibition, 1867. The building is not well adapted for the reception of instruments, but the site is all that can be desired.

The work of the Observatory is divided into three distinct departments:—(*a*) Meteorology, including terrestrial magnetism and the physics of the atmosphere; (*b*) the chemistry of the atmosphere, and agricultural meteorology; (*c*) microscopic investigation of the atmosphere. The two last sections have been added recently.

In the first section, eye observations are made every three hours from 6 a.m. till midnight, and self-recording instruments work continuously. The standard barometer, on M. Renou's pattern, has a cylindrical cistern, the area of which is 100 times that of the tube. The self-recording barometer is a mechanical one by Salleron.* The thermometers, as generally in France, are exposed in a screen which differs considerably from those in use in England, being of sheet-iron, with a double roof, having a small space between, and with metal side shields. The thermometers are placed about 7 feet above the ground, and are not protected from terrestrial radiation.† Experiments have shown, however, that the mean results differ but slightly from those obtained by a Kew screen, or by a sling thermometer. The Observatory also possesses a mechanical meteorograph, constructed by Rédier, and described in the *Annuaire* for 1876. An index traces a white curve on blackened cylinders, the black surface being afterwards fixed by immersion in a solution of shellac and alcohol. The air-temperature at an altitude of about 67 feet is observed by means of an electrical thermometer by Becquerel. The underground temperature is observed by thermometers placed in a shaft of powdered coke, in order to render the readings comparable. Three rain gauges are in use, one being self-recording; the rims are about 6 feet above the ground. The direction and velocity of the wind are recorded, at an altitude of 66 feet, by means of Hervé Mangon's anemograph, which gives the direction under eight principal points, every ten minutes, and the veolcity for every half-kilometre (=0·3 mile) traversed Wind pressure is also recorded by a Ventouri-Bourbon aspiration tube. The motions of cirrus clouds are observed by a mirror fixed horizontally. Magnetic instruments were erected in the winter of 1877–8.

Publications: The monthly Bulletin (of which the publication seems

* See *Met. Mag.* vol. xiii. p. 65. † See *Met. Mag.* vol. xiii. p. 49.

to be suspended) contained the eye-observations and a selection from the indications of the self-recording instruments. The *Annuaire Météorologique*, which is published regularly each year, contains *résumés* of observations and various useful articles relating to agriculture and hygiene; also a magnetic chart of France revised from observations at various places by MM. Marié-Davy (the Director) and Descroix. The funds at the disposal of this observatory amount to £2,500 a year, of which the town of Paris contributes £500, and the State the rest. An additional sum of £800 was voted in the year 1878 for the completion of the instruments. The director resides in the observatory.

The Central Meteorological Office.

This office was established in the spring of 1878, and is located in the Rue de Grenelle, Paris. On the decease of the renowned Le Verrier (in September, 1877), the meteorological service of the National Observatory was separated from the astronomical work, to the advantage of both sciences; the former being placed under M. E. Mascart, formerly Professor of Physics at the *Collége de France*. The meteorological work of the Observatory, *before its transfer*, may be subdivided into two general heads: (1) the study of the general movements of the atmosphere, and (2) the general physics of the various basins in France, and the organization of the labours of the Departmental Commissions engaged in this work. Until the year 1854 the Paris Observatory was limited, with regard to meteorology, to its own observations, and (excepting the telegraphic weather service,) until the year 1864, there was scarcely any governmental organization in France worth mentioning. There was no lack of observing stations, but there was no connection between them, and no superintending central station. In 1864, Le Verrier, with the approval of the Minister of Public Instruction, invited the Councils-general to establish observing stations at the Normal Schools. This proposal was favourably received, and the discussion of the observations was undertaken by the Observatory. A further development soon followed by the establishment of Departmental Commissions, composed chiefly of professional men, whose duty it was to collect all observations made in their departments, and to forward them to the Observatory, and later (in 1873) to undertake the first inspection of the stations, and to superintend the publication of the observations made in their respective departments. In 1865, the special study of thunderstorms was begun, and additional observers were found among the clergymen, medical men, teachers and others. No instruments were required for this service; the observations recorded were: (1) time of commencement and end of storm, (2) direction of its appearance, (3) direction of its disappearance, (4) direction and rapidity of clouds, (5) direction and force of wind, (6) intensity of lightning, (7) intensity of thunder, (8) intensity and duration of rain, (9), intensity and duration of hail

(10) damage done, (11) state of crops before and after storm, (12) money value of losses. The results of these observations were published in the *Atlas Météorologique de la France*, 1865-76. This atlas also contains some valuable discussions, including contributions by scientific men abroad. Our space will not permit us to give a list of these articles; we can only state here that among the subjects will be found—(1) Agricultural and Forest meteorology (Becquerel and Mathieu); (2) Rainfall of the W. basin of the Mediterranean, of Algeria, and of Central France, 1765–1870 (Raulin); (3) General movements of the atmosphere (Hébert and Peslin); (4) Meteorological Charts (Brault); (5) Meteorology of Portugal (Brito-Capello). France, which is specially affected by thunderstorms, was foremost in the systematic study of these observations; other countries, *e.g.*, Belgium, Norway, and Sweden, subsequently instituted similar observations. The publication of observations made at the stations of the second order has been much neglected by the Observatory. Out of 89 Departmental Commissions, only about four have published their observations partially *in extenso*, *e.g.*, Lyons, Hérault, Pyrénées-Orientales, and Vaucluse. We have, however, recently received from the Central Office two large quarto vols. of *Annales* for the year 1878, containing detailed observations relating especially to thunderstorms and rainfall, and also important discussions, and several other volumes are in course of publication for the years 1878-9. In 1877 the number of stations of the second order was 67, most of which were provided with standard instruments. The times of observation differed from three to even eight observations daily. Unfortunately, however, many stations discontinued the observations during *fêtes*, which are not few in France! But a recent decree has made observations compulsory at the Normal Schools.

To Le Verrier is also due the honour of first using the telegraph in Europe (in 1855) for the dissemination of weather information for the benefit of shipping; the idea, however, was first mooted by Romme, in France, in 1793, by means of the optical telegraph, and subsequently by Kreil in Austria in 1842, and by Redfield in the "*American Journal of Science and Art*" in 1847, and it will also be remembered that telegrams from all parts of the United Kingdom were posted up at the International Exhibition of 1851. The "Balaklava Storm" of 14th November, 1854—which did so much damage to the allied fleets—had drawn attention to the possibility of giving useful storm warnings. It was only since 1860 that Le Verrier's sphere of action was extended to foreign countries. It should be mentioned, however, that Le Verrier telegraphed *facts*. In a letter dated 4th April, 1860, he wrote to the Astronomer Royal:—*Signaler un ouragan dès qu'il apparaîtra "en un point de "l'Europe, le suivre dans sa marche au moyen du télégraphe, et informer "en temps utile les côtes qu'il pourra visiter, tel devra être le dernier "résultat de l'organisation que nous poursuivons.*" Admiral FitzRoy

was the first to institute *warnings* in the true sense of the word (February, 1861), by telegraphing notice of *impending* storms to our own coasts, and indicating their direction and intensity by "drum" and "cone" signals. This—but one out of various public services—made his honoured name a household word throughout the United Kingdom, and to this work, humanly speaking, he sacrificed his life. On and after August 12, 1863, Le Verrier not only telegraphed facts, but also forecasts of the impending weather. One of Le Verrier's last acts was the extension of the agricultural service all over France. This service was established by a decree of 13th February, 1873, and the first notices were dispatched on the 12th August, 1876. On the 1st May, 1878, the service comprised 1587 stations. Notices which are useful to the agriculturist are different from those which concern the navigator. The former is interested in the occurrence of thunderstorms, rain and hail, while generally the wind is of little consequence. To foretell rain—which is often a local phenomenon—is one of the most difficult problems of meteorological science. The agricultural notices contained the barometer readings of a few stations, and the general state of the weather.

The labours of Le Verrier in the domain of Ocean Meteorology must not be left unmentioned. In 1861 he proposed the sub-divison of this work among different nations. In this scheme England was banished to the Indian Ocean, France taking the Atlantic. The plan did not meet with general approval; it resulted in so much, however, that it drew general attention to the subject, and a series of synoptic charts for the Atlantic Ocean, N. of 40° N. lat., embracing nine months in the year 1864 and the whole of 1865, were published in the "*Atlas des mouvements généraux de l'atmosphère.*" Similar charts have been begun by Meldrum for the Indian Ocean; and recently Capt. Hoffmeyer, of Copenhagen, has published a more elaborate set of charts for the North Atlantic, for September, 1873, to November, 1876. We should also mention Capt. Toynbee's very careful discussions of the weather in the Atlantic, published by the London Meteorological Office.

As before stated, the meteorological work of the Observatory has been transferred to the Central Meteorological Office. This office is under the Ministry of Public Instruction, and is superintended by a council. The decree establishing the office lays down the following general lines of action, which resemble those hitherto followed by the Observatory:—(1) The study of the general movements of the atmosphere; (2) notices to ports and to agriculturists; (3), researches in meteorology and climatology, so that generally speaking there is no change, but considerable improvement in the system. We have no exact information as to the funds which were at the disposal of the meteorological branch of the observatory, but they could not have been less than £2,500 a year. The expense of publication was mostly borne by the *Association Scientifique*. Telegraphy

was free, except the agricultural notices, for which a charge of 40 francs (33s.) a year was made to each station receiving the report.

ALGERIA.

This African colony has also a meteorological organization, thanks to the efforts of the late M. C. Sainte-Claire Deville, and is under the control of the Governor-General. It contains 36 stations of all classes, some of which are in the Sahara. The observers are mostly volunteers, those in the far south being missionaries. The instruments, generally, are of the same patterns as those at Montsouris Observatory. Monthly *résumés* of the observations, including some stations in Tunis and Morocco, are published, together with a table of the daily rainfall. A telegraphic weather service has also been established for the coast stations, under the charge of Captain H. Brocard. This last service promises to be of special importance in connection with the proposed system for the Spanish coast. A large part of the storms which approach Europe from the Atlantic in the latitude of Portugal, escape notice at Paris, and can only be signalled thence when they have arrived in the Gulf of Lyons. It is also proposed to make the station in Senegal more permanent, where observations were made for some years by Dr. Borius.

PUY-DE-DÔME OBSERVATORY.

This observatory (altitude 4,813 feet) was completed and inaugurated in the autumn of 1876, but the instruments were not erected until a somewhat later period. The establishment of this Observatory is due to the exertions of M. Alluard, Professor of Physics at Clermont-Ferrand, who submitted a plan to the Minister of Public Instruction early in 1869, and M. Faye received directions to examine and report thereon, in consequence of which the sum of £4,000 was given by the Government and the local authorities for the establishment of the Observatory. In the present state of Meteorology, this Observatory is of great importance, as a knowledge of the physics of the upper strata of the atmosphere is indispensable,—and neither balloon ascents, owing to their ephemeral character, nor mountain-pass stations, owing to various local causes of disturbance, have hitherto helped us very much. In 1877 the instruments were only those of a station of the second order, and the observations are carried on under considerable difficulties,—the mean temperature resembling that of Christiania. The Observatory of *Rabanesse*, which lies in the plain near Clermont-Ferrand, is 3,609 feet lower, and a little over 6 miles distant as the crow flies, is in telegraphic communication with the Puy-de-Dôme. At Rabanesse eye observations are taken at the same times as at the mountain Observatory, and it receives from it two weather telegrams daily. M. Alluard has published a few fragmentary papers, but the corresponding observations of the two observatories are, we believe, not yet published.

Observatories have also been established—or are in course of

establishment—at the following places, in connection with the Central Office :—*Cluny*, *St. Maur* (station improved), *Mont-Ventoux* (7,663 feet), *Nancy*, *Pic-du-Midi* (7,763 feet), *Perpignan*, *Bordeaux*, and *Besançon*. The observations from the high-level stations at the *Puy de Dôme* and the *Pic du Midi* are telegraphed to Paris daily, and inserted iu the "*Bulletin*."

The following separate meteorological organizations also deserve special mention :—(1). The Hydrological Service of the Seine, which has published tidal and rainfall observations since 1854. Since 1872 similar observations have been made all over France ; the system is divided into 12 regions, numbering upwards of 1,100 stations. (2). The Hydrometrical Commission of Lyons (established in 1843), which publishes a report yearly ; in 1876 its stations numbered 29. (3). Researches in the domain of Ocean Meteorology at the *Dépôt des Cartes et Plans*, especially Lt. Brault's charts of the Atlantic. (4). Observations on Underground Temperature in the *Jardin des Plantes*, by M. Becquerel. (5). The Toulouse observations, 1839-62. (6). The *Dijon* observations, published in separate sheets for a number of years. (7). *St. Martin-de-Hinx* (Landes), where observations have been published since 1864.—J. S. HARDING.

SCHWACKHÖFER'S HYGROMETER.

IN the recently-issued report of the Meteorological Council, Mr. F. N. Shaw gives a summary of the instruments he is using in the investigation he is now conducting on Hygrometry and Hygrometers, on behalf of the Council.

In his memoir he states that he takes as his standard of reference the instrument designed by Prof. Schwackhöfer of Vienna, and as this hygrometer is not well known to English observers, we have made a brief extract of a notice respecting it which appeared in the *Zeitschrift für Meteorologie* for 1878.

After stating the great uncertainty which attaches to the various hygrometers now in use, due to causes beyond the control of the observer, Prof. Schwackhöfer concludes that the only correct determination of the amount of aqueous vapour suspended in the atmosphere is that of directly estimating it by chemical methods.

Of these methods there are two : analysis by weight, and analysis by volume. Hitherto the first has been the only plan employed, and to prosecute it satisfactorily not only is a heavy tax put upon the time and abilities of the observer, but the result obtained usually gives but an average for a lengthened period of time, not the humidity at any given moment. The volumetric method is free from these and other objections, and may be worked with a comparatively simple apparatus, kept ready to hand, and capable of giving the desired result with accuracy in a few minutes.

As to the degree of delicacy required, it may be remarked that as $0{\cdot}1^{mm.}$ (0·039 in.) of vapour tension represents about 0·013 per

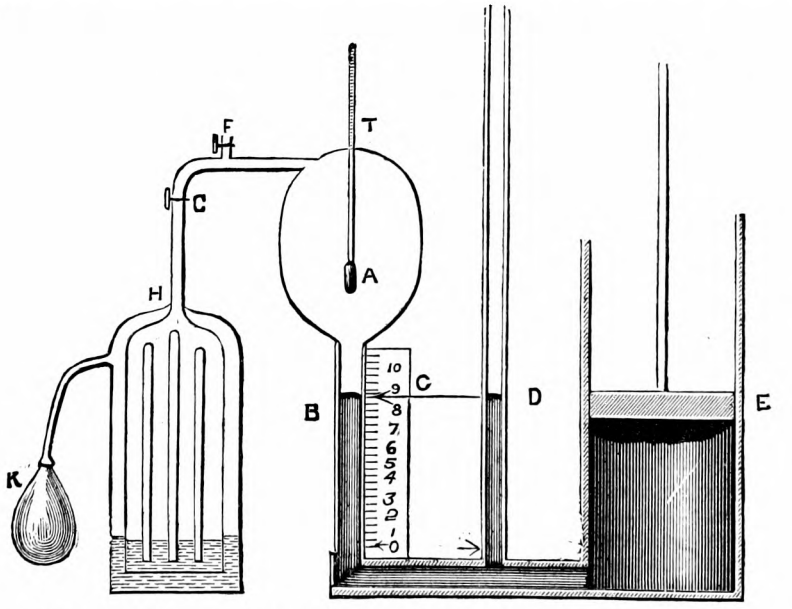
cent. of the volume of aqueous vapour in the air, the apparatus should indicate with certainty the change of one-hundredth per cent. or one-ten-thousandth part in the volume of air measured.

Although Schwackhöfer first constructed his instrument for the particular purpose of determining the humidity of the air at different levels in forests, and comparing it with air at similar heights in the open country, yet he considers that it may equally well be employed in place of ordinary pschycrometers for daily observations at meteorological stations, since it is always ready for immediate use, and without much calculation will give the humidity, the operation occupying about ten minutes or a quarter of an hour.

The principle of the instrument may be briefly stated to be as follows:—a volume of air is enclosed in a glass vessel and its temperature accurately determined; it is then forced into a second vessel, where by intimate contact with concentrated sulphuric acid, it is deprived of all its water. The dried air is then again transferred to the first vessel, and the amount which it has lost in volume is measured. If the temperature and pressure be the same as it was before drying a short calculation based on the quantity determined, gives the vapour tension at the time of the experiment.

In the case of fog, the air is heated slightly before it is passed into the apparatus, so that the watery vesicles may be converted into vapour.

The diagram will afford an idea of the construction of the instrument.



A is the receiver to contain the air to be experimented upon; T being the thermometer to measure its temperature. H is the drying vessel, exposing a large glass surface wetted with concentrated

sulphuric acid. E is the mercurial pump to force the air into and out of the receiver A, and D is a pressure gauge to indicate the pressure of the air in A. K is an indiarubber ball by compressing which the sulphuric acid is caused to flow over the inner surface of the drying chamber.

In order to make an observation, the plunger in E is depressed to nearly its full extent, and the tap F being open, all the air is expelled, and the mercury caused to fill A as far as F, the column in the pressure gauge D of course rising to the same level. On raising E the mercury falls, and the air follows it until the surface of the column in both C and D is at the zero of the scale. F is then closed, and the temperature of A read off on thermometer T. Next G is opened, and the plunger E being a second time forced down, the air is expelled from A and driven into G, where, coming into contact with the acid-wetted surface, its moisture is speedily absorbed. Finally E is again raised withdrawing the mercury from A, into which the dried air then passes, and when the pressure gauge D has regained its old level at the zero of the scale, the level in C will be found to stand above it by an amount which, when measured on the scale, represents the diminution of volume of the air in A by the quantity of aqeuous vapour withdrawn from it, and retained by the acid in B. The temperature at the conclusion of the experiment is again observed by the thermometer D.

In order to ensure the complete removal of all the aqueous vapour from the air, it is desirable when it is very damp to repeat the operation of forcing it into the drying chamber two or three times, until it is found that it does not diminish in volume by the process.

Schwackhöfer shows by a small calculation that the acid is not materially deteriorated as regards its drying properties by many thousands of operations.

As, however, the receiver A, and its divided tube B, form virtually an air thermometer, it becomes of vital importance to maintain the temperature of the air as nearly as possible constant during the operation, and to determine it with the greatest possible accuracy at least to 0°·03 C (0°·05 F.). With the view of maintaining this constancy of temperature, A is surrounded with a large jacket apparatus, filled with glycerine, which is not represented in the drawing.

The capacity of both receiver A and its tube B, which of course in the apparatus is much smaller relatively than that shown in the figure, must be accurately determined beforehand, and the values of the divisions on the scale C found by calibration, and expressed in terms of the volume of A.

For the complete demonstration of the theory of the instrument and the formulæ for the reduction of observations made by it, we must refer the reader to Schwackhöfer's original paper in the *Zeitschrift*, Band xiii., s. 241.

It only remains to state that the cost of the Hygrometer at Vienna is 160 florins, or about £14; with the heating apparatus for evaporating fog it is raised to about £18. G. M. WHIPPLE.

THE SNOW STORMS OF JANUARY 17TH TO 21ST.

(Continued from page 24.)

MIDLAND RAILWAY,
General Manager's Office,
Derby, February 14th, 1881.

DEAR SIR,—In accordance with the request contained in your letter of the 3rd inst., I have much pleasure in enclosing you the particulars you require respecting the late snow storms, so far as they affected the districts served by the Midland Railway Company.

I need hardly say that the information has been compiled at considerable trouble, and if it is printed in a handy form, I should like to have a copy if you have one to spare.—I am, yours faithfully,

G. J. Symons, Esq. JOHN NOBLE.

PLACE.	Average depth of snow. in.	Depth of snow in drifts. ft.	Extent to which Traffic was interfered with.
JAN. 18th :—			
Newstead and Sutton (between Nottingham and Mansfield)	4 to 7	4 to 6	Traffic interfered with at Sutton for about an hour on evening of 18th. Up line blocked about 7 hours on morning of 19th, owing to a coal train getting stuck fast in the snow.
Syston, near Leicester...	5 or 6	4 to 6	Several goods trains delayed during night of 18th.
Between Leicester and Rugby, and between Leicester and Market Harbro'	6 to 8	5 to 8	Several passenger and goods trains delayed between these points during the night of the 18th, and on the morning of the 19th.
Between Huntingdon and Thrapstone	7 or 8	1 to 6	The line between these points was impassable from 11 p.m. 18th, until the evening of the 20th, and traffic entirely suspended.
Between Wellingboro' and Sharnbrook	7 or 8	4½ to 5	The up line was blocked for a short time between these stations during night of the 18th, and the traffic was delayed.
Bedford and Northampton Branch, and Bedford and Hitchin Branch	—	2 to 5	These branches were completely blocked with snow from the evening of the 18th to the evening of 20th, and traffic entirely stopped.
Between Leagrave and Luton	—	2 to 3	Goods traffic delayed for several hours on the morning of the 19th.
In neighbourhood of London	about 9	4 to 6	No serious obstruction was caused to the traffic.
Between Burton and Leicester	5 or 6	1 to 3	Several goods and passenger trains considerably delayed during the night of the 18th, and on the 19th.
JAN. 19th.			
In neighbourhord of Ashwell, Whissendine, Saxby, & Melton (between Peterboro' and Leicester)	about 9	4 to 6	All traffic was more or less delayed during the whole of the 19th, owing to the drifts between these points.
Between Barnt Green and Evesham	about 6	3 to 4	The line between these points was partially blocked by snow during the 19th, and traffic was considerably interfered with.

PLACE.	Average depth of snow. in.	Depth of snow in drifts. ft.	Extent to which Traffic was interfered with.
Between Ashchurch and Beckford	do.	about 3	The up line was blocked by snow between these points from the morning of the 19th to the evening of the 20th.
Between Ashchurch and Cleeve	do.	6 to 7	The line was entirely blocked from about midnight of 18th to 10 a.m. on the 19th, and partially blocked until the evening of that day. Traffic considerably delayed.
Stonehouse and Nailsworth Branch	6 to 8	4 to 5	Goods traffic stopped on branch on this day.
Nate and Thornbury Branch	about 12	6 to 20	Traffic stopped, except for a few hours in the morning.
Mangotsfield, near Bristol	about2ft	4 to 9	Line partially blocked for several hours, and traffic considerably interfered with.
Between Hereford and Brecon, and between Brecon and Swansea.	about 8	6 to 15	The line between Hereford and Brecon blocked nearly the whole of the 19th, and the line between Brecon and Ynisygenio Junction from the evening of the 18th to the morning of the 24th, and all traffic stopped.

SOUTH EASTERN RAILWAY,

General Manager's Office,
London Bridge Station, S.E., 18th February, 1881.

SIR,—In compliance with your request of the 3rd inst., asking for information respecting obstruction of this railway, &c., by snow, on the 18th ult., I beg to enclose herewith a statement giving the particulars I have been able to collect, and which I trust may be of service to you.

I would explain that, not anticipating any possibility of such information being required, no exact account was taken at the time, and, in consequence, there has been some difficulty in getting the facts together; and this, moreover, is the explanation of my having failed to send you the enclosed sooner.—Yours faithfully,

MYLES FENTON,
General Manager.

G. J. Symons, Esq.

SOUTH-EASTERN RAILWAY.

One line was blocked between Erith and Dartford from the afternoon of the 18th until late on the 19th.

The down loop line was blocked near Dartford from 7.50 p.m. on the 18th until late at night, and the same line was also blocked at Pope Street for about the same period.

The down line between Plumstead and Abbey Wood was blocked from 8 p.m. on the 18th until the next morning.

The Mid-Kent lines, both up and down, were blocked between

Catford Bridge and Lower Sydenham from about 2 p.m. on the 18th till 9 p.m. on the 19th.

The Whitstable Branch (which is a single line) was blocked from about 8 p.m. on the 18th until 12.30 on the 19th.

On the Ashford and Hastings Branch, two or three sections were blocked on one line only from 2 p.m. on the 18th to 7 p.m. on the 19th.

Between Wokingham and Earley both lines were blocked for about four hours on the 18th.

Between Wye and Chilham there was a block on the down line from 10 p.m. on the 18th until midnight on the 19th.

The down line on the Margate Branch was blocked from the morning of the 18th until 10 p.m. on the 19th.

The Sevenoaks line was kept open for traffic, but considerable delay occurred.

The up line between Blackwater and Farnborough was blocked for some few hours from about 5.37 a.m. on the 19th.

The Caterham Branch (which is a single line) was blocked for about three hours only on the 18th.

With the exception of the single lines, and the block on both lines of the Mid-Kent section, the traffic was kept going, although, of course, with some amount of delay, &c.

Particulars in connection with the Snow Storm on the 18th January, 1881.

Locality.	Average depth of drifts.	Remarks.
Charing Cross to Paddockwood viâ North Kent Line—		
Charing Cross to Erith	12 in.	Down line between Plumstead and Abbey Wood blocked 8 p.m. till next morning(19th).
Erith to Dartford.....	4 to 12 ft.	In one cutting, ¼ mile long, 12 to 14 ft. deep. Traffic suspended from afternoon of 18th till next day.
Dartford Junction	5 ft.	250 yards.
Dartford to Gravesend	5 ft.	In various cuttings, ¼ mile long.
Strood to Mainstone	4 ft.	Short drifts.
Maidstone to Paddockwood.	...	Average fall about 15 inches.
North Kent Loop Line—		
Lee to Dartford	...	Line blocked at Pope Street on night of 18th inst.
,, ,, ...	3 to 4 ft.	Short drifts. Down line near Dartford blocked 7.50 p.m. till next morning.
Mid Kent Line—		
Lewisham Junct. to Catford Bridge	12 in.	
Catford Bridge to Lower Sydenham	3 to 6 ft.	In cutting, ½-mile long, train blocked in. Traffic suspended from about 2 p.m. on 18th till 9 p.m. on 19th.
On various parts of the Line below Lower Sydenham	2 to 3 ft.	

Locality.	Average depth of drifts.	Remarks.
Main Line to Tonbridge viâ Sevenoaks—		
Grove Park	3 ft.	30 yards long. Considerable delay to traffic.
Halstead	18 in.	Considerable delay to traffic.
Chelsfield	13 to 14 ft.	50 yards long. Considerable delay to traffic.
Caterham Branch (single line)	...	Blocked about 3 hours on 18th. Train ran into drift and partially left the metals.
Reading Branch—		
Farnboro' to Blackwater	2 ft.	Up line blocked for some hours on 19th.
Wokingham to Earley	1 ft. 6 in.	Line blocked about 4 hours on 18th.
Tunbridge Wells and Hastings Branch—		
Tunbridge Wells to Hastings	...	Average fall about 15 inches.
,, Goods Station	3 ft.	About ¼-mile.
Wadhurst	2 to 3 ft.	200 yards.
Ticehurst Road	3 ft.	200 yards.
Etchingham	3 ft.	200 yards.
Main Line — Tonbridge to Dover—		
Marden (Cutting and Station Yard)	1 ft.	800 yards.
Staplehurst	2 ft.	100 yards.
Headcorn	9in. to 1ft.3in.	470 yards.
Pluckley	1 ft.	250 yards.
Ashford to Smeeth	1in. to 1ft.3in.	900 yards.
Westenhanger	3 ft.	170 yards. Siding blocked.
Westenhanger to Shorncliffe.	1 to 1 ft. 6 in.	Various drifts, about 390 yards.
Marden to Dover	...	Average fall, 5 or 6 inches.
Ramsgate and Margate Branch		
Ashford to Wye	2 to 5 ft.	Up line blocked 10 p.m. on 18th to 9 a.m. on 19th.
Wye to Chilham	3 ft.	Block on down line 10 p.m. on 18th till midnight on 19th.
Grove Ferry to Minster	2 to 3 ft.	Down line blocked from morning of 18th till 10 p.m. on 19th.
Margate Branch	3 to 7 ft.	Up line blocked 11.30 a.m. on 18th till 5 p.m. on 22nd.
Ashford to Ramsgate and Margate	...	Average fall, 5 inches.
Whitstable Branch (single line)	3 to 4 ft.	Line blocked from 1 p.m. on 18th until noon on 19th. Obstructed again 7 a.m. to noon on 20th.
Ashford and Hastings Branch.	4 ft.	Traffic suspended from 2 p.m. on 18th to 7 p.m. on 19th. Average fall, 4 inches.

FEBRUARY, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32°. In shade.	No. of Nights below 32°. On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	3·09	+ 1·45	·76	20	16	52·7	3	26·7	7	9	17
II.		Maidstone (Hunton Court)	1·79	+ ·17	·48	23	17	...	...	...	...	...	...
,,		Strathfield Turgiss	2·18	+ ·43	·55	7	11	53·3	3	23·4	7, 28	12	19
III.		Hitchin	2·91	+ 1·31	·60	20	22	50·0	3	21·0	28	18	...
,,		Banbury	2·95	+ 1·11	·66	7	18	50·0	3	23·0	7	16	...
IV.		Bury St. Edmunds (Culford)	2·83	+ 1·06	·79	9	18	49·0	3, 4	23·0	6	13	...
,,		Norwich (Cossey)	3·45	+ 1·70	·72	9	21	50·0	4, 9	22·8	13	15	16
V.		Bridport	5·46	...	1·41	14	12	50·0	10	23·0	28	13	...
,,		Barnstaple	3·83	+ ·64	1·31	9	15	54·0	3*	28·0	26†	...	...
,,		Bodmin	7·29	+ 2·42	1·88	13	18	51·0	14	27·0	28	7	11
VI.		Cirencester	5·03	+ 2·39	·99	14	15	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	4·11	+ 1·60	1·15	9	20	49·5	3	?21·5	28	...	...
,,		Tenbury (Orleton)	3·46	+ ·99	·63	9	19	52·0	3	22·5	7	12	14
VII.		Leicester (Town Museum)	3·63	...	·67	7	18	51·0	3	11·3	13	14	18
,,		Boston	3·70	+ 1·92	·85	21	16	...	...	...	...	...	...
,,		Grimsby (Killingholme)	2·55	+ ·75	·54	14	23	51·0	4	29·0	2, 7	10	...
,,		Mansfield	4·44	+ 2·27	·83	7	19	49·6	4	21·8	24	15	20
VIII.		Manchester (Ardwick)	5·52	+ 3·33	1·17	15	18	55·0	4	21·0	7	15	...
IX.		Skipton (Arncliffe)	7·29	+ 2·65	1·69	7	16	47·0	3	15·0	28	14	...
,,		Malton	...	...	...	...	...	...	...	...	...	...	...
X.		North Shields	3·81	+ 1·97	·74	26	22	47·0	4	23·7	7	15	18
,,		Borrowdale (Seathwaite)	10·27	− 1·18	1·49	3	16	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	5·12	+ 1·46	1·25	9	14	...	...	...	...	...	...
,,		Haverfordwest	5·04	+ ·59	·67	9, 13	16	50·5	2, 3	21·0	24	10	13
,,		Aberystwith Goginan	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	3·05	+ ·76	·68	7	15	53·6	18	28·0	25	5	...
XII.		Cargen	4·32	+ ·51	·89	13	11	49·0	3, 4	26·0	28	10	...
,,		Hawick (Silverbut Hall)	2·62	− ·27	·52	7	13	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	3·77	+ ·60	·62	9	17	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	...	...	...	...	...	...	...	...	...
,,		Kilmory	4·92	+ ·53	1·23	13	15	...	...	19·0	12	...	...
,,		Mull (Quinish)	4·23	...	·83	3	15	..	...	...	...	...	...
XVI.		Loch Leven	5·60	+ 2·64	1·90	4	9	...	...	...	...	...	...
,,		Arbroath	3·87	+ 1·71	·75	3	13	47·0	4	23·0	28	15	...
XVII.		Braemar	2·32	...	·55	3	14	42·2	3	27·0	12	25	26
,,		Aberdeen	4·96	...	·90	10	22	44·0	4	21·0	6	14	...
XVIII		Portree	4·87	− ·31	·89	7	19	...	...	...	...	...	...
,,		Inverness (Culloden)	1·85	+ ·80	...	...	..	45·0	16	21·0	12‡	17	28
XIX.		Dunrobin	3·31	...	1·40	3	15	45·5	1	22·8	12	17	...
,,		Sandwick	5·30	+ 2·75	1·66	7	17	43·8	1	26·0	12	10	17
XX.	IRELAND.	Cork (Blackrock)	5·95	+ 1·36	·86	6	16	55·0	13	20·0	28	9	...
,,		Darrynane Abbey	...	...	...	...	...	...	...	...	...	...	...
,,		Waterford	4·40	...	1·00	6	9	...	...	...	..	...	...
,,		Killaloe	5·05	...	1·79	9	15	53·0	14	25·0	24	9	...
XXI.		Portarlington	3·69	+ 1·48	1·10	9	18	53·0	7	26 0	27	8	...
,,		Monkstown	2·36	...	·60	9	13	57·0	7	28·0	1, 6	..	...
XXII.		Galway	3·55	...	·58	7	12	52·0	8	25·0	28	5	...
XXIII		Waxingstown	3·06	+ ·81	·70	9	20	51·0	3, 7	23·0	27	13	16
,,		Londonderry	3·85	...	·64	7	19	50·0	3, 7	31·0	1§	5	16
..		Edenfel (Omagh)	2·73	+ ·45	·46	3	19	49·0	7	20·0	28	15	...

* And 4, 17. † And 27. ‡ And 28. § And 6, 12.

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

METEOROLOGICAL NOTES ON FEBRUARY.

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

ENGLAND.

STRATHFIELD TURGISS.—Clay lands sodden and water-logged at the beginning of the month; genial weather much wanted at the close. First wild primrose gathered on 2nd; first daisy on 25th.

HITCHEN.—S on eight days; L on 7th, 8th, and 9th.

BANBURY.—S on eight days.

CULFORD.—The month throughout was unsettled and very cold, with but little sunshine.

COSSEY.—A wet, cold month; floods prevalent.

BODMIN.—Mean temp., 41°·8; temp. at the end of the month lower than has ever been recorded before.

CIRENCESTER.—Wind variable, but a full share from the E. Several heavy falls of R.

ORLETON.—A very cold and gloomy month, with much S and R, and severe frost at intervals. Sky generally cloudy, and the sun rarely visible. Violent winds on 7th and 11th; high floods on the Teme on the 8th and 11th, and very great flood on Severn on 12th.

KILLINGHOLME.—Very cold and wet; scarcely any sunshine, and not more than two pleasant days.

MANSFIELD.—S on 11 days, and a good deal of frost.

NORTH SHIELDS.—S on 15 days; very cloudy and much R.

WALES.

HAVERFORDWEST.—The first 17 days very wet, with heavy floods; fine solar halo on the 6th; exceedingly stormy from the 7th to the 11th. T and L, with heavy gale and R on the 8th. On the 20th the air completely changed, the wind, which had generally blown from S.W. or N.W., gradually drew to E. and N.E., and fine clear weather prevailed for the last 8 days, with sharp frosts, the mean temp. of that period being only 32°·8. Mean temp. of the month, 39°·2. Precelly range white with S, from end to end, on 27th.

LLANDUDNO.—Month relatively warmer than January, but still more than $2\frac{1}{2}°$ below the average. February is usually the driest month of the year, but in this the rainfall was excessive. The general character of the month was showery, and S or H fell on 5 days. Though there were 7 hours of bright sunshine recorded, the atmosphere was not so clear as usual, but was sometimes hazy, approaching even to fog. Polar winds prevailed on 16 days, and tropical on 12. Force variable, occasionally rising to above half a gale.

SCOTLAND.

CARGEN.—A dull, cloudy month, with low temp. and little sunshine. Mean temp., 36°·6, 3°·3 below the average.

HAWICK.—A very frosty February, garden and farm work consequently much in arrear. All vegetation in a very bad state.

NEWMAINS.—S on six days.

BRAEMAR.—A very cold month; hill and dale, road and paths still covered with S.

ABERDEEN.—Winds very variable, westerly at first, shifting to E., S.E., and finally to N.E. Raw weather was the consequence, with frequent heavy showers of S, sleet, H and R. Rainfall above the average by about 2 inches. Aurora seen on night of 27th.

PORTREE.—A cold month; sheep suffering much from the continuous hard frost. Provender for cattle getting very scarce.

CULLODEN.—The month was remarkable for the steady continuance of frost.

SANDWICK.—Very cold, wet, and stormy. Temp. 3°·4 below the mean. Gales of 50 miles an hour occurred on the 4th and 7th. S fell on the 4th, covering the ground, and became deeper daily till the 13th, when a thaw set in. Another fall occurred on the 27th and 28th.

IRELAND.

BLACKROCK.—A dull, wet, and stormy month. Splendid display of auroral lights on 1st.

KILLALOE.—Strong wind from S.W. on 7th, increasing in force, with heavy R, until late on 10th. Some severe frost towards the end of the month.

LONDONDERRY.—The wettest February for several years; wind variable.

SUPPLEMENTARY TABLE OF RAINFALL IN FEB., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	3·26	XI.	Corwen, Rhug	4·88
,,	Margate, Acol	1·28	,,	Port Madoc	4·41
,,	Littlehampton	3·24	,,	Douglas.....	7·37
,,	St. Leonards	1·91	XII.	Carsphairn	5·30
,,	Hailsham	2·86	,,	Melrose, Abbey Gate...	3·13
,,	I. of W., St. Lawrence.	4·06	XIV.	Glasgow, Queen's Park.	3·66
,,	Alton, Ashdell.....	2·83	XV.	Islay, Gruinart School..	4·89
III.	Great Missenden.....	3·45	XVI.	Cupar, Kembach.....	4·34
,,	Winslow, Addington ...	2·54	,,	Aberfeldy H.R.S.	...
,,	Oxford, Magdalen Col...	2·68	,,	Dalnaspidal	3·47
,,	Northampton	2·76	XVII.	Tomintoul.....	...
,,	Cambridge, Merton Vil.	2·34	,,	Keith H.R.S.	2·20
IV.	Harlow, Sheering	3·38	XVIII.	Forres H.R.S.	2·03
,,	Diss	2·83	,,	Strome Ferry H.R.S....	2·94
,,	Swaffham	3·28	,,	Lochbroom	2·32
,,	Hindringham	3·24	,,	Tain, Springfield.....	2·87
V.	Salisbury, Alderbury...	3·63	,,	Loch Shiel, Glenfinnan.	5·62
,,	Calne, Compton Bassett	3·63	XIX.	Lairg H.R.S.	2·00
,,	Beaminster Vicarage ...	7·26	,,	Altnabreac H.R.S.	...
,,	Ashburton, Holne Vic..	10·15	,,	Watten H.R.S.	3·16
,,	Langtree Wick	4·39	XX.	Fermoy, Glenville	5·69
,,	Lynmouth, Glenthorne.	5·41	,,	Tralee, Castlemorris ...	3·85
,,	St. Austell, Cosgarne...	5·71	,,	Cahir, Tubrid	4·80
,,	Taunton	...	,,	Tipperary, Henry St....	4·28
VI.	Bristol, Ashleydown ...	3·84	,,	Newcastle West	3·12
,,	Ross	3·08	,,	Kilrush	2·99
,,	Wem, Sansaw Hall.....	3·37	,,	Corofin	4·02
,,	Cheadle, The Heath Ho.	5·39	XXI.	Kilkenny, Butler House	...
,,	Bickenhill Vicarage ...	3·99	,,	Carlow, Browne's Hill..	3·66
VII.	Melton Mowbray	3·43	,,	Kilsallaghan.....	...
,,	Horncastle, Bucknall...	3·30	,,	Navan, Balrath	3·36
VIII.	Walton-on-the-Hill.....	4·11	,,	Athlone, Twyford	3·25
,,	Broughton-in-Furness ..	6·44	,,	Mullingar, Belvedere...	4·44
IX.	Wakefield, Stanley Vic.	3·26	XXII.	Ballinasloe	..
,,	Ripon, Mickley	4·84	,,	Clifden, Kylemore	7·04
,,	Scarborough.....	3·13	,,	Crossmolina, Enniscoe..	4·74
X.	Mickleton.....	3·91	,,	Carrick-on-Shannon ...	4·18
,,	Haltwhistle, Unthank..	3·28	XXIII.	Dowra	3·80
,,	Shap, Copy Hill	5·50	,,	Rockcorry.....	4·28
XI.	Llanfrechfa Grange	7·08	,,	Warrenpoint	5·06
,,	Llandovery	4·34	,,	Newtownards	4·11
,,	Solva	2·68	,,	Carnlough.....	4·26
,,	Castle Malgwyn	4·82	,,	Bushmills	4·25
,,	Rhayader, Nantgwillt..	8·27	,,	Buncrana	3·79
,,	Carno, Tybritle	7·27			

SYMONS'S
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RECENT WINTERS IN LONDON.

WE must start with a definition—by winter we desire always to indicate the three months, December, January and February. With our variable climate March is sometimes, as it has been this year, colder than the preceding December, and then of course January to March is colder than December to February. But in making comparisons rigorous uniformity is essential, and that is why we preface our notes with this definition.

In the next place, we must probably justify ourselves for taking the mean temperature at 9 a.m., instead of the mean daily temperature. For this we have several reasons—(*a*) That it is not settled whether the Greenwich corrections to the arithmetical means of the maximum and minimum readings are or are not generally applicable, nor how far they are dependent on the pattern of thermometer stand employed; while, therefore, uncertainty hangs over one method, and another is free from it, we prefer to adopt the simpler: (*b*) The mean temperature at 9 a.m. is not very different from the mean daily temperature, probably within 1°, and presumably its departure from the true mean in every year is nearly alike. Hence, *if* the adoption of the mean 9 a.m. temperature instead of the mean daily temperature involves any error, it is probably a nearly constant one, and in that case will not affect the comparison of successive winters: (*c*) By giving simply arithmetical means without any corrections, we give values which are at any future time identifiable and available for future treatment: and lastly, (*d*) It is a very simple way of comparing temperatures, and our readers can easily make a table of their own observations in the same form and compare their results with ours. One more prefatory remark. The whole of the readings have been made from thermometers absolutely without error, but mounted on a Glaisher pattern thermometer stand.

Mean Temperature at Camden Square, London, at 9 a.m. 1858-1881.

	Mean Temperature.				Diff from Mean of 23 years.			
Year.	Dec.	Jan.	Feb.	Mean.	Dec.	Jan.	Feb.	Mean.
1858-9	39·9	39·8	42·1	40·6	+ ·7	+1·8	+2·0	+1·5
1859-60.....	36·5	39·8	35·2	37·2	—2·7	+1·8	—4·9	—1·9
1860-1	35·6	33·0	41·2	36·6	—3·6	—5·0	+1·1	—2·5
1-2	39·6	38·7	41·4	39·9	+ ·4	+ ·7	+1·3	+ ·8
2-3	43·3	42·2	41·0	42·2	+4·1	+4·2	+ ·9	+3·1
3-4	43·2	36·4	36·0	38·5	+4·0	—1·6	—4·1	— ·6
4-5	38·2	35·6	36·6	36·8	—1·0	—2·4	—3·5	—2·3
5-6	42·4	42·7	41·3	42·1	+3·2	+4·7	+1·2	+3·0
6-7	43·3	34·8	45·2	41·1	+4·1	—3·2	+5·1	+2·0
7-8	38·4	37·8	43·9	40·0	— ·8	— ·2	+3·8	+ ·9
8-9	46·1	41·3	45·8	44·4	+6·9	+3·3	+5·7	+5·3
9-70.....	37·8	38·2	36·5	37·5	—1·4	+ ·2	—3·6	—1·6
1870-1	33·9	33·5	42·3	36·6	—5·3	—4·5	+2·2	—2·5
1-2	38·2	40·8	44·3	41·1	—1·0	+2·8	+4·2	+2·0
2-3	42·4	41·8	34·6	39·6	+3·2	+3·8	—5·5	— ·5
3-4	40·6	41·5	38·3	40·1	+1·4	+3·5	—1·8	+1·0
4-5	33·4	43·4	34·8	37·2	—5·8	+5·4	—5·3	—1·9
5-6	38·7	36·7	41·1	38·8	— ·5	—1·3	+1·0	— ·3
6-7	43·9	42·4	43·6	43·3	+4·7	+4·4	+3·5	+4·2
7-8	39·9	39·6	41·6	40·4	+ ·7	+1·6	+1·5	+1·3
8-9	33·3	31·8	37·8	34·3	—5·9	—6·2	—2·3	—4·8
9-80.....	32·1	32·2	40·7	35·0	—7·1	—5·8	+ ·6	—4·1
1880-1	42·8	30·2	37·8	36·9	+3·6	—7·8	—2·3	—2·2
Mean.....	39·2	38·0	40·1	39·1	...	...	...	...
Max	46·1	42·7	45·8	44·4	...	...	...	...
Min	32·1	30·2	34·6	34·3	...	...	...	...
Range ...	14·0	12·5	11·2	10·1	...	...	...	...

As regards the individual months, the years in which the temperatures have been more than 5°, either above or below the average, have been as follows :—

December : 6°·9 *above* in 1868.
„ 5°·3 *below* in 1870, 5°·8 *below* in 1874, 5°·9 *below* in 1878, and 7°·1 *below* in 1879.
January : 5°·4 *above* in 1875.
„ 6°·2 *below* in 1879, 5°·8 *below* in 1880, and 7° 8 *below* in 1881.
February : 5°·1 *above* in 1867, and 5°·7 *above* in 1869.
„ 5°·5 *below* in 1873, and 5°·3 *below* in 1875.

The first striking fact in this analysis is, that of the four *hot* months, all but one occurred before 1870; and of the nine *cold* months, all occurred in or after 1870, and five of them in the last three years.

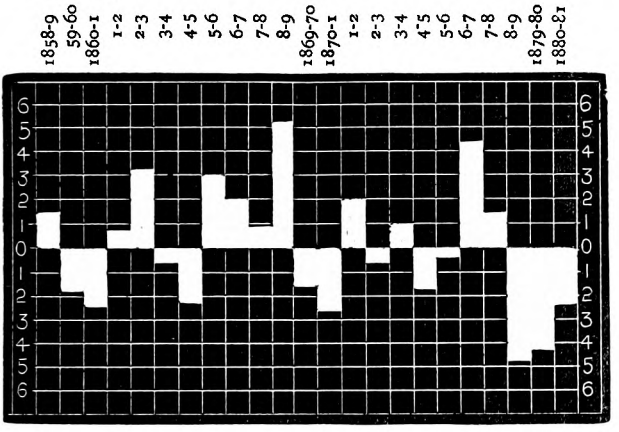
For the whole winter we must not expect so wide a range as for

individual months. We will take instances of winters 4° above or below the average :—

Winters *above* the average : 1868-9, 5°·3, and 1875-6, 4°·2.
„ *below* „ „ 1878-9, 4°·8, and 1879-80, 4°·1.

The foregoing figures will show that, at any rate as regards the past twenty-three years, the last three winters have been extremely severe.

This is further illustrated by the following diagram, which shows the amount by which each of the past twenty-three winters was above or below the average.



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

(Continued from page 39.)

II.—Belgium.

The following article—like the previous one for France—has been almost entirely compiled, in a condensed form, from the very able report by Dr. Gustav Hellmann to the Prussian Minister of Instruction.

In considering the meteorological service of Belgium, we propose to divide the subject as follows :—(*a*) the observations made at the Royal Observatory, (*b*) the network of meteorological stations, and (*c*) the telegraphic weather service under the Royal Observatory.

(*a*) The "Royal Observatory of Brussels" owes its origin to the strenuous efforts of the late L. A. J. Quetelet, for many years the permanent secretary of the Royal Academy of Sciences. As early as March, 1824, Quetelet laid a paper before the Academy, strongly advocating the establishment of the Observatory, which was finally decided upon on the 8th June, 1826. It was not, however, until

* See *Met. Mag.*, March, 1881.

the beginning of 1832 that the Observatory was ready for work. From the time of its first establishment it has included a meteorological and a magnetical department (in addition to one for astronomy) and has rendered important services to these sciences---especial attention having been given to climatological and phenological observations. After Quetelet's death (7th February, 1874), the service at the Observatory was entirely re-organized, at an expense of about £4,000, and M. J. C. Houzeau was appointed director.

In Vol. xi. (1857, 4to) of the Annals of the Observatory, will be found a detailed description of this establishment, and of the instruments used before the re-organization, and in the Annuaire for 1880 (18mo), particulars are given respecting those now in use. The position of the Observatory, on the N.E. of the city of Brussels is not so favourable as might be; the prevalent S.W. winds, for instance, are not felt until they have traversed the town and have consequently become somewhat heated. This fact partially explains the somewhat high temperatures published by Quetelet, in addition to which the exposure of the thermometers outside a window was objectionable.

The magnetic observations also are somewhat influenced by the iron railings of the garden, and by the proximity of the railroad.

The Observatory is rich in self-recording instruments. One of Kreil's barographs (*Prag Jahrbuch*, 1843), which registers by mechanical means every five minutes, has long been in use. Eye observations of the barometer and thermometer have been published in the *Annals*. The anemometer is of Osler's construction, and is fitted with an apparatus which registers the rainfall continuously. The wind observations have also been published in the *Annals*. The direction and velocity of the upper and lower clouds are also given. Two rain gauges (area 2 sq. dm., *i.e.*, $6\frac{1}{4}$ in. diam.) are placed on the south terrace of the Observatory—one for rain and the other for snow; there is also a third gauge, which receives the falls according to the eight principal directions of wind. This gauge has an aperture of 5 dm. = 19·7 in., which is kept to the wind by means of the wind vane; the gauge communicates with a cylindrical vase within the tower by means of a small tube. Two series of underground temperature observations are made at various depths, and atmospheric electricity is observed daily at noon, by means of a Peltier electrometer. Since the re-organization the Observatory has acquired, *inter alia*, barographs of the Kew (photographic) pattern and M. van Rysselberghe's (electrical) pattern, a Robinson's anemometer, and a barometer and thermometer-testing apparatus. The new earth thermometers are to be read off in a room, by an arrangement proposed by M. van Rysselberghe.

The following is a list of the principal publications, which also include astronomical observations:—

1. *Annales de l'Observatoire.* 25 vols., 1834—77. 4to.
2. *Annales Météorologiques de l'Observatoire.* 13 vols., 4to. 1867—79 (containing the meteorological and magnetical observations of the above series).

3. *Annuaire de l'Observatoire.* Containing among various other matters, meteorological and magnetical articles. 47 vols., 1834—80. 18mo.
4. *Sur le Climat de la Belgique.* 2 vols., 1849—57. 4to.
5. *Sur la Physique du Globe.* 1 vol., 1861. 4to.
6. *Météorologie de la Belgique, comparée à celle du Globe.* 1 vol., 1867. 8vo,
7. *Observations sur les Phénomènes périodiques.* In the Memoirs of the Royal Academy, which also contain various articles, principally by Quetelet. 4to.
8. *Catalogue des Ouvrages d' Astronomie et de Météorologie de la Belgique.* 1878. Large 8vo.

(*b*) It is only recently that the complete network of stations has been established. The Observatory had for many years lent instruments to individual observers, but there was no regular return of registers, nor inspection of stations. Some results, however, have been published by Quetelet in the *Climat de la Belgique* and in the *Mémoires de l' Académie.* On the 1st January, 1879, the observing system consisted of 1 station of the first order (Brussels), 3 International stations (for which the observations are published *in extenso* on the plan recommended by the Vienna Congress), and about 30 climatological stations. Most of the latter are volunteer stations, and are furnished with instruments similar to those at stations of the second order. The positions and other particulars are given in the *Annales Météorologiques.* The observations are taken at 8h. a.m. and 1h. p.m., and are sent monthly to the central station, and the monthly results are published in a special work entitled "*Observations des Stations Climatologiques.*

Since 1870 observations on thunderstorms have been made, the number of stations now being about 100, the observations being similar to those taken in France. A *résumé* is published yearly in the *Annuaire de l' Observatoire.* A special work on this subject by M. Lancaster, entitled "*L' étude des Orages en Belgique,*" has been published.

(*c*) The service for Weather Telegraphy is also of recent date; daily weather reports have been published since 1877. The *bulletin* contains two charts for 8h. a.m. of the *previous day*, also two charts for 8h. a.m. of the day of publication; and also a graphical representation of the curves of the photographic self-recording instruments at Brussels for the previous 24 hours, and a general summary of the weather.

Telegraphic reports are received from 50 inland or foreign stations, and summaries are sent in the afternoon to the seaports, and later in the evening the *bulletin* is distributed to the principal places of the kingdom.

The Observatory is superintended by a council of five members. The yearly income at the disposal of the Service at the time of Dr. Hellmann's report amounted to £3,256, including the astronomical

department—exclusive of the allowance for outfit at the time of the re-organization.

The meteorographs devised by M. van Rysselberghe, which are erected at Brussels and Ostend, are deserving of special mention, being at once simple, accurate, very ingenious and comparatively cheap, by means of which the indications of a number of meteorological instruments of any kind can be registered, whether they be placed near to or far from the registering apparatus. The instrument engraves automatically on metal plates, from which as many copies as desired may be struck off. A single burin put in motion by a simple electro-magnet can engrave successively on one and the same metallic plate the elements of all the curves. It is obvious that much expense and labour are thus saved in the reproduction of the curves themselves, without any intermediate work of reduction or preparation for the engraver or lithographer. The apparatus costs from £160 to £200, and is made by Olland, of Utrecht, and Schubart, of Ghent. A full description of it will be found in the *Quarterly Journal of the Meteorological Society*, Vol. II. In the Brussels instrument the curves for five days are included on one plate, whereby the cost of production is considerably diminished.

III.—Holland.

The "Royal Meteorological Institute of the Netherlands," at Utrecht, the official establishment for Meteorology, was permanently established in 1854; but it had already existed as a private institution since 1849. It is under the immediate control of the Minister of the Interior, and the director is the eminent meteorologist, M. C. H. D. Buys-Ballot, Professor of Mathematics in the University of Utrecht, and whose name is well-known in this country. The chief assistants are Baron van Heerdt and Captain van Hasselt, who are specially charged with the departments of Land and of Ocean Meteorology. We shall consider each of these branches separately.

(A) *Land Meteorology.*—There are two observing stations of the first order, viz., Utrecht and Gröningen; three of the second, five of the third, and thirty of the fourth order. Four of the stations are partially provided with self-recording instruments, and at the other stations of the second and third order eye observations are generally taken at 8h. a.m., 2h. and 8h. p.m. The stations of the fourth order record rainfall and phenological observations. Some of the observers are volunteers and provide their own instruments; others receive their instruments from the Institute or other public establishments. All the instruments are compared at Utrecht, and the stations are regularly inspected. The observations taken at the land stations are published in the *Nederlandch Meteorologisch Jaarboek*, for 31 years (1849-79), including the volumes published before the Institute became a state establishment. There was also a previous publication by Van Rees, entitled, *Uitkomsten van de meteor, waarnemingen gedaan te Utrecht in de Jaaren*, 1839-1843, Utrecht, 1844. The year-

books contain the observations made three times a day at from 7 to 10 stations, as well as rain, phenological, and other observations at from 30 to 40 stations. They also contain the *differences from the means* for barometer and thermometer and meteorological summaries for the respective years. Magnetic instruments of the Kew and Lamont's pattern are placed in an observatory in a garden adjoining the "Sonnenburg" at Utrecht, and similar observations are also made at Helder.

The service for Weather Telegraphy is much simplified in Holland, owing to the small extent of territory. Telegrams are received daily from 4 Dutch and 23 foreign stations, and weather reports are issued twice daily—at 8h. a.m. and 6h. p.m.—to 14 seaports. These reports are exhibited for public inspection, and further made known, by means of an apparatus called the "Aeroclinoscope" provided with arms, and designed to indicate the direction and extent of the greatest difference of pressure existing at the Dutch stations. A somewhat similar apparatus was tried experimentally in this country, but was soon discontinued. A daily bulletin is not published, but the weather reports are communicated to the newspapers.

We should mention that Holland was one of the first countries which used the telegraph for the dissemination of weather information. From June, 1860, *barometrical differences* from the mean were telegraphed to the seaports, and made public by means of blackboards. Admiral FitzRoy's storm signals were also adopted for some years, but in 1867 the Aeroclinoscope (above mentioned) was erected at eight of the Dutch seaports by means of which, and by the use of a ball by day and a lamp by night, notice of unfavourable weather was given to the seafaring community — fuller particulars being given on the blackboards. We are also indebted to Professor Buys Ballot for having persistently urged since 1857 the relation between wind and pressure, and the fact that all winds obey the law of storms. This relation was of course previously known to the writers on the cyclone theory, and in a paper by Captain Parish, R.N., communicated to the Royal Geographical Society on 25th February, 1856 (Procs. vol. i. p. 36), we find a distinct reference to the universal application of the principle to all winds in the sentence. "His conclu-"sions are—That all winds, excepting where influenced by the "proximity of much land, are parts of cyclones; obeying in their re-"spective hemispheres the laws which have now been proved to govern "hurricanes, both with regard to their tracks and rotary motion"; but, as pointed out by Mr. R. Strachan, in his instructive lecture on "The Barometer and its uses" (*Modern Meteorology*, Lond., 1879, 8vo.), although the principle was acted on by Admiral FitzRoy in forecasting, he failed to make his views generally intelligible to the public. Hence the credit of popularly enunciating the principle is due to Prof. Buys Ballot, and it is now generally known as "Buys Ballot's Law."

M. Buys Ballot has for many years endeavoured to bring about a meteorological publication of an international character. In the *second*

part of the year-book, which has been published from the year 1865, observations have been given referring to the weather of the whole of Europe, and including some important stations in other parts of the globe *e.g.*, Paramaribo, Nagasaki, Buenos Ayres, &c., for which the observations have been published *in extenso*. The second part of the year-book also contains the deviations of daily temperature and pressure for the principal stations of Europe, as well as a summary of the rainfall and winds for various parts of the globe. Some of the recent volumes (1870-72) also contain long series of barometer and thermometer observations made in Europe, with means for months and for decades from observations made three times a day. A joint publication by Belgium and Holland is also issued, containing observations made at some stations in each country, according to the plan recommended by the International Meteorological Committee.

(B) *Ocean Meteorology.*—Holland was one of the first countries which adopted the plans proposed by the Brussels Maritime Conference of 1853, and sent its observations to Commodore (then Lieut.) Maury at Washington for discussion. Owing to the exertions of Prof. Buys Ballot, however, a special department for ocean meteorology was established, which of course receives the numerous observations made on the Dutch men-of-war and merchant ships. Those captains who were willing to make regular observations received a supply of instruments and registers from the Institute. Two kinds of log-books are issued, which do not differ very materially from those in use in this country. When the logs are returned to the Institute, they are classified according to their character into four grades. The observers receive copies of the marine publications of the Institute. Medals are also given to the observers by the Societies interested in the promotion of ocean meteorology. A silver medal is awarded for two "excellent" logs, and a gold medal for six. The practice of awarding medals as a slight acknowledgment for valuable records was, we believe, first instituted in France, by the *Association Scientifique*, at the instigation of Le Verrier. The method of dealing with the extraction and discussion of the data may be mentioned, being somewhat peculiar. Each register is copied on forms having headings corresponding with the books supplied, and ruled on one side only. Each extract receives a number referring to the register from which it is taken, in order to facilitate any future reference if necessary. The forms are then cut into strips, so that each contains only those observations which belong to the same degree of latitude. They are then sorted according to month and place, ready for entry on charts when required, or are arranged beneath each other for the deduction of mean values.

By far the greatest part of the materials are for voyages made between Holland and India and China. The earlier publications have become out of date by the publication of more recent works. These latter publications differ essentially from the publications in this country, by referring to one element only, *e.g.*, wind, barometer, sea

temperature, &c., each being treated separately. Our space will not allow us to give a complete list of the valuable publications by the Marine department of the Institute. The following summary of some of the the principal works will suffice to show the activity of the Institute in this branch :—"Investigations on Sea Temperature and Currents, 1853, 1861, 1867, 1872"; "Trade-wind Chart, 1856"; Wind Charts of the North Atlantic, 1856"; "General Wind Chart, 1860"; "Storm, Rain, &c., Chart, 1862"; "Atlas and 4 Charts of the Chinese Sea, 1863"; Monthly Wind Charts of the North Atlantic, 1st series, December to May, 1877; 2nd series, June to November, 1878"—a very valuable investigation; "Sailing Directions to and from Java, 1860, 1868—70"; "Routes for Steamers between Aden and the Straits of Sunda, 1871"; "Mean Barometer around the Cape of Good Hope, 1874"; "Routes in China Seas and the Western part of the N. Pacific, 1876." The department has been recently engaged in the investigation of the Meteorology of the China Seas (0° —30° N. lat., 100° —150° E. long.), and the study of the typhoons of that district. It has also entered into an exchange of observations with the German Meteorological Office, supplying the data for the North Atlantic N. of 20° in exchange for the data required for the above investigation undertaken by themselves.

The funds at the disposal of the Institute amount to about £1,700 a year, but this is exclusive of the salaries of the Director and Marine Superintendent, who are paid from other sources. If these salaries are included the annual amount would be about £2,100.

J. S. HARDING.

THE WINTER OF 1880–81.

To the Editor of the Meteorological Magazine.

SIR,—In my letter which you published in November last (see *Met. Mag.*, Vol. xv. p. 160), I stated that "the coming winter should be somewhat colder than (39°·2) the average of the last 40 years." In the following month I stated (see *Met. Mag.*, Vol. xv. p. 166) that "when snow has been observed near London as early as October we have had a colder winter than the average ten times in eleven," and the accompanying table showed that, seven times in eleven, the winter was more than 1° below the average of the last 40 years.

Then, in the following rule (on p. 167) I said, "The years 1869, 1870, 1878, 1879, and 1880 furnish the only instances, since 1865, of the normal condition of things being so reversed, that August was wetter in England than in Scotland, and in each case, up to the present time, the following winter has been cold." We have now to add the winter of 1880–81 to the list of *fulfilled* instances. At the conclusion of my letter I said, "On the whole, we may reckon on the winter of 1880–81 being somewhat colder than the average, but still not much below the mean."

The mean of the winter (December to February, inclusive) two

years ago, was 4°·6 below the Greenwich average of 40 years. The next winter (1879–80) was 3°·4 below the average, and the mean of the winter just past 1°·7 below the average, but not more than 0°·6 below the Greenwich long (110 year) average. So the winter forecast has been fulfilled exactly. We have have had a cold season, "but still it has not been much below the mean."—Yours truly,

GEORGE D. BRUMHAM.

Barnsbury, 5th March, 1881.

SNOW STORM GALES.

IN transferring to our pages the following portion of an article which appeared in the *Inverness Courier* of March 17th, we express no opinion upon the views of the writer, but we know that he is not alone in holding them, and we think that it would be useful if some of our correspondents were to turn their attention to them. We may add, that we believe that the writer resides at Ballachulish, which is in a valley running eastwards from Loch Linnhe, in the north of Argyleshire; but it will be noted that he states that his impressions as to snow storm gales are confirmed by the experience of maritime men, when remote from the disturbing influence of mountains :—

NETHER-LOCHABER.

Of a truth this present month of March came in, in aphoristic phrase, "like a lion," roaring, rampant, raging! with a gale from the east-nor'-east that lashed Loch-Leven and the Linnhe-Loch into angry waves, and sent the spray and spindrift in snow-like showers far over the mountains of Morvern and Mull. In all our thirty years' residence in Nether-Lochaber, we do not remember so violent and lasting a storm from the east; for so fiercely and continuously did it rage that for three consecutive days and nights even Ballachulish Ferry, less than a hundred yards in breadth, was uncrossable, well adapted to their purpose as are the boats in use, and thoroughly skilled in all the moods and tendencies of winds and tides in their every conceivable combination as are the ferrymen. It may be believed that a sharp eye was kept on the slightest lull in the storm, that instant advantage might be taken of it, in order that our postal communication at all events should not be interrupted; and yet for three whole days we had no papers or letters, except such as reached us *via* Fort-William and Kingussie. All the while it was snowing heavily on the Grampians, with a swirl and drift in such a wind that must have caused vast accumulations in many a narrow pass, and corrie, and gorge, and many an upland glen. Along the seaboard but little snow fell: it was, to use an expressive Gaelic phrase, no more than a *spìonadh sneachd a slugan an t'soirbheis*, a phrase untranslateable with any literalness of rendering, but which means that the snowflakes came reluctantly, and as if with difficulty and against their will, from out the œsophagus of the howling storm; a phase of snow-storms frequently seen along the western seaboard when the gale is easterly, and on the eastern seaboard when the gale is westerly. The gale, in such a case, is always oscillating and unsteady in direction, and the cold intense. It was so on this occasion, and it will always be found to be so when the swirling snowflakes are few and far between, and small, and crisp, and dry, and seem to come reluctantly from out "the throat and gullet" of the storm. What may be called the *anemoscopy* of snow-storms—the constant tendency, that is, of the accompanying winds to frequent shiftings, and lawless eddyings and gyrations—has not yet received the attention which we think it deserves; and we recommend it as a subject in

the study and elucidation of which some of our good friends of the Meteorological Society, with more idle time on their hands than ourselves, might very usefully employ themselves. The puzzle to be solved may be briefly stated thus: How comes it; why is it that no snow-storm gale ever blows for an hour together otherwise than fitfully, unsteadily, and eddyingly? Why should it gyrate and swirl and twirl unceasingly, while other storms frequently blow steadily from compass point to compass point for hours together? We can remember referring to this matter in a communication to the late Admiral FitzRoy; and we have been searching among our meteorological papers for his reply, but cannot for the moment find it. A living meteorologist of eminence to whom we propounded the anemoscopical swirling snow-storm gale as above, endeavoured at a ready solution by suggesting that *all* gales blew in the same gyratory and eddying way, only that the gyrations and eddyings of snow-storms are more palpable, more tangible, so to speak, and more readily discernible, just because of the accompanying snow-flakes, which make the swirlings and fitful shiftings of the gale for the time visible to the eye. This way of putting it, however, is unsatisfactory, when we remember that a *rain*-storm is just as visible to the eye as is a snow-storm; and yet a rain-storm usually blows across the compass card from point to point, with some shiftings and oscillations it may be, but steadily enough upon the whole for hours together; while to the observant dweller by the sea all gales are sufficiently visible to the eye as they sweep across the deep, to convince him that they usually blow with very little of the swirling and eddyings so characteristic of snow-storm gales. If you question a seaman on the subject, whether mere coaster or circumnavigator, he will tell you that in a snow-storm, because of its constant eddyings and gyrations, frequent trimming of sails is more necessary than in any other gale, and that to steer a straight and steady course under such circumstances is for the time simply impossible. Admiral FitzRoy, in his letter to us on the subject, says something about an anemometer specially designed for snow storm gales, which he intended getting made for use at certain selected stations, in order to have the matter thoroughly investigated. He died soon afterwards, however, and the question is still waiting patient, intelligent investigation, and satisfactory solution when "the man and the hour" shall have come.

THE METEOROLOGICAL SOCIETY.

THE usual Monthly Meeting of this Society was held on Wednesday, the 16th ultimo, at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., president, in the chair. The Revs. A. J. C. Allen, and E. W. Ford, and Messrs. E. Chapman, G. T. Gwilliam, H. B. Jupp, A. Ramsay, and J. Stokes were elected Fellows. The President gave a historical sketch of various classes of hygrometers, and described about 120 different patterns, after which the Fellows and visitors proceeded to inspect the following instruments:—

Objects.	Exhibitor.
Leslie's Hygrometer	*Mr. P. Adie.*
Dines' Hygrometer, original pattern, for use with iced water	*Mr. L. P. Casella, F.M.S.*
Regnault's Hygrometer (original pattern) ...	,,
Scale and Instructions of Hygrometer, by Prof. G. M. C. Barnabita	,,
Daniell's Hygrometer, unusual shape	*Mr. G. Dines, F.M.S.*
Dines's Hygrometer, first attempt	,,
,, ,, first made	,,
,, ,, to test glass against metal for deposit of the dew...	,,

Objects.	Exhibitor.
Dines's Hygrometer, for use with water or ether, metallic face, the centre separate from the outer part of the metal	*Mr. G. Dines, F.M.S.*
Meteorological Journal, from 1824–27, with observations of the dry and wet bulb thermometers	,,
Damp Detector	*Mr. J. J. Hicks, F.M.S.*
Dry and Wet Bulb Thermometers (Marriott's arrangement)	,,
Bogen's Hygrometer	*Mr. W. Marriott, F.M.S.*
Weather House Hygrometer	,,
Improved form of Rain Gauge receiving bottle..	*Mr. E. Mawley, F.M.S.*
Jones's Hygrometer	*Messrs. Negretti & Zambra.*
Leslie's Hygrometer	,,
Turnover Dry and Wet Bulb Thermometers ...	,,
Mason's Hygrometer with Table for calculating Dew Point	*Mr. F. Pastorelli, F.M.S.*
Dry and Wet Bulb Thermometers with glass scales, for travellers	,,
Dry and Wet Bulb Thermometers with glass scales, mounted on brass pedestal ...	,,
Sick Room and Hospital Meteorological Case ...	*Dr. B. W. Richardson, F.R.S.*
Alluard's Hygrometer	*Mr. R. H. Scott, F.R.S.*
Klinkerfues' Patent Hair Hygrometer	,,
Lowe's Graphic Hygrometer	,,
Regnault's Hygrometer (second pattern) ...	,,
Saussure's Hair Hygrometer	,,
Catgut Hygrometer	*Mr. G. J. Symons, F.R S.*
Daniell's Hygrometer (original pattern) ...	,,
De Luc's Whalebone Hygrometer	,,
Dines's Hygrometer, new pattern, for use with water or ether	,,
Mason's Hygrometer	,,
Photographs of Yorkshire Waterfalls, January, 1881	,,
Saussure's Hair Hygrometer	,,
Radiogram obtained by Winstanley's Radiograph	*Mr. G. M. Whipple, F.M.S.*
Welsh's Slide Rule for Hygrometric Calculations	,,
Table to facilitate finding the Humidity of the Air, by H. C. Russell	,,
Whipple's Cloud Camera	,,
Admiral Jerningham's Hygrometer	*Mr. R. H. C. Wilson.*
Moisture Meter	,,
Swan Quill Hygrometer	,,

SUPPLEMENTARY TABLE OF RAINFALL IN MARCH, 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·38	XI.	Carno, Tybritle	5·87
,,	Margate, Acol	1·54	,,	Corwen, Rhug	2·20
,,	Littlehampton	2·53	,,	Port Madoc	3·28
,,	St. Leonards	3·22	,,	Douglas...	4·35
,,	Hailsham	2·87	XII.	Carsphairn	...
,,	I. of W., St. Lawrence.	2·54	,,	Melrose, Abbey Gate...	3·18
,,	Alton, Ashdell.....	2·41	XIV.	Glasgow, Queen's Park.	2·44
III.	Great Missenden.....	2·94	XV.	Islay, Gruinart School..	4·83
,,	Winslow, Addington ...	1·74	XVI.	Cupar, Kembach.....	2·79
,,	Oxford, Magdalen Col...	1·38	,,	Aberfeldy H.R.S.	2·00
,,	Northampton	1·51	,,	Dalnaspidal	3·02
,,	Cambridge, Merton Vil.	1·13	XVII.	Tomintoul.....	2·13
IV.	Harlow, Sheering	1·93	,,	Keith H.R.S.	1·80
,,	Diss	1·85	XVIII.	Forres H.R.S.	1·92
,,	Swaffham	2·04	,,	Strome Ferry H.R.S....	5·01
,,	Hindringham	1·69	,,	Lochbroom	6·63
V.	Salisbury, Alderbury...	2·52	,,	Tain, Springfield.....	2·12
,,	Calne, Compton Bassett	2·14	,,	Loch Shiel, Glenfinnan.	11·43
,,	Beaminster Vicarage ...	2·91	XIX.	Lairg H.R.S.	3·54
,,	Ashburton, Holne Vic..	9·50	,,	Altnabreac H.R.S.	...
,,	Langtree Wick	3·67	,,	Watten H.R.S.	2·34
,,	Lynmouth, Glenthorne.	3·33	XX.	Fermoy, Glenville	6·68
,,	St. Austell, Cosgarne...	5·38	,,	Tralee, Castlemorris ...	3·51
,,	Taunton	...	,,	Cahir, Tubrid	4·80
VI.	Bristol, Ashleydown ...	...	,,	Tipperary, Henry St....	4·80
,,	Ross	1·87	,,	Newcastle West	2·56
,,	Wem, Sansaw Hall.....	1·81	,,	Kilrush	1·82
,,	Cheadle, The Heath Ho.	3·31	,,	Corofin	3·21
,,	Bickenhill Vicarage ..	...	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	1·49	,,	Carlow, Browne's Hill..	2·80
,,	Horncastle, Bucknall ...	1·54	,,	Kilsallaghan.....	...
VIII.	Macclesfield Park	3·97	,,	Navan, Balrath	2.01
,,	Walton-on-the-Hill.....	3·03	,,	Athlone, Twyford	2·20
,,	Broughton-in-Furness ..	7·54	,,	Mullingar, Belvedere ...	2·30
IX.	Wakefield, Stanley Vic.	2·77	XXII.	Ballinasloe	..
,,	Ripon, Mickley	3·98	,,	Clifden, Kylemore	7·30
,,	Scarborough.....	2·94	,,	Crossmolina, Enniscoe..	4·63
,,	Mickleton.....	5·28	,,	Carrick-on-Shannon ...	3·22
X.	Haltwhistle, Unthank..	3·49	XXIII.	Dowra	3·78
,,	Shap, Copy Hill	5·36	,,	Rockcorry.....	2·88
XI.	Llanfrechfa Grange	4·28	,,	Warrenpoint	5·73
,,	Llandovery	3·55	,,	Newtownards	3·79
,,	Solva	2·23	,,	Carnlough.....	6·50
,,	Castle Malgwyn	3·99	,,	Bushmills	4·43
,,	Rhayader, Nantgwillt..	6·71	,,	Buncrana	3·48

MARCH, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	2.30	+ ·69	·59	4	11	60·3	18	23·7	1	8	15
II.		Maidstone (Hunton Court)	1·54	— ·04	·46	5	11	...	...	...	...	...	...
,,		Strathfield Turgiss	1·49	+ ·09	·44	5	12	61·7	16	22·2	27	12	17
III.		Hitchin	1·39	— ·09	·43	5	11	56·0	10	22·0	26‖	16	...
,,		Banbury	1·54	— ·06	·45	5	14	58·3	11	21·5	30	15	...
IV.		Bury St. Edmunds (Culford)	1·48	— ·08	·46	5	11	59·0	7, 20	19·0	26‖	16	...
,,		Norwich (Cossey)	1·38	— ·30	·51	5	13	61·0	10	22·0	28**	15	16
V.		Bridport	2·61	...	·62	5	10	60·0	10	21·0	1	12	...
,,		Barnstaple	2·93	+ ·44	·41	4	16	58·0	7	23·0	1	...	...
,,		Bodmin	5·80	+ 2·64	1·60	3	17	58·0	23	23·0	1	7	13
VI.		Cirencester	2·32	+ ·25	·47	6	9	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	2·46	+ ·30	·69	5	16	59·5	17	23·0	30	13	...
,,		Tenbury (Orleton)	2·06	+ ·19	·57	5	14	62·8	17	20·5	28	15	19
VII.		Leicester (Town Museum)	1·43	...	·45	5	13	59·7	11	22·8	1	12	21
,,		Boston	1·73	+ ·44	·61	5	9	60·0	11	23·0	1	14	...
,,		Grimsby (Killingholme)	2·24	+ ·58	·65	5	14	56·5	7	22·0	2	9	...
,,		Mansfield	3·07	+ 1·25	·89	5	11	58·6	11	16·8	1	14	19
VIII.		Manchester (Ardwick)	4·31	+ 1·86	·91	9	18	59·0	10††	23·0	1	11	...
IX.		Wetherby (Ribstone)	3·16	+ 1·03	1·56	6	7	...	...	...	..	...	...
,,		Skipton (Arncliffe)	7·37	+ 2·61	1·85	9	20	57·0	12	15·0	1	12	...
X.		North Shields	2·92	+ 1·47	·91	5	17	55·0	17	16·2	2	16	17
,,		Borrowdale (Seathwaite)	15·52	+ 5·63	3·30	9	22	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	4·13	+ 1·44	·67	4	11	...	...	...	...	..	...
,,		Haverfordwest	3·70	+ ·51	·70	13	14	54·5	6, 7	24·2	28	11	12
,,		Aberystwith Goginan	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	2·13	+ ·25	·42	8	17	56·0	17	28·0	31	10	...
XII.		Cargen	5·57	+ 2·79	·96	23	18	56·0	15	19·0	22	13	...
,,		Hawick (Silverbut Hall)	1·96	·00	·50	6	15	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	5·11	+ 1·97	1·44	9	15	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	...	...	...	...	...	...	...	...	...
,,		Kilmory	6·51	+ 1·90	1·00	23	21	...	...	15·0	2	15	...
,,		Mull (Quinish)	3·44	...	·64	18	18	..	...	...	..	...	...
XVI.		Loch Leven	5·10	+ 2·98	2·40	6	9	...	...	...	...	...	...
,,		Arbroath	2·63	+ 1·00	·87	13	10	56·0	11*	21·0	2,3¶	15	...
XVII.	SCOTLAND.	Braemar	1·68	— ·51	·30	3	17	51·3	18	3·8	3	21	27
,,		Aberdeen	2·72	...	·96	5	21	59·0	17†	18·0	2§	18	...
XVIII		Portree	6·03	+ ·17	1·16	18	21	...	...	...	...	...	...
,,		Inverness (Culloden)	1·25	— ·50	...	...	..	49·0	13	18·0	22	14	24
XIX.		Dunrobin	2·26	...	·33	10	17	57·0	18	21·0	22	16	...
,,		Sandwick	3·43	+ ·79	·46	27	23	52·1	16	12·7	3	15	19
XX.		Cork (Blackrock)	5·67	+ 2·91	1·66	2	16	62·0	10‡	24·0	28	12	...
,,		Darrynane Abbey	...	...	...	...	...	...	...	...	...	...	...
,,	IRELAND.	Waterford (Brook Lodge)	3·40	...	·66	3	13	59·0	...	23·0	..	...	...
,,		Killaloe	3·18	...	·50	8	17	61·0	15	23·0	30	13	...
XXI.		Portarlington	2·09	— ·07	·45	6	19	55·0	17	26·0	29	8	...
,,		Monkstown	2·55	...	·53	3	14	62·0	10	23·0	28	..	...
XXII		Galway	...	...	...	...	...	56·0	14	25·0	30	7	...
XXIII		Waringstown	2·80	...	·50	5	17	60·0	11	20·0	29	15	16
,,		Londonderry	3·39	...	·49	8	20	55·0	16	28·0	31	7	17
,,		Edenfel (Omagh)	2·53	+ ·44	·42	13	20	55·0	17	21·0	21**	16	...

* And 17. † And 18 ‡ And 15. § And 21. ‖ And 28. ¶ And 22. ** And 29. †† And 15.

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

METEOROLOGICAL NOTES ON MARCH.

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

ENGLAND.

STRATHFIELD TURGISS.—Latter part of the month cold, with sharp frosts at night. Wild heartsease in flower on 1st; honey bee seen on 2nd; first wild violet gathered on 7th; brimstone butterfly flying on 11th.

HITCHEN.—Cold in the latter part of the month; the frost the hardest ever recorded so late in March.

BANBURY.—S on five days; high wind on seven days.

CULFORD.—A stormy and very cold month, with little R; temp. twice fell to 19°.

COSSEY.—The month was cold at the beginning, and very cold at the end; dry weather after the 8th, favourable for agricultural operations.

BODMIN.—Mean temp. of the month, 45°·7.

CIRENCESTER.—Rainfall moderate; some West wind in the early part of the month, then North-west, and afterwards North-east and East, with frosts and fine weather. A good month for cultivating the land.

WOOLSTASTON.—Mean temp. of month, 41°·8.

ORLETON.—The first four days were cold and frosty, with S. R fell all day on the 5th, but not heavily; and on the 6th the Teme was much flooded. The weather then became warmer, and was generally fine and pleasant, with a temp. much above the average, till the evening of the 20th, when the wind set in from N. and E., and continued to blow steadily, and frequently strongly from those points till the end of the month, with a generally clear atmosphere and severe frost every night. Mean temp. nearly 0°·5 above the average.

GRIMSBY.—Month very cold throughout, excepting a very few days; first part wet, latter part dry. Farm work very backward, and much disease among ewes and lambs. Trees very backward.

MANSFIELD.—S on six days; frost at beginning and end of month.

ARNCLIFFE.—S on five days.

NORTH SHIELDS.—S more or less on 13 days.

SEATHWAITE.—Fearful snowstorm on the 4th. On the 8th and 9th, 6·07 in. of R fell, causing a terrible flood on the latter day. Frost and S towards the end of the month.

WALES.

HAVERFORDWEST.—The first two days were extremely cold; on the 3rd a gale of terrific violence occurred, and it is generally believed that the force of the wind exceeded that during the memorable gale and snowstorm of January 18th and 19th. From the 4th to the 15th the weather was generally wet and, at times, stormy; sharp frosts occurred on the 16th, and from about the 20th to the end of the month, with cutting Easterly winds, the sky being generally clear and often cloudless. A fine double solar halo was seen on the 8th, and at night the wind blew half a gale, increasing in force the next day. Mean temp. of month, 42°·3; mean temp. of last 11 days, 37°·4. Wind blew from E. or S.E. on 10 days, and from W. or N.W. on 10 days.

LLANDUDNO.—Both ends of the month were cold and inclement, but from the 5th to the 21st there was some fine mild weather, and the mean temp. of the whole month was about 2°·0 above the average. There were 85 hours of bright sunshine during the month, and the rainfall was about the average. Polar winds prevailed on 16 days, and tropical on 15. Frost occurred on 10 nights.

SCOTLAND.

CARGEN.—From 21st to end of month very cold weather; vegetation greatly checked, and everything very late. Mean temp., 39°·4, 1°·9 below the average. S on five days.

HAWICK.—Such a severe March was never seen before by anyone living in Hawick, more S than dust, and lambs suffered much; vegetation and farm work extremely backward. There were only seven days, from 11th to 18th, that were at all spring-like.

KILMORY.—S on nine days, and frequent sharp frosts.

QUINISH.—From 1st to 8th, bitterly cold and very stormy: from 9th to 19th, fine and very mild; from 19th to end of month, very cold and stormy.

ARBROATH.—On the 4th and 5th occurred the greatest snowfall since January and February, 1823.

BRAEMAR.—Agricultural and horticultural labour entirely prevented by frost.

ABERDEEN.—Weather cold, unsettled and stormy; heavy snowfall on the 5th, accompanied by strong S.E. gales, causing drifts which blocked the railways North and South for several days; the telegraph wires too were broken by the gale. Gales and showers of R, H, and sleet were frequent, retarding agricultural operations very much. Faint Aurora was seen on three nights.

PORTREE.—A cold stormy month, with more S and frost than usual; heavy Westerly gale on 23rd and 24th. Sheep in bad condition on hill pastures.

CULLODEN.—The month was cold and very ungenial, with heavy falls of S during the early part. Work in garden and field much retarded.

SANDWICK.—The month was unprecedentedly cold and stormy; mean temp., 35°·8, lower than that of any other March during the last 55 years. The anemograph recorded 19,702 miles of wind, which is 5,393 miles more than the average, and more than in any March during the past 21 years, though one of the cups was broken off by a storm on the 6th and was wanting the greater part of the month. There were six gales of 50 miles an hour or more, amounting on two occasions to 62 and 63 miles respectively. S covered the ground on 15 days, with occasional drift; Aurora was seen on 2nd.

IRELAND.

CORK.—Very wet on 2nd and 3rd; 2·91 in. of R fell, flooding many streets in Cork.

WATERFORD.—March winds and frost at night; very cold from 24th to end. Heavy gale on 3rd and 4th. Very little growth of vegetation.

KILLALOE.—Continuous rains and heavy gales in the early part of the month, dull and wet from 18th to 25th, remainder of month splendid seasonable weather; some very sharp frosts and cold N.E. winds in the last fortnight.

MONKSTOWN.—The month was very variable; the early part rainy, heavy S and H on 21st, the end very cold, with winds from N.W. to N.E., and occasionally hard frost; very dry and parching.

WARINGSTOWN.—Spring very backward.

ASSOCIAZIONE METEOROLOGICA ITALIANA.

WE have been requested to announce that the Italian Meteorological Alpin Apennine Correspondence (Established about 1866) and the Italian Meteorological Society, formerly presided over by Prof. Ragona, have been fused, and that a new body has been formed under the title of the Italian Meteorological Association, which has H.M. the King of Italy for its Honorary President, and Padre Denza for Acting President. The offices of the Association are at 13, Via Lagrange, Turin, but the Central Observatory, to which scientific correspondence should be sent, is that at Moncalieri, which is about five miles south of Turin.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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EASTER AT SORBONNE.

ACCORDING to our custom, we give a brief note of the papers upon Meteorology read at the annual *Réunion des Sociétés Savantes;* and as we like to be systematic, we report them in alphabetical order. It would conduce to the comfort and greater instruction of the delegates if some approximation to system, order, or sequence prevailed in the reading of the papers. At present the only way of being sure to hear any particular paper is to attend every meeting continuously, from the moment of its opening to its close. And after all one may find, as this year, that a communication which is down on the list is not read at all, either because the author is not present when called upon, or because he has not come to Paris, but has sent the memoir to the Secretary, to whom it evidently is far too great a labour to read other persons' communications.

Prof. ALLUARD (of Clermont Ferrand). *New mode of graduating Hygrometers.*—The author proposes placing in a glazed chamber one of his condensing hygrometers, and in the same vessel a Saussure's hair hygrometer. By passing into the vessel successive quantities of moist or dry air, any desired range of humidity can be produced in it. The Alluard hygrometer will show precisely the dew-point temperature in the vessel, and the Saussure's hygrometer being read off at the same time, the errors of various portions of its scale can be accurately determined.

Prof. ALLUARD. *On the Wind at Mountain Observatories.*—The author said that in order to become acquainted with the velocity, direction and rotation of the winds in a large country like central France, it was better to study the observations made at a great height in the atmosphere, far from any disturbing cause, as on the summit of the Puy de Dôme, than nearer to the earth, where variations in the configuration of the country have a marked influence and render the anemometrical results complicated. Hence it is that the records from the observatory on the Puy de Dôme (4813 ft.) have a special interest. During 1880 it was found that the vane made 32 complete *direct* rotations (=N.E.S.W.N.), and only 6 retrograde ones

(=N.W.S.E.N.), 17 direct rotations embracing 270° of the compass, and 7 retrograde, and, lastly, 34 direct semi-rotations and 17 retrograde semi-rotations.

M. C. BALTET. *On the effects of the Frost of* 1879–80, on vegetables, fruit, ornamental, and forest trees.—He considered that the plants had all been in a state ill adapted to resist the frost which came so early, that the sap had not gone down. He also suggested that the portions above the snow not only suffered from radiation cold, but from the joint heat of the direct rays of the sun and of their reflection from the snow. He mentioned the extreme cold of the valleys, in one case, —22° F. in the valley, while it was +9° F. on the adjacent hill. He admitted that there were some cases, both of injury and of escape, which he could not explain; but he urged, in conclusion, that the experience lately gained should be turned to profit by planting specially those varieties which had best resisted the rigours of the recent winters.

M. GARBAN (of Clermont Ferrand). *On the Rate of Evaporation.*—This was an account of experiments made with a series of vessels filled with various earths and regularly weighed. The author found the evaporation from chalk less than that from sand; in fact, the latter appeared to collect most dew and vapour, and also to yield its vapour more readily than any other variety of earth.

M. HEBERT (of Allier), who had not undertaken to prepare a paper, gave a *vivâ voce* account of the results at which he has arrived respecting the *great movements of the atmosphere*, and the movement of *cyclonic depressions* as explained in the work which will shortly be published by the *Société Météorologique de France*. M. Hébert considers that the Foehn and sirocco are produced when under the influence of a great Atlantic storm, a current of warm humid air moving rapidly impinges on a chain of mountains, which compels it to dilate and to become cooler, and therefore to produce a large fall of rain. When the air reaches the top of the mountain it contains only the quantity of vapour necessary to saturate it at the low temperature to which it fell during its ascent, and falling down the other slope with a circular or spiral motion, it becomes warmed by the compression, and as much drier as it is warmer. When the point of this system reaches the plain, the gyratory descending motion, and the centrifugal force jointly, produce a diminution of pressure which gives rise to an internal gyratory ascending current of considerable force, which produces the low pressure found in the centre of a storm. This phenomenon is very comparable with the reflections of sonorous waves by a fixed obstacle. A complete storm thus consists of two parts—an interior region of low pressure, where the air is ascending in conical spirals, and an external area of high pressure and descending spirals. The air in the cyclones becomes rapidly more damp, and thus while commencing with a very dry air, they finish with violent winds and torrential rains.

In the second part M. Hébert examines these phenomena as they occur in N. America. The sirocco is produced all along the chain of mountains which fringe the western side of the United States, and it gives rise to numerous cyclones which present precisely the features above described, and cross the States from S.W. to N.E. preparatory to their passage over the Atlantic.

Lastly, in the third part, the author applies a similar investigation to the records from the Continent of Asia and the surrounding seas, and finds that there also similar phenomena occur; and that the cyclones of the Bay of Bengal, the typhoons of the China Seas, and the tempests of the Pacific are identical with those of the Atlantic. He also finds a similar obedience to the general formation above described in the storms which, coming from the north-west, cross Siberia and Central Asia.

M. MASURE (of Orléans). *New Researches on the Evaporation of Water and on the Transpiration of Plants.*—This author supplied to the Secretary, as an abstract, the following remarks; as it is entirely different from what he *said*, we give first his abstract and then an epitome of our notes :—

"M. Masure, of the Agricultural Society of Orleans, explained the result of his researches on the influence of the arable lands on the evaporation of the water which they contain. It is to the manure contained in the soil that most of this influence is due, it is the compost in the arable lands which renders them more porous, more ærated, more hygroscopic and therefore better adapted to retain the rain water in the soil among the roots and thus feed them with carbonic acid, oxygen and ammonia. Manure is not merely manure, it is also a powerful physical agent in the fertilisation of arable land." Thus far M. Masure's *précis;* now for our notes.

The author began by stating that the amount of evaporation could be determined by a formula containing values for, (*a*) temp. of the water, (*b*) temp. of the air, (*c*) temp. of solar radiation, (*d*) humidity of the air, (*e*) velocity of the wind. He then exhibited one of a series of 51 charts, on each of which he had placed curves giving hourly observations of all the meteorological instruments which he possessed. The air temperature was taken by a *thermomètre fronde*, and the same thermometer was subsequently used to ascertain the temperature of the water in the evaporator. His observations were made in a garden rather full of plants. He found the temperature of the water at sunrise always below that of the air. He considered that the temperature of stagnant water was different from that in a river, where it was tossed about. During the early morning hours he not infrequently found that instead of evaporating, condensation had taken place on the surface of the water in his evaporator. He found the range in the temperature of the water in one day as much as from 49° F. to 85° F., or 36° F. He had also made experiments as to the amount of evaporation from a tobacco plant, and found that the hourly amount passing off was markedly less when the sky was

overcast; the life and breathing of the plant were, in fact, checked by want of sunshine, the influence of which was greater even than that of heat. He stated the amount evaporated, but as that would be useless without knowing the size of the plant, we need only quote his concluding remark, that tobacco plants evaporate freely, and that their capacity in that respect being known it is evidently possible to determine what amount of subterranean water the soil must contain if they are to reach their perfect development.

M. Hébert presented, on behalf of M. POINCARRE, the first part of a *Manual of Weather Forecasts*, founded upon the observations and experience of the 16 years, 1864–1880, at Bar-le-Duc, and requested the criticism of the members upon it.

M. LEON VIDAL (of Marseilles). *On a Photometer for recording continuously the Amount of Daylight.*—The author said that the records hitherto made were records of the amount of actinic energy and not of light. He had studied the experiments of Werner Siemens, Hittorf, Adams, and others, and believed that by the use of selenium, a galvanometer, and one or, at the most, two Daniell's cells, he should be able to complete a recording apparatus well adapted for meteorological observatories.

THE METEOROLOGICAL SOCIETY.

THE usual Monthly Meeting of this Society was held on Wednesday, April 20th, at the Institution of Civil Engineers; Mr. C. Greaves, F.G.S., Vice-President, in the chair. W. H. Goss, F.G.S., and Admiral T. L. Massie were balloted for and duly elected Fellows of this Society. The following papers were read:—(1) "On the Frequency and Duration of Rain," by Dr. Wladimir Köppen, of Hamburg; (2) "Results of Experiments made at the Kew Observatory with Bogen's and George's Barometers," by G. M. Whipple, B.Sc., F.R.A.S.; (3) "On a Discussion of Mr. Eaton's Table of the Barometric Height at London with regard to Periodicity," by G. M. Whipple, B.Sc., F.R.A.S.

THE SNOW STORM OF MARCH 4TH & 5TH.

To the Editor of the Meteorological Magazine.

SIR,—There are still extensive snow-drifts on the N.W. slope of Pensher Hill, five miles off the sea, and 360 ft. in altitude, in hollows of what seems to be an old quarry, now a wood. One drift is over 100 feet long, and one is 7 feet deep, where deepest! They are chiefly the result of the unprecedented snow-storm of March 4th and 5th —unprecedented, at least, in the memory of any one I have come across; but beneath this there remain the drifts either of January 18th and 19th, or of February 7th, or of both.—Yours truly,

T. W. BACKHOUSE.

Sunderland, 26th April, 1881.

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

IV.—RUSSIA.*

THE following article, like the preceding ones, has been prepared from Dr. Gustav Hellmann's very able reports to the Prussian Minister of Public Instruction, this being the first of a *second* series, published in the *Zeitschrift* of the Prussian Statistical Office for the year 1880.

1. *The Central Physical Observatory of St. Petersburg.* In tracing the history of the development of systematic observations in Russia, it is easily perceived that the Observatory and the extensive meteorological system of that country owe their origin to the great impulse given to researches in Terrestrial Magnetism by Baron A. von Humboldt and Prof. K. F. Gauss in Germany some 50 years since. The simultaneous magnetic observations agreed upon by Arago, of Paris, and by Kupffer, of Kasan, in the years 1825-6, were followed at the instigation of von Humboldt by the establishment of several small observatories in Russia and Siberia in 1830. These observations were continued for three years, and were published in detail by Kupffer in one volume (St. Petersburg, 1837).

The reforms introduced by Gauss in the methods of magnetic observations and the reorganization of the Magnetic Union gave Kupffer the desired opportunity of advocating and effecting the firmer establishment of a system of magnetic and meteorological observations; a normal observatory was established at St. Petersburg in 1840, and was charged, in addition to the superintendence of the regular magnetic and meteorological observations at the various stations, with the undertaking of physical observations and researches in the strict sense of the word. The meteorological and magnetic observations collected at the observatory were published *in extenso* in the *Annales de l'observatoire physique central*, 1847–64, and mean values and other meteorological communications were published in the *Correspondance Météorologique*, 1850-64. In addition, the *Comptes-rendus annuels*, 1850-64, contain evidence of the activity of the observatory by various communications, both meteorological and magnetical. In 1849, according to a report presented by Kupffer to the Academy of Sciences, the Russian system consisted of 8 stations of the First Order and 48 stations of the Second Order, and the cost of publication of the observations was borne by the Administration of Mines.

On the death of Kupffer, in the beginning of 1865, Prof. Kämtz, an eminent meteorologist of Dorpat, was appointed director of the service, and on his decease, in December, 1867, the present able director, Dr. H. Wild, of Berne, was selected by the Academy of Sciences to fill this important position. Under his energetic superintendence the quality of the observations has greatly improved. He

* Continued from *Meteorological Magazine* for April.

found that for 20 years the stations had not been inspected; the observations had simply been printed without checking, and contained numerous press errors. As far as relates to the barometer, the errors for the years 1842-55 have been corrected in Rykatchew's *Marche diurne du Baromètre en Russie* (St. Petersburg, 1879), and they occupy 36 4to pages with double columns! Scarcely anything was known as to the quality, exposure, and the errors of the instruments, and the number of stations had decreased more than 50 per cent.

The observatory, as at present constituted, is not merely a central station, but, as before stated, a Physical Observatory. Our article deals specially with the *meteorological* branch, and the system of observing stations as they existed in the year 1879. The Central Physical Observatory lies on the southern edge of the large island Wassili-Ostrow, and is nearly a mile from the sea, in a south-westerly direction.

Since the year 1878 the observing department of the Observatory has been principally transferred to the Meteorological and Magnetical Observatory at Pawlowsk (referred to subsequently), so that the observations at the St. Petersburg Observatory are now only those of a very complete station of the Second Order, with the addition of such special observations as may be from time to time required. Self-recording and other instruments for all elements are, however, in use; but the observations, except for the anemograph, are not regularly discussed, as the Pawlowsk Observatory is only about four miles distant. We quote a few particulars respecting the various instruments:—

(1) *Barometers.*—In addition to self-registering barometers, Turettini's cistern-syphon barometers and Naudet's aneroid are read at 7h. a.m., 1h. and 9h p.m. (2) *Thermometers.*—These are exposed in a cylindrical zinc screen. Full details respecting the results obtained by this method of exposure are given by Prof. Wild in *Repertorium f. Met.* Bd. vi. No. 9 (St. Petersburg, 1879). Earth thermometers are read at various depths; much attention is paid to this subject, and full particulars respecting the observations, of which there are several series, are given by Prof. Wild in his *Repert. f. Met.* Bd. vi. No. 4. (3) *Raingauges* are erected at heights of 1, 2, 3, 4, and 5 metres, (3 to 16 ft.), they all have a receiving area of 1-20th sq. metre = ·54 sq. ft., and are painted white. There is also a self-registering gauge by Salleron, which is, however, generally out of action during the severe winter weather. (4) *Evaporation.*—Wild's balance-atmometer is observed daily at 1h. p.m., and gives a direct measurement of the evaporation. (5) *Anemometers* of various kinds are in use, viz., Beckley's, Wild-Haslar's, Breguet's, and Casella's small instrument. The anemometrical observations are discussed in the appendix to the Annals of the Observatory and, since 1878, are published in a separate part of the same. Hourly observations of clouds between 6h. a.m. and 10h. p.m. were made during the years 1876-7, and pub-

lished in the Annals for those years; various experimental researches also have been made and published in the *Repert. f. Meteorologie.*

Meteorological Stations.—The Russian system of observing stations is the most extensive on the globe; its area embraces 170° of longitude, and 30° of latitude, and is situated entirely within the north temperature and frigid zones. The Annals for the year 1877 contain the observations of 104 stations; for 73 stations they are given *in extenso*, and for 31 stations monthly *résumés* are given. Observations were also taken at other stations, but not published owing to imperfections. In 1878 the observatory received observations from 133 places. All the stations receive instructions and verified instruments from the Central Observatory, and all the observers are volunteers, excepting at the coast stations, where the observers, if they are not attached to the Navy, receive a remuneration of £28 a year. Copies of the printed observations and the annual reports are presented to all observers. Observers of long standing receive the honorary title of "Correspondent of the Central Physical Observatory," and occasionally receive presents, such as brilliant rings, orders, &c. Some copies of Capt. Hoffmeyer's synoptic charts have also been presented to observers interested in the subject.

Most of the stations have a syphon or cistern barometer, and the new stations have also a Naudet or a Goldschmid Aneroid, to be used as a check instrument. The very remote stations have only an Aneroid. Particulars of these instruments are given in Wild's *Repert. f. Met.* Bd. iv., in a paper entitled *Uber die Bestimmung des Luftdruckes.* The thermometers are in zinc screens erected outside a window with a north aspect, or in an open space, sheltered by large louvred screens. For further particulars see *Repert. f. Met.*, Bd. vi., No 9. Two rain-gauges are supplied to each station, and the more recently-established stations are provided with Wild's simple pendulum or swinging-plate wind-gauge (see *Bulln. Acad. Sc. de St. Petersb.* T. xxi). Observations are made at 7h. a.m., 1h. and 9h. p.m., local time, and are sent to the Observatory monthly, where they are subjected to regular supervision, and a proof of each printed sheet is submitted to the observers for any remarks or further corrections which may be necessary. We must express our approval of this method of distribution of responsibility as tending to secure perfect accuracy, and increasing the interest of the observers in their own work. Since 1871 about 70 stations in European and Asiatic Russia have been *once or twice* inspected, but many remote stations still remain uninspected. The reports of the Inspectors are printed *in extenso* in the annual reports.

Publications.—The *Annales de l' observatoire physique central de Russie*, 1865–9, are similar in form and contents to those previously published by Kupffer; from the year 1870 they take a different form with the German title, *Annalen des physikalischen Centralobservatoriums*, 1870–8. With the year 1878 the Annals begin to appear in two parts; the first part contains the hourly observations of Pawlowsk Observatory, and other supplementary observations; the second con-

tains the observations of the stations of the second order, according to the international form of publications. The central observatory has undertaken the discussion of the older (as well as the recent) materials. Thus M. Wesselowsky was entrusted with a comprehensive work, entitled, *Ueber das Klima von Russland* which was published in Russian in the year 1857. Several articles of this valuable work were reprinted by Kupffer in his *Correspondance Météorologique*, and a tolerably detailed analysis of the work was given by Wojeikoff in the Report of the Smithsonian Institution, 1872, entitled *Meteorology in Russia*. Kämtz commenced a *Repertorium für Meteorologie* which has been continued by Professor Wild. This work, which has been frequently referred to above, is in French or German (chiefly the latter), and contains a wealth of information, which, as far as our country is concerned, is buried, for the work is very scarce, and the general title gives no clue to the contents. We have, therefore, thought it expedient to give a list of the *principal meteorological* articles, which will be useful for reference. It may be well to mention that the Repertorium and many other important works are printed by the Imperial Academy of Sciences.

KÄMTZ: REPERTORIUM, DORPAT, large 4to.

Vol. I., 1862, 424 *pp.*

L. F. Kämtz.—Meteorological Instructions and Tables. 58 pp.
,, Temperature of Arkangel. 26 pp.
,, Deduction of mean results from Meteorological Observations, 28 pp. and Tables. (Translated in Quarterly Journal of the Meteorological Society for July, 1876,)
,, Climate of the S. Russian Steppes (2 papers). 56 pp. and 53 pp.

Vol. II., 1862, 424 pp.

L. F. Kämtz.—Barometric Windrose at Dorpat. 31 pp.
C. Kreil.—Contribution to the Climatology of Central Africa. 24 pp.
L. F. Kämtz.—Climate of the S. Russian Steppes (2 papers). 69 pp. and 24 pp.
,, Remarks on Hygrometry. 20 pp.
,, Temperature and Winds of Mitau. 32 pp.

Vol. III. (*no date*), 286 pp.

L. F. Kämtz.—On the "*Buran*," or Hot Wind of the Russian Steppes. 18 pp.
,, Psychrometer Tables (2 papers). 51 pp. and 65 pp.
,, Climate of the S. Russian Steppes. 46 pp.
,, Climate of Astrabad. 20 pp.

WILD'S REPERTORIUM. ST. PETERSBURG, large 4to.

Vol. I., 1870. 417 pp.

H. Wild.—Meteorological Instructions and Tables (2 papers). 93 pp.
W. Köppen.—Wind and Rainfall of Taurida (S.W. Russia). 72 pp.
M. Rykatchew.—Daily Range of Temperature at Barnaoul and Nertchinsk. 24 pp.
J. Pernet.—Yearly Range of Temperature at St. Petersburg. 52 pp.
A. Wojeikoff.—Distribution of Rain in Russia. 26 pp.

Vol. II., 1872. 364 *pp.*

H. Wild.—Meteorological Instructions and Tables (2 papers). 44 pp.
H. Fritsche.—Earth Temperature at Peking. 20 pp.
J. Pernet.—Determination of Earth temperatures with Thermopiles. 24 pp.
W. Köppen.—On succession of non-periodic changes of Weather. 52 pp.

H. Wild.—On the amount of Cloud in Russia. 28 pp.
F. Clawer.—Catalogue of published meteorological observations in the Russian Empire. 36 pp.

Vol. III., 1874. 427 *pp.*
H. Wild.—On Meteorological Instruments and methods of observation (3 plates), 145pp.
F. Dohrandt.—Ditto ditto. 16 pp.
M. Rykatchew.—Range of Temperature at St. Petersburg on clear and on cloudy days. 16 pp.
W. Köppen.—Tables for the deduction of mean temperature from 2 or 3 observations daily. 40 pp.

Vol. IV., 1875. 511 *pp.*
F. Dohrandt.—Determination of Anemometer Constants. 60 pp.
M. Rykatchew.—Distribution of pressure in European Russia. 60 pp.
H. Wild.—Daily and yearly range of Humidity in Russia. 90 pp.
M. Thiesen.—Theory of the wind force plate (1 plate). 73 pp.

Vol. V., 1877. 538 *pp.*
H. Wild.—Meteorological Instructions (1 plate). 32 pp.
,, Influence of height upon temperature and humidity. 36 pp.
H. Fritsche.—On the Climate of Peking. 52 pp.
A. v. Oettingen.—On the Wind-component Integrator (4 plates) 51 pp.
M. Thiesen.—Theory of Robinson's Cup Anemometer. 31 pp.

Vol. VI., 1879. 618 pp.
H. Wild.—Underground Temperature at St. Petersburg and Nukuss. 96 pp.
F. Dohrandt.—Determination of Anemometer Constants (continued from Vol. IV). 28 pp.
E. Stelling.—Photo-chemical observations on the intensity of total Daylight at St. Petersburg (1 plate). 32 pp.
M. Rykatchew.—Winds in the Baltic (2 plates). 19 pp.
G. Hellmann.—Inter-comparisons of Normal Barometers. 50 pp.
H. Wild.—On the exposure of Thermometers (3 plates). 18 pp.
M. Rykatchew.—Diurnal Range of Barometer in Russia (4 plates). 194 pp.

Vol. VII. (*vol. not yet complete*).
M. Rykatchew.—Winds in the White Sea (2 plates). 26 pp.
E. Stelling.—Yearly range of Evaporation in Russia (1 plate). 75 pp.
E. Wahlen.—Yearly range of temperature at St. Petersburgh, from 118 years' daily means (1 plate). 119 pp.

J. S. HARDING.

[*To be continued.*]

REVIEW.

Traité elémentaire de Météorologie par J. C. HOUZEAU, *Directeur de l'Observatoire Royal de Bruxelles, et* A. LANCASTER, *Météorologiste-Inspecteur au même établissement.* Mons. H. Manceaux, 1880. Large 12 mo, 324 pages, 2 plates.

OUR space for reviews is so limited that we cannot notice a tithe of the works which we should do if time and space allowed. For the same reason it is not possible for us to give, as is the case in many reviews, a general summary of the contents of the works noticed. The work before us certainly presents no special difficulties in this respect, but it would be the reverse of complimentary to the authors to suggest that their 324 pages could be epitomized in one—the thing is impossible and therefore we do not attempt it.

The work is one of a series the *Bibliothèque Belge*, which will eventually consist of 50 volumes, whereof 23 are already published. Their object is the popularization of the Sciences and Arts, and if the whole series is equal to the volume before us we congratulate the editor upon his success.

We will first state that the work is divided into two portions, viz., Theoretical and Practical Meteorology. We do not greatly admire this classification, but the following list of the contents of the chapters will best explain the plan of the work :—Temperature, Atmospheric Pressure, Wind, Humidity, Atmospheric Electricity, Terrestrial Magnetism, and Optical phenomena form the first group. Weather charts, Depressions, Anticyclones, Local forecasts and Weather signs form the second.

Having already intimated our high opinion of the work as a whole, there is nothing inconsistent therewith in mentioning a few points to which we object.

On page 15, after having described Fahrenheit's and other thermometers, the authors say :—

"Lastly, the celebrated Linné, to whom we owe the centigrade scale, took for 0° the invariable temperature of melting ice, and for 100° the equally invariable temperature of boiling water."

The authors, as well as we trust all our readers, know that the temperature of boiling water, far from being invariable, is largely employed in determining altitudes, because it varies with every change of atmospheric pressure, about 2°·0 for every inch of barometric pressure. We have turned to the chapter upon the barometer, and finding no reference there to the thermometric determination of heights, or to the variable temperature at which water boils, we consider the above mis-statement seriously misleading.

They must have some very bad instrument makers in Belgium, for the authors state that the change of zero point in mercurial thermometers due to their being graduated too soon after being filled "is not rarely 2°," that is 2°·0 C. or 3°·6 F., rather an alarming change for anything professing to be worthy of looking at.

On page 23 the *only* maximum thermometer described is that of Rutherford!

On page 90 we are told that "Baudin's barometer is used at the Belgian meteorological stations," and on page 95 the statement is repeated with a description of the instrument, which seems to us either very primitive or else not fully described. It is a syphon tube, the mouth of the short leg closed with a cork through which a curved capillary tube allows the pressure to act, but very little dust to enter. The graduations are *on* the long leg and are contracted (as in the Kew pattern barometers) to correct for the change of level in the short leg. So far well, but then we are told that the readings are made by simple inspection without the use of slide or vernier. As the divisions are very close (about thirty to an inch) the vernier

may perhaps be dispensed with, but a slide to avoid parallactic errors would certainly be an improvement.

We find an absolute novelty on page 110, a novelty to us, but evidently not to the authors and possibly not to some others. They are describing Lind's anemometer and say in the quietest way possible—"This tube is filled with water or preferably with mercury, in order to avoid freezing in the winter." The specific gravity of mercury being 13½ times that of water, the variation of level will obviously be only 1-13th that which is usual, and we should have thought that the instrument would thus become deficient in sensitiveness. Possibly a contracted tube is employed, but the engraving represents one of equal bore.

On page 139 there is a statement, which we by no means impugn, but which it is of general interest to reproduce—"During a violent storm which raged upon the 11th of January, 1878, at Mount Washington, U.S.A., the anemometer indicated 83 mètres per second." That is equal to about 186 miles an hour. No wonder that aeronauts travel 60 or more miles an hour if winds of nearly 200 miles an hour prevail at high altitudes.

It is a pity that the old generalization that the rainfall increases from the poles to the equator is repeated on 171; but curiously enough a good illustration of its want of precision is given accidentally on the very next page. On page 171 we have a table which shows that while the mean fall at Calmar, in Sweden, is 325 mm. (12·8 in.) it increases with decreasing latitude until at Gibraltar it is 1201 mm. (47·2 in.) But on page 172 we have the mean fall at Bergen, in Norway, lat. 60° N. given as 2250 mm. (88·6 in.) or more than double that in lat. 36° N. As a broad generalization, the rule may not be inaccurate, but it is equally easy to bring a hundred records to prove an increase in either direction.

In conclusion, we give as a specimen of the easy style of the book a translation of the first part of the chapter on Humidity.

Humidity of Air.—*General Remarks.*

The air is never perfectly dry. It is always charged with a certain quantity of the vapour of water; the more it contains the damper it is; the less it contains the drier it is.

This charge of watery vapour has, however, a limit, and when that limit is reached we say that the air is *saturated*. Beyond that limit the vapour cannot remain in its *transparent*, or invisible state. The surplus is condensed and falls.

The saturation-charge depends upon the temperature. The hotter the air the more vapour can it hold in the transparent state; the colder it is the less can it contain.

It must not be inferred from the use of the words *transparent vapour* that its presence is therefore insensible. It is this vapour which lessens the intense blueness of the sky. The more it is present in the air, the paler is the sky and the more grey the horizon—as in

the mornings of spring. The surrounding objects seem at a great distance; the humidity of the air is considerable.

But later on in the day, the sky becomes of a deeper blue, objects seem to come nearer, one would think it easy to converse with persons far away in the fields. The air has resumed its purity; the humidity is much less.

Thus the vapour, notwithstanding its transparency, whitens the mass of air, and throws a greyish veil over the landscape. It is, however, necessary not to confound this vapour with fog or cloud. It is dissolved in the air, while fog and clouds are separate from it.

* * * * * * * * * *

Evaporation.

Water is constantly evaporating,* and it is this evaporation which supplies the air with moisture. At the surface of the sea the air contains all the humidity which is possible; it is saturated. But in the interior of the Continents its humidity is but partial.

When air is saturated it cannot gain more humidity, and it cannot cause evaporation from the surface of the earth. But when it is not, everything which is wet furnishes it with vapour and becomes dry. The rate of drying depends, therefore, on the dryness of the air.

Moreover, when the air is at rest, evaporation soon ceases, because the air is soon saturated. But when the air is in motion, if fresh dry air continues to arrive, evaporation goes on and the drying continues.

These considerations show us why East winds are so desirable for hay, for corn, and for some dyeing operations. They are dry winds, and consequently produce rapid evaporation.

Thus *evaporation increases in proportion to the dryness and strength* of the wind.

But evaporation produces another physical effect—cooling. Everybody knows that wet linen hung out to dry is much colder than dry objects. Cooling then accompanies evaporation.

And this explains why our sensations often disagree with the indications of the thermometer. We are chilled by the cold, while the thermometer is at 39° or 40°. We feel overpowered by a temperature of 67°, while at other times 75° is quite agreeable.

Our bodies, in fact, are moderately sensible to heat and cold, but very sensible to evaporation; more or less perspiration is constantly passing through the skin. The evaporation of this moisture constantly cools the surface of the body. When this evaporation is active, we do not really feel all the heat which prevails; thus our skin is always colder than it would be without this evaporation.

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* This, though true in a general sense, is not *absolutely* so. Recent experiments by Dines and Griffith, in England, and by Masure, in France, have proved (what theory would have indicated) that if water is below the dew-point temperature, it becomes a condenser, and, far from evaporating, it increases in volume.—Ed.

SUPPLEMENTARY TABLE OF RAINFALL IN APRIL, 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	·37	XI.	Carno, Tybritle	1·28
,,	Margate, Acol	·64	,,	Corwen, Rhug	·49
,,	Littlehampton	·65	,,	Port Madoc	2·47
,,	St. Leonards	·65	,,	Douglas.....	1·77
,,	Hailsham	·78	XII.	Carsphairn	1·57
,,	I. of W., St. Lawrence.	1·23	,,	Melrose, Abbey Gate...	1·12
,,	Alton, Ashdell.....	·45	XIV.	Glasgow, Queen's Park.	1·33
III.	Great Missenden	1·09	XV.	Islay, Gruinart School..	1·30
,,	Winslow, Addington ...	·59	XVI.	Cupar, Kembach.....	1·24
,,	Oxford, Magdalen Col...	·80	,,	Aberfeldy H.R.S.	·17
,,	Northampton	·70	,,	Dalnaspidal	1·73
,,	Cambridge, Merton Vil.	...	XVII.	Tomintoul.....	1·64
IV.	Harlow, Sheering	·86	,,	Keith H.R.S.	·94
,,	Diss	1·19	XVIII.	Forres H.R.S.	·67
,,	Swaffham	1·12	,,	Strome Ferry H.R.S....	1·04
,,	Hindringham	·85	,,	Lochbroom	1·24
V.	Salisbury, Alderbury...	·56	,,	Tain, Springfield.....	1·14
,,	Calne, Compton Bassett	·70	,,	Loch Shiel, Glenfinnan.	3·25
,,	Beaminster Vicarage ...	1·44	XIX.	Lairg H.R.S.	1·53
,,	Ashburton, Holne Vic..	1·47	,,	Altnabreac H.R.S.	2·91
,,	Langtree Wick	·88	,,	Watten H.R.S.	1·30
,,	Lynmouth, Glenthorne.	1·69	XX.	Fermoy, Glenville	2·31
,,	St. Austell, Cosgarne...	1·74	,,	Tralee, Castlemorris ...	·94
,,	Ilebrewers, Walrond Pk.	...	,,	Cahir, Tubrid	1·51
VI.	Bristol, Ashleydown ...	...	,,	Tipperary, Henry St....	1·92
,,	Ross	·57	,,	Newcastle West	2·66
,,	Wem, Sansaw Hall.....	·91	,,	Kilrush	1·49
,,	Cheadle, The Heath Ho.	1·12	,,	Corofin	1·53
,,	Bickenhill Vicarage ..	...	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	1·29	,,	Carlow, Browne's Hill..	1·33
,,	Horncastle, Bucknall ...	1·28	,,	Kilsallaghan.....	...
VIII.	Macclesfield Park	1·44	,,	Navan, Balrath	1·58
,,	Walton-on-the-Hill.....	1·86	,,	Athlone, Twyford	1·56
,,	Broughton-in-Furness ..	2·18	,,	Mullingar, Belvedere ...	1·47
IX.	Wakefield, Stanley Vic.	1·40	XXII.	Ballinasloe	1·09
,,	Ripon, Mickley	1·03	,,	Clifden, Kylemore	2·85
,,	Scarborough.....	·76	,,	Crossmolina, Enniscoe..	1·31
,,	Mickleton	1·69	,,	Carrick-on-Shannon ...	1·06
X.	Haltwhistle, Unthank..	1·65	XXIII.	Dowra	1·90
,,	Shap, Copy Hill	1·11	,,	Rockcorry.....	2·27
XI.	Llanfrechfa Grange	1·05	,,	Warrenpoint	2·34
,,	Llandovery	1·70	,,	Newtownards	1·59
,,	Solva	1·39	,,	Carnlough.....	1·81
,,	Castle Malgwyn	2·67	,,	Bushmills	1·12
,,	Rhayader, Nantgwillt..	2·46	,,	Buncrana	2·07

APRIL, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	.46	— 1·56	·21	11	9	67·8	17	27·8	21	6	14
II.		Maidstone (Hunton Court)	·42	— 1·43	·13	26	8	...	...	...	...	...	...
,,		Strathfield Turgiss	·44	— 1·47	·29	11	7	66·4	17	26·2	21	8	18
III.		Hitchin	·73	— 1·22	·12	11	12	62·0	13	25·0	3, 6	12	...
,,		Banbury	·65	— 1·36	·28	11	10	61·5	13	27·5	4	11	...
IV.		Bury St. Edmunds (Culford)	1·61	— ·18	·40	14	15	65·0	11*	25·0	9	13	...
,,		Norwich (Cossey)	1·02	— ·84	·24	12	15	64·0	11	29·0	4	11	15
V.		Bridport	1·74	...	1·08	13	9	64·0	17	26·0	1, 21	8	...
,,		Barnstaple	1·50	— ·88	·46	13	9	69·0	17	31·5	21	...	...
,,		Bodmin	1·91	— 1·42	·70	10	13	65·0	17	29·0	4	5	9
VI.		Cirencester	·87	— 1·53	·42	11	6	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	1·12	— 1·20	·42	11	9	65·0	13	23·0	4	11	...
,,		Tenbury (Orleton)	·91	— 1·26	·59	11	8	66·2	28	24·2	21	12	14
VII.		Leicester (Town Museum)	1·50	...	·85	14	11	69·3	17	24·0	4	10	21
,,		Boston	1·16	— ·73	·27	15	10	65·0	13	27·0	4	6	...
,,		Grimsby (Killingholme)	1·25	— ·51	·35	11	13	60·0	29	30·0	4	2	...
,,		Mansfield	1·12	— ·70	·61	14	12	62·5	13	24·0	4	11	16
VIII.		Manchester (Ardwick)	1·45	— ·58	·67	15	11	67·0	13	27·0	4	9	...
IX.		Wetherby (Ribstone)	1·08	— 1·43	·48	12	8	...	...	...	..	...	...
,,		Skipton (Arncliffe)	2·17	— ·89	·52	30	13	61·0	13	27·0	3	12	...
X.		North Shields	1·05	— ·95	·26	26	11	...	...	...	...	...	...
,,		Borrowdale (Seathwaite)	3·75	— 1·19	·73	30	13	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	..	...
,,		Haverfordwest	2·09	— ·73	·63	13	8	63·5	18	27·0	3	9	11
,,		Aberystwith Goginan	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	·94	— ·94	·43	11	8	66·0	13	27·8	4	7	...
XII.	SCOTLAND.	Cargen	1·41	— ·87	·26	30	13	61·8	13	24·0	4	10	...
,,		Hawick (Silverbut Hall)	1·60	— ·61	·42	26	8	...	...	...	...	...	...
XIV.		Douglas Castle (Newmains)	1·04	— ·84	·55	30	7	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	...	...	...	...	...	...	...	...	...
,,		Kilmory	2·05	— ·58	·68	25	9	...	...	23·0	4	13	...
,,		Mull (Quinish)	·97	...	·30	24	8	...	...	...	...	...	...
XVI.		Loch Leven	·70	— 1·51	·20	30	6	...	...	...	...	...	...
,,		Arbroath	·78	— 1·13	·32	30	8	59·0	24	28·0	6	5	...
XVII.		Braemar	1·09	— ·99	·36	26	11	57·0	29	16·0	3	18	25
,,		Aberdeen	·92	...	·31	29	19	60·0	29	23·0	2	9	...
XVIII		Portree	1·80	— 1·75	1·07	24	9	...	...	...	...	...	...
,,		Inverness (Culloden)	·20	— 1·15	...	...	..	61·2	13	24·0	3	10	17
XIX.		Dunrobin	1·47	...	·44	25	11	56·5	28	24·0	3	7	...
,,		Sandwick	1·53	— ·34	·37	24	15	53·2	17	29·6	2	3	9
XX.	IRELAND.	Cork (Blackrock)	1·79	— 1·31	·66	10	10	70·0	28	29·0	2	8	...
,,		Darrynane Abbey	...	...	...	...	...	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	1·66	...	·36	29	11	60·0	16	31·0	1, 2†	5	...
,,		Killaloe	2·10	...	·97	30	10	68·0	15	28·0	9	9	...
XXI.		Portarlington	1·44	— ·59	·30	25	13	61·0	15	26·0	8	9	...
,,		Monkstown	1·22	...	·54	13	9	63·0	26	27·5	1	..	...
XXII.		Galway	1·21	— 1·62	·43	29	14	62·0	16	26·0	2	8	...
XXIII		Waringstown	1·69	— ·20	·34	13	15	63·0	15	23·0	3, 5	12	13
,,		Londonderry	1·45	...	·50	13	12	60·0	12	30·0	3	4	11
,,		Edenfel (Omagh)	2·16	— ·16	·56	12	14	60·0	18	25·0	2, 5	10	..

* And 29. † And 3, 5, 20.

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

METEOROLOGICAL NOTES ON APRIL.

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

ENGLAND.

STRATHFIELD TURGISS.—Nightingale first heard on 14th, first swallow seen on 16th, cuckoo first heard on 16th; mountain ash in leaf on 11th, larch on 12th.

HITCHEN.—One of the driest and coldest Aprils on record; S on the 20th.

CULFORD.—The first part of the month was very dry, with cold E. winds and frost at night, but it ended with beautiful growing weather and fine showers.

COSSEY.—Very bright but cold weather for the first ten days, with frosty nights; swallows seen on 12th, nightingale heard on 17th.

BODMIN.—Mean temp. 49°·1.

CIRENCESTER.—A very dry month, with a long continuance of N.E. winds; a good time for farmers to clear the land, which very much needed the dry weather. Vegetation backward.

WOOLSTASTON.—Mean temp. of the month 44°·4; cuckoo first heard on 17th, sand martins seen on the same day, swallows not seen till the 30th; T and H on 25th and 26th.

ORLETON.—The strong drying N.E. winds which set in during March continued till the 11th of this month, with a sky generally clear, and severe frosts almost every morning; a change of wind then took place, and the weather was warm and pleasant till the 18th, when it became cold again, with frequent severe frosts till the 24th; the remainder of the month was again warm and pleasant. The mean temp. was more than 3° below the average of 20 years, and the prevalence of severe frosts at night was very unusual; the bar. was high and steady, and the rainfall very small, which greatly favoured all farming operations. Very distant T was heard on the 26th; the chiffchaff was seen on the 12th, swallows on the 16th, and the cuckoo heard on the 21st, no thrush has been seen for five months, and blackbirds have become very scarce. Cherry and damson trees came into full blossom about the 30th.

LEICESTER.—TSS at 2 p.m. and 3.30 p.m. on 14th, and T on 23rd; lunar halo on 12th, dense fog on night of 16th.

KILLINGHOLME.—With the exception of two or three days, the weather was very cold until the last week, when there was a great improvement. All forms of vegetation unusually backward, but altogether the prospect is hopeful. First swallow seen on 15th, first willow wren on 17th, and cuckoo heard on 24th. T and L on 26th.

MANSFIELD.—Generally bright and sunny, with cold dry easterly winds till the 10th, and variable during the remainder of the month, with occasional showers, but warmer. A little S on the 19th and 20th.

ARNCLIFFE.—A dry cold month, with much E. and N.E. wind.

N. SHIELDS.—Fine till the 10th, then variable; S on the 19th, 20th and 21st; TS on the 25th.

SEATHWAITE.—TS with H on 26th.

WALES.

HAVERFORDWEST.—From March 25th to April 7th the shade temp. was several degrees below the freezing point every night, with a bitter icy blast from the E., which ceased not day or night; fine R occurred about the 10th, with a more genial atmosphere, but the weather again became cold with sharp night frosts on the 18th; the end of the month was, however, fine and spring like. Mean temp. 46°6.

LLANDUDNO.—The month was, on the whole, cold and very dry, the mean temp. being 3°·5 below, and the rainfall little more than half, the average. The low temperatures were confined chiefly to the first eight days of the month, during which time frost occurred each night but one, a very unusual occurrence, but fortunately vegetation was not sufficiently forward to sustain any

damage. The weather altogether was most favourable for cleaning the land and seed sowing. Fruit blossom abundant and promising; 116 hours of bright sunshine.

SCOTLAND.

CARGEN.—The temp. was low during the month, and easterly winds prevailed to an unusual extent. L on 16th. Mean temp., 44°·3; 2°·5 below the average. 172 hours of sunshine.

HAWICK.—A cold, frosty month; patches of S on the hills from beginning to end. Pastures very backward. T on 26th.

BRAEMAR.—A very cold, but dry month, favourable for sowing. Vegetation making very slow progress. Hills covered with fresh S.

ABERDEEN.—Dry and cold, with variable winds. Rainfall very much below the average; vegetation backward, but the weather was favourable for sowing and planting. S and H on 1st and 20th.

PORTREE.—A very cold, frosty month, and pastures in extremely bad condition. S from 20th to 25th.

CULLODEN.—Weather generally cold and ungenial; vegetation very late, but a great quantity of fruit blossom. Rainfall small.

SANDWICK.—Cold, with N. and E. winds; mean temp. nearly 3° below the average of 54 years, and rainfall small; vegetation, in consequence, exceedingly backward. Gales of 45 miles an hour on 11th and 12th, and one of 40 miles an hour on 25th. Aurora on 2nd and 27th. S on the 1st.

IRELAND.

WATERFORD.—The driest April since 1875, and the hedges were only getting green at the end of the month. Swallows arrived on the 17th.

KILLALOE.—Rather a dry month; mean temp. above the average. Copious R at the close of the month, with a rise of temp. encouraged vegetation, which had been very backward.

MONKSTOWN.—The early part of the month was very dry and cold, with N.E. wind and bright sunshine; and this weather again prevailed for a few days after Easter. The month closed mild and rainy.

WARINGSTOWN.—Beautiful spring weather at the close of the month, but everything three weeks late.

LONDONDERRY.—On the whole a very favourable month for farming operations. Wind principally E. and N.E.

THE COMING SUMMER.

SIR,—When January or February has been very severe, and the following April colder than the average at Greenwich, we have almost always had an unsettled and somewhat cool summer in the same year. When, however, January and April have been dry, as in 1861 and 1855, we have usually had rather frequent periods of dry weather in the following four or five months, and the summer has been better than when the previous January and April have been wet. In the present year, January was exceedingly severe, and the mean temperature of April considerably below the mean temperature at Greenwich; but, as those months were dry, the coming summer should be not unfrequently rather dry in character, though changeable, and often cool. I may add, that the mean temperature of the period from the second week of July to the second week of August, will probably be warmer than the average at Greenwich.—Yours truly,

GEORGE D. BRUMHAM.

Barnsbury, May 2nd, 1881.

SYMONS'S
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CLXXXV.] JUNE, 1881. [PRICE FOURPENCE, or 5s. per ann. post free.

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.

Brounow, 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	£5,438

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 anywhere. 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 mechanician. 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. Borenius 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. Nordenskjold. 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° 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. Nordenskjold 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° 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 Jaktagelser 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

$$y = \cdot0001545\ (T - t)\ N,\ \text{centigrade},$$

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°·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°·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	,,

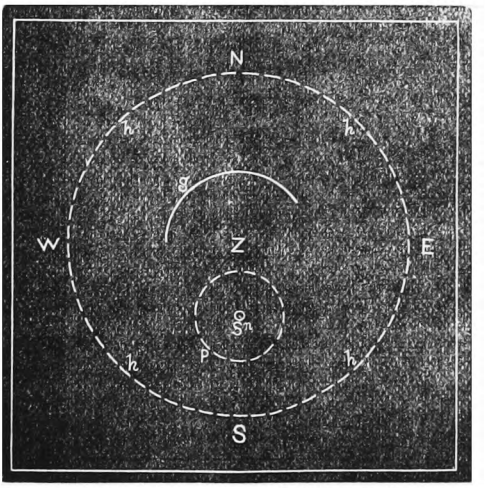
ZENITHAL HALO.

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 $22\frac{1}{2}°$ 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.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	1·49	XI.	Carno, Tybritle	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	,,	Carlow, Browne's Hill..	2·19
,,	Horncastle, Bucknall ...	1·14	,,	Kilsallaghan.....	...
VIII.	Macclesfield Park	3·47	,,	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, Enniscoe..	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. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	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	...	...	...	...	...	...
,,		Strathfield Turgiss	·97	— ·71	·32	17	12	80·9	31	27·9	11	2	12
III.		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	...
IV.		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 (Wcolstaston	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 (Arncliffe)	5·89	+ 2·77	1·56	17	13	79·0	29	31·0	10	1	...
X.		North Shields	1·65	— ·20	·89	24	11	...	...	...	...	...	...
,,		Borrowdale (Seathwaite)	13·31	+ 6·33	4·00	5	16	...	...	...	...	...	...
XI.	WALES.	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.	SCOTLAND.	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.	IRELAND.	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; T S 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°·2.

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

WOOLSTASTON.—Mean temp. of month 52°·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°·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°·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.

BRAEMAR.—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.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CLXXXVI.] JULY, 1881. [PRICE FOURPENCE, *or 5s. per ann. post free.*

BIBLIOGRAPHY.*

DR. HELLMANN estimates that he could compile and publish a thousand copies of a meteorological bibliography, with upwards of 30,000 titles, in a bound octavo volume of about 1,300 pages, for about £1,200. This is a work which once well done, would, as far as the past is concerned, be done for all time, and an annual supplement would be a simple matter.

We should be delighted to acknowledge that we have been misinformed, but at present we believe that we are correct in stating, that Dr. Hellmann's proposal has been shelved on account of the expense.

We have been so astounded at the trumperiness of this objection, that we have tried to ascertain how much the various meteorological establishments are costing per annum at present. It is not possible to find out; no one knows what the English office costs, and *à fortiori*, one cannot find out the total cost all over the world; but the figures given in the report of the Congress at Rome, give a total of £144,000 per annum, with England and France left blank. And besides these, there is the elaborate Indian system; there are Australia, New Zealand, South Africa, Mauritius, &c., so that we are certainly far within the mark when we say that Governmental meteorology is costing the various nations £200,000 per annum.

Whence it results that the representatives of official meteorology cannot see their way to spending 1-167th part of one year's income in learning what their predecessors have done; or, to get rid of the fraction, it comes to this, that a man with a hundred pounds a-year to spend upon meteorology, will not give twelve shillings to know where to look for the recorded experience of his predecessors!

That we are not solitary in setting a high value on bibliographical information, is proved by the courageous way in which the subject is being attacked by Mr. Ramsay, in the work to which he has given

* "The Scientific Roll and Magazine of Systematized Notes," by Alexander Ramsay, F.G.S. Vol. I., Part I., Nos. I.-III. Bradbury & Co., London. 8vo.
"Report of the International Meteorological Committee, meeting at Berne, 1880." Stanford, London. 8vo.

the somewhat vague title of "The Scientific Roll." Although there are many points in it of which we do not approve, we would not be without our copies for five times their cost; and we advise all who are interested in meteorological bibliography to procure copies, either for their own use, or to encourage a useful work.

But we want something far and away beyond what Mr. Ramsay is giving us. We want Dr. Hellmann's scheme carried out in its entirety, and carried out at once. We believe that he has under-estimated the cost; he puts it at £1,200; we prefer facing the worst state of affairs, and admit that it *may* cost £2,000.

Now; how is this to be raised? We think that it might be easily and promptly effected with very little trouble. The leading directors have already (Berne meeting, page 8) promised their aid. We would, in consideration thereof, allow those of them who desired, to buy one copy of the "Bibliography," at half the published price. We would not allow a single copy of the "Bibliography" to be given away. The whole thousand copies should be stamped with a rotation number, and a numbered list of all those ordered before publication should be given in the volume. This list would of itself be very instructive.

We should put the price *very high*, certainly not less than £5 per copy, and we should prefer £10, or even £20, and we are quite ready to put our name down for that sum if it will at all help to bring matters to a crisis. If the book is not worth as much as one barometer it would be a wretched catalogue, quite unworthy of printing.

Then, quoting again from the Berne Report, page 44, and assuming the very limited sale of 150 copies, we should have—

At £5 per copy, and printing 1,000.	£	At £10 per copy, and printing only 500.	£
Say 12 copies at half-price ...	30	Say 12 copies at half-price.....	60
,, 138 ,, full-price ...	690	,, 138 ,, full price	1380
Cost of remaining 850 copies	1280	Cost of remaining 350 copies...	460
	£2000		£1900
Cost covered when 406 are sold.		Cost covered when 196 are sold.	
Profit when 500 sold	£470	Profit when 250 sold	£540
Eventual profit if all sold..	£2970	Eventual profit if 500 sold.....	£3040

We are not drawing up the prospectus of a Limited Liability Company, but we firmly believe that if Dr. Hellmann personally, or in conjunction with some large printing firm, undertakes the task, he will eventually make a handsome profit.

It might be well to consider the expediency of doubling the price after a certain fixed date, say, three months from issue of circular. But the main essentials to financial success are the absolute prohibition of free copies, and the fixing of a very high price.

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

VII.—SWEDEN.

1. *The Central Meteorological Office.*—The Royal Academy of Sciences at Stockholm established a meteorological network of stations, in the years 1856-8, at the instigation of Professor Edlund, who undertook the management of the stations, and provided them with verified instruments. He wrote a set of instructions for the observers (Stockholm, 1858), and in 1859 he began the publication of the observations in *Meteorologiska Jaktagelser i Sverige*, which were continued until 1872, and appeared in 14 vols. In these year-books the observations of 12 stations are printed *in extenso*, together with the five-day means of the same for all elements; for the remaining stations five-day means only are given. In 1873 the service was re-organized, and a Special Central Office was established, with Dr. R. Rubenson as director. The service only includes stations of the second and third order, as the only station of the first order, viz., Upsala, is an independent institution. The stations of the second order number 32, about half of them being on the sea-coast. The observers, who are mostly telegraph clerks, receive a remuneration of about £11 10s. a-year. Observations are taken at 8 a.m., 2 and 9 p.m.; the mean temperature has been deduced by the formula :—

$$\frac{8h. + 2h. + 5 \times 9h.}{7}$$

The stations are supplied with siphon barometers. The thermometer screen is similar to Glaisher's; the rain gauges have an area of one-tenth square metre (14 in. diameter). The stations are inspected on an average every three years.

From the year 1873-77 (the last published), the year book above mentioned, contains (1) the daily observations of 18 stations, printed *in extenso;* (2) monthly and yearly *résumés* of all stations (now 34 in number), and (3) 5-day means of temperature of all stations; the text is given in Swedish and French. The materials published since 1859 have been discussed in several ways by MM. Edlund, Rubenson, and Hildebrandsson. The following publications may be specially mentioned :—

E. Edlund, Bidrag till kännedom om Sveriges klimat (K. Svenska Vet-Akad. Handl. Bd. 12).

R. Rubenson, Nederbördsmängden i Sverige.....1859-72 (Id. Bd. 13. No. 10).

R. Rubenson, Månads-och Årsmedia af temperaturen.....1860-72 (Id. Bd. 14).

R. Rubenson, Om storleken af temperaturens dagliga varation i Sverige (Id. Bd. 14. No. 10).

H. H. Hildebrandsson, Vindarnes freqvens i Sverige, under Jan. och Juli.....1852-63 (Öfversigt k. Vet. Akad. Förh. 1869. No. 5.

* Continued from *Meteorological Magazine* for June.

Recently M. Rubenson has published a *Catalogue des Aurores, boréales observées en Suede depuis le XVI me. siècle jusqu' à l'année* 1877 *y comprise.*

The rain stations first established by M. Hildebrandsson, in the year 1876, and at the present time numbering 200, are now under the superintendence of the central office.

Daily telegraphic reports are received from 27 inland and foreign stations, and bulletins are issued to the principal places. The weather chart published in the newspapers, is prepared by a special method, invented by Lieutenant Rung, which is also used in Germany. The funds at the disposal of the central office amount to a little over £1,200; but telegraphy is free, and office accommodation is given in the Academy of Sciences, which also bears the expense of the publication of the year books.

2. *The Nautical Meteorological Office.*—This office was established in 1877, with a yearly vote of about £490, and a first outlay of £385. As the ships' logs received are few, they are, after examination, forwarded to a larger foreign institute for utilization. The logs used are those of the English Meteorological Office, with the addition of the heading in Swedish. By mutual agreement, Sweden also undertakes the special discussion of the meteorology of the Baltic; Denmark takes the Cattegat, and Norway the North Sea; and the materials collected are mutually exchanged. An abridged and very convenient form of register is used for these inland seas. Observations are also taken thrice daily at the numerous lighthouses, in connection with the stations of the central office. The barometers in use are on the cistern-siphon principle. Stevenson's thermometer screens are employed, and Hagemann's anemometer is used for determining wind force. Some stations are also furnished with Negretti and Zambra's deep-sea thermometers, and with tide gauges. The director of this office is Captain Malmberg.

3. *The Meteorological Observatory of the University of Upsala.*—Meteorological observations were begun at Upsala about the middle of the last century, but have only been regularly printed *in extenso* since the year 1855, at the cost of the Royal Society of Sciences of Upsala (1855-62); the later years 1863-65 are contained in the Swedish year-books. From 30th May, 1865, to 9th August, 1868, hourly observations were made by the University students. These valuable observations with some additions have been published under the superintendence of Dr. Rubenson, and at the expense of some private gentlemen (Upsala, 1877). Latterly, eye observations have been replaced by the indications of Theorell's Meteorograph, which registers every 10 minutes. From the year 1869, the Observatory has published a monthly Meteorological Bulletin, the last being for 1880. Since 1878 the Observatory has been an independent institution under the superintendence of M. Hildebrandsson, whose valuable works are well known in this country Among the publications of the observatory may be specially mentioned :—

Hildebrandsson, Sur la classification des nuages. Upsala, 1879.*

Hamberg, La température et l'humidité de l'air à différentes hauteurs observées à Upsal pendant l'été de 1875. (Act. Soc. R. Ups. 1876).

Hjelström, Om den dagliga förändringen i vindens hastighet, Upsala, 1877.

The Observatory of Upsala is the central station for the purely climatological stations of Sweden. This system was begun in 1869, and embraced observations of thunderstorms, hail, and subsequently, observations on the freezing and thawing of the rivers, &c., nights of frost, and phenological observations. These observations have been discussed in various papers published between 1872 and 1879. The observers are volunteers, and number about 400.

Cirrus Observations.—In December, 1873, M. Hildebrandsson organised a system of cirrus observations. These were taken by observers interested in the subject at the same times as the ordinary observations, and in November of 1874 he published his *Essai sur les courants supérieurs de l'atmosphère dans leur relation aux lignes isobarométriques*, based upon the operations of 21 stations in Sweden. The utility of the observation of the motions of cirrus clouds in the dynamic problems of meteorology was fully proved, and resulted in their further extension over the whole of Europe, and a more comprehensive discussion was published by M. Hildebrandsson in his *Atlas des mouvements supérieurs de l'atmosphère, Upsal*, 1877.

The Director of the Observatory draws his salary as a Professor at the University. The funds at his disposal for assistance, &c., amount to little more than £100. A portion of the cost of printing is borne by the Royal Society of Sciences of Upsala.

Observations of earth temperature were made by Angström in the garden of Physical Institute of the University. In 1867, four thermometers were placed at depths of 1, 2, 3, and 4 metres (3, 6, 10, and 13 feet), and the observations have been regularly continued, every second day, from 1868 until the present time.

In the same garden there is a massive structure for magnetic observations; but the iron ore in the soil of Sweden interferes with magnetic observations, They, however, have been the means of discovering the subterranean beds of iron :—

R. Thalén :—Sur la recherche des mines de fer à l'aide de mesures magnétiques. Upsal, 1877.

VIII.—SPAIN.

In the year 1737, F. F. Navarette published the first "*Efemérides barometrico-medicas*, and, besides these, the only observations made during the latter part of the 18th century which are deserving of

* This work, of which only 60 copies were printed, contains some of the best photographs of clouds that had been taken. Some very successful photographs have recently been taken by Mr. G. M. Whipple, at the Kew Observatory.

mention are those of Madrid, Barcelona, and San Fernando. After many vain attempts at establishing a good system of observations, the Government seems to have lost courage, for it is not until October, 1850, that we find a Royal decree establishing 23 meteorological stations at the universities and gymnasiums. At the same time, the Madrid Astronomical Observatory was re-organised and received a special department for meteorology, which was also to serve as the central meteorological station. A number of the proposed stations were provided with English instruments, and instructions were prepared by M. Rico y Sinobas (Madrid, 1854). Many of the observers, however, who were unpaid, soon ceased observing, and the observations were not published in a regular form but in separate sheets, the best of which was in the "*Revista de la Academia de ciencias.*" Consequently, the Government placed the superintendence of meteorological observations under the newly-formed statistical commission (*Junta de Estadistica*).

At the instigation of one of the members of the commission, the present director of the Observatory, A. Aguilar y Vela, that body took up the matter warmly, and finally brought a definite organisation into the meteorological system, and the observers received remuneration and verified instruments. The observations were published, or at least the results, in the "*Anuarios estadisticos de España*" (1858-65). In July, 1865, the meteorological service was placed under the Ministry of the Interior, which, on its part, entrusted it (for the second time) to the Observatory at Madrid.

In addition to the Observatories of the first order—viz., Madrid and San Fernando, which will be referred to presently—there are at present 22 official stations of the second order, the observers at which receive remuneration varying from about £10 to £21 per annum. In addition, observations are received from 6 unofficial stations. The stations of the second order are better furnished generally than other similar stations in Europe, but observations are only taken at 9 a.m. and 3 p.m., and no regular inspection of the stations is undertaken.

Publications. The results of the observations are published in some detail in the annals, "*Resumen de las observaciones meteorologicas efectuadas en la Peninsula*" (1865-75). The stations, Murcia, Valencia and Santiago, also publish *résumés* of their observations separately. For Burgos, the wind observations for 4 hours daily, recorded by a Salleron's anemograph, have been published in detail for the year 1867 (Burgos, 1868). The "*Anuario del Observatorio,*" issued since 1860, contains a *résumé* of the meteorological observations, and vol. xvi. (1858) contains the means for 10 years (1865-1874). The "*Resumenes*" are rather late in appearing, but since September, 1879, a *résumé* of the observations, brought up to time, is published in the "*Boletin mensual*" of the "*Direccion general de Beneficencia y Sanidad,*" from which we are glad to see that several new stations of the second order have lately been established.

Weather Telegraphy. Since the year 1864, telegraphic reports have been received. The reports now number 48 besides the Canaries, and are supplemented by summaries from Portugal and France. Telegraphic *résumés* of the actual and probable weather are forwarded about 2 p.m. to the ports; the bulletin appears in the papers of the following morning, and a collective telegram containing reports from 8 stations is sent to Paris. The telegraphic reports for the years 1872-9 have been separately published.

The cost of the meteorological service amounted in 1878 to about £1,050, exclusive of the salaries at the central station and of telegraphy, which is free.

Meteorological Observations at the Madrid Observatory. Although J. Juan had proposed the establishment of the Observatory as early as 1780, it was only in 1847 that the building was finished, and no suitable staff was appointed until 1854. From the commencement of the working of the Observatory, meteorology formed an integral part of its operations. With regard to earlier series of observations at Madrid, it may be mentioned that M. Juan had commenced tolerably complete observations as early as 1747 (*Cotte: Mémoires sur la météorologie*, vol. ii.), and J. Garriga had also made observations for 25 years.

Two standard barometers are in use at the Observatory, one by Newman and one by Casella. The thermometers are exposed in a Glaisher's stand. Earth thermometers are placed at depths of 0·6, 1·2, 1·8, 3·0, 3·7 metres (2, 4, 6, 10 and 12 ft.), and are read at noon. A rain-gauge with square receiver of 11·8 ins. a side is used, and near it an atmometer of similar dimensions, which is filled daily with two litres (122 cubic inches) of water. It is observed daily by means of a tube, due allowance being made for any rainfall during the meantime. The wind is recorded by anemometers on Osler's and Robinson's principles. In 1860, the Observatory obtained one of Secchi's meteorographs, but notwithstanding every exertion it has not been possible to keep it in working order. From the year 1859, direct observations have been made every three hours from 6 a.m. till midnight.

Publications.—Up to the year 1865 more complete abstracts of the results have been published in the following works:—

"Anuarios del Real Observatorio de Madrid,"
"Revista de l'Academia de ciencias," and
"Resumen de las observaciones meteorologicas efectuadas en Madrid, 1865."

With the year 1866 the publication of the observations, *in extenso*, was begun in the work, "*Observaciones Meteorologicas . . . de Madrid.*"

The observations for the ten years, 1860—69, were subjected to a careful discussion by M. Merino. In vols. xi.-xiii. and xv.-xvii. of the "*Anuaris del R. Observatorio de Madrid*," he discusses the various elements, and their mutual dependence upon each other.

The Marine Observatory of San Fernando.—This is a station of the first order, and possesses one of the best series of observations in Spain. From 1850 the series is unbroken, and the observations are taken many times a day. From the year 1875, complete self-recording observations have been made.

Publications.—From the year 1870 the observations have been published in detail in the Annals of the Observatory for the years 1870—78. From the year 1875 hourly observations have been given, except for the rainfall.

The director of the Observatory, Captain C. Pujazon, attended the Maritime Conference in London in 1874, and has induced his government to establish a regular system of observations in the Spanish Navy. The Observatory supplies verified instruments to the ships of war, and also to such mercantile captains as are willing to take the observations.

IX.—PORTUGAL.

The organisation of the meteorological service in Portugal is highly developed—in some points it is ahead of that of other countries. It possesses two completely furnished observatories, a sufficient number of stations of the second order, a telegraphic weather service, and a system for maritime meteorology.

The Observatory of the Infante D. Luiz, at Lisbon.—The labours of Maury in the domain of ocean meteorology, and the participation of Portugal in the Brussels Conference in 1853, gave G. J. Pegado occasion to advocate the establishment of an observatory at Lisbon, and of a network of stations. The Crown Prince D. Luiz, then Admiral of the Fleet, and now King, favoured the plan, and the erection of the observatory was begun in the year 1853; the first observations were made on 1st October, 1854. These are published in great detail in the "*Trabalhos do Observatorio*," for the years 1854—63. On the death of Pegado, M. Silva was appointed director, and he was succeeded by M. Fradesso da Silveira, who did much for the development of the service. At his death, in 1874, the present director, J. C. de Brito Capello. was entrusted with the superintendence. The Observatory forms the central station, and is also a station of the first order, at which complete magnetical and meteorological observations are taken. The self-recording instruments were made by Salleron of Paris, and in addition to the records of these instruments, direct observations are taken five times daily. Becquerel's electrical earth thermometers are placed at seven different depths, and are read at 9 a.m. daily. Since January, 1880, five of Lamont's earth thermometers have been placed at similar depths. Two rain gauges are in use, one attached to the anemometer, at a height of 23 metres (75 feet) above the ground. Another, of 1-100th square metre area (4½ in. diameter), is placed 1·6 metre (5 feet) above the ground. One of Cator's pressure anemometers is also in use. There is also one of Thomson's electrographs (modified by

Branly). Its records have been published in the Annals for the year 1877. All the principal instruments in use are described in detail in the second volume of the Annals, and also in Fradesso da Silveira's "*Relatorio do serviço* (Lisboa, 1872).

Publications.—The observations at the Observatory are published in the Annaes of the Observatory, vols. i.-xvi., for the years 1856-78. The first vol. contains a discussion of the observations of the years 1856-63, which are contained in greater detail in the *Trabalhos* above mentioned. In the first two vols. (1864-65) hourly observations are given, and subsequently two-hourly observations. The discussion of these rich materials for Lisbon has recently been undertaken by M. Capello, and published as appendices to the Annals in the following monographs :—

1—Resumo das principaes observações meteorologicas executadas durante o periodo de 20 annos decorridos desde 1856–1875 (Annaes XIV. 1876).
2—Temperatura do ar em Lisboa, 1856-75 (Lisboa, 1878).
3—Pression atmosphérique à Lisbonne, 1856-75 (Lisb., 1879).
4—La pluie à Lisbonne (Lisbonne, 1879).

We may mention that particular attention is paid to magnetic observations, although these do not enter into our present subject.

The Stations of the Second Order.—In the year 1861 the station at Oporto was established, and two years later those of Campo Maior and Guarda. In 1865 the Parliament voted funds for the establishment of 10 stations, including those of Madeira and the Azores. There are also some colonial stations, *e.g.*, on the island of St. Thomas. Goa and St. Paolo de Loanda, publish their observations independently, but these observations are almost unknown in European circles. The stations generally are well furnished, including Kew barometers, and small Robinson's anemometers. The results of the observations at the stations of the second order are published as follows :—Up to the end of the year 1872, 10 day and monthly means for all hours of observation, and for all elements, in the *Annals* of the Observatory, vols. i.-x., 1863-72; from the year 1873, the 9 a.m. readings, daily means, maxima, and minima for every day, and monthly means are published in the half-yearly publication, *Postos Meteorologicos*, 1874–77. In the year 1877, the publication of the observations of five stations (including Lisbon) was begun upon the "international" system. In vol. xi. (1873) of the *Annals*, there is a *résumé* of nine years observations (1864-72) for seven stations.

Weather Telegraphy.—Reports are received daily from nine inland stations, and from Funchal (Madeira), and a summary from Paris, and a bulletin containing forecasts for the next day has been published in the newspapers since 1865. Storm warnings, similar to those in use in England, and with night signals at some stations, were begun in 1871.

Ocean Meteorology.—There has been a special department for this

service since 1854. Both the navy and the mercantile marine are supplied with verified instruments by the Lisbon Observatory, but the amount of information received is naturally but small.

The funds at the disposal of the Central Observatory are only about £1,560 a year, but the salaries of the director (chiefly) and two principal assistants are drawn from the navy, and telegraphy is free.

The Observatory of Coimbra.—This observatory is independent of the central institution, and belongs to the University of Coimbra, and would rank as a station of the second order, according to the definition of the Vienna Congress. For the years 1864-66, results of observations are published in the "*Resumos Annaes*" of the University (Coimbra, 1870). With the year 1867, detailed observations are published in "*Observaçoes Meteorologicas, &c., de Coimbra,*" and the publication is brought well up to time, the last volume being for 1879. Observations on solar physics have also considerable attention. The present director is Dr. A. S. Viégas, who appears recently to have succeeded M. J. A. de Sousa. The funds at the disposal of the Observatory, including the charges for magnetic observations, amount to about £540 a year.

We are again indebted to Dr. Hellmann's able reports for the above particulars.

J. S. HARDING.

METEOROLOGICAL OBSERVATIONS AT GABOON, WEST AFRICA.*

THE exhaustive and enervating character of the climate of Western Africa, or at any rate, of that part which extends from the banks of the Senegal to those of the Congo, has one natural result, viz., it renders accurate and systematic records of the climate extremely scarce.

The large pecuniary profits to be made on the shores of the Gulf of Guinea, tempt many men of all nations to face the climate, but from one cause or another, the scientific tastes which they may have had in other localities, soon become dissipated, and hence, though there are sundry fragmentary records, there are very few which are of much scientific value.

Occasionally we get a bright exception, as in the work of Dr. Borius, *Recherches sur la Climat du Sénégal*, which was fully reviewed in Vol. X. of this Magazine, pages 17 to 22.

We have the pleasure of noticing a similar, but smaller, work on the present occasion, epitomising a most careful series of observations made by Herr Soyaux during the year 1880.

The station is almost exactly on the Equator, 0°25 N., and 9°35 E.,

* Die Ergebnisse der meteorologischen Beobachtungen des Herrn Hermann Soyaux in Ssibange-Farm am Awandu (Munda), Gabun, Westafrika, während des Jahres, 1880. Von Dr. A. Von Danckleman.

about five miles E.N.E. of the town of Gaboon, and about 300 feet above sea level. The surrounding country is primitive forest, with many streams, rivers, and mangrove swamps. The thermometers were in a lattice-work box on a high post over grass. All the thermometers had been compared with standards, and were also compared during the year. The rain gauge had its receiving surface 5 ft. 9 in. above the ground.

The regular observation hours were 7 a.m., 2 p,m., and 9 p.m., but twice a month observations were made every hour, so as to determine the curve of daily temperature, and to be able to deduce true mean values. Observations were also made very nearly every hour throughout November. It appears that for this station the true mean daily temperature within about 0°·2 is given by :—

$$\frac{7\text{ a.m.} + 2\text{ p.m.} + 2 \times 9\text{ p.m.}}{4}$$

The following table gives perhaps one of the best sets of values of air temperature for West Africa yet obtained :—

1880.	7h. a.m.	2h. p.m.	9h. p.m.	Mean.	Mean. Max.	Mean. Min.	Absolute Max	Absolute Min.
	°	°	°	°	°	°	°	°
January	74·5	85·3	75·9	77·9	86·9	72·1	90·0	69·8
February	74·5	84·7	74·7	77·2	87·4	72·0	92·1	68·5
March	74·8	83·1	75·2	77·2	85·6	72·7	90·3	68·7
April	75·4	84·0	75·2	77·5	86·5	72·9	90·3	70·0
May	74·8	83·1	74·8	77·0	85·5	72·1	89·8	70·0
June	69·6	79·3	71·6	73·0	82·6	68·0	85·3	63·3
July	70·3	77·4	72·0	72·9	80·6	68·7	84·7	64·9
August	71·1	79·2	72·1	73·6	82·4	69·4	86·0	66·7
September	73·0	81·7	74·1	75·7	85·5	71·1	90·0	67·1
October	73·9	81·9	74·8	76·5	84·7	72·1	88·3	68·2
November	73·4	81·1	73·9	75·6	84·2	72·3	90·5	70·3
December	73·2	82·6	74·1	76·1	85·3	72·1	88·0	67·5
Year...	73·2	82·0	74·1	75·9	84·7	71·2	92·1	63·3

As might be expected from the description of the locality, the air is excessively damp, the mean elastic force of vapour being 0·795 in., and the mean relative humidity 87·9 ; and Herr Soyaux says, that "in the morning the mosquito nets over the beds are dripping water, hence rheumatic affections are very frequent."

The direction and force of the wind was recorded thrice daily at the before-mentioned observation hours, and nearly every hour throughout November. The result shows that usually there is a dead calm from 11 p.m. to 6 a.m., and the direction during the remaining hours is almost wholly due to a slight sea breeze in the afternoon.

The sky is generally cloudy ; there were only five clear days in 1880, while there were 179 overcast ones ; the mean for the year is about 7·8. Herr Soyaux has diligently taken the direction of cirri, which always come from E.S.E., the paths of cirro strati and cirro cumuli are somewhat more variable, but chiefly from E.

The fall of rain, including collected mist and dew, is given in the following table :—

1880.	Total.	Greatest Fall. Amount.	Date.	Days Above 0·1 in.	Above 1·0 in.
	in.	in.			
January	6·69	2·55	7	8	3
February	10·68	4·64	28	14	3
March	19·31	4·01	14	22	6
April	13·02	2·59	21	16	5
May	2·50	·77	14	10	0
June	1·18	1·14	8	3	1
July	·04	·04	14	1	0
August	1·07	·56	20	8	0
September	4·26	1·52	24	8	3
October	7·78	1·65	29	20	2
November	24·36	5·24	25	21	10
December	11·78	3·54	18	17	3
Total	102·67			148	36

The above yearly total seems to be regarded as probably a fair average one. There fell in one hour on February 28th, 1880, 1·46 in.

In bringing this summary to an end, we are sure that we are justified in offering to Dr. Von Danckelman thanks for his able summary of the observations, and still heartier thanks to Herr Soyaux for making them. May someone soon provide him with a barometer, if he will accept the offer, and long may he resist the rheumatism and other disadvantages of the climate, and send to his native country records as accurate as those which we have been discussing.

THE METEOROLOGICAL SOCIETY.

The closing monthly meeting of this Society for the present session was held on Wednesday, June 15th, at the Institution of Civil Engineers; Mr. G. J. Symons, F.R.S. (President), in the Chair. Eleven gentlemen were elected Fellows of the Society, viz. :— F. Crowley, A. M. Davis, Rev. R. Drake, F. H. D. Eyre, W. M. Gibson, E. W. Mathew, J.P., D.L., J. Parnell, M.A., F.R.A.S., J. Rigby, T. G. Rylands, F.L.S., F.G.S., H. Smith, and A. H. Wood, C.E.

The following Papers were read :—

(1). The use of Synchronous Meteorological Charts for determining Mean Values over the Ocean, by Charles Harding, F.M.S.

(2). The Climate of Fiji, by R. L. Holmes, F.M.S. This paper gives the results of meteorological observations taken at Delanasau, Bua, Vanua Levu, during the ten years, 1871-80.

(3). Note on the Formation of Hail, by J. A. B. Oliver.

(4). Note on a Comparison of Maximum and Minimum Temperature and Rainfall observed on Table Mountain and at the Royal Observatory, Cape Town, during January and February, 1881, by John G. Gamble, M.A., M. Inst.C.E., F.M.S.

Mr. E. J. Spitta exhibited and described a new mercurial maximum and minimum registering thermometer.

SUPPLEMENTARY TABLE OF RAINFALL IN JUNE, 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	...	XI.	Carno, Tybritle	3·17
,,	Margate, Acol	2·41	,,	Corwen, Rhug	3·14
,,	Littlehampton	2·11	,,	Port Madoc	4·62
,,	St. Leonards	2·75	,,	Douglas.....	4·75
,,	Hailsham	2·52	XII.	Carsphairn	6·54
,,	I. of W., St. Lawrence.	...	,,	Melrose, Abbey Gate ...	3·29
,	Alton, Ashdell.....	1·92	XIV.	Glasgow, Queen's Park.	2·26
III.	Great Missenden	2·80	XV.	Islay, Gruinart School..	...
,,	Winslow, Addington ...	1·97	XVI.	Cupar, Kembach.....	2·32
,,	Oxford, Magdalen Col...	1·78	,,	Aberfeldy H.R.S.	1·55
,,	Northampton	1·97	,,	Dalnaspidal	4·64
,,	Cambridge, Merton Vil.	3·25	XVII.	Tomintoul.....	1·66
IV.	Harlow, Sheering	1·71	,,	Keith H.R.S.	2·42
,,	Diss	1·45	XVIII.	Forres H.R.S.	1·64
,,	Swaffham	1·89	,,	Strome Ferry H.R.S....	5·49
,,	Hindringham	1·98	,,	Lochbroom	2·85
V.	Salisbury, Alderbury ...	2·02	,,	Tain, Springfield.....	...
,,	Calne, Compton Bassett	2·43	,,	Loch Shiel, Glenfinnan.	10·99
,,	Beaminster Vicarage ...	4·47	XIX.	Lairg H.R.S.	2·27
,,	Ashburton, Holne Vic..	5·25	,,	Altnabreac H.R.S.	..
,,	Langtree Wick	...	,,	Watten H.R.S.	2·84
,,	Lynmouth, Glenthorne.	2·88	XX.	Fermoy, Glenville	5·83
,,	St. Austell, Cosgarne...	4·48	,,	Tralee, Castlemorris ...	5·05
,,	Ilebrewers, Walrond Pk.	...	,,	Cahir, Tubrid	4·19
VI.	Bristol, Ashleydown ...	...	,,	Tipperary, Henry St....	4·28
,,	Ross	2·90	,,	Newcastle West	3·30
,,	Wem, Sansaw Hall.....	2·29	,,	Kilrush	4·52
,,	Cheadle, The Heath Ho.	2·40	,,	Corofin	5·07
,,	Bickenhill Vicarage ..	...	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	1·81	,,	Carlow, Browne's Hill..	4·16
,,	Horncastle, Bucknall ...	1·88	,,	Kilsallaghan.....	...
VIII.	Macclesfield Park	2·27	,,	Navan, Balrath	...
,,	Walton-on-the-Hill.....	2·26	,,	Athlone, Twyford	4·97
,,	Broughton-in-Furness ..	6·09	,,	Mullingar, Belvedere ...	4·20
IX.	Wakefield, Stanley Vic.	1·48	XXII.	Ballinasloe	4·60
,,	Ripon, Mickley	2·49	,,	Clifden, Kylemore	11·40
,,	Scarborough.....	1·26	,,	Crossmolina, Enniscoe..	4·97
,,	Mickleton.....	2·98	,,	Carrick-on-Shannon ...	4·62
X.	Haltwhistle, Unthank..	2·92	XXIII.	Dowra	4·22
,,	Shap, Copy Hill	4·70	,,	Rockcorry.....	4·56
XI.	Llanfrechfa Grange	3·40	,,	Warrenpoint	5·21
,,	Llandovery	2·88	,,	Newtownards	3·71
,,	Solva	1·98	,,	Carnlough.....	...
,,	Castle Malgwyn	4·44	,,	Bushmills	3·57
,,	Rhayader, Nantgwillt..	3·79	,,	Buncrana	4·30

JUNE, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32°. In shade.	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	1·72	— ·95	·58	5	10	82·7	1	37·4	9	...	...
II.		Maidstone (Hunton Court)	2·32	+ ·25	·81	5	9	...	...	...	...	...	...
,,		Strathfield Turgiss	1·92	— ·18	·57	6	12	81·7	1	34·7	9	0	1
III.		Hitchin	1·55	— ·58	·71	5	14	75·0	2	35·0	8	0	...
,,		Banbury	2·28	— ·16	1·00	5	16	80·0	1	36·0	9	0	...
IV.		Bury St. Edmunds (Culford)	1·50	— ·77	·54	5	9	81·0	4	33·0	9	0	...
,,		Norwich (Cossey)	1·66	— ·56	·64	5	12	79·0	2, 4	37·0	14	0	1
V.		Bridport	2·88	...	·59	5	13	71·0	24	29·0	10	1	...
,,		Barnstaple	3·40	— ·68	·79	19	17	82·0	1, 2	38·0	9	0	...
,,		Bodmin	5·79	+ 2·58	1·02	20	22	75·0	1	40·0	9	0	0
VI.		Cirencester	2·57	+ ·08	·95	5	17	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	3·22	+ ·35	·55	6	20	75·0	2	38·0	7,8	0	...
,,		Tenbury (Orleton)	2·53	— ·21	·35	16	19	79·8	1, 2	32·5	9	0	1
VII.		Leicester (Town Museum)	2·59	...	·67	6	16	79·0	1	36·2	7	0	3
,,		Boston	2·14	— ·11	·64	5	13	85·0	3	37·0	10	0	...
,,		Grimsby (Killingholme)	1·17	— 1·20	·27	16	16	75·0	2	39·0	8	0	...
,,		Mansfield	2·00	— ·77	·32	16	15	78·1	1	38·0	9	0	0
VIII.		Manchester (Ardwick)	1·74	— 1·42	·34	25	14	81·0	2	39·0	9	0	0
IX.		Wetherby (Ribstone)	1·43	— 1·44	·29	20	8	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·77	+ ·95	·89	16	18	83·0	1, 2	34·0	9	0	...
X.		North Shields	1·41	— ·62	·29	16	16	...	...	...	...	...	...
,,		Borrowdale (Seathwaite)	16·38	+ 8·57	4·99	30	20	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	4·29	+ 1·26	·65	4	15	77·0	2	36·6	8	0	2
,,		Aberystwith Goginan	...	...	...	...	...	...	...	...	...	..	...
,,		Llandudno	2·99	+ ·99	·47	6	19	72·9	2	40·4	8	0	...
XII.	SCOTLAND.	Cargen	4·78	+ 1·61	1·09	30	18	77·4	1, 2	39·0	9	0	...
,,		Hawick (Silverbut Hall)	2·49	— ·02	·65	30	12	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	2·99	— ·02	1·00	30	18	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	...	...	...	...	...	...	...	...	...
,,		Kilmory	5·68	+ 1·84	·99	30	21	...	...	29·0	8	2	...
,,		Mull (Quinish)	6·37	...	·81	20	20	...	...	...	...	...	...
XVI.		Loch Leven	4·00	+ 1·23	·80	30	13	...	...	...	...	...	...
,,		Arbroath	1·96	— ·65	·48	24	13	76·0	2	34·0	8	0	...
XVII.		Braemar	2·45	— ·64	·78	17	20	75·8	1	26·5	10	2	8
,,		Aberdeen	3·06	...	1·10	19	19	75·0	1	32·0	9	1	...
XVIII		Portree	5·58	+ ·76	·85	4	20	...	...	...	...	..	...
,,		Inverness (Culloden)	1·24	— 1·01	...	...	...	75·2	1	34·8	10	0	2
XIX.		Dunrobin	3·30	...	·40	30	17	73·8	2	31·0	8	2	...
,,		Sandwick	2·51	+ ·71	·39	4	19	68·0	1	37·3	9	0	1
XX.	IRELAND.	Cork (Blackrock)	5·23	+ 1·68	·97	20	19	85·0	1, 2	36·0	8	0	...
,,		Darrynane Abbey	...	...	...	...	...	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	4·78	...	·86	16	21	78·0	2	34·0	8	0	...
,,		Killaloe	5·89	...	·78	30	20	84·0	2	34·0	9	0	...
XXI.		Portarlington	3·89	+ 1·46	·65	20	22	78·5	1	34·0	8	0	...
,,		Monkstown	...	...	...	...	...	...	...	...	...	...	...
XXII.		Galway	4·86	+ 1·05	1·02	4	21	76·0	1	38·0	9	0	0
XXIII		Waringstown	4·11	+ 1·45	·56	20	18	85·0	1	35·0	8	0	1
,,		Londonderry	3·75	...	·49	22	22	77·0	1	40·0	8	0	0
,,		Edenfel (Omagh)	3·91	+ ·86	·53	4	26	79·0	1	32·0	5	1	0

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

METEOROLOGICAL NOTES ON JUNE.

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

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was very favourable for agricultural work, and the crops made good progress. Hay crop very light; wheat crop promising. First hay cut on 2nd; wheat in ear on 3rd. Dog rose in flower on 6th; privet in flower on 25th. TS on 6th.

CULFORD.—A very dry month, crops very much in want of rain on this light soil. H and T on 6th; H and S on 9th.

COSSEY.—Hawthorn fully out on 1st; wheat bursting into ear on 7th; hay crop very light, wheat and barley short in straw.

CIRENCESTER.—A genial month, rather cool, except the first three or four days; the refreshing showers which began about the middle of the month were very beneficial to the crops.

ORLETON.—The first four days were very fine and warm, the temp. attaining a max. of 79°·8 on the 1st and 2nd, and 79°·7 on the 3rd. On the 5th, the wind changed to N., and a great fall of temp. occurred accompanied by slight R and a cloudy sky; on the morning of the 9th a frost occurred on the ground, and the weather continued cold till the 12th. The remainder of the month was variable, with a few bright days, but generally a cloudy sky and frequent falls of R. Mean temp. 0°·8 below the average of 20 years; distant T on 6th, 8th. and 22nd.

LEICESTER.—Thunderstorm with R, S, and H at 6 p.m. on 6th. At and in the vicinity of Charnwood Forest the H was about two inches deep.

KILLINGHOLME.—Another dry month, R much wanted for grass land and turnip crop. The country has been very beautiful, the flowers on laburnum, lilac, and hawthorn more abundant than usual. Bar. steady, much haze; T on 15th, 16th, and 22nd.

MANSFIELD.—Thunderstorm at 3.30 p.m. on 22nd.

MANCHESTER.—A month of broken weather, sometimes genial and warm, at others cold and chilly, but altogether rather favourable agriculturally.

ARNCLIFFE.—So dark from 9·40 to 11 a.m. on 16th that in the house one could scarcely see to read.

NORTH SHIELDS.—Thunderstorms on 6th, 16th, 18th, and 21st.

SEATHWAITE.—Rainfall in 24 hours twice exceeded 4 in.: 4·50 in. falling on the 4th, and 4·99 in. on the 30th. H on 7th; S and T on 8th.

WALES.

HAVERFORDWEST.—The fine warm genial weather of May continued till the 3rd of June, after which a great fall of temp occurred, accompanied by R; the weather remained cold with frequent R; very bad for haymaking; towards the end of the month it became warmer, and there were many fine pleasant days with occasional falls of R at night.

LLANDUDNO.—A showery month, the rainfall being 34 per cent. above the average, yet not in excess of the requirements of the crops; a cold wave occurred from the 9th to the 11th inclusive, but notwithstanding this, the mean temp. was only a fraction of a degree below the average. There were 194·4 hours of bright sunshine during the month. S on distant hills on 7th.

SCOTLAND.

CARGEN.—With the exception of the first few days, the month was cold and unsettled, with a rainfall greatly above the average; mean temp. 55°·7, 1°·2 below the average. Turnip crop much injured by the fly; all other crops and pastures exceedingly good. T on 7th, and T and H on 8th.

HAWICK.—A month of fine genial growing weather, and the country never looked more beautiful; not a mavis nor a wren to be seen here.

QUINISH.—The month throughout was very ungenial and cold ; following on the drought of April and May the heavy rains have done much good to crops and pastures.

ABERDEEN.—The weather during the month was showery, but with bright intervals ; H on 7th, T and L between 2 and 3 p.m. on 21st.

PORTREE.—A wet cold month ; heavy H showers frequent.

CULLODEN.—Month generally cold, except on the 1st and 2nd, which were hot, clear, and sunny ; the rain fell in small quantities, and in consequence of the continued prevalence of W. wind the land has become very dry. Cereals promising, potatoes good, turnip crop deficient.

DUNROBIN —Cold and wet with the exception of a few days at the beginning.

SANDWICK.—The first days of the month were warm, but on the 5th the wind changed to N., and remained in that quarter to the 14th (giving us sleet and H showers, with a smart frost on the night of the 9th) ; from the 15th to the 22nd the wind was mostly south-easterly, with rather higher temp., and during the remainder southerly and westerly, with a considerable improvement in the weather. There was a wind of 40 miles an hour for four hours before noon on the 16th. Vegetation very backward.

IRELAND.

WATERFORD.—Temp. low, except on the first three days ; rainfall above the average of the last five years ; prevailing winds S.S.W. Hay crop generally short. T on 2nd ; H on 5th and 7th. Gales on 17th and 21st.

KILLALOE.—Weather generally sultry and showery during the month ; crops late. The frost which occurred in many parts of the country on the 9th was not felt here.

WARINGSTOWN.—The last week of the month was rather cold and wet, but caused no injury. Vegetation very luxuriant, and all crops promising ; slight frost on grass on night of 8th, doing much damage to potatoes in neighbouring districts, especially on low ground.

LONDONDERRY.—On the whole a very genial month, warm and showery, crops growing rapidly. Wind principally S.W. A very heavy H shower on 7th ; T and L on 20th.

REGULAR OBSERVATIONS UPON THE TOP OF BEN NEVIS.

We have not space upon the present occasion to express fully our views respecting mountain stations, but we should be sorry for this number to go forth without chronicling the laborious undertaking commenced on June 1st by Mr. Clement Wragge, whose station on the Weaver Hills, in Staffordshire, we have already noticed.* Mr. Wragge having left Farley, opened communication with Mr. Buchan respecting the efforts of the Scottish Meteorological Society to establish an observatory at Ben Nevis, and the final result briefly is, that a complete set of instruments is fixed upon the top of Ben Nevis, the highest point in the British Isles, 4,406 feet above sea level. Mr. Wragge has gone into residence at Fort William, and has commenced the somewhat alarming task of rising between 4 and 5 a.m., and after making a low level observation, climbing to the summit in readiness for observations at 9, 9.30, and 10 a.m. *every day*. If this be not devotion to Meteorology, we should rather like to know to what that term should be applied.

* *Meteorological Magazine*, Vol. xv., p. 98 (August, 1880).

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

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THE HEAT IN JULY IN THE BRITISH ISLES, AND IN EUROPE GENERALLY.

THE occurrence of a temperature which at Greenwich has not been equalled for at least 40 years, and of a temperature at Brussels which has not been equalled for at least 48 years, naturally claims notice at our hands.

We have made special efforts to place the actual facts before our readers, and we desire in the first place to thank the Directors of nearly all the chief observatories of Europe for the promptitude with which they have supplied the information which we applied for.

We think that it will be convenient to separate the information relating to our own country from that furnished by our Continental friends, and we will therefore dismiss the records from our own little country first.

THE BRITISH ISLES.

We might almost dismiss all parts of the British Isles except the South of England, for the exceptional temperatures were very local —a line from Barnstaple in Devonshire, to Peterborough in Northamptonshire would on its S.E. side have all the temperatures which could be regarded as exceptional. July 5th was a hot summer day, temperatures slightly exceeding 90° were recorded at several stations, and over the greater part of England it was the hottest day of the month, but we are not aware that any of the temperatures observed on that day were unprecedented. The remarkable feature of the month was the temperature reached on July 15th, in a belt of country extending from Wiltshire, through the north of Hampshire, north Surrey, west Kent, Middlesex, Essex, Suffolk and Norfolk.

The following tables contain the principal data upon which the foregoing remarks are based. These tables are mainly compiled from letters and returns sent by our own staff, but have been checked and completed by reference to those sent in to the Meteorological Society.

Space is so valuable that we have been obliged to condense much of the information furnished into a very small space; but we print

two letters in extenso, one because it shows the evidence upon which we print the excessively high value of 101°·0; the other is inserted in support of the general statement as to the limitation of the phenomenal heat to the southern counties. As regards this, a curious illustration will be found in the Remarks, on page 132, where our correspondent at Portree, in the Isle of Skye, on the N.W. of Scotland, says July was "The coldest July on record." These letters will be found at the end of the article.

MAXIMUM TEMPERATURES ON JULY 15TH, 1881.

Verified Thermometers in Stevenson's Stands.

(Large type indicates that the max. was the absolute max. of the month.)

95·0	Camden Square, Middlesex.
94·9	Eltham Green, Kent.
94·1	South Norwood, Surrey.
93·9	Strathfield Turgiss, Hants.
93·8	Walton-on-Thames, Surrey.
93·5	Regent's Park, Middlesex.
93·2	Beddington, Croydon, Surrey.
92·9	Isleworth, Middlesex.
92·4	Addiscombe, Croydon, Surrey.
92·0	Cranleigh, Surrey.
91·0	Watford, Herts.
90·9	Southend, Essex.
90·3	Tunbridge Wells, Kent.
90·2	Throcking, Buntingford, Herts
89·4	Swarraton, Alresford, Hants.
89·3	Harestock, Winchester, Hants.
88·5	Somerleyton, Lowestoft, Nrflk.
87·7	Eastbourne, Sussex.
86·8	The Graig, Ross, Hereford.
86·0	Woodway, Teignmouth, Devon
85·8	Portsmouth, Hants.
85·7	Burghill, Hereford.
85·5	Cullompton, Devon.
85·4	Hodsock Priory, Wrksop, Nots.
85·3	Kenilworth, Warwick.
85·0	Cheltenham, Gloucester.
84·9	Bitton, Teignmouth, Devon.
84·8	Mansfield, Notts.
84·6	Loughboro', Leicester.
84·4	Strelley Hall, Nottingham.
83·7	Druid, Ashburton, Devon.
83·3	Ramsgate, Kent.
82·8	Babbacombe, Devon.
81·0	Brampford Speke, Devon.
80·8	Belper, Derby.
80·5	Guernsey.
80·3	Scarborough, York.
79·7	Oakamoor, Stafford.
79·7	Cardiff, Glamorgan.
78·5	Wakefield, Yorks.
78·4	Lowestoft.
78·2	Heath Ho., Cheadle, Stafford.
77·5	Macclesfield, Cheshire.
77·5	Sidmouth, Devon.
71·9	Llandudno, Carnarvon.
71·8	St. Michael's-on-Wyre, Lncsh.
65·9	S. Shore, Blackpool, Lncsh.

Records from Stands of other or unknown patterns.

(D.W.R.—Daily Weather Report of the Meteorological Council.)

101·0	Alton, Hants.
100·0	Alderbury, Salisbury.
97·1	Royal Obs., Greenwich, Kent.
96·7	Foxgrove, Beckenham, Kent.
95·6	Enfield, Middlesex.
95·0	D.W.R., London.
94·6	Camden Square, Middlesex.
94·2	Hornsey, Middlesex.
94·0	Hindringham, Norfolk.
93·8	Addiscombe, Croydon, Surrey.
93·3	Walton-on-Thames, Surrey.
92·0	Merton Villa, Cambridge.
92·0	Ipswich, Suffolk.
92·0	Diss, Norfolk.
92·0	Cossey, Norwich, Norfolk.
91·0	Bromley Common, Kent.
91·0	D.W.R., Cambridge Obsvrty.
90·0	D.W.R., Nottingham.
89·0	Ellough, Beccles, Suffolk.
87·0	D.W.R., Oxford Observatory.
85·6	St. Leonards, Sussex.
85·0	Compton Basset, Calne, Wilts.
85·0	D.W.R., Jersey.
83·0	D.W.R., Spurn Head, Yorks.
83·0	Langton Herring, Weymouth.
82·5	Hythe, Kent.
81·0	D.W.R., Hurst Castle, Hants.
80·0	D.W.R., Dover.
80·0	Northampton.

CAMDEN SQUARE.—It was found that the temperature in different parts of the Stevenson stand varied more than a degree—a thermometer near the top recorded 95°·6, or one degree higher than on a Glaisher stand close by. The maximum on the Glaisher stand, 94°·6, is higher than has been recorded since observations commenced in 1858; the highest previously was that on July 21st, 1868, viz., 93°·3.—*G. J. Symons.*

ADDISCOMBE.—Observations have been made here with a Glaisher stand since 1872, hitherto the max. was 13th August, 1876 = 93°·6, but on the 15th July, 1881, it rose to 93°·8 on that stand, and to 92°·4 in the Stevenson.—*E. Mawley.*

GREENWICH.—The maximum temperature (97°·1) on July 15th is higher than any previously recorded in the period 1841-81. On July 22nd, 1868, the maximum temperature was 96°·6.—*G. B. Airy.*

FOXGROVE, BECKENHAM.—The following are all the readings of 90°·0 or upwards on Glaisher stand since 1867 :—1868, July 21st, 91°·9; 22nd, 93°·8; September 7th, 90°·0. 1869, June 12th, 90°·4; 18th, 90°·6; 22nd, 90°·0. 1870, June 22nd, 90°·8. 1871, August 12th, 90°·8; 13th, 90°·0. 1872, July 25th, 90°·0. 1873, July 22nd, 90°·6. 1874, July 9th, 92°·6; 19th, 91°·7. 1876, July 14th, 91°·3; 15th, 94°·1; 16th, 92°·1; 17th, 91°·3; August 13th, 93°·8; 14th, 90°·4; 15th, 90°·1. 1878, June 26th, 90°·1; 27th, 90°·1. 1881, July 5th, 92°·7; 15th, 96°·7 —*P. Bicknell.*

WALTON-ON-THAMES.—It is remarkable that the max. in the Stevenson stand is half-a-degree higher than on the Glaisher. The max. in the louvre screen on the tower, 50 ft. above ground, was only 91°·0, against 93°·8 at 4 ft. above ground.—*G. Dines.*

To the Editor of the Meteorological Magazine.

SIR,—As it was the hottest day I ever knew here yesterday, I thought you would like to be informed that my thermometer in the shade stood at 101°. The thermometers were made by Burrows, of Malvern, are about 4 feet from ground, on a stand made by them, painted white, facing North, with double back to the South; they were compared at Kew and found correct.—I am, yours truly,

FREDERICK CROWLEY.

Ashdell, Alton, Hants, July 16th, 1881.

To the Editor of the Meteorological Magazine.

SIR,—So much has been said and written about the almost tropical heat of July in the South, that it may interest you to contrast it with the cool moist weather we have experienced here in the North-west of England during the same month.

The mean temperature of July at this station was 57°·7, which is 1°·8 below the average for the month during the previous nineteen years.

The maximum thermometer in the shade reached 70° on only one day during the month, viz., on the 5th, when the reading was 78°·2 (this was just before a thunderstorm). The next highest shade temperature was 68°·4, on the 13th.

Rain fell on 20 days during the month; the total amount being 4·633 inches, and the heaviest fall in 24 hours, 1·680 inches, on the 24th.—I am, Sir, yours truly,

H. DODGSON, M.D., F.R.A.S., &c.

Cockermouth, Cumberland, August 3rd, 1881.

EUROPE GENERALLY.

We believe that the tables given on pages 118 to 121 are unique in several respects. Although printed within a fortnight of the close of the month, they give complete records from Portugal, Spain, Italy (2 stations), France (4 stations), Switzerland, Austria, Belgium, Germany (2 stations), England, Russia (2 stations), Denmark, and Norway.

For the convenience of the Continental readers of this Magazine, we have printed the values in the Centigrade scale as well as in that of Fahrenheit.

We do not think it necessary to add many remarks, for the notes with which we have been favoured by several of the directors of the observatories on the Continent relieve us of that necessity.

It will be remembered that in the South of England the hottest day was the 15th. On that day the temperature reached or exceeded 100° F. at the following French stations—Paris, 100° (37·8 C.); Nancy, 101·°1 (38°·4 C.); Nantes, 101°·5 (38°·6 C.); and Biarritz, 100°·4 (38°·0 C.).

On July 19th, the hottest day for many years (perhaps ever) at Paris and at Brussels, the following are additional data to those given in the table :—in France, Charleville, 100°·4 (38°·0 C.); and Le Mans, 101°·7 (38°·7 C.); and in Belgium: Arlon, 96°·8 (36°·0 C.); and Maeseyck, 99°·1 (37°· 3 C.)

REMARKS.

MADRID.—The maxima are below those usually reached, which are 104° to 106°.—*A. Aguilar.*

PARIS, MONTSOURIS.—The maximum of the 19th (99°·0), although exceptionally high, is not without precedent even during the short period since 1872, for on July 9th, 1874, the maximum was 101°·1. —*H. Marie-Davy.*

[At the *Observatoire National*, about a mile nearer the centre of Paris than Montsouris, the temperature is reported to have exceeded 99° on the following occasions, viz. :—

1705.	Aug. 5th & 6th	=	102·2	1765.	Aug. 26th	=	104·0
1720.		=	104·0	1766.	July 10th	=	100·0
1757.	July 14th	=	99·9	1773.	Aug. 14th	=	102·9
1760.	,, 18th	=	99·9	1782.	July 16th	=	101·7
1763.	Aug. 19th	=	102·2	1793.	,, 8th	=	101·1

We have not heard that the temperature is still recorded at the National Observatory, but it is hardly likely to differ much from that at Montsouris. But in the last number of the *Comptes rendus*, M. Renou gives his reasons for believing that several of these readings are too high, and for believing the recent temperature to be without precedent.— *Ed. M.M.*]

PARIS, ST. MAWR.—The recent extraordinary temperature was most accurately determined. The ordinary shade maximum thermometer, the *thermométre fronde*, which I observed repeatedly, and the shade maximum thermometer at my old station, all gave 101°·1 (38°·4 C.). I sent my assistant to observe with the *thermométre fronde*, on a plateau half a mile E. of Chenevières, and he there found the temperature reached 100°·2 (37°·9 C.). At a station rather lower than that of St. Mawr, the temperature in shade rose to 103°·1 (39°·5 C.).—E. RENOU.

GENEVA.—The mean maximum (83°·9) is the highest observed, 1826-81; the highest previously being 83°·3 in 1827. The absolute maximum (96°·6) has been exceeded both in 1827 (97°·2) and in 1870 (97°·5). The mean temperature (71°·4) is rather below that of July, 1859 (72°·1), but is above that of every other July since 1826.—*E. Plantamour.*

VIENNA.—The maximum temperatures given are those observed at the Central Institute, on the Hohe Warte, 664 ft. above sea level. The temperature in the city of Vienna would rise nearly 2° higher. The maximum in the city was in 1832, July 14th = 101°·7; the maximum at the Central Institute, Hohe Warte, was 95°·9 in July, 1857. The recent maxima are therefore far from unprecedented.—*J. Hann.*

BRUSSELS.—The maximum of July 19th (95°·4) is higher than had previously been reached since the foundation of the observatory in 1833. The absolute maximum previous to 1881 was on June 15th, 1858, when the temperature reached 94°·5.—*J. C. Houzeau.*

BERLIN.—The absolute maximum of the 34 years, 1848-81, was 98°·6 on July 20th, 1865, or 4°·1 higher than in 1881.—*G. Hellmann.*

HAMBURGH.—The absolute maximum for July for the last 33 years has *averaged* 83°·8, the absolute max. this year is therefore only 3°·5 above the average.—*G. Neumayer.*

COPENHAGEN.—The absolute and mean maximum temperatures are very near the average of the previous twenty years. In Denmark generally, they have been rather lower than the average.—*V. W. Tantzen* for *F. Hoffmeyer.*

CHRISTIANIA.—The maximum temperatures in July have been 2°·2 below the average; and the absolute max. is only 81°·0, while 90°·0 has been recorded at this observatory.—*A. S. Stern* for *H. Mohn.*

MAXIMUM TEMPERATURE IN SHADE

AT SOME OF THE PRINCIPAL CAPITALS

FAHRENHEIT

DATE.	PORTUGAL. Lisbon Observatory. *J. de B. Capello.*	SPAIN. Madrid Observatory. *A. Aguilar.*	ITALY. Rome Observatory. *P. Tacchini.*	ITALY. Modena Observatory. *D. Ragona.*	FRANCE. Avignon-Ecole Normale *Giraud.*	FRANCE. Bordeaux Observatory. *J. Rayet.*	FRANCE. Paris—Montsouris Obs. *H. Marie-Davy.*	FRANCE. Paris—Paro St. Mawr *E. Renou.*	SWITZERLAND. Geneva. *E. Plantamour.*
1	80·1	97·9	81·7	77·7	91·8	94·5	81·1	83·7	73·8
2	66·4	69·3	85·1	82·0	88·3	88·5	81·5	85·5	80·2
3	75·9	86·7	88·2	85·6	94·3	93·6	84·4	85·6	84·0
4	69·8	95·0	89·6	88·9	98·6	100·4	90·7	90·5	87·8
5	69·8	93·9	93·2	93·0	97·2	96·8	94·5	96·1	94·8
6	76·3	86·0	**94·8**	93·7	92·5	75·7	78·4	78·8	90·3
7	79·5	93·2	94·1	91·9	90·0	77·5	67·1	72·7	81·5
8	74·3	92·8	86·5	87·6	86·4	81·0	72·9	73·8	82·9
9	82·0	95·7	87·1	88·3	88·2	77·0	72·5	74·7	75·2
10	88·5	90·5	88·2	82·4	88·2	79·0	72·0	73·8	78·8
11	91·8	94·3	89·2	80·4	91·2	91·9	80·8	83·1	75·2
12	81·1	97·7	86·9	82·0	95·7	86·9	90·1	92·3	79·7
13	81·1	96·1	86·5	86·4	98·2	89·6	80·8	83·1	84·9
14	80·2	95·2	90·1	88·9	97·9	98·8	88·5	91·0	84·9
15	87·1	95·7	91·8	90·0	96·8	102·2	97·7	100·0	90·9
16	73·0	100·2	91·9	90·5	97·9	100·2	93·2	95·2	94·3
17	78·8	101·1	93·6	93·7	**101·1**	97·0	86·5	89·2	91·8
18	79·3	100·8	93·6	92·7	97·0	**102·4**	92·7	94·1	86·9
19	75·2	98·1	94·5	91·6	97·2	98·6	**99·0**	**101·1**	**96·6**
20	75·2	80·8	91·2	93·2	97·2	92·5	78·3	82·2	94·3
21	73·2	85·8	92·8	**94·1**	92·8	71·6	71·2	72·1	91·6
22	80·4	90·3	90·9	93·4	86·5	81·0	74·1	76·1	76·3
23	92·8	95·7	92·5	86·5	87·1	82·0	77·5	78·3	76·8
24	**93·9**	100·6	90 0	85·5	92·8	87·1	80·1	80·4	85·5
25	89·2	**102·6**	91·8	88·2	94·1	82·2	65·7	65·8	84·6
26	78·8	96·6	91·6	85·5	87·8	73·0	66·2	67·5	80·6
27	82·8	92·5	90·1	85·3	79·3	75·2	66·7	67·6	69·3
28	87·4	94·1	87·4	77·7	83·7	80·8	71·8	73·2	71·4
29	90·1	80·1	86·4	79·7	89·1	92·7	80·6	81·7	82·8
30	83·1	90·7	86·5	81·7	87·4	84·6	84·9	83·8	84·6
31	82·4	95·0	88·5	87·6	88·2	88·3	75·7	75·7	89·4
Mean..	80·6	93·0	89·9	87·3	92·1	87·8	80·6	82·2	83·8
Max...	93·9	102·6	94·8	94·1	101·1	102·4	99·0	101·1	96·6
Min...	66·4	69·3	81·7	77·7	79·3	71·6	65·7	65·8	69·3
Range.	27·5	33·3	13·1	16·4	21·8	30·8	33·3	35·3	27·3

ON EACH DAY IN JULY, 1881,

AND OTHER CITIES OF EUROPE.

SCALE.

DATE	AUSTRIA. Vienna. *J. Hann.*	BELGIUM. Brussels. *J. C. Houzeau.*	GERMANY. Berlin. *G. Hellmann.*	GERMANY. Hamburg. *G. Neumayer.*	ENGLAND. London—GreenwichObs *G. B. Airy.*	RUSSIA. Moscow. *A. Fadeeve.*	RUSSIA. St. Petersburgh. *F. Wild.*	DENMARK. Copenhagen. *F. Hoffmeyer.*	NORWAY. Christiania. *H. Mohn.*
1	69·3	80·6	76·6	75·0	82·6	74·8	81·1	76·3	59·2
2	77·4	81·0	80·2	79·5	77·1	75·0	77·4	80·4	74·3
3	72·9	78·6	86·0	70·9	84·7	78·3	76·6	73·4	68·5
4	81·1	84·7	79·0	68·9	90·1	80·8	80·2	67·1	78·4
5	88·9	89·6	84·2	73·6	92·8	82·2	67·3	68·4	70·7
6	92·1	80·1	85·1	80·8	68·1	73·0	66·0	71·8	76 3
7	79·7	64·9	74·7	65·8	66 1	63·0	65·3	65·5	75·7
8	79·3	67·1	69·1	65·1	65·8	62·8	56·3	63·9	64·4
9	69·8	68·2	71·4	65·7	72·7	71·8	65·7	66·2	69·8
10	69·8	67·1	60·8	67·5	74·1	73·6	72·0	68·2	72·5
11	64·6	78·4	66·2	69·8	79·6	79·3	76·3	70·5	75·7
12	73·8	88·2	79·9	79·2	86·2	77·0	77·4	80·6	**81·0**
13	81·3	77·5	89·1	77.2	81·4	69·8	74·8	82·4	77·0
14	80·6	82·9	81·7	76·5	89·1	75·2	70·0	78·4	76·3
15	84·0	93·2	90·5	83·8	**97·1**	68·9	64·6	**86·5**	78·8
16	**92·3**	85·1	87·8	74·8	84·3	70·0	72·0	72·3	73·4
17	84·2	78·8	70·9	68·2	85·2	72·7	64·4	68·2	72·0
18	78 8	88·3	84·6	80·2	90·2	59·9	59·4	75·2	64·9
19	86·0	**95·4**	92·1	86·9	88·0	63·7	61·9	79·9	76·6
20	88·3	80·6	**94·5**	**87·3**	76·0	68·5	65·8	79·3	72·1
21	89·1	70·3	71·4	68·7	73·4	75·2	64·4	69·8	74·8
22	74·7	70·2	71·6	66·7	63·1	79·3	72·1	65·3	72·9
23	73·8	71·6	75·2	67·1	73·6	76·5	72·0	71·2	64·4
24	79·3	75·6	78·6	71·4	73·1	81·0	66·4	70·3	65·8
25	84·4	68·0	73·6	69·8	71·3	82·2	70·7	67·1	59·2
26	85·8	56·8	72·1	64·2	73·1	88·7	78·6	67·1	64·2
27	78·8	62·8	63·7	60·3	65·1	90·5	**82·9**	61·5	59·5
28	65·8	70·3	66·7	64·9	75·9	**92·5**	71·2	61·3	68·0
29	73·6	73·4	72·9	65·3	74·5	66·2	68·7	60·8	68·9
30	80·2	80·8	75·7	72·0	68·1	70·0	71·6	67·5	69·4
31	84·7	71·2	82·0	73·2	67·7	69·4	71·8	71·2	62·8
Mean..	79·5	76·8	77·7	72·3	77·7	74·6	70·5	71·2	70·6
Max...	92·3	95·4	94·5	87·3	97·1	92·5	82·9	86·5	81·0
Min ...	64·6	56·8	60·8	60·3	63·1	59·9	56·3	60·8	59·2
Range.	27·7	38·6	33·7	27·3	34·0	32·6	26·6	25·7	21·8

MAXIMUM TEMPERATURES IN SHADE

AT SOME OF THE PRINCIPAL CAPITALS

CENTIGRADE

DATE.	PORTUGAL. Lisbon Observatory. *J. de B. Capello.*	SPAIN. Madrid Observatory. *A. Aguilar.*	ITALY. Rome Observatory. *P. Tacchini.*	ITALY. Modena Observatory. *D. Ragona.*	FRANCE. Avignon-Ecole Normale *Giraud.*	FRANCE. Bordeaux Observatory. *J. Rayet.*	FRANCE. Paris—Montsouris Obs. *H. Marie-Davy.*	FRANCE. Paris—Parc St. Maur *E. Renou.*	SWITZERLAND. Geneva. *E. Plantamour.*
1	26·7	36·6	27·6	25·4	33·2	34·7	27·3	28·7	23·2
2	19·1	20·7	29·5	27·8	31·3	31·4	27·5	29 7	26·8
3	24·4	30·4	31·2	29·8	34·6	34·2	29·1	29·8	28·9
4	21·0	35·0	32·0	31·6	37·0	38·0	32·6	32·5	31·0
5	21·0	34·4	34·0	33·9	36·2	36·0	34·7	35·6	34·9
6	24·6	30·0	**34·9**	34·3	33·6	24·3	25·8	26·0	32·4
7	26·4	34·0	34·5	33·3	32·2	25·3	19·5	22·6	27·5
8	23·5	33·8	30·3	30·9	30·2	27·2	22·7	23·2	28·3
9	27·8	35·4	30·6	31·3	31·2	25·0	22·5	23·7	24·0
10	31·4	32·5	31·2	28·0	31·2	26·1	22·2	23·2	26·0
11	33·2	34·6	31·8	26·9	32·9	33·3	27·1	28·4	24·0
12	27·3	36·5	30·5	27·8	35·4	30·5	32·3	33·5	26·5
13	27·3	35·6	30·3	30·2	36·8	32·0	27·1	28·4	29·4
14	26·8	35·1	32·3	31·6	36·6	37·1	31·4	32·8	29·4
15	30·6	35·4	33 2	32·2	36·0	39·0	36·5	37·8	32·7
16	22·8	37·9	33·3	32·5	36·6	37·9	34·0	35·1	34·6
17	26·0	38·4	34·2	34·3	**38·4**	36·1	30·3	31·8	33·2
18	26·3	38·2	34·2	33·7	36·1	**39·1**	33·7	34·5	30·5
19	24·0	36·7	34·7	33·1	36·2	37·0	**37·2**	**38·4**	**35 9**
20	24·0	27·1	32·9	34·0	36·2	33·6	25·7	27·9	34·6
21	22·9	29·9	33·8	**34·5**	33·8	22·0	21·8	22·3	33·1
22	26·9	32·4	32·7	34·1	30·3	27·2	23·4	24·5	24·6
23	33·8	35·4	33·6	30·3	30·6	27·8	25·3	25·7	24·9
24	**34·4**	38·1	32·2	29·7	33·8	30·6	26·7	26·9	29·7
25	31·8	**39·2**	33·2	31·2	34·5	27·9	18·7	18·8	29·2
26	26·0	35·9	33·1	29·7	31·0	22·8	19·0	19·7	27·0
27	28·2	33·6	32·3	2 ·6	26·3	24·0	19·3	19·8	20·7
28	30·8	34·5	30·8	25·4	28·7	27·1	22·1	22·9	21·9
29	32·3	26·7	30·2	26·5	31·7	33·7	27·0	27·6	28·2
30	28·4	32·6	30·3	27·6	30·8	29·2	29·4	28·8	29·2
31	28·0	35·0	31·4	30·9	31·2	31·3	24·3	24·3	31·9
Mean..	27·0	33·9	32·2	30·7	33·4	31·0	27·0	27·9	28·8
Max...	34·4	39·2	34·9	34·5	38·4	39·1	37·2	38·4	35·9
Min. ..	19·1	20·7	27·6	25·4	26·3	22·0	18·7	18·8	20·7
Range.	15·3	8·5	7·3	9·1	12·1	17·1	18·5	19·6	15·2

ON EACH DAY IN JULY, 1881,

AND OTHER CITIES OF EUROPE.

SCALE.

DATE.	AUSTRIA. Vienna. *J. Hann.*	BELGIUM. Brussels. *J. C. Houzeau.*	GERMANY. Berlin. *G. Hellmann.*	GERMANY. Hamburg. *G. Neumayer.*	ENGLAND. London—GreenwichObs *G. B. Airy.*	RUSSIA. Moscow. *A. Fadeew.*	RUSSIA. St. Petersburgh. *F. Wild.*	DENMARK. Copenhagen. *F. Hoffmeyer.*	NORWAY. Christiania. *H. Mohn.*
1	20·7	27·0	24·8	23·9	28·1	23·8	27·3	24·6	15·1
2	25·2	27·2	26·8	26·4	25·1	23·9	25·2	26·9	23·5
3	22·7	25·9	30·0	21·6	29·3	25·7	24·8	23·0	20·3
4	27·3	29·3	26·1	20·5	32·3	27·1	26·8	19·5	25·8
5	31·6	32·0	29·0	23·1	33·8	27·9	19·6	20·2	21·5
6	33·4	26·7	29·5	27·1	20·1	22·8	18·9	22·1	24·6
7	26·5	18·3	23·7	18·8	18·9	17·2	18·5	18·6	24·3
8	26·3	19·5	20·6	18·4	18·8	17·1	13·5	17·7	18·0
9	21·0	20·1	21·9	18·7	22·6	22·1	18·7	19·0	21·0
10	21·0	19·5	16·0	19·7	23·4	23·1	22·2	20·1	22·5
11	18·1	25·8	19·0	21·0	26·4	26·3	24·6	21·4	24·3
12	23·2	31·2	26·6	26·2	30·1	25·0	25·2	27·0	**27·2**
13	27·4	25·3	31·7	25·1	27·4	21·0	23·8	28·0	25·0
14	27·0	28·3	27·6	24·7	31·7	24·0	21·1	25·8	24·6
15	28·9	34·0	32·5	28·8	**36·2**	20·5	18·1	**30·3**	26·0
16	**33·5**	29·5	31·0	23·8	29·1	21·1	22·2	22·4	23·0
17	29·0	26·0	21·6	20·1	29·6	22·6	18·0	20·1	22·2
18	26·0	31·3	29·2	26·8	32·3	15·5	15·2	24·0	18·3
19	30·0	**35·2**	33·4	30·5	31·1	17·6	16·6	26·6	24·8
20	31·3	27·0	**34·7**	**30·7**	24·4	20·3	18·8	26·3	22·3
21	31·7	21·3	21·9	20·4	23·0	24·0	18·0	21·0	23·8
22	23·7	21·2	22·0	19·3	17·3	26·3	22·3	18·5	22·7
23	23·2	22·0	24·0	19·5	23·1	24·7	22·2	21·8	18·0
24	26·3	24·2	25·9	21·9	22·8	27·2	19·1	21·3	18·8
25	29·1	20·0	23·1	21·0	21·8	27·9	21·5	19·5	15·1
26	29·9	13·8	22·3	17·9	22·8	31·5	25·9	19·5	17·9
27	26·0	17·1	17·6	15·7	18·4	32·5	**28·3**	16·4	15·3
28	18·8	21·3	19·3	18·3	24·4	**33·6**	21·8	16·3	20·0
29	23·1	23·0	22·7	18·5	23·6	19·0	20·4	16·0	20·5
30	26·8	27·1	24·3	22·2	20·1	21·1	22·0	19·7	20·8
31	29·3	21·8	27·8	22·9	19·8	20·8	22·1	21·8	17·1
Mean..	26·4	24·9	25·4	22·4	25·4	23·7	21·4	21·8	21·4
Max...	33·5	35·2	34·7	30·7	36·2	33·6	28·3	30·3	27·2
Min...	18·1	13·8	16·0	15·7	17·3	15·5	13·5	16·0	15·1
Range.	15·4	21·4	18·7	15·0	18·9	18·1	14·8	14·3	12·1

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

X.—THE METEOROLOGICAL SERVICE IN AUSTRIA.

The Central Office for Meteorology and Terrestrial Magnetism, Vienna.—Meteorological observations were begun in Austria, as in most other European countries, in the last century, and, as usual, at the astronomical observatory. At the beginning of the present century a considerable number of stations had commenced regular meteorological observations, and in Dove's *Repert. der Physik* (1837–44) about 94 stations in Austria are quoted. At the instigation of Kreil, the Imperial Academy of Sciences of Vienna turned its attention specially to Meteorology in 1847; in 1848 many stations were provided with instruments, and the system was placed under the supervision of a commission. The Central Office owes its existence to this commission, and Kreil was called from Prague and appointed director of the Institution; observations were begun there on the 1st September, 1852.

Kreil published the *Jahrbücher der k.k. Central-Anstalt für Meteorologie und Erdmagnetismus.* The first vol. contains the observations for 1848-49; the eighth and last contains the observations for 1856, and was published in 1861. Subsequently, owing to the want of funds, Kreil was obliged to limit his publications to the Results only. These first appeared (1853-8) in the Sitzungsb. of the Academy, and afterwards (1859-63) as an independent work under the title *Uebersichten der Witterung in Oesterreich.*

Such was the pitiable condition of the Central Office when Dr. Jelinek undertook the direction. He soon obtained funds for the publication of the observations, and the first vol. of the *Jahrbücher* (new series), containing the observations for 1864, appeared in the year 1866. The last published is Vol. XVII., n.s. Part I. (1880), or the twenty-fifth volume of the *whole* series. The condition of the service continued to improve, owing to Jelinek's activity and influence with the Ministry, and in May, 1872, the new institution on the *Hohe Warte* at Döbling, a suburb of Vienna, was established. On Jelinek's death in October, 1877, Professor J. Hann, then an assistant at the Central Office, was appointed Director. The following details of the activity of the Central Office, and of the stations in connection with it, refer to the year 1879. Formerly all the stations both in Austria and Hungary sent their observations to the Vienna office, but since the establishment of a Central Office at Buda-Pesth, in the beginning of the year 1871, the Hungarian stations have sent their observations

* Continued from *Meteorological Magazine* for July.

to the latter office. The stations in connection with the Vienna office have nearly doubled in number in nine years, being 122 in 1871, and 239 in 1879, including six stations of the first order. There is on an average one station for about 23 square miles, the stations being closer together than in any other of the larger systems. The stations of the second order are provided with standard barometers on Kappeller's and on Fortin's principles; aneroids are not used. The thermometers are placed in cylindrical metal screens, open at the bottom, and towards the north, and they are provided with conical roofs. The rain-gauges have a receiving area of 1-20th square metre = 9·93in. diameter. Windvanes and atmometers are supplied to a few stations.

At stations of the third order, temperature, cloud, direction and force of wind, and rainfall only are observed; at stations of the fourth order, rainfall only. Excepting at a few mountain stations all the observers are volunteers, and in many instances they supply their own instruments, all of which are verified at the Central Office. At most stations the observations are taken at 7h., 2h. and 9h., local time, at others the hours of observation are 6h., 2h., 10h., or 8h., 2h., 8h. Generally speaking the observers reduce their own observations, which are afterwards checked at the Central Office. Prior to the year 1880, there was no regular inspection of the stations. The best inspected stations are those of the Dalmatian coast by the Adria commission, those of Bohemia, and some of the Alpine stations.

Publications.— The observations are published in the *Jahrbücher* above referred to; for 17 of the so-called international stations (including also Corfu, Alexandria, and Beyrout), and for the Central Office at Vienna, the observations are now printed *in extenso*; for the others only the monthly and yearly results are published.

The following stations also publish their observations monthly in a more or less complete manner :—

Cracow, Lemberg, Klagenfurt, Görz (Gorizia), Trieste, Pola, Trient, and Prague (yearly only).

The materials received at the Central Office since 1851 have been discussed in various ways; of these discussions the following may be mentioned :—

Jelinek : The yearly range of temperature and pressure in Austria and some adjacent stations.—*Denkschriften Akad. Wissench.* xxvi. *Wien*, 1866.

Jelinek : The daily variations of temperature from the observations of the meteorological stations in Austria.—*Idem* xxvii. *Wien*, 1867.

Jelinek : Five day means of temperature for 88 stations referring to the 20 years 1848-67.—*Sitzungsbericht Akad. Wissensch. Feb.* 1869.

Jelinek : The temperature conditions of the years 1848-63 at the Austrian stations represented by 5 day means.—*Wien*, 1869.

Jelinek: On the annual distribution of days with thunderstorms in Austria and Hungary. (*Sitzungsb. May*, 1869.)

Kostlivy: Five day means of temperature for 24 stations. (*Sitzungsb. March*, 1878.)

Hann: Enquiry into the rainfall in Austro-Hungary. (*Sitzungsb. Oct.*, 1879, *and Jan.*, 1880.)

Also observations at individual stations, *e.g.*, Bodenbach, Pola, Trieste, Cracow, &c.

Observations at the Central Office at Vienna.—Fortin's barometer is read at 7 a.m., noon, 2 p.m., and 9 p.m.; a registering aneroid by Hipp records every ten minutes by a mechanism adapted to it by Osnaghi, but the records are not at present used. A Kreil's barograph has been in uninterrupted action for 25 years; this instrument registers every five minutes. There is also a Theorell's printing meteorograph, which records every 15 minutes, but its indications are not utilised.

The thermometers are fitted in a spacious screen about $3\frac{1}{2}$ metres (12 feet) high, by 2 metres ($6\frac{1}{2}$ feet) wide and deep. On the W. and E. sides it is closed by metal with an outer covering of wood, and fitted on the S. and N. sides by louvre-work. The screen contains, in addition to the ordinary thermometers, a thermograph by Hipp, which is used for the interpolation of the eye observations.

Earth thermometers are sunk at depths of 0·37m. (1ft. 2in.), 0·58m. (1ft. 11in.), 0·87m. (2ft. 10in.), 1·31m. (4ft. 4in.), and 1·82m. (6ft.) The deepest three thermometers, are read once daily; the two others thrice daily.

Two rain gauges are placed at a height of $1\frac{1}{2}$m. (5ft.) above the ground, and one level with the ground, and in addition self-registering gauges are in use.

Anemometers on Beckley's, Osler's, and Osnaghi's principles are in use.

Publications.—From the year 1876, the *Jahrbücher* contained hourly values for pressure, temperature, and wind direction and force; the other observations (three times daily) are published monthly in the *Wiener Akademischen Anzeiger.*

Of the discussions of the observations at Vienna itself may be mentioned:—

Jelinek: On the mean temperature at Vienna from 90 years' observations made at the Observatory.—*Sitzungsb. Wiener Akad. Nov.*, 1866.

Hann: Temperature at Vienna from 100 years' observations. (*Idem, Nov.* 1877.)

Hann: Influence of the winds on the mean values of the principal meteorological elements. (*Idem.* 1867.)

Hann: The daily period of the velocity and direction of the wind. (*Idem. Jan.* 1879.)

Considerable attention is also paid to magnetic observations, and the results are published in the *Jahrbücher.*

Weather Telegraphy. — From January, 1877, the telegraphic weather reports, which had previously only appeared in the newspapers and in the year books, were published in a special bulletin under the superintendence of M. Osnaghi. *Storm warnings* to seaports are not yet issued, but *résumés* are sent to Trieste and Pola, and to various foreign institutes. Since the year 1877, forecasts have been issued in the interest of agriculture at the special request of the agricultural societies. These service telegrams are allowed to pass at a reduction of 50 per cent. on the ordinary tariff. Full particulars respecting the utilization of meteorology for the benefit of agriculture, in Austria, may be found in the Austrian weekly journal of Agriculture, No. 6, 1878, and in M. Kostlivy's lecture on "Weather Telegraphy in the service of Agriculture" (Vienna, 1879). The Central Institute is under the Ministry of Public Worship and Education. The funds at its disposal are not fixed; for the year 1880 they amounted to £2,690. The director, three chief assistants, and porter have free residence, and postage and telegraphy (with the reservation above referred to) are also free.

The Stations of the First Order.—There are several stations of the first order in Austria, besides that at Vienna, *e.g.*, the observatories of Cracow, Kremsmünster, Prague; the Hydrographic Office at Pola, and the Nautical Academy of Trieste. But these institutions are not exclusively devoted to meteorology, and are independent of the Central Meteorological Office.

(*a*) *Cracow.*—In addition to the record of the self-registering instruments, direct observations are taken three times daily, and published in monthly parts. This Observatory also superintends the Galician system of stations of the second and third orders, established in 1865 by the Academy of Sciences of Cracow. In 1878 there were 29 such stations in action; and the observations have been published by M Karlinski, in *Materyaly do Klimatografii Galicyi*, 1867-78.

(*b*) *Kremsmünster.*—Observations were begun in 1763, but up to 1790 they were of little value; the temperature, for instance, was only observed once a day, and not at any regular time. From November, 1791, observations were taken three times a day; from 1821, five times a day; and from 1830, ten times daily (from 4 a.m. to 10 p.m.) The older series of observations (1763-1851) have, as far as possible been reduced and published in vol. 1 of the Vienna *Jahrbücher* (Vienna, 1854). The present director, Professor G. Strasser, extended the meteorological work by procuring self-registering instruments in the years 1877-78. These observations are published in detail in the Vienna *Jahrbücher.*

(*c*) *Pola.*—The Hydrographic Office of the Austrian Navy possesses a very complete set of self-registering instruments. Instruments are verified and supplied to the ships, and voluntary observations are made on the larger vessels. The results of the meteorological observations at Pola from 1864-73 have been discussed by F. J. Pick, and published in *Mittheilungen aus dem Gebiete des Seewesens* (Pola, 1874);

from the year 1872 monthly and yearly summaries have been published. The Director of this Institution is Dr. R. Müller.

(*d*). *Prague.*—This Observatory was established in the middle of the 18th century; the first meteorological observations date from the year 1752, and have been continued up to the present time. The first "year-book" was published by Kreil in 1839, and this publication was continued without material alteration by the subsequent Directors, Drs. Böhm and Hornstein. Direct observations are made by a Fortin's barometer five times daily, and a mechanical barograph, constructed by Kreil, registers every five minutes. Until 1874, a registering thermometer by Kreil was in operation; there is also a thermograph, by Hipp, in addition to the usual thermometers. The rain gauge is placed 72 feet above the ground. An Osler's anemograph by Adie records the pressure and direction of the wind, and a Robinson's anemograph is always in operation. The Observatory belongs to the University, and the Director is paid as one of the professors. A very noteworthy discussion of the various meteorological elements was published by Dr. Jelinek, which has served as a pattern for many subsequent investigations. *Ueber den täglichen Gang der vor züglichsten meteor. Elemente aus den stündlichen Beobachtn. der Prager sternwarte abgeleitet.* 70 pp. Fo. 6 plates. Wien, 1850.

(*e*). *Trieste.*—The meteorological observations at the Commercial and Nautical Academy began in the year 1841. Since that year a complete set of self-registering instruments has been in operation. Direct observations are made five times a day. The observations for the years 1841—73 have been discussed by M. Osnaghi, and the results are published in the year-book of the Vienna Institute (vol. ix. n.s). The director of the Academy, M. Paugger, has established a service for weather telegraphy, and publishes a daily bulletin.

(3). *The hydrometrical observations in Bohemia.*—This service is in connection with the forest associations, and is chiefly due to the exertions of Dr. E. von Purkyné, and to the liberality of some large landed proprietors. In January, 1880, observations were being made at 715 stations; the mountain declivities are well represented, the highest station being the Schneekoppe, 1,601 metres (5,253 feet). The observers are mostly forest-men, who record phenological observations, rainfall, &c., at the request of their employers. All the rain gauges are placed 1 metre (3 ft. 3 in.) above the ground, and the observations are made at 8 a.m., and are entered on post-cards, and these are sent on the first of each month to the Forest School at Weisswasser. Since January, 1879, M. Purkyné has published the observations of all stations *in extenso*, and has also published a useful index map of the stations. The cost of the service is about £300 a-year, exclusive of the cost of the rain gauges, which amounted to about £800.

(4). *The Austrian Meteorological Society.*—This society was formed by the exertions of the late MM. Jelinek and Fritsch, in 1863, but the first regular meeting was held on the 16th November, 1865.

The journal of the society, *Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, which has appeared since 1866, is, without doubt, the leading meteorological journal, and generally recognised repertory for the progress of meteorological science. The present editor is Dr. J. Hann, the director of the Central Meteorological Institution of Vienna, and a meteorologist of great eminence. On the 1st of January, 1879, the number of ordinary and honorary members was 307.

(5). *The "Adria Commission."*—This commission was established in 1865 by Baron von Wüllerstorf. Its duties consist in the investigation of tidal observations, sea temperature, specific gravity of the sea, and meteorological observations of the Adriatic, both on land and on ships. The observations made on land stations have been published in four reports by MM. Lorenz, Jelinek and Osnaghi (Vienna, 1869—78). The fourth report contains a discussion of the daily range of temperature at Lesina (1870—75) by M. Osnaghi.

XI.—THE METEOROLOGICAL SERVICE IN HUNGARY.

The Hungarian Central Meteorological Office at Ofen.—Until the year 1870 the Hungarian stations, 42 in number, were amalgamated with the Austrian system, but they were made an independent service on the 8th of April, 1870, under the direction of Prof. G. Schenzl. In the first vol. of the *Jahrbücher* of the Hungarian Institute, M. Schenzl gives detailed information respecting the earlier observations in Hungary. We may mention especially a discussion of the older observations by A. Berde (Klausenburg, 1847), and the more recent materials, up to 1865 by Prof. Hunfalvi (Budapest, 1865), an extract of which was published in the journal of the Austrian Meteorological Society, vol. ii. We shall briefly notice the duties of this service under the two heads (*a*), the meteorological stations in Hungary; (*b*), the observations at the Central Office.

(*a*). In the beginning of 1879 there were two stations of the first order (Ofen and Agram), 99 stations of the second order, and 13 stations of the third order. Most of the stations of the second order are provided with standard barometers, duly compared at the Central Office, and also with swinging-plate wind gauges, on Wild's principle somewhat modified. The observations are made three times a day. The observers are mostly volunteers, or receive a very small remuneration. The stations have been from time to time inspected by M. Schenzl. At the stations of the third order rainfall only is observed. At the end of the year 1880 the total number of stations amounted to about 130.

Publications—The meteorological observations are published in the Hungarian *Jahrbücher*, vols. i—viii, 1871—8. Since 1874, the plan proposed by the International Meteorological Committee has been adopted, as far as relates to the publication of monthly and yearly *résumés*. The Ofen observations only are published *in extenso*. M.

Schenzl has published a discussion of the earth temperature observations at Ofen, for the years 1863—71 (Jahrbuch II., 1872).

(*b*). The central station at Ofen possesses a barograph, but its indications are not published, for want of funds and clerical assistance. Direct observations of all the ordinary instruments are taken three times daily. The telegraphic weather service is restricted at present to receiving a few telegrams, from which a bulletin isdrawn up and posted in some public places and published in the newspapers. We may mention, that particular attention is paid to magnetic observations. The funds at the disposal of this institution amount only to about £1,330 a year.

The Agricultural Society of the valley of the Neutra (a tributary on the left of the Danube), has established two meteorological stations of the second order, and 22 rain stations, in the interest of agricultural meteorology, at the instigation of Baron G. Friesenhof. Complete monthly summaries of these observations are published in the reports of the society for 1876—8. In 1879 the society commenced weather forecasts, based on the *résumés* from Vienna, and on their own observations; in the monthly reports published since October, 1879, account is given of the success of these forecasts.

We are indebted to Dr. G. Hellmann's valuable reports for the above particulars.

J. S. HARDING.

OBSERVATIONS ON BEN NEVIS.

To the Editor of the Meteorological Magazine.

SIR,—In your last number it is stated that I ascend Ben Nevis *every* day. Kindly allow me to say that a trained assistant usually relieves me at the rate of twice a week. It is certainly hard and trying work, especially so in bad weather; but it must be remembered that, through the kindness of the Scottish Meteorological Society, I take a horse half-way, and this is a great relief to me.

Yours faithfully,

CLEMENT L. WRAGGE, F.M.S.

Fort William, August 2nd, 1881.

GREAT VARIATION IN TEMPERATURE.

To the Editor of the Meteorological Magazine.

SIR,—On Tuesday, July 5th, 1881, the maximum shade temperature here was 92°, and at night there ensued a series of thunderstorms, during which the thermometer fell rapidly. The following day, Wednesday, July 6th, the maximum shade temperature was only 62½°, so that the difference between the highest readings of the two successive days was no less than 29½°. A change of such extreme and sudden character is seldom experienced, even in this variable climate.—Your obedient servant,

W. F. DENNING, F.R.A.S.

Ashley Down, Bristol, July 11th, 1881.

SUPPLEMENTARY TABLE OF RAINFALL IN JULY, 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	...	XI.	Carno, Tybritle	3·13
,,	Margate, Acol	1·26	,,	Corwen, Rhug	1·20
,,	Littlehampton	2·12	,,	Port Madoc	5·89
,,	St. Leonards	2·68	,,	Douglas.....	2·81
,,	Hailsham	2·00	XII.	Carsphairn	4·53
,,	I. of W., St. Lawrence.	1·87	,,	Melrose, Abbey Gate...	2·37
,	Alton, Ashdell.....	2·01	XIV.	Glasgow, Queen's Park.	3·80
III.	Great Missenden	1·92	XV.	Islay, Gruinart School..	4·40
,,	Winslow, Addington ...	3·34	XVI.	Cupar, Kembach.....	3·05
,,	Oxford, Magdalen Col...	2·18	,,	Aberfeldy H.R.S.	1·75
,,	Northampton	3·58	,,	Dalnaspidal	...
,,	Cambridge, Merton Vil.	1·64	XVII.	Tomintoul.....	3·61
IV.	Harlow, Sheering	1·77	,,	Keith H.R.S.	5·31
,,	Diss	1·94	XVIII.	Forres H.R.S.	4·26
,,	Swaffham	2·64	,,	Strome Ferry H.R.S....	8·40
,,	Hindringham	2·22	,,	Lochbroom	4·16
V.	Salisbury, Alderbury...	1·82	,,	Tain, Springfield.....	4·05
,,	Calne, Compton Bassett	2·06	,,	Loch Shiel, Glenfinnan.	11·52
,,	Beaminster Vicarage ...	1·86	XIX.	Lairg H.R.S.	3·77
,,	Ashburton, Holne Vic..	3·40	,,	Altnabreac H.R.S.	..
,,	Langtree Wick	...	,,	Watten H.R.S.	3·10
,,	Lynmouth, Glenthorne.	1·78	XX.	Fermoy, Glenville	2·90
,,	St. Austell, Cosgarne...	...	,,	Tralee, Castlemorris ...	1·68
,,	Ilebrewers, Walrond Pk.	...	,,	Cahir, Tubrid	2·16
VI.	Bristol, Ashleydown ...	...	,,	Tipperary, Henry St....	1·94
,,	Ross	1·53	,,	Newcastle West	...
,,	Wem, Sansaw Hall.....	1·97	,,	Kilrush	1·51
,,	Cheadle, The Heath Ho.	2·16	,,	Corofin	1·94
,,	Bickenhill Vicarage ..	...	XXI.	Kilkenny, Butler House	1·09
VII.	Melton, Coston	2·05	,,	Carlow, Browne's Hill..	2·26
,,	Horncastle, Bucknall...	2·91	,,	Navan, Balrath	2·44
VIII.	Macclesfield Park	2·74	,,	Athlone, Twyford	1·79
,,	Walton-on-the-Hill.....	3·33	,,	Mullingar, Belvedere ...	2·40
,,	Broughton-in-Furness ..	7·89	XXII.	Ballinasloe	2·01
IX.	Wakefield, Stanley Vic.	1·88	,,	Clifden, Kylemore	...
,,	Ripon, Mickley	5·37	,,	Crossmolina, Enniscoe..	1·86
,,	Scarborough.....	3·29	,,	Carrick-on-Shannon ...	2·65
,,	Mickleton.....	4·91	XXIII.	Dowra	1·87
X.	Haltwhistle, Unthank..	4·37	,,	Rockcorry.....	1·76
,,	Shap, Copy Hill	5·45	,,	Warrenpoint	2·69
XI.	Llanfrechfa Grange	3·03	,,	Newtownards	3·07
,,	Llandovery	3·19	,,	Carnlough.....	...
,,	Solva	1·47	,,	Bushmills	3·33
,,	Castle Malgwyn	1·92	,,	Buncrana	2·74
,,	Rhayader, Nantgwillt..	2·52			

JULY, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg	Date.	No. of Nights below 32°. In shade.	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	1·85	— ·62	·55	5	14	94·6	15	44·3	28	0	0
II.		Maidstone (Hunton Court)	1·13	— ·91	·36	27	8	...	...	...	...	...	...
,,		Strathfield Turgiss	1·80	— ·50	·47	31	11	93·9	15	37·0	28	0	1
III.		Hitchin	2·29	— ·41	·78	5	12	84·0	5	46·0	20	0	0
,,		Banbury	2·25	— ·73	·56	30	14	88·0	5	38·0	28	0	...
IV.		Bury St. Edmunds (Culford)	2·68	— ·29	·72	8	15	88·0	5	40·0	28	0	0
,,		Norwich (Cossey)	2·13	— ·62	·61	19	12	92·0	15	44·2	28	0	0
V.		Bridport	1·76	...	·45	30	8	...	...	...	...	...	...
,,		Barnstaple	1·83	— 1·72	·57	30	...	87·0	6	34·0	8	0	...
,,		Bodmin	3·21	— ·23	·84	30	17	80·0	5	45·0	27	0	0
VI.		Cirencester	2·72	— ·29	·95	30	11	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	1·14	— 1·89	·25	23	13	83·5	5	44·5	7, 21	0	...
,,		Tenbury (Orleton)	1·47	— 1·44	·48	5	13	87·7	5	37·0	28	0	0
VII.		Leicester (Town Museum)	1·36	...	·40	5	13	87·0	15	43·0	28	0	0
,,		Boston	3·71	+ 1·18	1·16	6	12	92·0	6	45·0	20	0	0
,,		Grimsby (Killingholme)	1·81	— ·97	·91	6	10	85·0	4	46·5	21	0	...
,,		Mansfield	1·30	— 1·39	·37	6	11	85·9	5	44·7	28	0	0
VIII.		Manchester (Ardwick)	3·65	— ·16	1·02	27	13	93·0	5	45·0	21	0	...
IX.		Wetherby (Ribstone)	2·61	— ·00	1·02	6	10	...	...	...	...	...	...
,,		Skipton (Arncliffe)	7·87	+ 2·92	1·78	31	22	78·0	14	44·0	1	0	0
X.		North Shields	3·65	+ 1·10	1·16	5	12	79·2	14†	41·5	21	0	0
,,		Borrowdale (Seathwaite)	13·04	+ 4·27	2·48	24	26	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·37	— 1·56	·58	31	13	80·8	5	38·2	27	0	...
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	..	...	...
,,		Llandudno	3·41	+ ·70	1·80	5	12	74·8	4	47·6	9	0	0
XII.		Cargen	2·32	— ·81	·88	5	16	72·6	5	43·6	21	0	0
,,		Hawick (Silverbut Hall)	2·31	— ·81	·69	5	15	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	5·87	+ 2·58	1·10	5	22	...	...	...	...	...	...
XV.		Loch Long (Arddaroch)	...	...	...	...	...	...	...	...	...	...	...
,,		Kilmory	5·59	+ 1·05	1·04	17	25	...	...	41·0	16	0	...
,,		Mull (Quinish)	7·42	...	1·18	3	27	...	...	...	..	...	...
XVI.		Loch Leven	4·20	+ 1·15	·60	6	16	...	...	...	...	...	...
,,		Arbroath	3·05	+ ·41	1·12	6	15	76·0	14	45·0	21	0	...
XVII.		Braemar	2·89	+ ·03	·51	6	20	70·7	14	39·4	16	0	2
,,		Aberdeen	4·43	...	1·57	6	20	75·0	4, 15	43·0	26	0	0
XVIII		Portree	8·96	+ 3·50	·93	3	30	...	...	...	...	...	...
,,		Inverness (Culloden)	3·74	+ ·96	·85	7	12	69·0	14	42·0	27	0	0
XIX.		Dunrobin	4·10	...	1·04	6	20	67·8	15	39·5	27	0	...
,,		Sandwick	4·47	+ 1·81	1·56	6	23	69·9	11	43·8	27	0	0
XX.		Cork (Blackrock)	2·02	— ·82	·93	7	10	84·0	4	42·0	20‡	0	0
,,		Darrynane Abbey	...	...	...	...	...	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	2·40	...	·74	30	13	74·0	4, 15	42·0	20‖	0	...
,,		Killaloe	2·64	...	·61	24	21	84·0	18	40·0	21‖	0	0
XXI.	IRELAND.	Portarlington	1·53	— 1·15	·41	30	22	77·5	17	42·5	26	0	...
,,		Monkstown	2·05	...	·47	30	12	...	...	..	...	...	...
XXII		Galway	2·56	— 1·13	·40	2	24	69·0	6, 17	44·0	27	0	...
XXIII		Waringstown	2·66	— ·92	·49	24	18	80·0	14	41·0	22	0	0
,,		Londonderry	2·82	...	·56	24*	21	72·0	5, 14	47·0	20	0	0
,,		Edenfel (Omagh)	3·00	— ·25	·64	16	27	73·0	5	37·0	20	0	...

+ Shows that the fall was above the average; — that it was below it.
* And 25. † And 15, 18. ‡ And 27, 31. ‖ And 27.

METEOROLOGICAL NOTES ON JULY.

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

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was all that could be desired for agricultural crops, with refreshing rains just at the right time to fill out the grain. The excessive heat caused a rather premature ripening, but not so as to do harm, and the harvest will be plentiful everywhere in this neighbourhood. TS on 5th.

BANBURY.—Thunderstorms on 5th, 6th, 16th, and 26th; high wind on 24th, 30th and 31st.

CULFORD.—Early part of the month very hot and dry, refreshing showers at the close. T on 19th, 24th, and 26th.

BODMIN.—Mean temp. of the month, 64°·2.

CIRENCESTER.—A fine month, with several very hot days. The corn crops improved greatly during the month.

WOOLSTASTON.—Mean temp. of month, 61°·0.

ORLETON.—A very fine month with much sunshine, and at times very hot, the nights frequently clear and cold. Frequent light falls of R, but not sufficient to wet the soil to any depth. Mean temp. of the month 0°·5 above the average. Hay crop the smallest for many years. Distant T on the 6th, 19th, and 26th.

BOSTON.—The shade temp. in the middle of the day on the 6th was 92°, and at the same time on the following day it was 57°, a difference of 35°; it was again very hot on the 15th, the max. in shade on that day being 91°. The fine sunny weather did an immense amount of good to the crops; the corn, although very thin, looks healthy with full ears; potatoes promise a good crop. Heavy TS on the 6th, with 1·16 in. of R; 1·08 of which fell in about two hours. Very heavy R followed by a whirlwind on the 30th.

KILLINGHOLME.—The finest July for several years past; as often occurs in dry seasons, there were many strong indications of R when none followed. T and L on 6th, 24th, and 31st; sheet L on 5th and 28th; distant T on 9th. Hay crop very light; wheat and barley good, but not heavy.

MANSFIELD.—TS on 24th; L on 5th; T on 23rd and 26th.

ARNCLIFFE.—Violent TS on 5th; heavy storm of R on 31st.

NORTH SHIELDS.—Thunderstorms on 5th.

WALES.

HAVERFORDWEST.—The general character of the month was close and damp; no very high temp. occurring except on one occasion, the 5th, when the shade max. registered 80°·8, followed in the evening and night by a TS of unusual severity, which lasted about three hours; the L was very vivid, but the storms were not so violent as in other places. The air was very relaxing during the remainder of the month, some days were fine and bright, but cloud and damp heat generally prevailed. Mean temp. 59°·9; S. and S.W. winds blew on 19 days. The night of the 27th was unusually cold, the temp. falling to 38°·2, and on only seven days did the shade temp. reach 70°.

LLANDUDNO.—From the 8th to the 16th inclusive the weather was fine and bright, but afterwards to the end of the month it was variable and showery; there were only 161 hours of clear sunshine during the month. Severe TS on 5th; mean temp. 3° below the average.

SCOTLAND.

CARGEN.—Rather a cold dull month; mean temp. 1°·5 below the average. T on 5th; T and L on 26th.

HAWICK.—The month was rather cold throughout, and from the 6th to the 16th high winds prevailed.

QUINISH.—An excessively wet and cold month, making to the end of it a period of seven weeks of continuous wet and cold. Hay crop much damaged, the greater part of it being uncut and over ripe.

ABERDEEN.—Rainfall considerably above the average; and the weather has been cloudy during the day, with low night temperatures, greatly retarding the ripening of the crops in this and neighbouring counties. T and L on 22nd; L on 3rd; distant T on 20th.

PORTREE.—The coldest July on record, and very wet throughout.

CULLODEN.—Temperature low during the month. Cereals a fair crop, particularly barley; potatoe crop promising; turnips very inferior; hay also below an average crop.

DUNROBIN.—Cold, wet, and deficient in sunshine.

SANDWICK.—Cold, wet and cloudy, with a low bar., the pressure being above 30 inches only for a few hours on the night of the 16th. On the 20th the wind, which had been a moderate breeze, burst suddenly at 6 p.m., into a gale of nearly 50 miles an hour, and thus a number of Shetland boats were caught and lost, and many poor fishermen perished. Distant T on 14th.

IRELAND.

WATERFORD.—Distant T on 5th and 26th; prevailing winds S. to S.W.

KILLALOE.—Rain fell frequently during the month, but at no time heavily; the heat was scarcely up to the average, the general character of the weather being dull, calm, and sultry. No T or L. The corn harvest will probably be late.

FROST IN JULY AND AUGUST.

To the Editor of the Meteorological Magazine.

SIR,—On the morning of July 28th, there was frost enough here to cut the potatoes and French beans; they are now all black from its effects. The thermometer here, 3 feet from ground, went to 31°. There was ice on a piece of wet board at 6 a.m.—Yours faithfully,

G. F. MARX.

Arle-Bury, Alresford, Hants, 31st July, 1881.

To the Editor of the Meteorological Magazine.

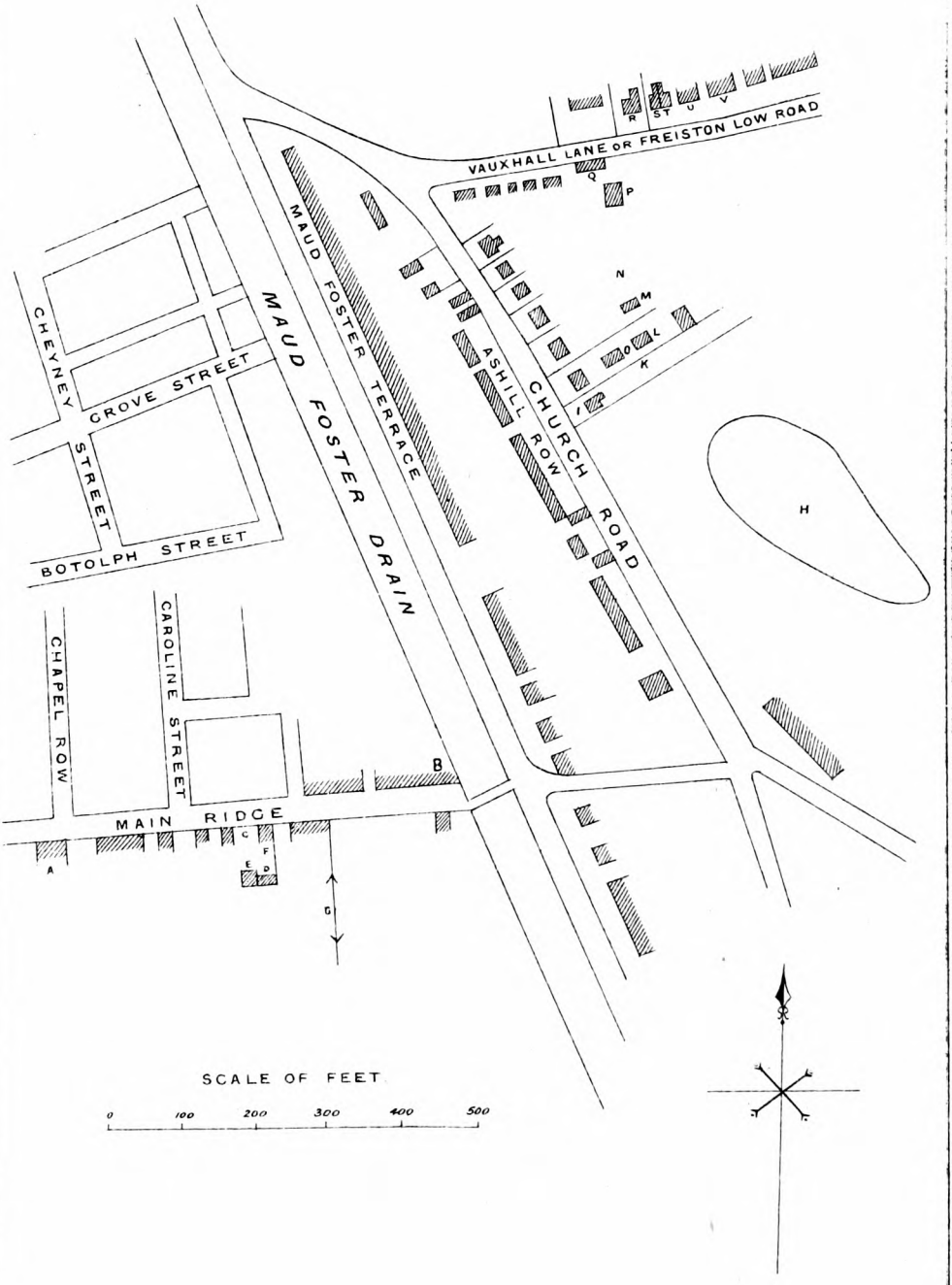
SIR,—At 10 p.m. on the 1st of this month, the sky was clear; air very sharp. At 4.30 a.m. on the 2nd, it was hard frost. Small pools of water were covered with ice as thick as writing paper; clothes, that had been left out all night. were frozen quite stiff; and the ground looked more like November than August. Fruit will have suffered.—Yours,

W. H.

Copy Hill, Shap, 3rd August, 1881.

WHIRLWIND AT BOSTON, JULY 30TH 1881.

PLAN.



ALFRED FOOT & SON LITHO 24 OLD BAILEY, E.C.

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CLXXXVIII.] SEPTEMBER, 1881. [PRICE FOURPENCE, *or 5s. per ann. post free.*

THREE WHIRLWINDS.

WE have been favoured by Mr. Wheeler, C.E., of Boston, with very full notes of the damage produced by a whirlwind on the north-east side of Boston, and Mr. Wheeler has also supplied maps whence the annexed one has been drawn. From these data we have compiled the following narrative.

On the afternoon of July 30th, between 2 and 5 p.m., nearly an inch of rain fell. After the rain ceased it became on the N.E. outskirts of the town intensely dark, and then a violent wind swept over a tract about 100 yards wide and a quarter of a mile long. The whole destruction was supposed to be over in two minutes.

A writer in the *Lincolnshire Guardian* says that the wind seemed to blow from all quarters towards Boston Market Place, and after a conflict the currents proceeded eastwards, making at the same time a loud noise. The noise is generally described as resembling the passage of several traction engines, and one writer says that it was a sort of whistling and rumbling combined, louder than thunder and not at all like it.

Phenomena of this kind pass so rapidly that it is not easy to be certain as to their sequence, although frequently the injuries themselves prove what it must have been. In this instance there is no doubt that as a broad general fact the line of injury was roughly from S.W. to N.E., from Main Ridge to Vauxhall Lane. The most south-westerly damage was the removal of some slates from the roof of Mr. Fenton's house (A) in Main Ridge, opposite Chapel Row, 1,200 feet east of the Market Place. The first distinct statement is from Mr. Leng, a builder, who was in the yard to the south of the letter C; he observed a few tiles whipped off the house at B (*) before his gate at C was blown open; then the shed D was blown down, the windows of the shop E were broken, and a stack of timber F blown into the adjoining garden to the east. At G there was a boarded fence 6 ft. high, of which about 100 feet was demolished, and carried eastwards.

* Some spouting from B was carried across Maud Foster Drain.

On crossing Maud Foster drain, which is about the size of a large canal, the water was sucked up about 1 ft. 6 in. or 2 ft. A little damage was done to the houses in Maud Foster Terrace, but nothing more serious than the loss of a few tiles and a few broken windows. The large pond (1½ to 2 acres) at H was much disturbed. According to some witnesses, its whole surface was lifted up from 1 ft. 6 in. to 2 ft., according to others even 3 ft., but that Mr. Wheeler says is impossible. Others says that it appeared to "boil all over and to swirl about."

Respecting this and other details, Mr. Wheeler remarks, "The wind created a vacuum as it passed along, lifting up the water in the river in small waves, and affecting the interior of the houses through the chimnies."

Several of the small houses in Ashill Row were slightly damaged, as was also the house in Church Road marked I. The fence K was blown down, and all the fruit trees, &c., torn up. A wooden shed at L, which was 8 ft. square and about 10 ft. high, was carried over the strawstack M into the garden at N. The roof was taken off the workshop at O, and part of the wooden spouting was found in the Frieston Road, 200 yards distant.

Hence to the foundry at P, there was open ground and the foundry received the full force of the wind. The chimney was blown down, part of the roof was taken off, and a strongly built shed smashed. The gable end and much of the roof of the house Q was taken off, and many of the tiles were carried across the road into the windows of the opposite houses, especially into R. This house was much damaged; a stack of chimnies was blown down, and part of the roof carried away, the ceiling of one bed-room was knocked down, the back doors were torn off their hinges, and a plum tree, 8 ft. high, was lifted bodily out of the ground in the garden. The adjoining houses S, T, U, V, were more or less damaged. No trace of injury was found in the open country beyond these houses.

On Friday, August 19th, about 3 p.m., a whirlwind passed in a north-easterly direction across the N.W. of Lincolnshire, passing close to the town of Brigg. The path undoubtedly extended from Upton, a village four miles S.E. of Gainsborough to Elsham, four miles N.E. of Brigg, a distance of nearly twenty miles, and in all probability extended further in both directions, one account stating that it commenced at the river Trent, E. of Lincoln, travelled across Lincolnshire, crossed the Humber, and disappeared in Yorkshire. The storm was accompanied along the greater part of its course by heavy rain, but at one or two points none at all fell.

Observers at Corringham and Grayingham noticed the heavy massing of the clouds, and the characteristic dark funnel-shaped cloud analogous to the upper portion of a waterspout.

The damage to the crops was very considerable, large quantities of grain being carried away and distributed promiscuously over the

country, and there was the usual complement of large trees snapped short off, and roofs and outbuildings destroyed, but apparently the track lay over very open country, or else the storm was not of the most severe character, as there are few reports of important structural damage to houses or substantial buildings, though several persons appear to have had narrow escapes from falling debris, &c.

At Upton, several sheep are said to have been rolled about and deposited in a ditch; at Springforth, a farmstead appears to have been directly in the track, and of course suffered considerably; all the farm buildings were unroofed, and some of them demolished; the stacks were overthrown, and the house suffered considerable damage to the roof and windows. At an adjacent house the kitchen was unroofed, and the windows broken, and the roof of one shed is reported to have been carried 100 yards; at Kirton in Lindsey, the minor damage was considerable, and a mill and its machinery was much injured. The windmill at Hibaldstow had the top shifted bodily 9 inches, and one of the sails was broken off, a piece of it weighing 4 stones, being carried half a mile, and a fragment 3 miles; the board schools and other buildings had their roofs damaged. At Brigg, several large trees and a greenhouse were blown down; the roof of the brewery was much damaged, and several children are said to have been lifted off their feet, and thrown down. To the north-east of Brigg, the damage appears to be of the general minor character.

To the Editor of the Meteorological Magazine.

SIR,—At a few minutes after 1 a.m. on Tuesday, the 9th inst., a destructive whirlwind just touched the edge of Bricket Wood, where it adjoins the high road close to a toll-gate about half-way from Watford to St. Albans. I have traced its path for half-a-mile or more in a S.W. and N.E. direction. In this course large trees are uprooted and portions of others broken off and scattered in all directions. One beech tree—about 11 feet in circumference 3 feet from the ground, and scarcely less 12 feet from the ground, and at least 60 or 70 feet in height (it had been sawn in pieces when I measured it)—fell across the high road, and another, which I did not measure, fell across a bye road leading to Waterdell Farm, at right angles to the former. Between these two a few branches are carried away from some fir trees at the extreme edge of Bricket Wood, and on, towards St. Albans, a small garden is laid waste, some trees have their lower and larger branches cut clean away, some are split down as if by lightning, and one has the upper portion cut off and carried away without injury to the lower branches. Other trees, in the direct path of the storm if it had travelled in a straight line, are quite uninjured.

The time of occurrence, and that the storm was a whirlwind, I was told by the toll-gate keeper, who had been up at 5 minutes to 1 to open the gate, and was awakened by the noise of the wind and the

crashing of the trees shortly afterwards. A more detailed account will, I believe, be presented to the Watford Natural History Society by a member residing in the neighbourhood.

I am, Sir, yours truly,

JOHN HOPKINSON.

Wansford House, Watford, 19th August, 1881.

To the Editor of the Meteorological Magazine.

SIR,—At 1.15 a.m. on the morning of the 9th inst., we were visited for a few minutes by a most tremendous gust of wind, which I estimated to be about "8" Beaufort notation, but the movement was very peculiar in the air, for though there was a force that rocked the large old elms close to my window nearly down to the ground, yet the large arms tossed wildly *to and fro*, but did *not* bend, as in a common gale, mainly in one direction, and then regain position.

The highest rate of movement appeared to be at 1.15 a.m., but I had been roused, as well as two others in the house, by the noise about four minutes before, and about the same number of minutes after, the great disturbance ceased.—Yours very truly,

ELEANOR A. ORMEROD.

Dunster Lodge, Spring Grove, Isleworth.

THE BRITISH ASSOCIATION AT YORK.

IT was generally understood that the Jubilee (or Jubile according to Dr. Haughton) meeting of the B.A. was to be a good one, but we think that few expected so brilliant a gathering as assembled to commemorate its original foundation. The special features of York society are fairly represented by its Minster, its Walls, and its Railway station. York stands pre-eminent as an ecclesiastical and antiquarian centre, but neither of these elements would furnish a large contingent to a B.A. meeting; but York is essentially a railway centre, and the North-Eastern directors rose to the occasion, and thus the meeting was largely recruited from Leeds, Bradford, and other surrounding towns. Moreover, York has never forgotten that its then new Museum sheltered the first B.A. meeting; and while the men of York with an able Lord Mayor at their head, had resolved that they would do their part and did it right well, the old members of the B.A. in many cases broke up their well-earned rest, in order to share in that meeting which they thereby helped to make a great success.

York possesses only one daily paper, *The York Herald*, but it discharged its extra duties with great credit to itself and benefit to all concerned, and as there was in addition an ample staff of representatives of the press from all parts of the Kingdom, the reporting was very well done. We, however, of course confine our notes to the proceedings bearing upon Meteorology.

First comes the list of meteorologists present at York, and this list was so long, that we have had to exclude all who are not known to us as Meteorological writers or observers. This necessarily involves risk of error, but we were bound to give either a shortened list or none at all.

Adams, Prof. J. C., F.R.S.	Cambridge.
Bateman, J. F., C.E., F.R.S.	London.
Bell, J. Lowthian, F.R.S.	Northallerton.
*Binnie, A. R., C.E.	Bradford.
*Black, Surgeon-Major	Edinburgh.
Brady, Sir Antonio	Stratford.
Chadburn, A.	Sheffield.
Clark, J. Edmund	York.
Corbishley, Rev. J.	Ushaw.
Crewdson, Rev. G.	Kendal.
Crossley, E.	Halifax.
*Curley, T., C.E.	Hereford.
Curtis, A. H.	Dublin.
*Cushing, T.	London.
Deacon, G. F., C.E.	Liverpool.
*Dines, G.	Walton-on-Thames.
*Dymond, E. E.	Apsley Guise.
*Dymond, Miss	Exeter.
Elliot, R.	Hawick.
Elliot, Sir W., F.R.S.	Wolfelee.
Evans, J., F.R.S.	Hemel Hempstead.
Everett, Prof. J. D., F.R.S.	Belfast.
*Field, Rogers, C.E.	London.
Filliter, E., C.E.	Leeds.
Fryer, J. F.	York.
Galton, F., F.R.S.	London.
Gilbert, J. H., F.R.S.	Harpenden.
*Glaisher, J., F.R.S.	Blackheath.
*Glaisher, J. W. L., F.R.S.	Cambridge.
Harrison, J. P.	London.
*Haughton, Rev. S., F.R.S.	Dublin.
*Healey, G.	Windermere.
Hennessy, H., F.R.S.	Dublin.
Hopkinson, J.	Watford.
*Howlett, Rev. F.	Alton.
*Jackson, M.	Ramsgate.
Knight, J. R.	Liverpool.
Knowles, G.	Shipley.
Larmor, Prof.	Galway.
*Latham, Baldwin, C.E.	London.
Lippincott, R. C.	Bristol.
Lloyd, Mrs.	Dolgelly.
Mackeson, H. B.	Hythe.
McLandsborough, J., C.E.	Harrogate.
Marten, E. B., C.E.	Stourbridge.
Mello, Rev. J. M.	Chesterfield.
*Muirhead, H., M.D.	Cambuslang.
Murdoch, J. B.	Glasgow.
Mylne, R. W., C.E., F.R.S.	London.
*Peggs, J. W., C.E.	London.
Pengelly, W., F.R.S.	Torquay.
Perry, Rev. S. J., F.R.S.	Stonyhurst.
*Preston, Rev. T. A.	Marlborough.

Procter, J. R.	Clementhorpe.
Richardson, H.	Cherry Hill.
*Scott, R. H., F.R.S.	London.
Smelt, Rev. M. A.	Cheltenham.
Smith, D.	Birmingham.
*Smith, Prof. H. J. S., F.R.S.	Oxford.
Stanley, W. F.	South Norwood.
*Symons, G. J., F.R.S.	London.
Talmage, C. G.	Leyton.
Tarbotton, M. O., C.E.	Nottingham.
Taylor, T.	Aston Rowant.
*Verney, Capt. R.N.	Rhianva.
Vincent, Rev. W.	Postwick.
*Watts, W.	Piethorne.
Wheeler, W. H., C.E.	Boston.
*Whipple, G. M.	Kew.
Woodd, C. H. L.	Hampstead.
Woodward, C. J.	Birmingham.

The extent to which the above list has been compressed is curiously illustrated by the fact that at the Meteorological Breakfast, the unprecedentedly large number of 40 sat down, and yet only 24 names in the above list are marked with the * indicating presence at it. The other 16, although more or less interested in the development of Meteorology, are not known to us as actual workers, and thus at present fail to obtain insertion.

REMARKABLE HAILSTONES.

To the Editor of the Meteorological Magazine.

DEAR SIR,—On the 27th August last I sent you a description of some remarkable hailstones which fell here. I had an opportunity myself of seeing last week some of the same, as well as others of an equally extraordinary shape.

I was in the Rainthal, a valley running up to the glacier at the base of the Zugspitz, with a friend, the Rev. James T. Fowler, vicar of Whittle-le-woods, Lancashire, when we were overtaken by a thunderstorm, at an elevation of about 3000 ft. (or 700 ft. above this valley). The storm lasted nearly an hour and a half, during which time rain descended in torrents, accompanied by heavy hail.

We took refuge in a small hay hut, in front of which ran a small track about a yard wide, between tall grass on either side. In this track, in the space occupied by the front of the hut (about four yards in length) we picked up hailstones as shewn in the accompanypanying sketch. The drawings were made on the spot by Mr. Fowler, and represent exactly the size and shape of the stones. 1 & 2, and 3 & 4, represent respectively the largest and smallest stones of the two shapes. Nos. 1 to 5 fell continuously as long as the storm lasted. Nos. 1 and 2 (which were exactly like hazel nuts), and 5 were opaque like porcelain and snow white. Nos. 3 and 4, (which with No. 11 will be recognized as the same as those of last year) were transparent, convex above, concave below, and perfect circles.

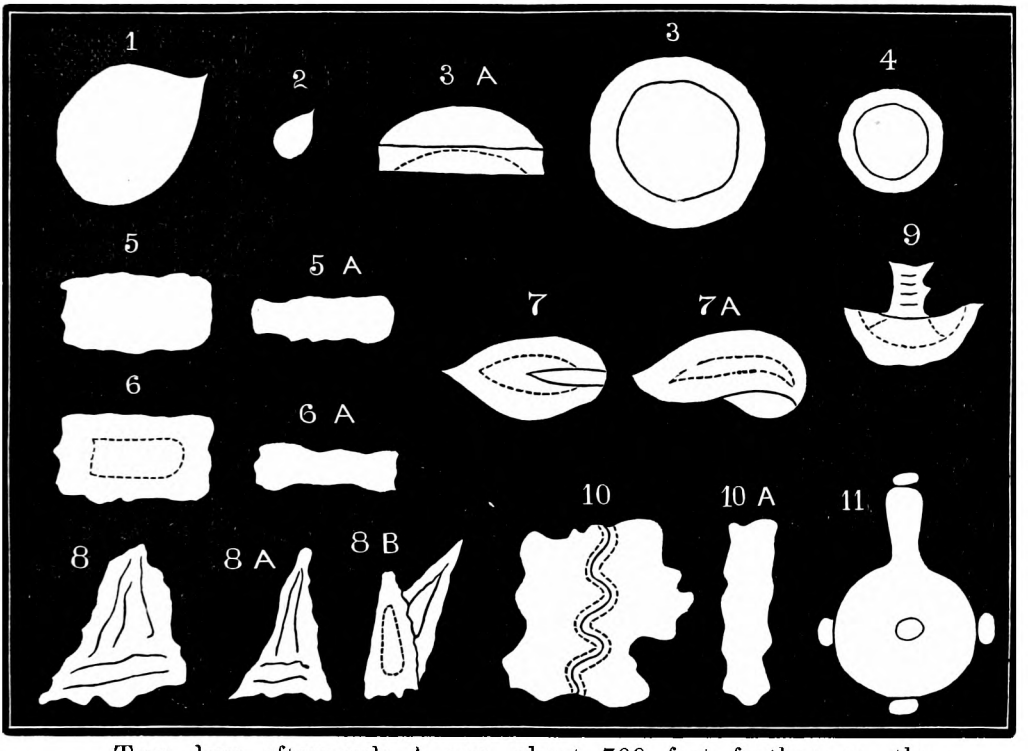
The remainder were all more or less transparent, and fell at intervals during the storm, after a more than ordinary brilliant flash of lightning.

In the sketch, the spaces between the dotted lines in Nos. 6, 7, 8B, and 10 were transparent as glass. In No. 8 A represents the side view of the stone, and B the end view.

No. 7 were like almonds split in half. No. 9 was like a mushroom and like No. 3 when viewed from above.

No. 10 resembled two pieces of rough ice dovetailed together, and was transparent at the dovetail.

No. 11 was precisely the same as those of last year, and the knobs were, as then, symmetrically placed.



Two days afterwards I was about 700 feet further up the mountain, and there the hail must have been much more severe, the ground being strewed with leaves and twigs of trees, the former in many cases perforated by the stones.—Faithfully yours,

MICHAEL FOSTER WARD, F.R.A.S. F.M.S.

Partenkirchen, Bavaria, 4th July, 1881.

THE SUMMER OF 1881.

To the Editor of the Meteorological Magazine.

SIR,—On the 2nd of May last (see *Met. Mag.*, Vol. XVI., p. 80) I predicted that "the coming Summer should be not unfrequently rather dry in character, though changeable and often cool." I also

said "that the mean temperature of the period from the second week of July to the second week of August, would probably be warmer than the average at Greenwich." Now, although the rainfall of June was almost equal to the average, July only 0·4 in. below, and August more than an inch and a half above the average of the last 66 years; yet, I think it will be remembered that the weather in these parts was not unfrequently dry up to the second week of August, indeed sometimes *very* dry. The Summer (June to August inclusive) has also been "changeable and often cool." Its violent changes of temperature appear to constitute its chief characteristic, and out of the 92 days, we had 56 cool ones and only 36 that were warm. The mean temperature of the Summer was about 0°·3 cooler than the Greenwich adopted average, but the period from the first day of the second week in July to the first day of the second week in August was 1°·8 warmer than the average. June was cooler than the average; we had two short intervals of cold weather even in July; and a long period of cold set in at Greenwich on the 9th of August. So the Summer forecast has been exactly fulfilled.

Your readers will perhaps like to know that the 15th of July last is not only remarkable for having the highest maximum temperature ever recorded at Greenwich (97°·1), but is equally distinguished by having the highest mean daily value (79°·5) ever recorded at that Observatory. The highest previously recorded (as shown by Mr. Glaisher's tables) are 79°·2 on the 24th of July, 1818, and 79°·1 on the 15th of July, 1825.—Yours truly, GEORGE D. BRUMHAM.

Barnsbury, 5th September, 1881.

THE HEAT IN JULY.

THERE was in the article in our last number one point left in some uncertainty, owing to the non-arrival of a letter from the National Observatory at Paris. It will be remembered that we gave (on page 117) a list of ten instances since 1704 on which the temperature at the National Observatory is reported to have reached 99°·9 or upwards, and at the same time stated that M. Renou had given reasons for considering most of these readings too high. But even if all of them are too high, it seems difficult to believe that the recent heat was unprecedented, for the max. at the National Observatory was only 97°·7. Doubtless some of the French authorities will discuss exhaustively both of the following questions—(1) at what stations, if any, was the temperature absolutely unprecedented? (2) what was the distribution of temperature on July 19th, and by what was it produced? Meanwhile, as we have been favoured with several records, we give a summary.

TEMPERATURE IN PARIS AND ITS ENVIRONS, JULY 19TH, 1881.

LOCALITY.	Distance and bearing from Cathedral of Notre Dame.	Max. temp. Fahrenheit.	Centigrade.
Wissous	7 miles S.	101°·1	38°·4
Parc St. Maur	7 ,, S.E.	101°·1	38°·4
,, ,, (Old Station)	6½ ,, S.E.	101°·1	38°·4
Chenevières	9 ,, S.E.	100°·2	37°·9
Montsouris Observatory	2¼ ,, S.S.W.	99°·0	37°·2
National ,,	1¼ ,, S.S.W.	97°·7	36°·5

From this it seems to have been two or three degrees hotter in the open country than in the city itself.

We may take this opportunity of quoting a few results which have reached us from verified thermometers, since the previous article was written :—

97°·0 on a Burrows stand, at Moor Hall, Harlow, Essex.
94°·5 on a Stevenson stand, at Guildown, Guildford.
89°·0 on a modified Glaisher stand, at Branch Hill, Hampstead.
87°·7 on a Stevenson stand, at St. Aubin's, Jersey.
87°·0 on a ,, ,, at Leicester.

THE RAINFALL OF THE PAST TWO YEARS.

To the Editor of the Meteorological Magazine.

SIR,—I beg to call your attention to the great contrast in the rainfall of this district during the two years ending 31st August, 1881. The following table will show this.

A difference of 118 per cent. between the two years. There was no fall that reached an inch in 24 hours during the first year, but in the second year there were no less than six falls of over an inch.—Yours truly,

J. PARK.

78, *Blatchington Road, West Brighton, Sept. 2nd,* 1881.

	BRIGHTON.		EASTBOURNE.		LITTLE-HAMPTON.		ST. LEONARDS		HAILSHAM.	
	79-80.	80-81.	79-80.	80-81.	79-80.	80-81.	79-80.	80-81.	79-80.	80-81.
	in.	in.	in.	in	in.	in.	in.	in.	in.	in.
Sept....	3·41	5·25	3·13	3·64	3·86	5·14	3·02	3·91	3·13	2·43
Oct. ...	·83	6·18	1·37	8·48	1·23	7·41	1·12	8·07	·88	6·37
Nov. ...	1·09	4·16	1·13	4·92	·74	4·27	1·03	4·78	1·35	4·11
Dec. ...	1·03	4·08	·86	4·96	·87	4·28	·98	5·00	1·20	4·64
Jan. ...	·63	2·50	·52	*1·18	·47	1·98	·42	*1·17	·49	* ·56
Feb. ...	2·76	3·52	3·46	3·26	3·31	3·24	2·90	1·91	3·28	2·86
March.	·91	2·85	·81	3·23	·90	2·53	·68	3·22	·50	2·87
April...	1·77	·64	1·94	·58	1·82	·65	2·23	·65	1·69	·78
May ...	38	1·07	·09	1·31	·48	1·05	·07	1·09	2·61	·89
June ...	1·56	3·42	2·78	2·51	1·61	2·11	3·14	2·75		2·52
July ...	3·22	2·34	2·87	1·97	3·20	2·12	4·00	2·68	3·28	2·00
Aug. ...	1·02	4·51	·41	4·22	·90	4·26	·55	3·99	·41	4·69
Total...	18·61	40·52	19·37	40·26	19·39	39·04	20·14	39·22	18·82	34·72
Pr.cent	100	218	100	208	100	201	100	195	100	184

[We have added to Mr. Park's table the amounts for four other stations, which indicate that the difference between the two years was greatest at Brighton, decreasing gradually all round, and the decrease continues northwards, the total for the second year expressed as a percentage of the first being at London 151, Barnstaple (Devon) 150, and Mansfield (Notts.) 134.—ED.]

* These amounts are probably too small, owing to the difficulty of measuring the great fall of snow on January 18th.

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

XII.—ITALY.

THE meteorological service in Italy is so complicated that it is difficult to give a satisfactory *résumé* of it. In addition to the Central Office, there is a large number of observatories and stations more or less completely furnished, which are for the most part independent establishments, but many of the so-called "observatories" only correspond to our stations of the second order.

1. *The Ufficio centrale di Meteorolgia* at Rome. We possess some long series of observations from Italy, owing to the early foundation of some of the Observatories, *e.g.*, Bologna (1723), Milan (1760), Padua (1767), Florence (1774), Rome, Collegio Romano (1787), Palermo (1790). M. Toaldo, the first Director of the Padua Observatory, established a system of more than sixty observers; the materials which he collected, mostly referring to temperature and rainfall, were published in a complete manner by M. Schouw, in his *Tableau du climat et de la végétation de l'Italie* (Copenhagen, 1839).

Towards the middle of the present century an attempt was made to organize an extensive system on an uniform plan in connection with the Museum of Pisa. A *prima publicazione* was issued containing some old and new observations made at Florence, since which no other publication appeared. A decided advance was made when the Government took the matter in hand, and by decree of 13th December, 1863, appointed a Committee for Weather Telegraphy, and in the next year established a section for Meteorology at the Ministry of Agriculture. In April, 1865, a Committee was charged with the collection of materials for a work on the climate of Italy. The only result, so far as we know, was the publication by M. Schiaparelli, entitled *Sul clima di Vigevano*, near Milan (1868).

In 1865, the meteorological section of the Ministry of Agriculture began the issue of the *Meteorologia Italiana*, containing 10-day means of about 30 stations, and out of this section sprang the Central Office in 1877. A superintending council of nine members was appointed, one of whom, M. P. Tacchini, is the Director of the Central Office at the *Collegio Romano*. About 80 stations now send in their observations every 10 days; 8 stations are of the first order, and about 20 have one or more self-registering instruments. The observations are generally taken at 9h, 3h, and 9h, and at some stations 6 times daily. About 20 of the stations take synchronous observations, which are sent every 10 days to Washington. All the stations were inspected in 1877.

Publications by the Central Office. These have assumed various forms; from 1865-73 they were large folio vols., containing observa-

* Continued from *Meteorological Magazine* for August.

tions partly *in extenso* and partly 10-day and monthly means. From 1874-7 a *Bollettino decadico* was issued, and from 1875 a *Bollettino mensile* has been issued, containing observations published on the plan recommended by the International Meteorological Committee. In January, 1878, the observations of 38 stations, and in 1879, 24 stations (only) were published. In the *Supplemento alla Meteorologia Italiana*, and now in the *Memorie e Notizie della Meteorologia Italiana* meteorological articles are published, forming really a Meteorological Repertory. In the *Meteorological Magazine* for January last attention was drawn to the increased activity of the Central Office, under the able superintendence of M. Tacchini, and to the first volume of the *Annali*.

The following general discussions may be specially mentioned :—

1872, Riassunto delle osservazioni eseguite nel settennio, 1866-72.

1878, *G. Grassi*, Sul calculo della temperatura media diurna in Italia.

1878, *G. Grassi*, Sul calculo dell'andamento annuale delle temperatura in Italia.

In the first volume of the *Annuario statistico Italiano* there are 11 years' means of the principal stations (1866-76).

Since the year 1872 several forest meteorological stations have been established on the same system as in Bavaria. Full particulars respecting these stations are given by M. Cantoni in the *Memorie e Notizie* for 1876 and 1878.

Considerable attention is paid to Agricultural Statistics. The observations include temperature of air and soil, solar radiation, humidity, evaporation, rainfall, and the state of the sky. In accordance with the proposal of M. Cantoni, the instruments are exposed to sun and rain on a iron support called *albero meteorico*, and latterly a kind of Stevenson's thermometer screen is employed at some stations.

The air-thermometers are placed at 20 ins., 3 ft. 3 ins., and 5 ft. above the ground ; and earth-thermometers are placed at depths of 10 ins., 18 ins., and 25 ins.

Radiation is observed by an apparatus by Bellani (*Radiometro collettore*), consisting of two bulbs filled with alcohol, one blackened and the other white.

For evaporation, Piche's little instrument is used. In March and October, observations are made at 8h, 11h, 2h, and 5h, and in the other summer months at 7h., 11h., 3h., and 7h. Some of the results deduced from these observations are published in the *Supplemento alla Meteorologia Italiana*, 1876, III., and 1877, I., and *Memorie e Notizie*, 1878, II. and III. Since November, 1879, a *Bullettino di Notizie agvarie*, has been issued containing 10-day means of temperature, the days of rain, thunderstorms, &c., at about 50 stations, together with notices upon the state of the crops, fruits, &c.

From the same date the Central Office has issued a daily *Bullettino meteorico*, containing the usual tables, and weather charts, and occasionally interesting notices of the weather.

The funds at the disposal of the Central Office were at first, before the almalgamation of other services, £2,000, mostly provided by the Ministry of Agriculture, which also pays for the printing. The Director draws part of his salary from another office.

2. The *Ufficio centrale meteorologico della R. Marina*, at Florence. This office was established in December, 1863; the first Director was the well-known M. Matteucci, whose book of Meteorological Instructions is still in use. On his death M. Donati was appointed Director, and subsequently M. Pittei. This service has now been amalgamated with the Central Office at Rome. Its principal duties were the organization of an extensive telegraphic weather service, chiefly in the interests of the marine, and the issuing of storm warnings with the FitzRoy signals. The funds at the disposal of this office were £500. We presume that this sum has now been transferred to the Central Office at Rome.

3. The "*Commissione idrografica.*" This Commission was formed in December, 1866, for the organization of rainfall and hydrometrical observations. In January, 1880, there were 500 rain stations, and about 850 hydrometrical stations; the observations are sent to the Ministry of Public Works. The rain gauge adopted by the Commission has a large receiver, of about two square feet (one-fifth square metre).

Hitherto the Commission has only published one bulletin (1872) in addition to a report upon its activity. It has also published 11 volumes of graphical representations of rainfall, &c., (*Bullettno idrografico, Fasc., I--XI.*, Rome, 1873-1878).

4. The "*Osservatorio del Collegio Reale Alberto,*" at Moncalieri, and the *Corrispondenza meteorologica Italiana Alpina—appennina.*" This Observatory was established in 1859, by M. F. Denza, and is now one of the best organized observatories in Italy; the funds are provided by the Barnabite College. The observatory restricts its labours entirely to meteorology, and embraces all the observations of a station of the first order.

The Bullettino meteorologico has already reached 13 vols. (1866-78). In 1872 a system of rainfall stations was established in Piedmont, which soon extended to all Upper Italy. The stations number about 300. The monthly values are published in the Moncalieri bulletin.

The untiring energy of M. Denza established the *Corrispondenza meteorologica Italiana Alpina—appennina*, in connection with the Alpine Clubs. The stations number about 115, and are distributed over the whole of Italy. About 20 of the stations have been established at the cost of the Government, and the remainder at private cost, amounting to not less than £10,000. The observations are taken generally three times daily, and most of the stations have been inspected by M. Denza. The results of the barometrical comparisons are published in "*Confronti dei barometri delle stazioni meteorologiche Italiane.*" The observations are published in 8 vols. (1872-9) containing 10-day means; monthly means are published in the Quarterly Bulletin of the Italian Alpine Club, and some observa-

tions are given in greater detail in the Moncalieri bulletin. This system has now been formed into an Italian Meteorological Association, with which is amalgamated the Italian Meteorological Society.

(To be continued).

SUPPLEMENTARY TABLE OF RAINFALL IN AUGUST, 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	5·39	XI.	Carno, Tybritle	5·66
,,	Margate, Acol	2·73	,,	Corwen, Rhug	5·31
,,	Littlehampton	4·26	,,	Port Madoc	5·90
,,	St. Leonards	3·99	,,	Douglas.....	5·31
,,	Hailsham	4·69	XII.	Carsphairn	4·44
,,	I. of W., St. Lawrence.	4·11	,,	Melrose, Abbey Gate...	6·30
,,	Alton, Ashdell.....	...	XIV.	Glasgow, Queen's Park.	3·33
III.	Great Missenden.....	6·39	XV.	Islay, Gruinart School..	2·37
,,	Winslow, Addington ...	4·75	XVI.	Cupar, Kembach.....	5·54
,,	Oxford, Magdalen Col...	4·64	,,	Aberfeldy H.R.S.	...
,,	Northampton	3·95	,,	Dalnaspidal	...
,,	Cambridge, Merton Vil.	...	XVII.	Tomintoul.....	3·34
IV.	Harlow, Sheering	4·89	,,	Keith H.R.S.	2·63
,,	Diss	4·73	XVIII.	Forres H.R.S.	2·77
,,	Swaffham	4·52	,,	Strome Ferry H.R.S....	4·51
,,	Hindringham	3·18	,,	Lochbroom	3·65
V.	Salisbury, Alderbury...	5·96	,,	Tain, Springfield.....	1·78
,,	Calne, Compton Bassett	4·90	,,	Loch Shiel, Glenfinnan.	6·68
,,	Beaminster Vicarage ...	7·06	XIX.	Lairg H.R.S.	..
,,	Ashburton, Holne Vic..	8·67	,,	Altnabreac H.R.S.	3·71
,,	Langtree Wick	4·49	,,	Watten H.R.S.	1·61
,,	Lynmouth, Glenthorne.	5·84	XX.	Fermoy, Glenville	4·66
,,	St. Austell, Cosgarne...	4·84	,,	Tralee, Castlemorris ...	5·80
,,	Taunton, Fullands	...	,,	Cahir, Tubrid	4·92
VI.	Bristol, Clifton	5·64	,,	Tipperary, Henry St....	5·64
,,	Ross	4·77	,,	Newcastle West	5·55
,,	Wem, Sansaw Hall.....	3·32	,,	Kilrush	4·83
,,	Cheadle, The Heath Ho.	5·81	,,	Corofin	...
,,	Coundon	5·61	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	4·73	,,	Carlow, Browne's Hill..	4·40
,,	Horncastle, Bucknall...	4·57	,,	Navan, Balrath	5·01
VIII.	Macclesfield Park	5·28	,,	Athlone, Twyford	5·95
,,	Walton-on-the-Hill.....	5·51	,,	Mullingar, Belvedere...	4·89
,,	Broughton-in-Furness ..	5·79	XXII.	Ballinasloe	4·44
IX.	Wakefield, Stanley Vic.	3·43	,,	Clifden, Kylemore	8·42
,,	Ripon, Mickley	6·03	,,	Crossmolina, Enniscoe..	...
,,	Scarborough.....	7·53	,,	Carrick-on-Shannon ...	3·59
,,	Mickleton	6·46	XXIII.	Dowra	...
X.	Haltwhistle, Unthank..	5·42	,,	Rockcorry.....	3·82
,,	Shap, Copy Hill	6·22	,,	Warrenpoint	4·78
XI.	Llanfrechfa Grange	5·57	,,	Newtownards	4·01
,,	Llandovery	5·81	,,	Carnlough.....	...
,,	Solva	3·30	,,	Bushmills	3·21
,,	Castle Malgwyn	3·99	,,	Buncrana	3·21
,,	Rhayader, Nantgwillt..	6·43			

AUGUST, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32° In shade.	No. of Nights below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	4·89	+ 2·15	·84	12	19	84·6	5	42·3	28	0	0
II.		Maidstone (Hunton Court)	3·57	+ 1·33	1·02	12	17	...	...	...	...	...	...
,,		Strathfield Turgiss	5·38	+ 2·96	1·35	12	17	77·4	4	38·0	29	0	0
III.		Hitchin	4·70	+ 2·42	·62	8	20	78·0	5	45·0	31	0	...
,,		Banbury	5·40	+ 2·70	·90	23	19	81·0	5	40·0	28	0	...
IV.		Bury St. Edmunds (Culford)	4·82	+ 2·65	·67	29	21	83·0	5	37·0	27	0	...
,,		Norwich (Cossey)	3·64	+ 1·02	·63	29	19	86·5	5	42·0	28	0	..
V.		Bridport	5·72	...	·86	22	17	69·0	7, 10	35·0	28	0	...
,,		Barnstaple	5·60	+ 1·50	·69	8	22	79·0	6	44·0	28	0	...
,,		Bodmin	4·63	— ·21	·74	8	24	70·0	5	44·0	28	0	0
VI.		Cirencester	5·37	+ 1·71	·74	25	16	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	4·48	+ ·40	·81	16	22	82·5	1	43·0	30	0	...
,,		Tenbury (Orleton)	3·88	+ ·16	·52	22	18	81·0	5	37·7	28	0	0
VII.		Leicester (Town Museum)	5·18	...	1·36	8	19	82·0	5	41·0	28	0	0
,,		Boston	4·34	+ 1·73	1·08	8	16	85·0	5	42·0	28	0	...
,,		Grimsby (Killingholme)	5·28	+ 2·36	1·10	16	21	81·5	5	46·0	12	0	...
,,		Mansfield	5·72	+ 2·59	1·34	23	24	82·7	5	41·3	28	0	0
VIII.		Manchester (Ardwick)	5·39	+ 1·47	·55	18	25	83·0	5	44·0	28	0	...
IX.		Wetherby (Ribstone)	4·04	+ 1·41	1·02	30	9	...	...	...	...	...	...
,,		Skipton (Arncliffe)	7·11	+ 1·31	2·05	25	25	76·0	4	38·0	1	0	...
X.		North Shields	4·76	+ 1·67	·78	23	21	79·0	5	41·2	28	0	0
,,		Borrowdale (Seathwaite)	13·53	+ 2·49	3·76	25	28	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	5·85	+ ·52	1·07	8	20	...	...	...	...	...	...
,,		Haverfordwest	4·89	— ·08	·96	21	20	70·6	4	38·0	31	0	...
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	...	..	...
,,		Llandudno	4·92	+ 1·73	·87	29	20	72·2	4	45·7	2	0	...
XII.	SCOTLAND.	Cargen	5·88	+ 1·61	1·54	25	19	66·8	4	40·2	2	0	...
,,		Hawick (Silverbut Hall)	5·44	+ 1·54	1·26	25	17	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	3·89	— ·41	1·03	25	17	...	...	...	...	...	...
XV.		Kilmory	3·53	— 1·69	·97	25	18	...	...	34·0	31	0	...
,,		Appin Airds	...	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	5·56	...	1·02	7	21	...	...	...	...	...	...
XVI.		Loch Leven	4·50	+ ·42	1·10	26	13	...	...	...	...	...	...
,,		Arbroath	3·94	+ ·61	1·04	25	14	73·0	4	39·0	29	0	...
XVII.		Braemar	4·86	+ ·43	2·56	25	23	69·2	4	31·0	23	1	9
,,		Aberdeen	3·16	...	1·35	25	18	70·0	3, 4	36·0	28	0	...
XVIII		Portree	7·64	+ 2·61	1·31	7	23	...	...	...	...	..	...
,,		Inverness (Culloden)	3·16	+ ·16	1·05	26	15	71·0	4	36·0	23	0	2
XIX.		Dunrobin	1·84	...	·50	25	15	69·5	4	40·0	23	0	...
,,		Sandwick	3·42	+ ·52	·69	5	21	64·8	5	42·4	25	0	0
XX.	IRELAND.	Cork (Blackrock)	5·40	+ 1·57	1·21	23	16	78·0	6, 15	36·0	31	0	...
,,		Dromore Castle	6·90	...	·95	24	22	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	6·52	...	2·08	24	21	69·0	8*	35·0	31	0	...
,,		Killaloe	6·86	...	·94	11	25	80·0	8	41·0	†	0	...
XXI.		Portarlington	5·31	+ 2·24	·96	18	25	69·0	4	41·5	20	0	...
,,		Monkstown	5·71	...	·95	28	20	...	...	..	...	..	...
XXII.		Galway	5·50	+ ·84	1·02	24	22	70·0	5	44·0	28‡	0	...
XXIII		Waringstown	4·77	+ 1·33	1·01	25	20	78·0	4	36·0	31	0	...
,,		Londonderry	2·86	...	1·02	25	20	72·0	5	43·0	31	0	1
,,		Edenfel (Omagh)	3·79	+ ·14	1·06	25	27	71·0	4	31·0	31	1	0

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

* And 11, 23. † Various. ‡ And 31.

METEOROLOGICAL NOTES ON AUGUST.

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

ENGLAND.

STRATHFIELD TURGISS.—A very wet and unsettled month; fine crops, which it is impossible to get in; potatoe crop the best for some years, but damaged by the wet.

HITCHEN.—The coldest August for more than 30 years.

BANBURY.—The three latter weeks of the month were disastrous to the corn crops; wheat much mildewed, and in many cases sprouted. T and L on 8th and 23rd; high wind on 10th, 19th, 24th, 25th, and 26th.

CULFORD.—The most dreary August ever remembered, most of the crops if not spoiled will be very much damaged. T on 17th, 18th, and 24th.

COSSEY.—A very fickle month after the 8th, with a low temperature and high winds from N.W., which enabled many farmers to cart and stack their corn in fair order.

BODMIN.—A cold, rainy, and unseasonable month; mean. temp. 62°·1.

CIRENCESTER.—The wettest month in the year to the present time, and the latter part of it cold and ungenial; corn much injured.

WOOLSTASTON.—A very harassing month to farmers; harvest operations, which began early, at a complete standstill for the last three weeks, and the quality of the grain much injured.

ORLETON.—The first seven days were fine and dry, with a temp. above the average, but the remainder of the month was very cloudy and wet; most unfavourable for the ripening and harvesting of the grain crops. Mean temp. nearly 2°·5 below average, and lower than that of any other August since 1860. The bar. was generally low after the 7th, and the wind cold and rough, especially on the 11th, 19th, and 26th. L and T on 8th and 23rd.

LEICESTER.—T and L on 9th and 23rd; L on 27th.

BOSTON.—The constant rain during the month interfered most seriously with the ingathering of harvest; the cutting of the corn commenced at the beginning of the month, and none had been stacked at the end.

GRIMSBY.—After the first week rain fell almost daily, and often in considerable quantities, damaging the corn to a great extent; potatoes have resisted the disease wonderfully. T and L on 8th and 29th.

MANSFIELD.—TSS on 8th, 17th, and 23rd.

ARNCLIFFE.—Unusually sunless and much rain; TS on 18th.

NORTH SHIELDS.—TS on 22nd; T on 4th, 17th, and 21st.

SEATHWAITE.—Fearfully wet weather: four falls of rain exceeding one inch in 24 hours.

WALES.

HAVERFORDWEST.—A rather changeable month; weather close and damp; very wet from 21st to 29th; crops very good and looking healthy, for although much R fell, no harm has resulted to the grain owing to the strong wind and low temp.

LLANDUDNO.—Notwithstanding a few fine days the month was cold, wet, and sunless: Mean. temp. more than 3°·5 below the average.

SCOTLAND.

CARGEN.—A cold dull rainy month: mean temp. 55°·9, 3°·1 below the average; sunshine, 173 hours, 43 hours below average. T on 22nd.

SILVERBUT HALL.—A cold, wet, and sunless month; potatoe disease spreading. T on 22nd.

QUINISH.—The month was like the two previous ones, very wet and cold. The rainfall of the 3 months, June-August, 19·35 in., is greatly in excess of that of any similar period.

BRAEMAR.—A very ungenial, cold month; crops very late.

ABERDEEN.—Sunless and cold except the first few days; rainfall about the

average. Heavy H showers on 27th. The squally weather during the month greatly hindered the herring fishery on the N.E. coast.

PORTREE.—The coldest August on record, and very wet; hard frost on the morning of the 29th, which blackened the potatoes.

CULLODEN.—Month cold and very ungenial; harvest late, turnips improving considerably.

SANDWICK.—Cold, from the prevalence of northerly winds; rainfall above the average, and the weather very cloudy. Barometer readings low. Crops about a fortnight later than usual. Wind reached a velocity of 40 miles an hour on 11th and 26th.

IRELAND.

DROMORE.—Hay crop good and heavy, but secured with difficulty, and in some cases injured; potatoes have suffered in heavy ground, but there is still a good crop.

WATERFORD.—Temperature very low all through the month, the rainfall of the 24th, 2·08 in. has only once been exceeded since 1875: 1·07 in. fell in an hour and a half.

KILLALOE.—Only five wetter Augusts since 1848; harvest greatly retarded and much injury to hay crop.

WARINGSTOWN.—The frequent rains of the latter part of the month rendered it very difficult to save late hay, and delayed harvest operations, but up to the end of the month no really serious damage had been done.

LONDONDERRY.—Crops looking well, and harvest work going on vigorously after the 18th.

EXTREME SUMMER HEAT.

A correspondent writes under date Odessa, August 12th—"Referring to the great heat of the present summer in certain parts of the United States and of Europe, especially in England and France, a local newspaper draws attention to a statement, presented to the French Academy in 1811 by Dominic Kassini, asserting that the years 1684, 1686, 1691, 1699, 1701, 1704, 1712, 1726, 1727, and 1781 were also remarkable for extreme summer heat. This list was, however, unaccompanied by details, and the summer of 1793 appears to be the first respecting which complete information exists, and which was probably the most intense that had been known in France up till that time. The preceding spring was a cold one, and lasted so long that household fires were kept up during the whole of June. But on the 4th July a warm wind set in, and by the 8th of that month the thermometer rose to 38 centigrade (100·4 Fahr.) in the shade. That abnormal heat, according to a writer at the time, especially as it followed upon such continuous cold, produced most ruinous effects. Every green thing in the fields dried up, the fruit upon the trees was burnt to cinders, furniture assumed all sorts of strange forms through being warped, and the earth everywhere showed cracks and crevices. This state of things lasted until the 17th of July, when a heavy hailstorm occurred and requickened nature. Although the summer of 1819 was temperate in Europe, it was so hot in Asia Minor that at Bagdad the thermometer rose, even in the most sheltered places, to 120 deg., and at midnight stood at 108. There the season was followed by heavy rains, which caused death to numbers of people, and even destroyed whole caravans during their journey. The next remarkably hot summer occurred in 1822, when, as in the year immediately preceding, fields on some parts of the Continent, especially in Alsace and Lorraine, were so over-run with mice that in the neighbourhood of Strasburg two millions of these little animals were killed in a couple of weeks; and this fact of their appearing in such great numbers in Spring has been accepted by some as a precursor of great heat. The harvest of that year was so early, too, that fresh flour was sold at some of the French markets on the 28th of June. The summer of 1832 is still remembered for its intense heat and its cholera, which carried off 18,400 persons in Paris alone, while that of 1811, on the other hand, is remembered for its abundant vintage and its comet. Since that time, the summers of 1842 and 1875 appear to have been the hottest in Europe."—*Leeds Mercury.*

[Of course we do not hold ourselves responsible for the accuracy of all these statements, but the paragraph seems of sufficient interest to justify preservation.—ED. *M. M.*]

SYMONS'S

MONTHLY

METEOROLOGICAL MAGAZINE.

CLXXXIX.] OCTOBER, 1881. [PRICE FOURPENCE, *or 5s. per ann. post free.*

THE BRITISH ASSOCIATION AT YORK.

(Continued from page 138.*)*

THE papers bearing on Meteorology were so numerous that we have decided on deferring the report of Mr. Symons's paper "On the Rainfall Observations on York Minster," and inserting it in the next volume of *British Rainfall*. The rest of the reports and papers were as follows :—

REPORT OF THE COMMITTEE ON LUMINOUS METEORS.

Special mention was made of an aerolite, about 5 inches in diameter, which fell near Middlesborough, and embedded itself in a considerable depth of earth. It was estimated that it struck the earth with a velocity of 412ft. per second—a velocity which might have been acquired by falling half-a-mile; but the meteor had undoubtedly fallen at least fifty miles. As the information the committee received was of a very miscellaneous character, the committee suggested that they should not make any further report for a few years.

The President observed that meteoric stones, instead of descending in a solid mass, as in this case, were generally shattered to pieces by the intense heat.

Professor Herschel observed that the stone in question had never been exposed to much heat, as it had only been falling some six or ten seconds.

The President remarked that the stone had had considerable vitrification over its whole surface, where evidence of fusion was seen. It was certainly not melted throughout when it struck the earth. The interior part of the stone had been cooled, and it was so cold as not to melt when it struck the earth. The stone was not actually observed to be luminous, but there was no doubt that it was luminous in the air. There was something marvellous in a body like this moving through space, and they could not help asking whether it was created as it now was. They could scarcely imagine the stone having been like that in all time. This was a lesson with regard to objections to the supposition that living matter might have come to the earth from meteorites. It seemed to him to be an exceedingly improbable supposition that there were not living plants on this earth at this moment whose ancestry was meteoric.

The Rev. Mr. Howlett asked the President whether there was any particular difficulty in the idea of germs of life being introduced by aerolites, considering the extremes of temperature, first of cold and then of heat, through which the seed would have to pass?

Sir W. Thomson said the subject was one for enquiry; but it was considered that extreme cold would not destroy life in dry seed or spores. In reply to another question, he said that there was a general concensus of sentimental belief that there was something like life in many other bodies of the universe besides the earth, but there was no scientific belief, because there was no certainty. No trace of organic life had been found in any meteorite.

REPORT ON THE CIRCULATION OF UNDERGROUND WATERS.

The results of the committee's investigation showed that the Permian, Triassic, and Jurassic formations of England and Wales are capable of absorbing from five to ten inches of annual rainfall, giving an average yield of from 200,000 to 400,000 gallons per square mile per day. The area occupied by the formations was in round numbers—Permian and Triassic, 8,600 square miles, Oolite, 6,600 square miles, capable of yielding 1,720 millions and 1,320 millions respectively, at the lowest rate of absorption; or united, affording a supply for 100,000,000 people, at 30 gallons per head.

The Secretary, Mr. De Rance, then described the water-bearing conditions of the Yorkshire area.

Professor Prestwich, of Oxford, remarked that the report was an excellent one.

Dr. Wright said that this report redeemed geologists from the charge which had been made against them that their researches were not of value to the public. There was no subject of greater importance than our water supply.

Mr. Baldwin Latham said that the underground waters were dangerous to health.

Professer Hull, from a considerable experience, disagreed with the last speaker. When the waters percolated, say two or three hundred feet in the red sandstone, they came out almost completely separated from organic impurities, and might be used with perfect safety.

The Chairman, in putting the thanks of the section to the reader of the report, said that it contained some valuable information.

REPORT OF THE COMMITTEE ON UNDERGROUND TEMPERATURE.

By PROFESSOR EVERETT.

Professor Everett remarked that if they went into the earth they found it gradually hotter, varying from one degree in 30 or 40 feet in some parts, to one in 100 feet in others. During the year observations had been taken at the East Manchester Coal Field, the Talavgoch Lead Mine, Flintshire, and at the Radstock Collieries, Bath. With respect to the observations in the East Manchester Coal Field, these were taken respectively at Ashton Moss, Bredbury, and Nook Pit. At Ashton Moss, at a depth of 2,790 feet, the temperature was 85·3 degs.; at Bredbury Colliery, at a depth of 1,020 feet, the temperature was 62 degs.; and at Nook Pit, at a depth of 1,050 feet, 63½ degs. These observations agreed exceedingly well. The mean natural temperature might be assumed to be 49 degs. The increments of temperature at that depth would then stand as follows:—Ashton Moss, 36·3 degs. in 2,790 feet; Bredbury, 13 deg. in 1,020 feet; Nook Pit, 13⅓ deg. in 1,050 feet. This gave for each deg. of increase—Ashton Moss, 76·9 feet; Bredbury, 78·5 feet; Nook Pit, 79 feet. In Flintshire the observations showed great irregularity last year, and the new observations taken this year increased the irregularity. The observations were taken at a place in the lead mine 660 feet deep, the temperature was 62 degs. Fahr., while 48 degs., being assumed to be the surface temperature, gave an increase of 14 degs. in 660 feet, or of 1 deg. for 47 feet. At the Radstock Colliery, observations were made at three pits—the Wells May Pit, 560 feet deep; the Ludlow Pit, 1,000 feet; and the third in the same pit, at a depth of 810 feet. He assumed 50 degs. in that locality as surface heat; and thus for 560 feet the increase was 11·7 degs.; for 810 feet, 13 degs.; and the same for 1,000 feet; giving respectively 1 deg. in 48 feet, 1 deg. in 62 feet, and 1 deg. in 77 feet.

Dr. Haughton suggested that the increase in temperature was due to chemical agency.

Father Perry remarked that time should be taken into consideration, because if chemical action were going on, it might vary according to the exhaustion of material.

ON A NEW THERMOGRAPH.

By Dr. W. D. Bowkett.

This instrument was for recording changes of temperature by the action of heat upon a hollow circular metallic ring connected with a circular vessel, the whole being filled with fluid and hermetically sealed. One end of the ring was fixed, the other free to move, and the amount of motion was magnified and measured by a series of levers, one end of which carried the recording pen. Increments of heat caused increments of pressure in the ring, which, as in Bourdon's pressure gauge, then moved at its free end. The instrument had been largely used by Dr. Bowkett in the Leeds Fever Hospital for clinical purposes; but it was also adapted for many branches of chemical and physical research.

THE SUN SPOT PERIOD AND PLANETARY TIDES IN THE SOLAR ATMOSPHERE.

Mr. F. B. Edmonds read a paper on the above subject, and at the outset said circumstances having led the author to what promised to be an important development of the planetary hypothesis of solar disturbance, he would direct their attention to some of the results already obtained. As a consequence of the fundamental assumption that the planets were the disturbing agents and universal gravitation the disturbing force, it followed that planetary influence would vary with the conditions under which it was exercised. The influence of the planet may be localised on a surface or stratum of small thickness, so that the disturbing force would vary inversely as the square of the distance of the planet. The predominance of Jupiter under this supposition seemed to preclude the idea that sun spot maxima and minima could depend simply on the opposition and conjunction of the planets. The consequence of such a supposition was not to be lost sight of, but may be taken together with the more general supposition that the attractive force is exercised on a gaseous or lunar body, of which the altitude is not insignificant. Again, the mass of the sun is acted on as a whole by the planets, and such parts as are fluid, whether in the liquid or gaseous form, were subject to a disturbance of a tidal character as a matter of course. The apparent insignificance of the cause seemed to have hitherto deterred investigation from following up this particular view, just as it has hindered the prosecution of the tidal hypothesis generally. According to the Newtonian or equilibrium theory of the tides, in its elementary form, tidal disturbing force varies directly as the diameter of the body disturbed, to the mass of the disturbing body, and inversely as the cube of the distance of this disturbing body. A disturbing force would, therefore, raise a tide on the sun more than one hundred times greater than the same force would raise if acting on a globe of the size of the earth, other things being the same. Looking at the sun spot numbers as a record of spring tides, and for the first approximation only recognising such tides as would be due to the conjunction and opposition of Venus and the earth, it remained that a relation should be established between these tides and the Javian tide in the form of special tides varying in magnitude with the sun spot numbers. The connection between the sun spots and magnetic disturbance discovered by Sabine and others is now established. The zodiacal light was now generally considered to be a solar appendage, and if so, might it not be one of those great waves to which he had referred—perhaps the Javian tide? It might be that we were at times, if not always, in actual material communication with the sun—touching the sun, in fact, although the touch might be light.

The Chairman remarked that the paper was a most valuable one, and would, he hoped materially help to the solution of a question which had excited the greatest interest amongst scientific men, and he hoped it would tend to promote the discovery of the truth.

ON THE PRESSURE OF WIND UPON A FIXED PLANE SURFACE.

By T. HAWKSLEY, P.P. INST. C.E.; F.R.S., &c.

The recent failure of the Tay Bridge and other important structures during heavy gales of wind, have attracted much attention to the subject of this paper. The general solution of the problem may be thus briefly stated :—

Let v = the velocity of the current in feet per second.

h = the height through which a heavy body must fall to produce the velocity v.

w = the weight in pounds of a cubic foot of the impinging fluid [for atmospheric air average about 0·0765 lbs.]

g = 32, the coefficient of gravity.

Then $h = \frac{v^2}{2g}$; and since p the pressure of a fluid striking a plane perpendicularly and then escaping at right angles to its original path, is that due to twice the height h [Daubuisson's *Hydraulics*; Rouse's *Experiments*] we have simply :—

$$p = \frac{wv^2}{g} =$$

(for atmospheric air) $$\frac{0{\cdot}0765v^2}{32} = \left(\frac{v^2}{20}\right)$$

very nearly.

From this easily remembered formula the following Table of Pressure is constructed :—

VELOCITIES IN		PRESSURES IN LBS. PER SQUARE FOOT.
FEET PER SECOND.	MILES PER HOUR.	
10	6·8	0·25
20	13·6	1·00
30	20·4	2·25
40	27·2	4·00
50	34·0	6·25
60	40·8	9·00
70	47·6	12·25
80	54·4	16·00
90	61·2	20·25
100	68·0	25·00
110	74·8	30·25
120	81·6	36·00
130	88·4	42·25
140	95·2	49·00
150	102·0	56·25

In general, only these, the maximum pressures, are required; but sometimes, as in the case of the enclosed sail of a windmill or ship, or the roof of a building, the diminished pressure of a surface placed obliquely to the *effective* current is needed; we have then

$$p = \left(\frac{v \sin. \theta^2}{20}\right)$$

in which v, = the absolute velocity with which the air strikes the receding plane; and θ = the internal angle between the obliquely placed surface and the direction of the impinging wind.

With regard to the phenomenon called "a gust of wind," nothing is known,

either as to its cause, or as to its exceptional but almost momentary velocity, or as to the extent of the area over which it temporarily operates; but it is, notwithstanding, certain that a wind pressure of even 40 lbs. on the square foot is unknown in these islands, because, as may be readily shewn, the intensity of pressure would suffice to have overthrown most of the long-existing factory chimnies, to have overset post windmills, and to have scattered the greater number of the slighter built domestic and other structures which have nevertheless "weathered many a storm," and still remain intact.

It remains to make a passing allusion to whirlwinds, tornadoes, and waterspouts, all the results of spiral motions apparently produced in some obscure manner by electrical action. These phenomena are very rarely observed to occur on an important scale in these kingdoms. The powerful forces concerned in, or generated by, these erratic movements have never been measured, and, consequently, cannot be formulated; but it may be observed that were they known they could not be introduced with propriety into calculations of the strength of structures intended to have commercial value, because of the extreme improbability of any particular structure falling within the range of their destructive effects. They fall, in fact, within the legal category of "Actus Dei."

The conclusion of the author of this paper, therefore, is that for structural calculations a maximum wind pressure of 40 lbs. per square foot may be very safely adopted, notwithstanding some common anemometrical observations to the contrary.

With regard to these observations, the author remarks that the instruments in use are little better than philosophical toys, and that, in general, they afford no direct, comparable, or reliable indications of either velocities or pressures; and that they are often so injudiciously placed as in many instances to record the effects of combined, and, therefore, locally accelerated currents; whilst, in other instances, they record only the effects of obstructed, and, therefore, locally extended currents.

As the acquisition of accurate data is of great and increasing importance, the author suggests that the British Association, and other learned societies interested in physical investigations, should unite in providing the necessary funds and observers for the purpose.

Mr. G. J. Symons, F.R.S., said that the paper made no reference to the report of the Treasury Committee appointed to inquire into the Tay Bridge disaster, which Report would require careful investigation before it could be accepted. Referring to the statement in the paper that whirlwinds were rarely observed on an important scale in these kingdoms, Mr. Symons said that within the last month there had been no less than four seriously destructive whirlwinds in different parts of the country. The first in point of violence occurred at Boston, in Lincolnshire, taking a path a quarter of a mile long, and, irrespective of slight damage, seriously damaged a carpenter's shed, carried a pile of timber into an adjoining field, went across a large drain, sucking the water up a foot and a half, lifted a carpenter's shop 8 feet high and 10 feet square bodily over a haystack, and deposited it on the other side, and went next to a foundry, part of the roof of which it deposited in a gentleman's drawing-room. There had also been a serious whirlwind at Bramham Park, the effects of which he had not yet investigated. He understood that one of the large railway stations of Vienna had had its roof lifted off and carried away. It had long been his fear that the roofs of Charing Cross or King's Cross would be carried away and dropped down in some inconvenient position not intended for them. He could give many instances of mechanical energy by these storms, and of such a character, too, that they might think him romancing if he were to relate them. At Baldock the roofs of three maltings were lifted up and re-deposited at a short distance, but a few of the slates were found sticking in the trees like the heads of axes. That would give them an idea of the energy of the wind. The Treasury Wind Pressure Committee had ignored entirely the question of whirlwinds. If they had heard that a whirlwind of 200 or 300 feet in breadth had gone against the Tay Bridge they would have the explanation of its downfall.

If they were to make their structures so strong that even a whirlwind would not carry them away, he was afraid their cost would be vastly increased.

Mr. J. F. Bateman, F.R.S., said that when the railway bridge was made across the Menai Straits, he went through the calculations of wind pressure with the late Sir Wm. Fairbairn, and the maximum pressure was 120lb. per square foot, upon which, he believed, the bridge was constructed. The actual pressure arrived at was what it might have to bear from a West Indian hurricane.

Mr. Head noticed that Mr. Hawksley assumed that the wind was always perpendicular to the plane of the pressure plate, and that it had a free escape all round.

Sir F. Bramwell, F.R.S.—Mr. Hawksley provides for those cases where it has not.

Mr. Head only wished to say that that seemed to be very seldom the case in practice. The author also appeared to put out of question the wind coming in gusts. But he believed on the night of the Tay Bridge disaster one of the great features was the extremely violent gusts which occurred. If gusts could occur in that way, and as air had weight, might it not be that momentum was involved as well as pressure. Therefore the calculations of merely so much surface operated upon by so much pressure were not sufficient. Then, again, the great danger was in heavy gusts on surfaces which were boxed in. They ought to make experiments on the effect of wind on different shapes, such as square, convex, concave, and other kinds of surfaces. Those things would have to be taken into account before they could know something permanently useful about wind pressure.

Sir F. Bramwell, in proposing a vote of thanks to Mr. Hawksley, said that the practical question for engineers was whether it was worth while to build structures so as to resist a hurricane, or must they be content to make them of sufficient strength to resist even extraordinary storms. It seemed to him that if the matter were investigated, the excessive extra cost of structures to resist hurricanes would be prohibitory. He stated the other day, on the authority of Mr. Barlow, that in the proposed Forth Bridge there were 2,000 tons more material in consequence of its being made to resist the pressure produced by known or anticipated winds; and if they added to that material for resisting hurricanes, the bridge would not only become too costly, but an impossibility.

Mr. Symons, replying to a question as to comparisons of observed pressure with observed velocity, stated that at Bidston an anemometer was erected with both plates and cups. The writer of the paper had alluded to the instruments at present in use as philosophical toys. Mr. Symons thought that that was going too far, and was rather hard upon the Government of this country, that had spent £6,000 or £7,000 in putting them up. He should like to see a better anemometer than they had now, but he did not know where he should have to look for it. All other countries were copying ours, which showed that if ours were toys, they were the best in the world.

ON THE EFFECTS OF GULF STREAMS UPON CLIMATES.

By Dr. S. Haughton, F.R.S.

He said that the Gulf Stream and its counter-current, the Labrador current, produced important effects upon climate. The northern hemisphere was warmer than the southern from lat. 0 degs. to lat. 30 degs., and it was colder than the southern from lat. 40 degs. to lat. 60 degs. The higher temperature of the southern hemisphere in the temperate latitudes was explained by the existence of three gulf streams in that hemisphere, while there was only one in the North Atlantic, and a partial one through Behring's Straits in the northern hemisphere. The general climatal effect of the Gulf Stream was therefore to make the annual range of temperature less, but it had no effect whatever upon summer heat, or upon the fruiting of plants and trees, as that required a given July temperature, for reproduction. The January temperatures in the North Atlantic at 70 degs. were raised by the Gulf Stream, whilst the July tempera-

tures remained unaffected. The effect of the cold currents, which were indirectly caused by the warm currents to preserve the proper condition of equilibrium, was nothing at all upon the January temperatures, and they lowered the July temperatures. The effect of the cold water was to lower the July temperature and to leave January untouched, and the effect of the warm current from the south was to raise January and to leave July unaltered.

ON SUN-SPOT MAXIMA AND TERRESTRIAL MAGNETIC DISTURBANCES.

By the Rev. F. Howlett.

The object of this paper was to promote discussion as to a correlation between the amount of terrestrial magnetic disturbances and the sun-spot area observable at such times, on the solar disc, as deduced from various observations made between the years 1859 and 1881 inclusive. Occasion was taken to point out the numerous cases of such a coincidence as recorded both at Kew and Greenwich between magnetic storms of greater or less intensity and unusual solar activity, as indicated by unusually large spots or groups of spots, showing also remarkable peculiarities at times in the forms and behaviour of such spots. Out of fifteen periods of large spot disturbance submitted for comparison with the Kew record, no less than twelve were in remarkable accordance with terrestrial magnetic storms of greater or less magnitude, whilst only one case, that of the unusually violent storm of January 4th, 1863, failed to show any but a comparatively feeble, though unusually prolonged, coincidence.

ON THE INFLUENCE OF BAROMETRIC PRESSURE ON THE DISCHARGE OF WATER FROM SPRINGS.

By Mr. Baldwin Latham, M. Inst. C.E., F.G.S., F.M.S.

The Author stated that it was alleged by some of the long-established millers on the chalk streams that they were able to foretell the appearance of rainfall by a sensible increase in the volume of water flowing down the stream before the period of rainfall. He had therefore undertaken a series of observations to investigate the phenomena, and he found in setting up gauges in the Bourne flow in the Caterham valley near Croydon, in the spring of this year, (1881), and selecting periods when there was no rain to vitiate the results, that whenever there was a rapid fall in the barometer there was a corresponding increase in the volume of water flowing, and with a rise of the barometer there was a diminution in the flow. The gaugings of deep wells confirmed these observations; for where there was a large amount of water held by capillarity in the strata above the water-line, at that period of the year when the wells became sensitive and the flow from the strata was sluggish, a fall in the barometer coincided with a rise in the water line, and under conditions of high barometric pressure the water-line was lowered. Percolating gauges also gave similar evidence, for, after percolation had ceased, and the filter was apparently dry, a rapid fall of the barometer occurring, a small quantity of water passed from the percolating gauges. The conclusion arrived at was that atmospheric pressure exercised a marked influence upon the escape of water from springs.

Dr. J. Evans, F.R.S., who had given the subject much consideration, and had taken observations for some years, thought Mr. Latham had brought forward facts sufficient to establish his interesting theories. He gave an account of the results which had come under his own observation, and hoped Mr. Latham would pursue his investigations, and endeavour to ascertain the amount of percolation in the chalk, and the quantity of water available from it for drinking and various other purposes.

Mr. W. Topley stated that although they were indebted to Mr. Latham for his valuable paper, the subject was not a new one, it having been brought forward years ago by Mr. Bailey Denton, who had made interesting observations on the subject.

Professor Hughes asked whether the author had taken into consideration the hygrometric conditions, as it appeared that he had observed that different flows coincided with the S.W. and E. winds. The different pressure on surface and subterranean waters due to evaporation of the surface water under the dry E. wind or moist S.W. wind, would be so great that it should not be neglected in considering such small differences of actual pressure as are to be referred to the atmosphere.

Mr. J. Lucas, as a resident in the neighbourhood, Mr. Mylne, F.R.S., and Mr. R. H. Scott, F.R.S., continued the discussion, the latter observing that Mr. Latham had distinctly proved his case.

The Chairman (Professor Ramsay, F.R.S.) said he had listened to the paper with great interest. He had given the subject his careful consideration, and the result had been that he had been enabled to predict the state of the weather with tolerable accuracy.

Mr. Latham stated in reply, that, with regard to the remarks of Professor Hughes, he had considered the bearing of hygrometric influences, but he had found no analogy whatever between water levels and the hygrometric state of the atmosphere. He had been led into this investigation by the fact that, although Croydon took its water supply from a chalk formation, it was visited with typhoid fever every ten years or so. He found that at an interval of every decade there were marked periods of low water, and these were marked periods of fever in the country. The underground water had an immense bearing on the public health of the country. If persons would take measurements in wells it would be found to be of great value with regard to sanitary results. The flows of the Bourne had nothing to do with barometric pressure; it was simply owing to the super saturation of the North Downs with water.

THE CALIBRATION OF MERCURIAL THERMOMETERS.

By Professor Rücker.

The author said that the late Mr. Welsh, of Kew Observatory, described before the British Association, in 1853, the methods which he introduced of making and correcting mercurial thermometers. Calibration is the determination of the amount of variation existing in the bore of the thermometer tube. The method of making this correction used by Mr. Welsh, and still employed at Kew, is theoretically less accurate than others, and has been unfavourably noticed by some foreign critics. Professors Thorpe and Rücker have recently calibrated a number of thermometers with great care, and by the most elaborate and perfect method hitherto proposed, viz., Bessel's. One set of three thermometers was made for them at Kew. They were calibrated according to Welsh's instructions, and afterwards the measurements necessary for the application of Bessel's were kindly made by the Kew authorities, the calculations being performed by Professors Thorpe and Rücker. They have thus subjected the Kew thermometers to the most rigorous test possible, and they were able to announce that in one instrument the errors left after the application of Welsh's method, were not greater than four-thousandths of a degree Centigrade, and in no case did they much exceed one-hundredth of a degree. As it is impossible to read on these thermometers less than a hundredth of a degree with certainty, Welsh's method as applied at Kew is almost perfect. The practical answer to the theoretical objections raised to it is, that the errors to which they point are negligible when the instrumental appliances are as perfect as they are at Kew.

ON A NEW INTEGRATING ANEMOMETER.

By Mr. H. S. Hele Shaw & Dr. Wilson.

This instrument is designed to give, by means of curves traced on a piece of paper, the direction and quantity of the wind passing over any given spot. It may be briefly described thus. The ordinary cup anemometer of Robinson is used to drive a train of wheels, and thus ultimately to turn a serrated roller, which moves a board in the direction of, and with a velocity proportional to,

that of the wind. On the board, which is horizontal and about two feet square, is placed a sheet of paper, upon which the roller presses, and in turning leaves the required trace, moving at the same time the paper underneath it. The board is prevented from having a rotary motion by means of a pair of frames, the upper moving by means of wheels on the lower, each of which is only capable of a motion in one direction and perpendicular to that of the other. By an application of clock work, the element of time is introduced, which in conjunction with space gives velocity, and a method of doing this was shown, as also the proposed form of the instrument for observatories. A number of curves already taken were exhibited, and their interesting nature was pointed out by combing them so as to shew the whole motion of the wind over University College, Bristol, for nearly a week.

Mr. Whipple, of Kew Observatory, said that he had no doubt that the instrument would be most valuable in observatories when further perfected by Mr. Shaw. He pointed out the difficulty that would be experienced in light winds with reference to the manner of application of the clock work.

Mr. R. H. Scott, F.R.S., pointed out the small expense of the anemometer compared with others for effecting the same object.

Mr. Shaw, answering an objection as to work put upon the cups, showed that care had been taken to so reduce it that the extent would be inappreciable.

ON THE RESULT OF OBSERVATIONS OF ATMOSPHERIC ELECTRICITY AT THE KEW OBSERVATORY DURING 1880.

By Mr. G. M. Whipple, F.R.A.S.

Having reviewed what had been done in the past in this direction, the author said that lately he had succeeded in devising a modification of Professor Everett's method, and had constructed a glass scale, by means of which the tabulation of the curves could be effected with the greatest facility and expedition. Accordingly they had now commenced the tabulation and discussion of the accumulated records, and by the kind permission of the Meteorological Council, he was able to lay a few of the facts derived from the curves for 1880 before them. Having determined the values of the atmospheric tension for every hour during the year when measurements of the trace were possible, the diurnal, monthly, and annual variations were computed. Having plotted these, the curves were contrasted with those given by Mr. Birt and by Professor Everett, with the view of finding what, if any, difference in the phenomena observed might be attributed to instrumental causes. The mean diurnal curve for 1880 closely followed Professor Everett's. As regards the curve of annual variation of tension, they found that for 1880 the curve more closely approached that of 1845–7 than it did that of 1863. The months of mean maximum tension were January, when it was 143 volts, and March was 136 ; and of the minima, August 37 volts, and September 47 volts. As the result of the year's observations in the first cases, it was found that generally the laws differed in summer and in winter. It was found at Kew that for the year maximum tension (109 volts) occurred with north-westerly winds, and the minimum (64) with south-easterly winds ; but for the summer months the tension was greatest (109 volts) with an east wind, and lowest (50) with a north wind ; whilst in winter the conditions are almost reversed, and northerly and north-westerly winds have the strongest tensions, 133 and 128 volts respectively, and south-easterly the weakest with 48. These results may be influenced by the intensity of the wind, as it is found that, contrary to what would be imagined, the light winds had a higher potential than strong breezes, the average tension being in the latter case but about one-third of that in the former. This, however, is not very well marked in summer, when there did not seem to be a very defined relation between the two phenomena—it is almost entirely due to the winter observations. An examination was also made of the relation between cloudiness of the sky and atmospheric electricity ; and, finally, its variations under changes of condition of the moisture of the air.

ON A UNIVERSAL SUNSHINE RECORDER.

By Mr. G. M. Whipple, F.R.A.S.

This is a new form of card supporter for the Campbell Sunshine Recorder, consisting of a light frame capable of holding the slip of cardboard to be burned by the sun in any desired position, being arranged so as to receive ordinary parallel strips of card at all times of the year, and to allow of the instrument being employed on any part of the earth's surface without detriment to its efficiency. The card-holders themselves were moveable, so as to permit of the cards being changed indoors, or dried, if wet, before removal, thereby avoiding tearing or mutilation of the record in the operation. The instrument is also furnished with an appliance for placing the card correctly in position to receive the sun's image.

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

XII.—ITALY *(Continued).*

5. *The "Osservatorio dell' Università,"* at Turin. Regular meteorotogical observations were begun at this Observatory in 1865. For he first two years, observations were only made three times a day, afterwards these were made 6 times daily, and since 1869, a Barograph and a Thermograph, by Hipp, have been in operation. From 1866 the observations have been published in the "*Bullettino meteorologico.....di Torino.*" The Director of the Observatory is M. A. Dorna, and there is a council of 6 members, including the Director. The expenses are borne by the Turin Academy, the University, and the town of Turin.

6. *The Meteorological Department* of the "*Reale Osservatorio di Brera,*" at Milan. Meteorological observations were begun here in 1763, and have been continued without interruption until this day. The Director of the Observatory is M. G. Schiaparelli. Of the older series of observations we may mention specially a discussion by M. Celoria, *Sulle variazioni periodiche e non periodiche della temperatura nel clima di Milano* (Milan, 1874). Of the more recent observations we may mention an elaborate discussion by MM. Schiaparelli and Celoria, *Sulle variazioni periodiche del barometro nel clima di Milano* in the *Meteorologia Italiana* for 1868. Since the year 1867 a Barograph by Hipp (Aneroid) has been working in a very satisfactory manner.

Publications. The meteorological observations of the Milan Observatory have been published as follows :—

1763-1834 in the "Effemeridi astronomiche di Milano."
1848-59 in the "Giornale dell' Istituto Lombardo."
1860-62 in the "Atti dell' Istituto Lombardo."
1863-78 in the "Rendiconti dell' Istituto Lombardo."

The observations for the later years are contained in the *Meteorologia Italiana.*

The following special discussions may also be mentioned :—

Carlini, Considerazioni sulle vicissitudine della quantità annuale delle piogge.....di Milano. (Eff. di Milano, 1859.)

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* Continued from *Meteorological Magazine* for September.

Schiaparelli, Dell' influenza della luna sulle vicende atmosferiche. (Milano, 1866.)

Celoria, Sul grande commovimento atmosferico avvenuto il 1° di Agosto 1872 nella bassa Lombardia e nella Lomellina. (Milano, 1873.)

Schiaparelli, Sul modo di ricavare la vera espressione delle leggi della natura delle curve empiriche. (Eff. di Milano, 1867.)

At the instigation of M. Schiaparelli, the Milan Observatory commenced the collection of observations of thunderstorms in Upper Italy, in 1876. The stations now number about 300. A little instrument (a kind of quadrant) is used for determining the approximate height of the lightning. Details of the working of this service will be found in M. Denza's *Ordinamento del servizio dei temporali nell' alta Italia, Torino*, 1879. The expenses of the meteorological branch of the Milan Observatory (exclusive of salaries) amounts to £100 yearly.

7. The *Reale Osservatorio* at Modena and the *Italian Meteorological Society*. Observations were begun here in 1830, and were greatly extended in 1864, under the superintendence of M. D. Ragona. Since 1873, the Observatory has possessed a complete series of self-registering instruments. The first series of observations, 1830-50, was published by M. Bianchi in the *Memorie della Società Italiana delle scienze, Vol.* XXV. 2; and the observations 1864-6 have been published by M. Ragona in the *Bollettino meteorologico* of the Modena Observatory, and the later observations have appeared in the *Meteorologia Italiana*. In addition to an ordinary rain gauge there is in use a *Pluviometro orvarico*, which gives the rainfall for each separate hour. This instrument is described in the *Annuario della Società meteorologica Italiana, Vol. I. p.* 305.

Publications. The climate of Modena is among the best studied in all Italy. The following special works by M. Ragona may be mentioned :—

1. Andamento annuale della temperatura. (Suppl. Met. Ital., 1875, III.
2. Andamento annuale delle variazioni delle temperature massime e minime. Ann. Soc. Met. Ital., Vol. II.
3. Andamento annuale della pressione atmosferica. Suppl. Met. Ital., 1877, II.
4. Andamento annuale della umidità relativa ed assoluta. Modena, 1879.
5. Andamento diurno ed annuale della velocità del vento. Modena, 1878.

Società meteorologica Italiana. This society was founded by M. Ragona in 1876, and has published two volumes of its proceedings This society is now amalgamated with the recently established Meteorological Association.

8. *The Meteorological Division of the R. Osservatorio de Campidoglio,*

at Rome. Observations were formerly made here by Madam C. Scarpellini, *Bollettino delle Osservazioni ozonometriche-meteorologiche fatte in Roma*, 1865-74. From the year 1873 a more extensive and reliable series of observations was begun. In addition to the records of some self-registering instruments, direct observations are made every three hours from 6 a.m. till midnight. The observations are published in the *Atti della Reale Accademia dei Lincei*, and in the *Bollettino mensile* of the *Meteorologia Italiana*. The Director of the Observatory is M. L. Respighi.

9. *The Meteorological Department of the Osservatorio del Collegio, Romano*, at Rome. At the instigation of the *Societas meteorologica palatina*, meteorological observations were begun here in 1782. Secchi's meteorograph was erected in 1858. After Secchi had published three vols. and one part of the *Memorie dell' Osservatorio del Collegio Romano*, 1852-63, he began in the year 1862 the *Bollettino meteorologico*, of which 17 vols. appeared, containing meteorological and magnetical observations at Rome, and some of the neighbouring localities. Of the discussions which have appeared in this Bulletin we may specially mention the following :—

Mancini, Sulla temperatura dell' aria in Roma (40 years); Bulletin for 1868.

Quadro delle quantita totale di pioggia caduta in Roma nel periodo di 85 anni (1782-1866); Bulletin for 1869.

Secchi, Sulla pioggia osservata al Collegio Romano.....dal 1825—al 1874; Bulletin for 1878.

Secchi, Sulla velocità del vento osservata al Collegio Romano; Bulletin for 1877.

Lais, Prolegomeni allo studio delle burrasche del clima di Roma (Rome, 1873).

Also a very elaborate discussion by G. St. Ferrari :—

Meteorologia Romana (Rome, 1878).

The *Collegio Romano* is now occupied by the Central Meteorological Office.

10. *The Meteorological Department of the R. Specola di Capo-dimonte*, at Naples.—The director of this Observatory is M. F. Brioschi. Observations have been published almost *in extenso* since 1866 in the *Bullettino Meteorologico* of the Observatory.

11. *The Reale osservatorio meteorologico Vesuviano.*—This observatory, renowned for its position upon Vesuvius, was built in the years 1841-7, at a height of about 2089 feet above sea-level. The director is M. Palmieri; his attention is more devoted to electricity and seizmology than to meteorology. Meteorological observations, similar to those of a station of the second order have been published in the *Corrispondenza meteorologica Italiana alpina-appennina*. The Observatory has published Annals for 1859, 1862, 1862-4, and (new series) 1873.

12. *The local climatology of various parts* :—

(*a*) *Vicenza.*—The *Accademia Olimpica* has erected a meteorological observatory which is under the direction of Count A. da Schio. In

addition to the ordinary instruments, various self-registering instruments have been in action for some years. Vicenza has become a centre for about 80 other stations of various kinds, chiefly for rainfall and thunderstorms. The observations have been partly published in the *Meteorologia Italiana.*

(*b*) *Velletri.*—This station is under the direction of Professor P. J. Galli. In 1876 it became a centre for other stations in the *Provincia Romana*, and published a monthly bulletin entitled *Meteorologia della Provincia Romana con applicazioni*, containing the Velletri observations *in extenso*, and the means of some other stations, and the daily rainfall at some 20 stations.

(*c*) *Potenza.*—Professor Fittipaldi organised a system of rainfall and earthquake stations, the results of which are given in the *Rendiconto della istituzione . . . . . di Potenza.*

(*d*) *Lecce.*—In a similar manner Professor C. De Giorgi established about 30 stations of the third order in this province, chiefly in the interest of agriculture. The observations for 1877-8 are published in *Note di climatologia agraria Salentina.*"

There are various other important independent establishments, among which may be mentioned, Alessandria, Padua, Venice, Pesaro, Urbino, and Ancona, Reggio Callabria, Palermo, Siracusa, many of which have published long series of observations. Our space will not permit of giving further particulars of these stations.

We are much indebted to Dr. Hellmann for these details, which have been extracted from his very valuable reports to the Prussian Ministry of Public Instruction. The present article concludes the series which he has hitherto published, with the exception of the service in England, the meteorological organization of which is pretty well known to the readers of this magazine.

J. S. HARDING.

[In thanking Mr. Harding for the service which he has rendered to English speaking meteorologists of all countries, by his translations of Dr. Hellmann's reports, we find only one point upon which we differ. He has thought it best to omit all notice of English work; we think that it is most necessary that we should

"See ourselves as others see us,"

and we therefore hope, ere very long, to add England as a separate paper.—ED. *M. M.*]

METEOROLOGICAL NOTES ON SEPTEMBER.

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

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was favourable for tillage operations, and especially favourable for root crops. Wasps very scarce.

BANBURY.—Harvest nearly completed at the end of the month. L on 18th; distant T and L on 9th; fog on ten days.

CULFORD.—Weather generally wet till towards the end of the month; distant T and L on 18th.

BODMIN.—A very dry and genial month ; mean. temp. 56°·6.

CIRENCESTER.—Rainfall moderate, but not a very good harvest month in consequence of the heavy dews, and the dry periods not being long enough.

WOOLSTASTON.—Mean temp. of the month 54°·3 ; swallows left about the 19th.

ORLETON.—A cloudy, cold, and damp month. with frequent falls of fine R, and a few clear days at intervals. Although the R was never heavy, it was long continued and greatly retarded the harvest. Thick fogs occurred on eight days. Bar. generally high and steady ; mean temp. about 1°·5 below the average ; no L or T.

BOSTON.—Harvest, which was commenced in the first week of August, was finished on the last day of September ; during this time R fell on 31 days, and the longest period of fine weather was four days. The sunshine and high temp. of May, June, and July produced grain of splendid quality and fair abundance, but the wet weather of August and September detracted much from its value, and added to the expense of harvesting.

KILLINGHOLME.—An excellent corn crop, both as to quantity and quality, such as has not been known since 1868, but greatly damaged by continuous wet. T and L on 18th.

MANSFIELD.—On the whole, dull and wet ; no great amount of R, but many damp and close days when nothing would dry. The last week was very fine and bright with heavy dews at night. Bar. very slightly below the average, wind very variable ; TS at 10.30 p.m. on 18th.

WALES.

HAVERFORDWEST.—On the whole a grand month of fine weather; crops saved in splendid condition. A heavy storm of R and wind on 24th and 25th ; several very cold nights.

LLANDUDNO.—A fine dry and calm month : Mean. temp. about 1°·5 below the average. Rainfall less than one-third of the average.

SCOTLAND.

CARGEN.—A dull, cheerless month ; great want of sunshine, and an unusual amount of humidity, most unfavourable for getting the crops into the stack-yard ; mean temp. about the average. Corn nearly all in at the end of the month, but generally in indifferent condition. A well-developed solar halo on the 6th.

SILVERBUT HALL.—A cold, wet and sunless month, retarding harvest work.

BRAEMAR.—A month of changeable weather, yet favourable for maturing the crops, a great part of them being still green.

ABERDEEN.—Although the rainfall was considerably below the average ; the weather was damp and misty, with an absence of sunshine ; prevailing wind northerly.

PORTREE.—A fine harvest month, crops fully an average ; disease appearing in potatoes ; hill sheep strong and healthy.

CULLODEN.—Harvest late ; oats thin ; turnips in many places much improved.

SANDWICK.—The driest September since 1846, the rainfall being 3·14 in. less than the mean of 40 years ; the first half of the month was cold, from the prevalence of northerly and easterly winds ; from the 21st to 24th, inclusive, there was a gale of S.E. wind, but after that the weather was generally fine. Aurora on three nights.

IRELAND.

CORK, BLACKROCK.—Mean temp. 57°·1.

DROMORE.—A very fine harvest month ; much sunshine and high temp. throughout. Hay and oat crops heavy, potatoes a good crop in inland districts but failed in many places on the coast, turnips promising.

WATERFORD.—The early part of the month was very favourable for harvest work ; frequent heavy dews ; distant T on 9th. Very few wasps.

KILLALOE.—Splendid harvest weather up to the 17th, latter part of the month variable. Mean temp. 56°·2.

MONKSTOWN.—A fine bright month, with warm sunny days, and but little R; in every way favorable for harvest operations.

WARINGSTOWN.—Pretty fair on the whole, though the third week was wet. Excellent crops of all sorts, no serious damage to grain.

LONDONDERRY.—Month on the whole favourable for farming operations, grain and potatoe crops yielding well. Wind variable.

SUPPLEMENTARY TABLE OF RAINFALL IN SEPT., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·49	XI.	Carno, Tybritle	1·71
,,	Margate, Acol	2·74	,,	Corwen, Rhug	1·82
,,	Littlehampton	3·46	,,	Port Madoc	2·20
,,	St. Leonards	2·84	,,	Douglas.....	3·49
,,	Hailsham	2·20	XII.	Carsphairn	2·47
,,	I. of W., St. Lawrence.	1·77	,,	Melrose, Abbey Gate...	3·94
,,	Alton, Ashdell.....	2·77	XIV.	Glasgow, Queen's Park.	1·91
III.	Great Missenden.....	2·84	XV.	Islay, Gruinart School..	3·38
,,	Winslow, Addington ...	1·70	XVI.	Cupar, Kembach.....	3·66
,,	Oxford, Magdalen Col...	1·39	,,	Aberfeldy H.R.S.	1·86
,,	Northampton	1·42	,,	Dalnaspidal	4·21
,,	Cambridge, Merton Vil.	...	XVII.	Tomintoul.....	2·42
IV.	Harlow, Sheering	2·16	,,	Keith H.R.S.	2·81
,,	Diss	3·12	XVIII.	Forres H.R.S.	1·75
,,	Swaffham	3·26	,,	Strome Ferry H.R.S....	...
,,	Hindringham	3·28	,,	Lochbroom	1·41
V.	Salisbury, Alderbury...	1·59	,,	Tain, Springfield.....	1·91
,,	Calne, Compton Bassett	1·97	,,	Loch Shiel, Glenfinnan.	4·05
,,	Beaminster Vicarage ...	...	XIX.	Lairg H.R.S.	..
,,	Ashburton, Holne Vic..	3·08	,,	Altnabreac H.R.S.	1·21
,,	Langtree Wick	2·90	,,	Watten H.R.S.	1·31
,,	Lynmouth, Glenthorne.	1·72	XX.	Fermoy, Glenville	2·73
,,	St. Austell, Cosgarne...	...	,,	Tralee, Castlemorris ...	2·46
,,	Taunton, Fullands	2·90	,,	Cahir, Tubrid.....	2·06
VI.	Bristol, Clifton	2·10	,,	Tipperary, Henry St....	3·15
,,	Ross	1·41	,,	Newcastle West	2·01
,,	Wem, Sansaw Hall.....	1·42	,,	Kilrush	1·54
,,	Cheadle, The Heath Ho.	1·81	,,	Corofin	1·76
,,	Coundon	2·13	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	2·43	,,	Carlow, Browne's Hill..	2·93
,,	Horncastle, Bucknall ...	2·44	,,	Navan, Balrath	1·48
VIII.	Macclesfield Park	1·98	,,	Athlone, Twyford	4·05
,,	Walton-on-the-Hill.....	2·00	,,	Mullingar, Belvedere ...	2·16
,,	Broughton-in-Furness ..	4·39	XXII.	Ballinasloe	3·72
IX.	Wakefield, Stanley Vic.	2·57	,,	Clifden, Kylemore	6·01
,,	Ripon, Mickley	3·28	,,	Crossmolina, Enniscoe..	3·44
,,	Scarborough.....	4·95	,,	Carrick-on-Shannon ...	2·66
,,	Mickleton.....	4·44	XXIII.	Dowra	2·77
X.	Haltwhistle, Unthank..	4·33	,,	Rockcorry.....	2·43
,,	Shap, Copy Hill	2·69	,,	Warrenpoint	2·65
XI.	Llanfrechfa Grange	1·86	,,	Newtownards	2·31
,,	Llandovery	2·61	,,	Carnlough.....	...
,,	Solva	2·07	,,	Bushmills	2·20
,,	Castle Malgwyn	1·61	,,	Buncrana	...
,,	Rhayader, Nantgwillt..	3·24			

SEPTEMBER, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	2·03	— ·47	·85	24	11	73·7	18	41·7	16	0	0
II.		Maidstone (Hunton Court)	3·06	+ ·75	·78	5	17	...	...	...	...	...	...
,,		Strathfield Turgiss	1·64	— ·66	·53	24	12	74·0	18	38·5	16	0	0
III.		Hitchin	1·91	— ·57	·47	24	17	65·0	18	38·0	15¶	0	...
,,		Banbury	1·23	— 1·58	·47	24	16	71·0	18	36·0	29	0	...
IV.		Bury St. Edmunds (Culford)	3·18	+ ·40	·48	24	20	69·0	18	35·0	30	0	...
,,		Norwich (Cossey)	2·56	— ·52	·44	22	19	73·0	18	38·5	28	0	...
V.		Bridport	2·30	...	·78	5	11	65·0	7, 18	35·0	29	0	...
,,		Barnstaple	2·31	— 1·97	·69	5	14	69·0	17	39·0	16	0	...
,,		Bodmin	1·98	— 3·26	·50	5	12	68·0	18	40·0	16	0	0
VI.		Cirencester	2·24	— ·90	·78	24	10	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	1·74	— 1·73	·57	20	18	66·5	18	41·0	2	0	...
,,		Tenbury (Orleton)	1·95	— 1·40	·56	24	17	70·7	18	36·0	17**	0	0
VII.		Leicester (Town Museum)	2·37	...	·66	24	18	73·6	18	37·5	17**	0	...
,,		Boston	2·53	— ·08	·49	5	16	74·0	18	42·0	28	0	...
,,		Grimsby (Killingholme)	2·82	— ·25	·50	22	20	69·0	18	41·5	17	0	...
,,		Mansfield	1·81	— 1·13	·39	22	19	70·8	18	37·0	17	0	0
VIII.		Manchester (Ardwick)	...	...	...	...	...	...	...	...	...	...	...
IX.		Wetherby (Ribstone)	2·84	— ·24	·91	23	12	...	...	...	...	...	...
,,		Skipton (Arncliffe)	2·81	— 2·77	·52	17	20	68·0	8	37·0	15††	0	...
X.		North Shields	4·64	+ 2·32	1·50	21	20	68·2	18	40·0	28	0	0
,,		Borrowdale (Seathwaite)	5·05	— 8·17	1·65	17	14	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	2·45	— 2·35	·46	5	9	...	...	...	...	...	...
,,		Haverfordwest	2·24	— 2·81	·80	24	10	64·5	20*	34·0	16	0	1
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	·98	— 2·77	·23	17	13	64·4	29	42·2	16	0	...
XII.	SCOTLAND.	Cargen	2·38	— 2·03	·58	17	15	65·4	8	40·0	1	0	...
,,		Hawick (Silverbut Hall)	2·32	— ·32	·73	21	18	...	...	...	...	...	...
XIV.		Douglas Castle (Newmains)	3·15	— 1·25	·61	17	16	...	...	...	...	...	...
XV.		Kilmory	2·80	— 2·96	·58	24	19	...	...	35·0	1, 15	0	...
,,		Appin Airds	3·24	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	3·32	...	1·15	29	16	...	...	...	.	...	...
XVI.		Loch Leven	3·50	+ ·27	1·00	22	10	...	...	...	...	...	...
,,		Arbroath	3·06	— ·01	1·54	22	12	66·0	16	40·0	28	0	...
XVII.		Braemar	2·54	— 1·40	1·50	21	14	62·0	11	31·2	28	1	19
,,		Aberdeen	2·11	...	1·01	21	15	64·0	26	37·0	27	0	0
XVIII		Portree	3·42	— 3·98	1·25	29	15	...	...	...	...	...	...
,,		Inverness (Culloden)	1·51	— 1·39	...	...	...	62·8	28	41·0	20	0	1
XIX.		Dunrobin	3·90	...	1·23	6	9	62·5	26	41·0	27	0	...
,,		Sandwick	·77	— 2·72	·22	29	12	59·5	3	44·0	19	0	0
XX.	IRELAND.	Cork (Blackrock)	2·57	— 1·58	·96	20	13	78·0	1	35·0	21	0	...
,,		Dromore Castle	3·06	...	·90	19	11	...	...	...	...	...	...
,,		Waterford (Brook Lodge)	2·96	...	·72	20	12	68·0	7†	35·0	13‡‡	0	...
,,		Killaloe	2·99	...	·66	17	10	72·0	1‡	36·0	16	0	...
XXI.		Portarlington	2·53	— ·65	·68	20	15	64·0	24	38·0	1	0	...
,,		Monkstown	1·31	...	·54	20	10	70·0	9, 22	37·0	1	0	0
XXII.		Galway	2·70	— 1·15	·81	20	17	65·0	§	39·0	16	0	...
XXIII.		Waringstown	2·33	— 1·02	·57	17	13	69·0	8, 10	37·0	18	0	0
,,		Londonderry	2·07	...	·45	23	16	64·0	20‖	42·0	12§§	0	0
.		Edenfel (Omagh)	2·48	— 1·56	·74	20	18	68·0	1	33·0	18	0	...

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

* And 23. † 21, 23. ‡ 8, 13. § Various. ‖ And 22. ¶ And 28.
** And 29. †† 28, 30. ‡‡ 14, 21. §§ And 19.

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

GREAT BRITAIN.

As we announced in our last number we give this month the translation of Dr. Hellmann's survey of British meteorology. The German original fills nearly ten folio pages, which translated would make at least thirty pages of this magazine. Hence it is obvious that our duty is to condense as much as possible, but at the same time to reproduce as faithfully as we can the statements and opinions expressed by Dr. Hellmann. For this reason we shall not (as in his articles Mr. Harding wisely did) bring the account down to the present time. Dr. Hellmann's paper on Great Britain was published in 1878; we merely reproduce the spirit of his report.

THE METEOROLOGICAL OFFICE.

The Meteorological Department of the Board of Trade was the first [Government] establishment for meteorology, and under the conduct of Admiral FitzRoy (1857-65) it published 14 so-called meteorological papers. After the decease of Admiral FitzRoy the title of the office was changed to the Meteorological Office, and the management was vested in a meteorological committee of the Royal Society. In November, 1875, the Treasury appointed a Committee to enquire—

(1) What scientific and practical results had been obtained by the Meteorological Office?

(2) What was the best arrangement for the future expenditure of the Treasury grant of £10,000?

The chief result of this enquiry was the raising of the grant to £15,000, and the appointment of a meteorological council instead of the former committee; the members of the Council receiving in the aggregate £1,000 per annum for their attendance.

* Continued from *Meteorological Magazine* for October.

Description of the Meteorological Office.—In the first place it is merely a computing, discussing, and publishing establishment, for, owing to want of space, all observations and comparisons are made in the outskirts of London—at the Kew Observatory. The office is situated in Victoria-street, Westminster, and is divided into three sections—ocean meteorology, weather telegraphy, and land meteorology. Ocean meteorology: Captains of merchant ships who are willing to make regular observations, and at the end of their voyages to send them in to the office, receive on loan a set of standard instruments and the necessary books of blank forms. The vessels of the Royal Navy are, at the request of the Admiralty, provided with similar instruments, and record the observations in somewhat similar books, which, however, they send to the Admiralty. Originally these books were, when needed, lent to the Meteorological Office. Moreover, the war ships can fill the Meteorological Office log books, but during 1867-75 ninety per cent. of the logs received were from merchant vessels. On account of the difficulty experienced in the interchange of data between the Admiralty and the Meteorological Office, the Treasury proposed to transfer the prosecution of marine meteorology to the Hydrographic Office of the Admiralty, as all the Royal Navy log books are in that office, and it could assume the same relation to the Mercantile Marine as the Meteorological Office has hitherto done. No steps in this direction have yet been taken.

[Dr. Hellmann next describes the existing arrangements both as to observers and instruments, the examination and discussion of the data in the log books, and the total amount of information collected. He gives short notes of the publications of this branch of the office, but as they have been mostly noticed in these pages, and Dr. Hellmann expresses no opinion, we pass to the next subject.]

Weather Telegraphy.—The Meteorological Office receives daily (Sundays excepted) telegraphic reports, at 8 a.m. from 51 stations, at 2 p.m. from 6 stations, and at 6 p.m. from 9 stations. These stations extend from 43° to 63° N., in fact from the Mediterranean to the northern part of Norway. From these telegrams the daily weather reports are compiled. and all necessary storm warnings authorized and issued. The original plan of notifying coming danger devised by Admiral FitzRoy, viz., a cone or a drum by day, and either three lamps to form a triangle or four to form a square by night, is maintained. Special warnings are sent to the Continent when exceptional disturbances are present. Reports and diagrams are prepared for various newspapers at various times daily and weekly. A weekly edition of the weather report is also prepared, chiefly for the use of agriculturists. This branch of the office also supervises the supply of what are called Fishery Barometers, *i.e.*, barometers of considerable accuracy, but specially constructed for strength, durability, and easy reading by the fishermen belonging to the smaller villages on the coasts of the British Isles, Of these instruments, 61 are placed in England and Wales, 46 in Scotland, and 32 in Ireland.

Land Meteorology.—The Meteorological Office has affiliated to it, under different conditions, many meteorological stations of different classes. The first order stations are Kew, Aberdeen, Armagh, Stonyhurst, Glasgow, Valentia, Falmouth, at all which all the meteorological elements—pressure, temperature, humidity, direction and force of wind, and amount of rain—are automatically continuously recorded. These records are carefully examined, reduced, and published. The office also publishes records from about 45 second order stations, 29 being in communication with the office, and 16 being furnished by the Meteorological Society. The office also receives returns from isolated stations in various parts of the world. The telegraphic reporting stations (in order to eliminate errors occurring in telegraphic transmission) forward each week a MS. copy of their observations. The seven principal stations are inspected annually by the Superintendent of Kew Observatory, the telegraph stations by the Director of the Meteorological Office, but recently Mr. Buchan, the Secretary of the Scottish Meteorological Society, has been appointed inspector for that country, with the remuneration of £150 per annum. Sea temperature: This has been observed since 1873 at several of the lightships round the coast in order to trace the relation between the temperature and the movements of the shoals of herrings, &c.; a subject previously investigated by the Scottish Meteorological Society.

Staff.—Receipts and Payments.—In the financial year 1876-77 the total receipts and payments were about £12,000. The principal payments were:—

General direction of Office..... ..	£1,400
Rent, fire, gas, &c.....	600
Postages, Library, and repairs	300
Marine Meteorology	2,200
Weather Telegraphy	3,400
Land Meteorology	4,100
	£12,000

But it must be remembered that in accordance with the English custom these amounts do not include printing, which is defrayed by the Stationery Office.

The expenditure for the library is also small, as nearly all the works are received as presents and in exchange for publications. Payment of Staff: The total staff of the office in 1877 was 29 in number, at salaries ranging from £800 per annum, down to boys at £32.

KEW OBSERVATORY.

Site of the Observatory.—This observatory is in the open portion of the old Deer Park at Richmond, near Kew Gardens, Richmond station, and the River Thames, the overflow of which occasionally reaches the Observatory, but in all other respects it is well adapted for, not merely astronomical and meteorological observations, but also for exceptionally delicate astronomical and physical investigations.

Character of the Observatory.—From 1841 until a comparatively recent period, Kew Observatory was controlled by the British Association for the Advancement of Science, and subsequently by the Royal Society. Now the cost of its maintenance is divided between the Royal Society and the Meteorological Office, and hence it has a somewhat double character.

Observations at Kew Observatory.—When the Meteorological Office was reconstituted in 1867, Kew was selected as the locality for one of the seven first-order stations, and consequently all these self-recording instruments have to be kept in operation, and the necessary check readings of the standard instruments made. Various temporary observations and experiments are also carried out, such as observations on the total intensity of daylight with Roscoe's photometer, on solar radiation with the black bulb thermometer in vacuo, on the duration of sunshine by a Campbell's Sunshine Recorder, and on the temperature at the bottom and top of the Pagoda (about 150ft. high). A complete set of Magnetographs is kept at work, continuously recording by photography, the declination of the needle, and the total amount of both the horizontal and vertical component of the terrestrial magnetic force. Atmospheric electricity is also continuously registered photographically by a Thomson Electrometer. The astronomical observations are limited to those with the photo-heliograph, and to eye observations of sun spots on Schwabe's method.

Testing and Comparison of Instruments.—The arrangements for the very important work of verifying the instruments issued by the Meteorological Office, and, indeed, the bulk of those used throughout the country, are the result of many years' experience, and at present unique. The importance and extent of this work may be gathered from the fact that in the year 1876 the total number of instruments compared or verified was 3782.

Organization, Staff, and Expenditure.—The observatory is under the control of a committee of ten members (the Kew Committee) and the staff consists of a Superintendent (Mr. G. M. Whipple) and ten assistants, most of whom enter very young. The total receipts and payments are about £1600 per annum, the principal items of expenditure being :—

Salaries	£1100
Fire, Gas, &c.	170
Printing, Postages, and Library ...	150
Chemicals, Repairs, &c	120

THE METEOROLOGICAL AND MAGNETICAL DEPARTMENT OF THE ROYAL OBSERVATORY, GREENWICH.

Independently of the Meteorological Office there has been, since 1840, a separate department of the Royal Observatory at Greenwich, specially devoted to magnetism and Meteorology.

Meteorological Observations.—The instrumental equipment consists of self-recording barometer, hygrometer, anemometer, and rain gauge,

with a full equipment of the ordinary instruments for eye observations, and in addition, a set of thermometers for taking the temperature of the earth at the depth of 3, 6, 12, and 24 Paris feet below the surface. Observations are also made daily of the temperature of the Thames, as it flows past the ship "Royalist," moored near Greenwich. Observations of atmospheric electricity are made by means of a wire stretched from a mast 80ft. high.

Magnetic Observations.—A complete set of magnetic instruments is kept in operation, and observations are also made upon the effect of earth currents on telegraph wires carried considerable distances. The observations are all published annually along with, and also separately from, the Greenwich Astromonical Observations. Special attention may be drawn to the universal practice in England, which is most fully developed at Greenwich, of providing ruled blank forms for the entry of observations, a practice which saves time, and leads to increased accuracy.

Staff and Budget.—This is not easily separated from that of the astronomical establishment presided over by Sir G. B. Airy. The meteorological and magnetical staff consists of a superintendent (Mr. Ellis), and about four assistants. The salaries range from £440 downwards, and are in the aggregate about £900; the repair, &c., of instruments, amounts to about £250, but the items of printing, coals, gas, &c., cannot be separated from those appertaining to the whole establishment.

THE METEOROLOGICAL REPORTS OF THE REGISTRAR-GENERAL OF BIRTHS, MARRIAGES, AND DEATHS.

Origin.—The statistical branch of the English General Register Office desiring to investigate the relation between climate and the death rate, applied in 1840 for meteorological data to the Royal Society, and as their observations were insufficient, subsequently to the Astronomer Royal, who, of course, easily supplied a weekly report from the Royal Observatory.

Mr. Glaisher was at that time superintendent of the Meteorological Department of the Royal Observatory, and he, partly through his connection with the Meteorological Society, and partly through his own personal efforts, established a corps of voluntary second order stations, which numbered 9 in 1845, and over 50 in 1875, some reporting to him daily, some weekly, and some monthly. On the recommendation of the Registrar-General, the Treasury granted Mr. Glaisher £150 per annum for this entirely private (*i.e.*, unconnected with the Royal Observatory) service, but in 1875 the grant was reduced to £100 per annum.

Publication.—Observations of three classes are published :—

(1). A weekly abstract for each of 23 large towns.
(2). A complete weekly report for Greenwich supplied by the Astronomer Royal.

(3). In the "Quarterly Returns of the Registrar-General," Mr. Glaisher gives the results from the above-mentioned 50 stations; these are well-known abroad, and were, especially in past times, in the absence of any other regular publication, much used by foreign meteorologists. They contain not merely tabular values, but remarks on the weather of each quarter as compared with the average of 30 previous years.

Similar tables are issued by the Registrars-General of Scotland and Ireland, as will be hereafter explained.

THE RADCLIFFE OBSERVATORY, OXFORD.

Observations have been made at this observatory for half a century, but it was only about 1854 that self-recording meteorological apparatus was erected. The observatory was then provided with photographically recording barometer, hygrometer, and anemometer. There is also a full supply of ordinary instruments. The observations are nearly all printed *in extenso* in the annual volume of Radcliffe observations. The total staff of the observatory consists of the director and four assistants, and it is not possible to separate the time or cost respectively appropriated to astronomy and to meteorology.

THE METEOROLOGICAL SOCIETY.

Origin of the Society.—On the proposal of the well-known meteorologist and aeronaut, Mr. J. Glaisher, and others, a society was formed in 1850, for the advancement of meteorology, and with the title of "The British Meteorological Society."* For many years the action of the society was limited to holding monthly meetings, at which papers and reports were discussed. A summary thereof will be found in the Proceedings of the British Meteorological Society, 1851-71. In the year 1866 the Society obtained a Royal Charter and became the Meteorological Society.

Fellows.—Publications.—Library.—Stations.—The number of Fellows in 1877 was about 400, new Fellows being elected on the recommendation of those already belonging to the Society and by ballot. All pay an entrance fee of £1, and the same amount as yearly subscription. A few distinguished foreign meteorologists are elected honorary members. Meetings for the reading and discussion of papers are held monthly (November–June), and the papers and discussions are printed in the Quarterly Journal. The somewhat important Library is open daily from 10 to 4, and it is one of the few astronomical and meteorological libraries of which there is a printed catalogue.

Besides the importance which attaches to the Quarterly Journal through its reporting the papers read to the Society, it has now the

* Some years earlier such a society had existed in London, and had published one volume of Transactions.

additional interest of containing the results from the series of stations of the second and third order recently started by the Society, which stations may, in many respects, be taken as models. The Society started upon the principle of only accepting observations from good localities, verified instruments, and trained observers, who were willing to obey implicitly rules adapted to ensure uniformity. There are now about 20 of these stations, and on account of the difficulty of obtaining the above requirements, it is scarcely likely to exceed 40. All are inspected carefully each year, the inspector having a blank form to fill up with details of his inspection, the results of which are published. A copy of the records from 15 stations is sent to the Meteorological Office for publication by the Government, and the records of all are printed by the Society, either *in extenso* or in abstract.

With the commencement of this system the Society also began what no one had previously done—viz., the publication of plans showing the precise situation of all the instruments at each station. We may add, that all imperfectly exposed instruments, such as thermometers at windows, are, very properly, strictly forbidden.

All the observers are volunteers and entirely unpaid.

Equipment of the Stations.—In order to satisfy myself upon this point I visited two of the second-order stations, viz.: Mr. Symons's, 62, Camden-square, in the N.W. of London, and Mr. Marriott's at Lower Norwood, six miles S.W. of London. Observations are made at these and at all other second-order stations daily at 9 a.m. and 9 p.m. The stations are provided with cistern barometers on Fortin's system, with Stevenson's thermometer screen containing dry and wet bulb and max. and min. thermometers. The height of the bulbs of the thermometers (which are rough, not polished) above the ground is 4 ft. The vessel holding the water for the wet bulb is covered with the exception of a small aperture for the wick. An earth thermometer (Symons's system) is buried with its bulb 1 ft. below ground. The terrestrial radiation thermometer lies on grass, and near it is the black bulb in vacuo. The rain gauge is 5 in. in diameter, and its orifice is 1 ft. above the ground. No anemometers were fixed, the localities not being favourable.

Phenological Observations.—The Meteorological Society has lately organised a system of observations of phenological phenomena. A conference of various Botanical, Horticultural and Agricultural Societies was held in 1874, and a system organised; and in 1876, 22 stations sent in reports, which were discussed and tabulated by the Rev. T. A. Preston.

Lastly, the Meteorological Society is distinguished from all similar societies by the fact (due to the magnitude of the metropolis) that the principal instrument makers—Casella, Negretti and Zambra, Hicks, Pastorelli, Adie and others—are active members of it, and through this intercourse many valuable improvements arise in

scientific instruments. All sides, manufacturers and purchasers, and especially science, derive the greatest advantage from this fact.

Administration.—Budget.—The President is elected from the Fellows, and holds office for two years. He is assisted by Vice-Presidents, Secretaries, &c. The correspondence, care of the Library, &c., is discharged by the Assistant Secretary, who receives £125 per annum; a computer is also employed. Receipts and payments in 1876, about £600.

THE SCOTTISH METEOROLOGICAL SOCIETY.

Origin.—When, in 1854, the Registrar-General for Scotland required meteorological data, his assistant (Dr. Stark) commenced the organisation of a Meteorological Society, the members of which should provide necessary data. This was done, and hence the Scottish Meteorological Society, which is now an independent body with no further relation to the Registrar-General than that of forwarding schedules from 55 of its stations to the Astronomer Royal for Scotland, in order that he may reduce them and hand over the results to the Registrar-General.

Meteorological Stations.—Journal of the Scottish Meteorological Society.—The Society possesses 104 voluntary second-order stations, some in Iceland and in the Faroe Isles, and 59 at lighthouses. The instruments have mostly been bought by the observers or presented by friends. The observations are made daily at 9 a.m. and 9 p.m., and reported monthly. Besides the report from the 55 stations already mentioned, an abstract of the observations from all the stations is published in the valuable organ of the Society, the Journal of the Scottish Meteorological Society. The Journal also contains independent meterological works by the members, of which many are very valuable.

Climate of Scotland.—One principal object of the Society is to thoroughly investigate the climate of Scotland as affecting Agriculture and Public Health. Much of this has already been done by Mr. Buchan. Occasionally rich members of the Society offer prizes of from £20 to £100 for the solution of meteorological questions.

Organization.—Budget.—The operations of the Society are directed by a President, Vice-President and Council, but all the correspondence, supervision of the returns, &c., is undertaken by the Meteorological Secretary (Mr. A. Buchan). Most of the members subscribe 10s. per annum, but some pay as much as £5. The total receipts and expenditure are about £400 per annum. The expenditure is somewhat thus—Salaries, £210; printing, £100; rent, &c., £40; sundries, £70. As Mr. Buchan has been made by the Meteorological Council, inspector of all Scottish stations, the Society may be partly regarded as receiving a Government grant.

There is not yet any Meteorological Society in Ireland, and the returns from that country are mostly sent to the Meteorological Office in London.

MR. SYMONS'S RAINFALL OBSERVATION SYSTEM.

Proximity of Rain Gauge Stations.—Origin of the System.—No part of the earth's surface (except, perhaps, the little Island of Barbadoes) has so close a network of rain gauge stations as Great Britain, for which, in the year 1877, there were about 2,100 stations. This is the work of Mr. G. J. Symons, who, from an insignificant beginning in the year 1860, developed the system, subsequently receiving assistance from the British Association for the Advancement of Science, but since 1876 conducting it again unaided.

Assistance of the British Association.—After Mr. Symons had given to the British Association in 1861, a report from 241 stations, and in the following year a report from 453, the Association appointed a Rainfall Committee, with Mr. Symons as Secretary. This Committee presented reports to the British Association yearly, from 1865 to 1876. Besides these, Mr. Symons has published yearly (1860-77) the well-known work *British Rainfall*, in which all experiments and observations in Great Britain relating to rainfall are described.

Monthly Meteorological Magazine.—A large portion of this work, which has been edited by Mr. Symons (1866-77), is also devoted to rainfall.

Rain Stations.—Inspection.—The majority of the 2,000 observers belonging to this system are volunteers, but about 40 in out-of-the-way and very elevated localities are paid. The pattern of rain gauge used varies with the locality, but one of 5 in. diameter, and with its orifice 1 ft. above the ground, is the most usual. The stations are inspected by Mr. Symons or some other competent person, in order to ascertain the accuracy of the gauges, and that they are properly placed.

Experiments.—Of special utility for observers in all countries are the experiments conducted or promoted by Mr. Symons, especially such as :—

(1) What are the best forms of rain gauge ?
(2) Is this form useful for all localities ?
(3) What is the best mode of measuring snow ?
(4) What is the influence of the height of the receiving surface on the amount of rain collected ?
(5) What is the influence of the size of the receiving surface on the amount of rain collected ?

Cost.—The cost of the maintenance of this system is met by the sale of *British Rainfall*, subscriptions and donations.

Finally, it is to be hoped that the maintenance of this system of observation, which is still developing, will be, in the event of the death of its leader, made certain by the Government.

EFFECTS OF A SUPPOSED "WATER-SPOUT" ON LITTLE HALDON, SOUTH DEVON, ON 21ST OCTOBER, 1881.

To the Editor of the Meteorological Magazine.

SIR,—On the morning of Friday, October 21st, a fall of water resembling a "water-spout" took place at Lidwell and Smallcombe farms near Teignmouth, and at Bishopsteignton, all lying at the foot of the slopes of Little Haldon, which, from the suddenness of the fall, and the damage that occurred, may be considered worthy of record.

Lidwell Farm, distant about two miles and a half from Teignmouth, and about the same distance from Dawlish, is situated on the highest level ground at the end of a deep narrow valley to the west of Dawlish, where it nestles in a nook at the foot of the abrupt hill-sides of Little Haldon. A small brook, commencing near the ruins of "Lidwell Chapel," runs to the west of the farm-house, and falls, just above the farm-yard, nearly at right angles into another brook which, also coming from Little Haldon, passes in nearly a direct line through the farm-yard. Sheds and cart-houses stand on the right of the brook, and the house and the more important farm buildings on the left. On the morning of Friday, October 21st, the fall of rain was moderate, until about 8 o'clock a.m., when a labourer, standing on a raised terrace that overlooked the farm-yard saw it filled with water in the course of a few minutes. The pigs below him were saved with difficulty, and such was the case with a cow and calf; a cart and horse ready to start were nearly washed away, but were saved by the farmer, who went through water that reached above his waist, and he is five feet eight inches in height. The only loss of life was of four fowls and one duck. Earth, sand, and stones were washed down in considerable quantity, and coloured marks on a cart-shed to the right of the brook show that the flood had risen about five feet above the ordinary height of the stream. The mass of water that caused this damage appears to have fallen suddenly on the upper part of the hill, and on the hill-sides to the west of Lidwell Farm; the hill-sides to the east and south are not injured. A neighbouring farmer in the same valley saw the water rolling down the hill-side, and rode home to prevent his farm being damaged by the flood. Smallcombe Farm, in the next valley to the north of Lidwell, stands near a brook that joins a short distance lower down, the brook that runs by Lidwell. This farm-house is also at the foot of the hill-side; the water rushed down upon it from Little Haldon. Some of the fields were much cut up, and the flood got into the house, bringing stones, gravel, and mud in such quantity that the lowest floor was made uninhabitable, and the household had to remove up-stairs. This is the most northerly place to which, according to my information, the immediate effect of the water-spout can be traced; the fall of rain to the west and north will be noticed hereafter. The fall of rain at Dawlish was not more than that of a heavy shower; such was the case at Holcombe,

distant about a quarter of a mile from Lidwell; and at my house, Woodway, about half a mile distant, where my gardener was at work. The amount of rain registered by me at nine on the morning of the 21st was 1·63 in. Rain had fallen during the previous night. The entry in my register is, "Rain up to 8.40 a.m., when the clouds cleared off gradually." The approach of the water-spout was not indicated by any fall of the barometer; mine, reduced to sea level, stood on the morning of the 20th, at 29·612, in the evening of the same day at 29·473, and on the morning of the 21st, at 29·511; the wind was S.W., with a force of "4." There are no traces of heavy rain on the Teignmouth and Exeter road, where it enters on the level ground on the southerly end of the summit of Little Haldon. About a quarter of a mile to the west of that point, on the road to Kingsteignton, a narrow lane turns off to the south, and leads down a valley to the west end of Teignmouth; shortly after the open ground on the hill top is left, there are traces of a rush of water, as shown by the rough stones that form the road being disturbed, and gravel being washed into banks, but these are so trifling that they would not have been noticed had this storm not taken place. The road to Kingsteignton is, I am informed, greatly damaged, being torn up to the depth of 18 inches, and banks of stone, gravel, and rubbish deposited. Similar damage has taken place on the road descending to Ideford; the rush of water has made a hollow, about three feet deep, along the centre of parts of the road from Ideford to Luton, and the foot-bridge at that place has been washed away. The water-spout has, apparently, damaged a greater area on the south-westerly and westerly sides of Little Haldon than elsewhere. The highway from Teignmouth to Kingsteignton, for the first mile and a half, has not been injured, but at that point it was broken up by the storm, and from that place to Bishopsteignton, lying at the foot of the south-west of Little Haldon, the damage is great. The road by Bishopsteignton Church was washed up to the depth of one foot, and the paved gutter damaged. Mr. M. Lewis Brown informs me that at his house, "Keittos," in Bishopsteignton, the rain "more like a water-spout than ordinary rain," commenced about 8 a.m. and continued about 50 minutes; he has not a rain gauge, but considers that the fall during that time was about two inches, the gravel paths in his garden were so much cut up that three men were occupied for a day in repairing the damage.

As no sudden down-pour is reported except at Bishopsteignton and the south-westerly and central parts of Little Haldon, the bursting of the water-spout was probably confined to that district, but a considerable fall of rain took place in the neighbourhood, particularly to the west and north. The fall for the 24 hours previous to 9 a.m. on the 21st October at my house (viz., 1·63 in.), has been mentioned. At Babbacombe, Mr. Glyde states that he registered 1·50 in. that morning, but of this amount 0·87 in. had fallen before 11 p.m. on the 20th, and that heavy rain had fallen between 5 and

5.30 a.m. on the 21st. At Totnes, according to the information of Mr. Edmonds, it rained on the 20th, and the rain continued through the night, and from 7 to 8 a.m. on the 21st "the rain came down in torrents," and he registered on the morning of the 21st, 1·93 inches; the roads were cut up into ruts. The fall of rain extended about half-way from Totnes to Ashburton, or about 4 miles to the north of Totnes. Mr. J. Amery, of Druid, near Ashburton, writes that the rain on the morning of the 21st was nothing extraordinary, that there was a good deal on the 20th, and that he had registered 1·38 inches on the morning of the 21st. At Newton Abbot, Mr. Cotton estimates that the heavy rainfall on the morning of the 21st lasted 20 minutes; the surfaces of the roads and paths were broken up. At Bovey Tracey and Chudleigh there was rain on the morning of the 21st. The amount registered by Mr. Divett at Bovey Tracey, on the morning of the 21st, was 1·32 inches, but I have not been able to procure full particulars from those places. Mr. Pycroft, of Kenton, has furnished me with information as to the district to the north of Little Haldon. All up the Exe Valley, between the river and Haldon, the rain came down straight and strong, between 8 and 9 a.m. on the 21st, it was "a shower like a heavy thunder-shower—nothing more—nothing worthy of record." He judges that on the flank of Haldon the rain must have been more severe from the swelling of two brooks.

From the above it would seem that a water-spout burst on the south-westerly and central parts of Little Haldon about eight o'clock on the morning of Friday, October the 21st, causing damage in the immediate district, and that heavy rain and showers took place at the same time in the surrounding country extending from the south-west to the north-east, but that to the south-east and south the fall was moderate.

G. WAREING ORMEROD.

Woodway, Teignmouth.

THE COMING WINTER.

To the Editor of the Meteorological Magazine.

SIR,—Twelve months ago (see *Met. Mag.*, Vol. XV., p. 160) I gave three reasons for expecting a severe winter in 1880-81. It is a remarkable fact that the same three reasons for expecting a cold winter have to be repeated this year. Last year, however, we had a great fall of snow in October. This year we had only a little snow about the end of last month. We may, therefore, expect a colder winter than the average, but still somewhat less cold, on the whole, than last winter was.—Yours, &c.,

GEORGE D. BRUMHAM.

Barnsbury, November, 1881.

SUPPLEMENTARY TABLE OF RAINFALL IN OCT., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	2·46	XI.	Carno, Tybritle	5·02
,,	Margate, Acol	5·65	,,	Corwen, Rhug	4·39
,,	Littlehampton	1·79	,,	Port Madoc	2·88
,,	St. Leonards	3·36	,,	Douglas.....	3·40
,,	Hailsham	2·64	XII.	Carsphairn	5·71
,,	I. of W., St. Lawrence.	1·68	,,	Melrose, Abbey Gate ...	3·66
,,	Alton, Ashdell.....	2·28	XIV.	Glasgow, Queen's Park.	2·22
III.	Great Missenden.....	2·73	XV.	Islay, Gruinart School..	2·70
,,	Winslow, Addington ...	2·96	XVI.	Cupar, Kembach.....	5·72
,,	Oxford, Magdalen Col...	1·88	,,	Aberfeldy H.R.S.	3·94
,,	Northampton	2·87	,,	Dalnaspidal	6·12
,,	Cambridge, Beech Ho...	2·39	XVII.	Tomintoul.....	4·78
IV.	Harlow, Sheering	2·68	,,	Keith H.R.S.	4·80
,,	Diss	3·27	XVIII.	Forres H.R.S.	3·29
,,	Swaffham	2·35	,,	Strome Ferry H.R.S....	3·40
,,	Hindringham	2·73	,,	Lochbroom	3·91
V.	Salisbury, Alderbury...	1·34	,,	Tain, Springfield.....	2·58
,,	Calne, Compton Bassett	1·41	,,	Loch Shiel, Glenfinnan.	7·89*
,,	Beaminster Vicarage ...	1·77	XIX.	Lairg H.R.S.	2·34
,,	Ashburton, Holne Vic..	7·63	,,	Altnabreac H.R.S.	3·86
,,	Langtree Wick	3·64	,,	Watten H.R.S.	3·07
,,	Lynmouth, Glenthorne.	3·87	XX.	Fermoy, Glenville	6·47
,,	St. Austell, Cosgarne...	3·66	,,	Tralee, Castlemorris ...	1·99
,,	Taunton, Fullands	2·41	,,	Cahir, Tubrid	4·50
VI.	Bristol, Clifton	2·26	,,	Tipperary, Henry St....	4·94
,,	Ross	2·73	,,	Newcastle West	4·10
,,	Wem, Sansaw Hall.....	2·29	,,	Kilrush	2·64
,,	Cheadle, The Heath Ho.	3·50	,,	Corofin	3·29
,,	Coundon	3·25	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	3·14	,,	Carlow, Browne's Hill..	4·24
,,	Horncastle, Bucknall ...	2·02	,,	Killsallaghan	...
VIII.	Macclesfield Park	2·85	,,	Navan, Balrath	3·04
,,	Walton-on-the-Hill.....	3·34	,,	Athlone, Twyford	2·08
,,	Broughton-in-Furness ..	3·68	XXII.	Mullingar, Belvedere ...	2·62
IX.	Wakefield, Stanley Vic.	2·30	,,	Ballinasloe	2·76
,,	Ripon, Mickley	3·44	,,	Clifden, Kylemore	5·32
,,	Scarborough.....	3·98	,,	Crossmolina, Enniscoe..	3·47
,,	Mickleton.....	5·10	XXIII.	Carrick-on-Shannon ...	2·72
X.	Haltwhistle, Unthank..	5·81	,,	Dowra	3·76
,,	Shap, Copy Hill	2·81	,,	Rockcorry.....	3·41
XI.	Llanfrechfa Grange	3·63	,,	Warrenpoint	4·31
,,	Llandovery	3·96	,,	Newtownards	3·86
,,	Solva	2·25	,,	Carnlough.....	...
,,	Castle Malgwyn	3·85	,,	Bushmills	4·14
,,	Rhayader, Nantgwillt..	5·54		Buncrana	3·72

* Glenfinnan gauge allowed to overflow on 10th.

OCTOBER, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	2·99	+ ·29	1·03	22	12	62·8	1	27·3	17	5	14
II.		Maidstone (Hunton Court)	3·69	+ 1·23	1·81	8	18	...	...	...	...	...	...
,,		Strathfield Turgiss	1·61	— 1·13	·77	22	10	...	...	...	...	...	...
III.		Hitchin	2·26	+ ·08	·70	13	17	58·0	11	25·0	16*	7	...
,,		Banbury	2·47	— ·29	·77	13	19	60·0	11	25·0	17	5	...
IV.		Bury St. Edmunds (Culford)	2·69	+ ·52	·63	13	20	61·0	11	24·0	30	9	..
,,		Norwich (Cossey)	2·83	+ ·50	·80	13	21	60·0	2	27·5	17	3	12
V.		Bridport	1·80	...	·52	22	14	62·0	11	17·0	31	...	...
,,		Barnstaple	2·94	— 2·51	·69	26	14	65·0	1	27·0	31	...	...
,,		Bodmin	4·96	— 1·31	1·12	23	14	65·0	8	27·0	31	2	6
VI.		Cirencester	2·04	— 1·20	·78	13	7	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	2·82	— 1·78	1·13	13	15	60·0	3	...	...	...	...
,,		Tenbury (Orleton)	3·00	— ·24	·99	13	19	62·5	1, 11	24·0	17	7	11
VII.		Leicester (Town Museum)	2·81	...	1·01	13	16	51·9	...	39·6	...	...	...
,,		Boston	2·54	+ ·51	·58	13	18	58·0	11	31·0	17	1	...
,,		Grimsby (Killingholme)	2·36	— ·29	·71	13	18	59·0	11	32·0	17†	0	...
,,		Mansfield	3·10	+ ·10	·64	13	20	59·5	2	28·6	17	4	10
VIII.		Manchester (Ardwick)	...	...	...	...	...	...	...	...	...	...	...
IX.		Wetherby (Ribstone)	3·14	— ·22	1·05	15	10	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·81	— 1·45	1·77	13	21	59·0	1	20·0	30	6	...
X.		North Shields	3·26	+ ·75	·74	13	20	60·2	11	25·5	31	5	6
,,		Borrowdale (Seathwaite)	6·82	— 9·73	3·02	13	16	...	...	...	...	..	...
XI.	WALES.	Cardiff (Ely)	3·63	— 1·60	·87	22	12	...	...	...	...	...	...
,,		Haverfordwest	3·42	— 3·03	1·18	13	14	60·0	11	20·0	30	5	10
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	..	...	...
,,		Llandudno	2·42	— 2·17	1·00	13	13	60·0	1	30·6	30	1	...
XII.	SCOTLAND.	Cargen	2·33	— 3·38	1·11	13	11	63·8	1	24·0	31	4	...
,,		Hawick (Silverbut Hall)	2·70	— ·47	·95	13	14	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	3·19	— 1·75	1·10	13	15	...	...	...	...	...	...
XV.		Kilmory	3·55	— 4·77	·82	13	14	...	...	26·0	16	6	...
,,		Appin (Airds)	3·00	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	3·84	...	1·36	13	14	...	...	...	...	...	...
XVI.		Loch Leven	4·00	— ·31	1·20	13	13	...	...	...	...	...	...
,,		Arbroath	3·43	+ ·36	1·34	13	15	61·0	1	30·0	17	2	...
XVII.		Braemar	6·54	+ 2·06	1·05	14	24	61·5	1	23·2	17	7	16
,,		Aberdeen	3·75	...	1·21	14	21	63·0	1	28·0	16	2	...
XVIII		Portree	4·73	— 4·83	1·68	10	13	...	...	...	...	..	...
,,		Inverness (Culloden)	3·36	+ 1·07	·83	10	9	65·0	1	33·3	25	0	16
XIX.		Dunrobin	3·22	...	·70	13	15	61·8	7	32·0	17	1	...
,,		Sandwick	3·44	— ·85	·62	10	20	59·1	1	35·6	16	0	2
XX.	IRELAND.	Cork (Blackrock)	6·35	+ 1·61	1·75	31	14	68·0	2, 3	26·0	29	4	...
,,		Dromore Castle	7·72	...	2·45	13	15	66·0	8	30·0	27‡	3	...
,,		Waterford (Brook Lodge)	3·56	...	·85	21	13	65·0	...	26·0	30	3	...
,,		Killaloe	3·56	...	1·52	13	13	65·0	2	26·0	16*	5	...
XXI.		Portarlington	2·30	— 1·17	·81	13	12	61·5	1	29·5	16	4	...
,,		Monkstown	3·23	...	·97	22	17	64·0	11	27·0	31	2	2
XXII.		Galway	2·94	— 2·08	1·16	13	15	62·0	1, 2, §	24·0	30	3	...
XXIII.		Waringstown	3·72	+ ·11	·97	13	16	65·0	1	21·0	29	5	8
,,		Londonderry	3·71	...	1·40	13	17	63·0	1	30·0	31	1	6
,,		Edenfel (Omagh)	2·95	— 1·37	1·00	13	16	63·0	1	19·0	29	5	...

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

* And 30. † And 31. ‡ And 29. § And 3, 4

METEOROLOGICAL NOTES ON OCTOBER.

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

ENGLAND.

STRATHFIELD TURGISS.—Gale from W. on the 13th and 14th, considerable damage done to trees, houses, and agricultural buildings.

HITCHEN.—The coldest October for more than 30 years. The bar. fell an inch from 9 a.m. on the 12th to 9 a.m. on the 13th, and rose exactly the same amount in the next 24 hours.

BANBURY.—Temp. of the month 5° below the average; high wind on four days, strength of wind on the 14th as great as on January 18th; a factory blown down near the L. & N. W. R. Station, and many hundred trees uprooted or broken. H on 14th and 29th.

CULFORD.—A very unsettled month, with unusually severe frost. Considerable damage to trees, &c., during the great storm of the 14th.

COSSEY.—A cold month, but the first part of it favourable for agricultural work; hurricane on the 14th, many trees blown down and others broken. H on 28th, 29th, and 30th.

BODMIN.—Mean temp. of the month 51°·1.

CIRENCESTER.—A dry, rather cold month. Great gale on the 14th; the bar. fell rapidly on the 13th, and heavy R set in at nightfall; the gale commenced about midnight, blowing down trees and unthatching ricks in all directions, but othewise no great damage was experienced.

WOOLSTASTON.—A most destructive hurricane on the 14th, many large trees blown down and much damage done; the most violent gale remembered in these parts. A severe gale on the night of the 30th, with S.

ORLETON.—The sky was generally cloudy, with cold winds till the 13th, when steady R set in about 4 p.m., continuing till daybreak on the 14th, with a rapid fall of the bar. and the wind increasing to a hurricane, which reached its greatest fury shortly before noon, and was as destructive to trees and buildings as the great gale of October 15th, 1877. The bar. at 9 a.m. on the 13th stood at 29·63 in. (uncorrected); at 9 a.m. on the 14th, at 28·73 in.; and at 9 a.m. on the 15th, had risen to 29·74 in. After this storm the sky was bright and clear for several days with severe frost at night, but on the 22nd a heavy fall of R occurred, preceded by a strong gale of wind. The remainder of the month was cloudy, gloomy, and cold. The mean temp. of the month was more than 3°·5 below the average.

BOSTON.—Temp. of the month 2°·5 below the average; easterly winds in excess. The gale of the 14th destroyed an immense number of trees; at 11 a.m. the bar. fell to 28·88 in.

ARNCLIFFE.—The month was cold, dark and stormy. S on the 29th.

WALES.

HAVERFORDWEST.—The first seven days were cold, with clear sky and easterly breezes; a period of mild broken weather then set in, culminating in the great storm of the 14th, which, from its effects was judged to be the severest since October, 1859; the weather remained unsettled, stormy and wet till the 25th, when a very cold period again set in, the frost on the night of the 30th being the most severe I ever registered in October; a very large sheet of water was covered with ice ¼ inch thick.

LLANDUDNO.—Month cold, dry, and bracing; the mean temp. being about 4°, and the rainfall about 45 per cent. below the average. There were 113·4 hours of bright sunshine during the month. A heavy gale occurred on the 14th, beginning in the W. and veering round to the N. towards its close.

SCOTLAND.

CARGEN.—Easterly winds unusually prevalent; mean temp. 45°·5, 3° below the average; 117 hours of sunshine, a little below average; severe gale on 14th.

SILVERBUT HALL.—A terrible storm of wind, R, H, and S on the 13th and 14th. Hills white with S on the 14th, 27th, and 28th.

QUINISH.—A very fine month, excepting a wet and stormy week from 7th to 14th. Nearly all the corn crop of this district was secured in the first few days of the month; an excellent crop in excellent order.

BRAEMAR.—A dull wet month; crops still exposed, and a considerable quantity unreaped.

ABERDEEN.—Very stormy weather from 10th to 25th, with heavy R and high seas. Rainfall about half an inch above the average. Aurora on 27th.

PORTREE.—Constant gales from 10th to 16th, with H, S, and R showers; the high winds enabled farmers to get their crops into the stockyard in fine condition.

CULLODEN.—Weather generally fine from the 1st to the 8th, and from the 16th to the end of the month.

SANDWICK.—A very stormy month, particularly on the 11th, 12th, 13th, 14th, 15th, and 23rd, when it blew from 50 to 60 miles an hour, but the storm of the 13th and 14th, which did so much damage further south, was not so disastrous here.

IRELAND.

DROMORE CASTLE.—Mean temp 50°·8; the month was marked by sudden and unforeseen changes, a good deal of sunshine and frequent heavy falls of R.

KILLALOE.—Fierce gale from S.E. on 13th and 14th, and again with less force from 18th to 24th; last week of the month very fine and frosty.

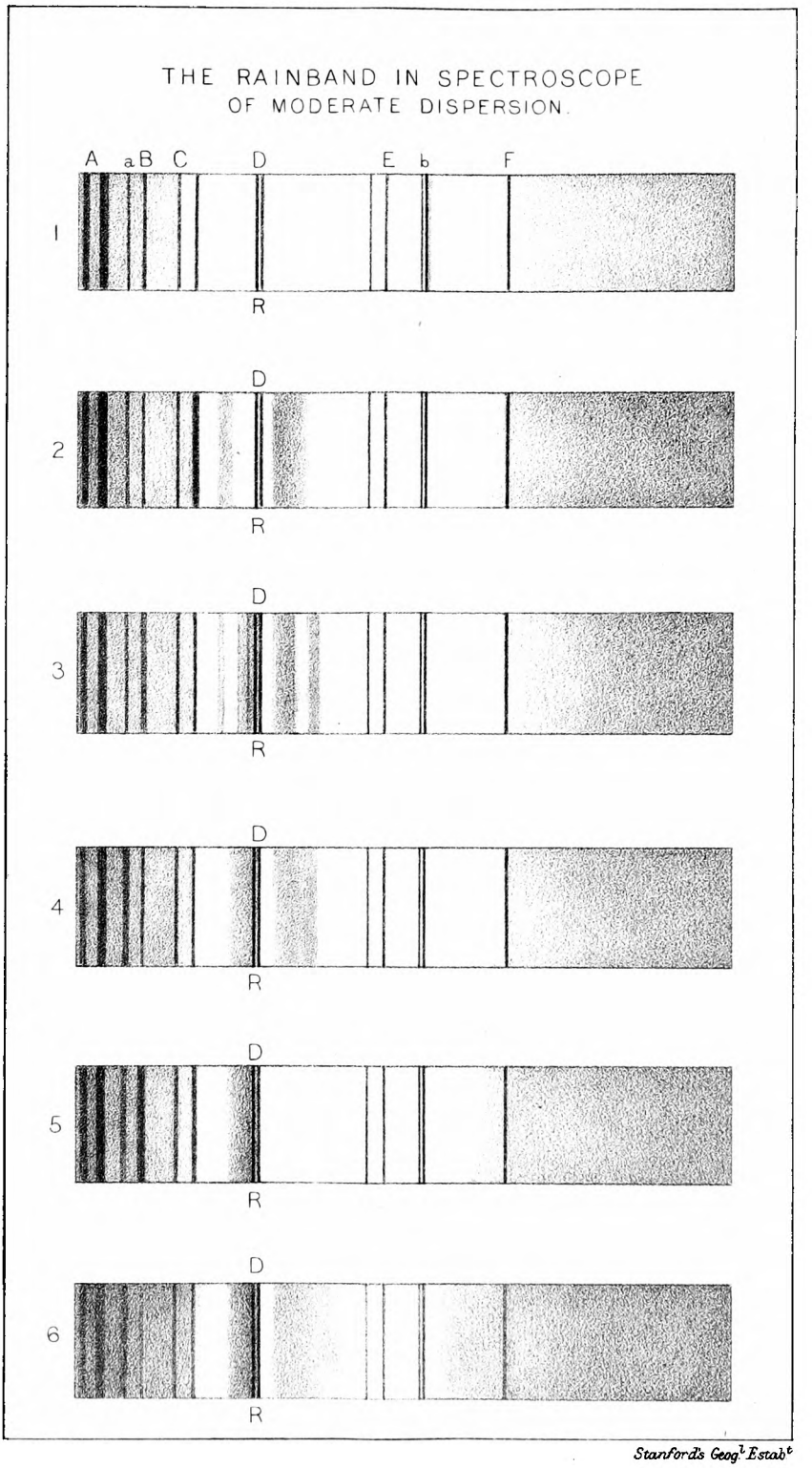
MONKSTOWN.—Early part of month fine and bright, followed by showery weather; violent gale from W. on morning of 14th; blowing hard from E.S.E. from 19th to 23rd, inclusive, bringing in a very heavy sea, especially on 22nd.

WARINGSTOWN.—Grain crops very late, the country not thoroughly cleared of stooks till the last week of the month. Tremendous gale for a few hours on 14th, and great destruction of timber; the bar. fell to 28·445 in.

LONDONDERRY.—Weather on the whole favourable, with the exception of the 13th and 14th, when we had a severe gale from N.W., with an extremely high tide in the river Foyle and adjoining streams. Wind variable.

THE GALE OF OCTOBER 13TH–14TH.

OUR readers may not unreasonably expect to find in these pages an account of the destructive gale which swept across Great Britain in the early hours (especially 7 to 10 a.m.) of October 14th; but we postpone it, because the subject will be fully discussed at the meeting of the Meteorological Society on November 16th, and we think that an abstract of the papers and discussion on that occasion will form the best summary of the subject which could be prepared.



Stanford's Geog.l Estab.t

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A PLEA FOR THE RAINBAND.

WHAT is the Rainband? This may appear a strange question to see put in a meteorological journal, and yet I venture to surmise that not very many of your readers have ever put the question to themselves, and that comparatively few of them have investigated it as a meteorological one. I do this the more boldly because as a matter of fact I rarely take up a weather record in which it is even named; the popular and wide-spread journal which owns the giant barometer reading feet in lieu of inches, never quotes from its readings; and so far as I can glean the gallant "daft" explorer who daily mounts Ben Nevis does not carry a spectroscope in his pocket, though the high altitude he attains would make its record most interesting. Probably, I should myself have hardly heard of and never enquired about it, but that some years since I had the pleasure and profit to make the acquaintance of the talented and kindly Astronomer Royal for Scotland; who, if Mr. Lockyer is said in university rhymes to have made himself owner of half the corona, has no less, undoubtedly, appropriated to himself three-fourths at least of the rainband.

Thanks to the information and advice then given me, and to subsequent publications sent me from the same source, I became a "rainband" observer, soon began to use it as a meteorological aid, and after some desultory observations at first, daily records of it from the 1st July, 1880, to the present time now lay before me.

My aim now is, if I can, to answer the question above put, in such a way as to make the subject as attractive to your readers (or some of them) as it has been to myself. I will, therefore, at once start by describing the rainband as a dark band or shading (or rather, under sufficient amplifying power, set of fine lines) seen on the less refrangible (red) side of the double line D in the atmospheric spectrum; and the presence or absence of which is indicative of the presence, or otherwise, of moisture (more strictly speaking, excess of moisture) in the atmosphere. Its history may be said to date from the time when Angström's maps of the solar lines were found to present different aspects according to the condition of moisture of the atmosphere at

the time of observation, and when that pioneer of spectroscopy proved the presence and absence of certain lines forming bands in the spectrum, more especially a set near D, to depend on that condition. No practical meteorological result followed, however, until, as Prof. Piazzi Smyth tell us, the subject was first presented to him as a marked feature in sky spectrum at Palermo before and after a sirocco in 1872. Next, when in July, 1875, destructive floods in both France and England (*not predicted by the barometer*) were noticed by him in connection with a peculiar band in the spectrum under dates July 19th and 26th, 1875. Prof. Smyth vividly describes in *Nature* (vol. xii., pp. 231, 252) the phenomena then observed, how the dark band near D was found the forecast of a drenching afternoon following the fine opening of a Scotch holiday in Edinburgh; and how, on another occasion, it became the "spectroscopic *prévision* of rain with a high barometer." Then followed observations in May, 1876, to the same effect in France, especially at Marseilles, where the rainband was seen in the spectrum and followed by rain to the surprise of the natives, who consulted only the public barometer and thermometers, and found none predicted. In February, 1878, appeared the fourteenth volume of the Edinburgh Astronomical Observations, 1870-1877, and here, under the head of "Meteorological Spectroscopy in the small and rough," we have the subject treated in a most complete and elaborate manner, and illustrated by a set of engravings of spectra. The Scottish Meteorological Society's Journal, N.S., Nos. li., lii., also contain contributions by Prof. Smyth on the subject. Again, in *Nature* of July 1st, 1880, vol. xxii., pp. 194, 5, the subject of "rainband spectroscopy" is dealt with in a condensed and epitomized form very acceptable to the reader, who, doubtless will recognise the identity of the "Edinburgh experimenter" in this useful contribution on the subject.

Having thus far, though imperfectly, given honour where it is due (for as far as I am aware no other rainband research of anything like such extent has been contributed from other quarters), I will again pass to the phenomenon itself. For its observation a spectroscope is of course necessary.

A large one with several prisms is desirable if the ultimate composition of the band or bands is to be examined; but for ordinary meteorological purposes and to observe the general character of the band near D, a pocket or miniature instrument is quite sufficient, indeed best adapted. This may be obtained from any scientific optician, and will cost, according to construction, from one to three guineas. The more expensive ones have an adjustable slit and achromatic lenses; but these are not necessities, and the cheaper form is nearly as useful.

I employ for my own observing a McClean's star spectroscope with a slit arrangement adapted, which makes also an efficient instrument with rather a larger spectrum than the pocket spectroscope.

Having obtained the instrument, close the slit and adjust the focus

till the lines in the spectrum are sharp and clear. This should be done on a bright part of the sky. Then point the instrument to the quarter of the heavens which it is desired to examine, and note results as to, especially, lines D and their neighbourhood.

I generally observe thus at 9 a.m. daily from my laboratory window (looking towards the south), but if time and opportunity allow three observations, at 9 a.m., 1 p.m. and 5 p.m. would be better, varying the parts of the sky tested; and I examine with the spectroscope elevated about 13 degrees. Prof. Smyth recommends to point as low as you can to the horizon provided you get transmitted light, and to observe when the sun is neither high nor low. I find in practice 9 a.m. (the same hour when my other instruments are observed) a good time to make the observation when only a single one is taken daily, and also that if I get *too* low on the horizon I am apt to have always a "rainband," or rather a false band due to earth moisture. In observing you will soon remark changes in the characters of some of the spectrum lines as compared with these when seen on a blue sky with an elevated spectroscope, and, moreover, bands of varying intensity are found added to the low spectrum not seen in the higher one. The lines and bands that change their character, or are variable in their appearing, are telluric; either rainbands or lines, called by Prof. Smyth "a function of moisture and temperature," or low sun bands and lines distinguished by him as "a function of dry air and low sun." The true solar lines remain unchanged. Prof. Smyth, in the Edinburgh volume before referred to, fully describes both in type and by illustrative drawings all these bands and lines and their changes, and points out that there are several smaller rainbands besides that near D. In practice it will, however, be found sufficient for meteorological observations generally, to examine the principal one on the red, or, if you have the spectrum as I do (with the red end of the spectrum to my left hand), left side of D. An examination of the other lines, though desirable for special purposes, will only tend to confuse the general observer. Prof. Smyth recommends, and has used, a dry air band on the right hand side of D as a standard of comparison with the rainband; but I have not often myself made use of it, judging independently by the rainband itself.

In enumeration of the darkness of the band, for the purpose of record, I use from No. 1 to 5 as under :—

1 means faint.
2 ,, faint to moderate.
3 ,, moderate.
4 ,, moderate to strong.
5 ,, strong.

1 to 10 is the enumeration recommended and employed by Prof. Smyth. I found, however, the dividing into so many degrees was difficult, especially when the intensity is slightly changing by passing clouds. Simultaneous observations should of course be made and

recorded of barometer, wet and dry bulbs, and wind (force and direction); and the circumstances of sun, sky, and cloud at the time should be shortly noted.

Ozone test papers may also be usefully referred to, as cold winds alike affect them and rainband readings. The D lines are generally more or less involved in the rainband shading.

To enable the observer to judge of the general appearance and intensity of the larger rainband near D, I have given (see *frontispiece*) some drawings of spectra as seen in a spectroscope of small dispersion, of which the following is a description :—

(1) Spectrum as seen upon a pure high sky, showing principal solar and telluric lines in their proper positions, and with their designations, but not showing the finer lines between, nor any bands.

(2) Spectrum observed January 17th, 1881, 8 a.m. Morning dull; red sunrise; low sunbands and lines (note especially band to right of D) strong. *No* rainband.

(3) Spectrum observed 24th August, 1881, 8 a.m., showing moderate low sunbands and lines, and a *faint* rainband, with rain lines showing through.

(4) Spectrum seen November 16th, 1880, 1 p.m. Rain and wind, but clearing in some parts of the sky. Low sunbands and lines weak. Rainband *moderate.*

(5) Spectrum seen December 9th, 1880, 8 a.m. Sun shining through watery clouds; low sun lines strong. Rainband *strong.*

(6) Spectrum seen July 6th, 1881. Rainband everywhere, and *exceptionally* strong, stretching nearly half way between C and D. Whole spectrum darkened and obscured.

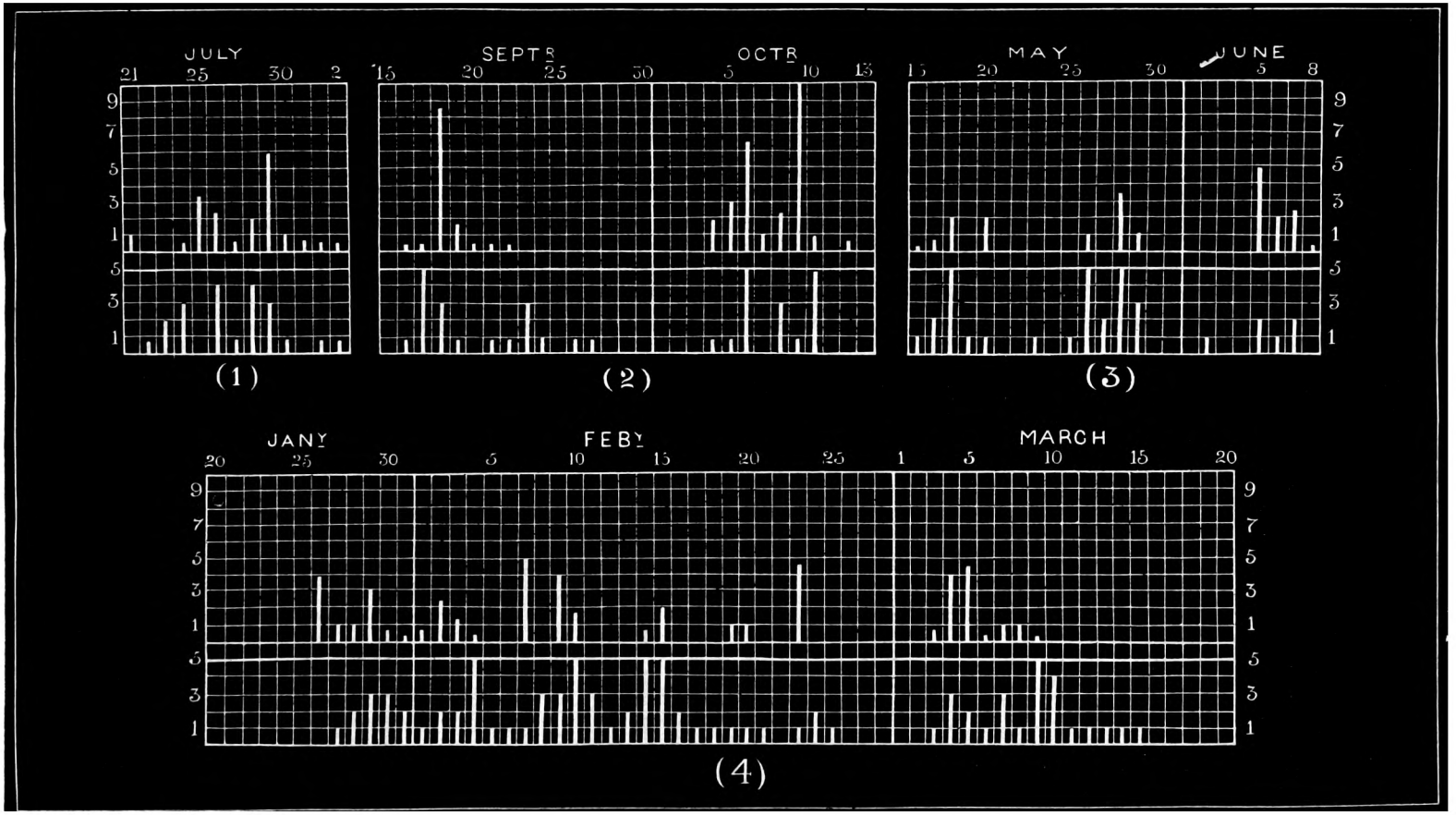
The above-described drawings do not give, except in a rough way, the details of the lines and bands other than the rainband, which is situate to the left of the double line D, and has its place marked by a R.

Spectra 2, 3, 4, and 5 are meant for observing by, as representing:—2, none; 3, faint; 4, moderate; and 5, strong. Rainband faint to moderate, and moderate to strong (the intermediate intensities) can be estimated, and in practice the eye and judgment will soon be found to accommodate themselves to the graduations 1 to 5.

Before proceeding to the questions affecting the rainband's value to forecast rain, it may be desirable at once to say that it does not claim absolute infallibility as to time and quantity of rain to follow, though Prof. Piazzi Smyth believes "it is never really absent when rain is imminent."

How its appearance and indications may be modified will be referred to later.

Its action is hygrometric, and involves the general principle that according to the amount of suspended moisture in the air so its appearance and strength. A faint, or faint to moderate, rainband may in some cases only show an amount of moisture which will remain suspended for some time. A moderately strong, or strong, rainband represents an excess of suspended moisture, which before long is sure to descend. Prof. Smyth mentions instances, and I



RAIN AND RAINBAND DIAGRAMS, 1880 & 1881.

have met with some myself, where an apparently perfectly transparent sky showing rainband has, on a change of temperature, condensed, as it were, into clouds which have poured.

A little while since (August) I observed only a faint, or at most, a faint to moderate, rainband in the morning at 9 a.m., on a beautiful blue sky, studded with white cauliflower innocent looking cumuli. I predicted wet, and at mid-day meal was twitted with the sunshine and brightness, but sure enough in the afternoon down came the rain. On the other hand it will sometimes be raining, and yet only a slight, perhaps even no rainband shows, an effect generally connected with a cold wind N. or E. No rainband is also sometimes observed when the wet and dry bulb readings only slightly differ, but the explanation of this may be that low earth moisture affects the bulbs, which is not recognised in the sky-directed instrument looking through a thin stratum of it.

In order to illustrate the practical working of the rainband I have prepared the accompanying diagrams, which show graphically by comparative line lengths the rainband and rainfall during two periods of 1880 and two of 1881. The rainfall is represented by vertical lines, in which each one-tenth inch is one-tenth inch rainfall; the rainband by similar lines, in which each one-tenth inch is one of the scale 1 to 5. The rainband was observed at 8 a.m. in 1880, and 9 a.m. in 1881 on each day. The rain represents the fall during the 24 hours following the rainband observations, so that where the lines correspond the rain follows the rainband within that period.

The general result of these diagrams is that the rainband predicts and also accompanies the rain, and to a certain extent corresponds in strength with the predicted rainfall. There are discrepancies and irregularities in most of the diagrams, it is true, some of which are to be explained and accounted for by incidental circumstances, the particulars of which I take from notes made at the time, and others (such as cases of rain at night after faint rainbands in the morning) by the interval of time elapsing between the spectroscopic observations and the rainfall, it sometimes happening that the rainband will much change its intensity during three daily observations. On the other hand, occasionally the rainband will precede the rain by a day or two.

Diagram 1—July 21st to August 2nd, 1880. This diagram represents a set of rainbands, of which moderate to strong is the highest figure, leading up to a moderate rainfall. July 25th appears as exceptional in the absence of the band. The day was fine and hot, and the rain fell during the night with a change of wind from W. to S. This fall (·35) was, however, shown to be in prospect by the bands on the 22nd, 23rd, and 24th, gradually increasing in intensity from faint to moderate.

Diagram 2—September 16th to October 13th, 1880. The first and last sets of lines agree fairly. The heavy rainfall of the 18th (nearly an inch) was forecasted by a strong rain-

band the day before, which was reduced to moderate during the fall itself, and as the rain passed away so did the rainband diminish in intensity, dropping to faint on the 19th, for ·20 of rain. On the 10th of October a strong rainband was only followed by a small rainfall, but the wet and dry bulbs were but 2° apart, so that much suspended moisture must have been in the lower atmosphere, and in fact on the 13th some more rain fell. In the centre of the diagram we have six rainbands (five faint and one moderate) with only a slight rainfall. The following figures, however, show for the five days on which these rainbands appeared the differences in the wet and dry bulbs.

1880.	Sept.	21.—2°	At 8 a.m.
	,,	22.—4°	
	,,	23.—4°	
	,,	24.—1°	
	,,	26.—2°·5	
	,,	27.—3°	

The following passages also appear in my journal at this time:—"The main feature of the week has been the persistent heavy morning and evening mists," and again (after quoting the above figures) "so that the air has been kept in a chronic state of saturation," a condition quite sufficient to account for a faint rainband." While on the subject of this diagram it may be mentioned that space would not well allow, otherwise I should have given in a graphic form the rainband and rain lines from 8th to 15th September, 1880, as they well illustrate how a strong rainband (on the 9th) came before very heavy rain on the 11th, while pending the actual rainfall the band was moderate and at last even faint. I insert instead the following tabular particulars:—

Date.			Rain.		Rainband.
1880.	Sept.	8th	·00		None.
	,,	9th	·04		Strong.
	,,	10th	·00		Faint.
	,,	11th	1·58		Moderate
	,,	12th	·54		Moderate.
	,,	13th	1·19		Faint.
	,,	14th	1·48		Faint.
	,,	15th	1·13		Faint.

We thus see that the rainband indicated the finely-divided transparent moisture ready to collect and fall as rain, and showed itself upon the saturated air and warm morning mists (wind mostly S. and S.W.) above referred to, while it only moderately or faintly appeared during the heavy rain itself.

A partial explanation of this peculiar phenomenon of a low number rain-band on falling rain may be that, pending heavy rainfall, the whole spectrum is more or less obscured, and thus the rainband shading near D for want of contrast is less observed. We shall, moreover, see later that it does appear strong on a light misty rain.

In connection with this diagram it may be further pointed out how a distinction lies between warm mists and cold fogs in the rainband's behaviour. The mists before spoken of were warm ones, and

a rainband, though faint, almost without exception, appeared upon them, but at a later period (in October) partly shown in the same diagram, there were cold foggy mornings with N. wind, during which the band was absolutely and persistently nil.

It results from this and similar observations that the rainband is less reliable in winter than in summer for indicating a rapid following of rain, and we can understand this in the fact that watery particles may remain without precipitation in a cold and comparatively even temperature in winter, while they will quickly descend from a warm air in summer, as the result of a few degrees fall of temperature.

We now pass to Diagram 3, representing rain and rainband from May 16th to June 8th, 1881, and to Diagram 4, which gives a two months' comparison of rainband and rain—viz., from 20th January to 20th March, 1881. The relative periods of rainfall and rainband agree fairly well in these two diagrams, and in some instances (June 5th, 6th, and 7th, and January 27th, 28th, and 29th) the intensities agree, but the peculiar feature about the diagrams is a certain number of strong, or moderate to strong rainbands, coinciding with a very disproportionate amount of rainfall (see especially dates February 4th and 14th and March 9th, when rainfall was only ·02, ·05, and ·02).

To be also noted is March 10th, when rainband 4 had no rain to follow, and where the observation is marked, "Sunshine through Clouds," and January 26th, rain ·40 with no rainband. On this last occasion there must have been more snow and sleet than rain (with wind N., and temperature 29° for maximum) which melted in the gauge. By the 27th the wind had changed to S. and a faint rainband appeared with rain ·11.

The strong rainbands before mentioned as accompanied by so little rain, being exceptional to the general rainband rules, I have tabulated, for comparison, all the cases (7) of No. 5 (strong) rainband between 1st January and 1st July, 1881, as under:—

Table shewing circumstances of all strong Rainbands (No. 5), between January 1st and July 1st, 1881.

No.	Date.	Bar.	Ther.	W.&D Bulbs. Diff.	Wind	Rain.	Rain-band.	Ozone	Notes, 9 a.m.
1	Feb. 4th	29·33	46°·0	·0	S.	·02	5	4	Clouds 10. Rain.
2	,, 10th	29·00	49°·5	·5	S.W.	·16	5	8	Clouds 10. Rain.
3	,, 14th	29·60	38°·5	2°·5	S.	·05	5	6	Clouds 10. Dull.
4	,, 15th	29·64	38°·0	·5	S.W.	·25	5	5	Clouds 10. Rain.
5	Mar. 9th	29·83	48°·0	·0	W.	·02	5	7	Dull heavy rain.
6	May 11th	29·56	53°·3	·3	W.	·08	5	8	Raining.
7	,, 26th	29·76	61°·0	3°·0	W.	·12	5	4	Overcast, slight mist, no rain.

These records present as peculiar features, barometer generally low, difference in wet and dry bulbs slight, wind S. and W., rain minute in quantity (except the 15th with $\frac{1}{4}$ of an inch), and ozone mostly strong, while in five cases out of the seven rain was falling at the time of observation. One can understand moderate rainbands accompanying the really moderate rainfalls of the half-year in question, but the above seem anomalous. A possible explanation is afforded by the strong air saturation at low level, indicated by the slight differences in the wet and dry bulbs, and the probability that the rain so small in quantity, was in quality of the misty drizzling character containing minutely divided particles, which is favorable to the strong enforcement of the moisture bands in the spectrum. I should be very glad to hear of spectroscopic observations by others on the occasions quoted, which, while abnormal, are strangely uniform over so long a period.

The foregoing diagrams and examples doubtless are failing in information which would have been furnished, and contain inconsistencies which would have been absent had the observations upon which they are founded been taken more frequently (say three times a day in lieu of once), and had the observer applied to them more of the patience and skill bestowed on the rainband and the story it tells, by its principal investigator. They may perhaps, however, effect the desired object of inciting enquiries on an interesting and comparatively unworked subject, and that thus a spectroscope may become a common companion of other meteorological instruments, if only for the purpose of testing its efficacy. Its little cost, the readiness with which observations can be made, and the practical results which a series of such would doubtless afford, cannot, I think, but recommend a trial of it. I propose to add a few general instructions and hints which may be useful to observers.

(1). Occasionally look to your instrument and see that the prisms and lens are clean, and remove any dust from the slit. This last should be done with a camel's hair pencil.

(2). Distrust observations and reports made by assistants or friends who are not practised in spectroscopic work. I have known dust accumulated on the face of the prism give a false obscurity to the spectrum;* persons (scientific or otherwise) who never could see a rainband at all; others who insisted on the horizontal dust lines as rainbands, and even well-practised observers, who have differed very widely in strength estimates (a matter which may possibly affect my own diagrams).

(3). Observe generally at the altitude which you may have selected as a standard, but do not altogether confine yourself to this, and note :—

(*a*) If the rainband is strong on the horizon and weakens to

* To guard against this I cement a plate of microscopic glass over the eye-hole of the spectroscope.

disappearance (or nearly this) at 15 or 20 degrees above, distrust it as a prognostic of rain.

(*b*) If strong on the horizon, and still strong at the height above mentioned, trust it as a prognostic.

(*c*) If strong on the horizon, above, and also to the zenith, or nearly so, then, as Professor Smyth says, "Beware!" He had only known two such instances (at the time he was writing) and deluges followed.

(4). A rainband will sometimes shew at the same time, of varying intensities on sky, clouds, and breaks in clouds. The respective intensities should be considered and valued in relation to the character of the various objects examined.—*e.g.*, I observed, on an occasion this summer, at 9 a.m. a faint (No. 1) rainband on an apparently perfectly pure blue sky, and a stronger one (moderate No. 3) on some by no means dangerous looking clouds floating in it. Rain soon came, and I have no doubt both sky and clouds were nearly equally charged with moisture, though under different conditions.

(5). The solar lines in the spectrum may be brought in aid in observing. When these are bright, clear, and sharp, rainband is usually absent; when they are obscure and seen faintly, rainband is generally present. A lady, who assisted me in observing, used to judge with success by the appearance of these lines when she felt in doubt about the rainband itself.

(6). The general rules of conduct of the rainband may be summed up as follows:—

(*a*) It indicates an excess of moisture in the air (often invisible) and presages according to its intensity, sometimes upon a clear, and sometimes on an opaque sky, the coming of rain and its quantity. "It is strong when the air is saturated with moisture ready to fall." (Piazzi Smyth).

(*b*) When the actual rain comes, the band frequently drops in intensity, sometimes becoming even quite faint during heavy rainfall. In summer, during a warm wind, a pronounced rainband will accompany rain. If the two last are not found together, it is during the prevalence of cold winds. In winter, a moderate rainband may be observed for some time, and yet rain does not fall. This is found during the presence of a warm wind, which holds the air moisture in suspension. Upon change to a cold wind, rain follows.

(*c*) A long continued faint, or faint to moderate rainband is pretty sure to be followed by rain, generally in quantity.

(*d*) A faint, or perhaps faint to moderate rainband may be often seen upon fog or mist. It does not necessarily presage rain, unless it get to strong, which it seldom does. If the sky above fog or mist be clear, the spectroscope

should be elevated to examine this as the test for the rainband true.

(7). Ozone and rainband are usually in accord with one another, both weak during cold winds and cold fogs, and both strong during warm winds and warm mists. Observations on the electric condition of the atmosphere might be usefully combined.

Lastly. Observers should not be discouraged if the rainband predictions are not always immediately and exactly fulfilled. If there were but one form of rainband, and one condition of moisture in the air, we might get the formula:—Rainband = rain; No rainband = no rain, in all cases; but this is far from the fact. The spectroscope is a delicate instrument of research, and the intensity of the rainband admits of degrees which may be considerably modified by, (1) circumstances of observing, such as width of slit, altitude of spectroscope, time of day, and part of the sky examined; (2) conditions of the matter examined in its graduations of transparent vapour, mist, cloud, and rain (the size and proportion of the aqueous particles varying in each); and (3) by other meteorological conditions and especially that of temperature, as largely affecting the quantity of moisture held in suspension.

If the character of the band is liable to be thus modified, the judgment to be formed as the result of its examination must be necessarily applied with caution, and with due regard to the probable effect of these modifications.

While the causes of some of these are apparent, others are much more obscure, and I think I may add, still imperfectly understood, It is, therefore, to the desirability of a system of regular rainband observations at varying altitudes, and by a number of observers at wide-spread stations, that I invite you and your readers' especial attention, at a time when meteorology is so much taxed, for the purpose of forecast, and requires every possible aid that scientific observation can bring to bear on so important and difficult a subject.

J. RAND CAPRON, F.R.A.S.

Guildown, Nov. 1881.

GALE OF OCTOBER 13TH-14TH, 1881.

THE opening meeting of the Meteorological Society for the present Session was held on Wednesday, Nov. 16th, at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., President, in the chair. Twenty-seven gentlemen were balloted for, and duly elected Fellows of the Society.

The evening was devoted to an account of "The Gale which passed across the British Isles, Oct. 13th-14th, 1881," which had been prepared by Mr. G. J. Symons, F.R.S., with the assistance and co-operation of Mr. C. Harding, and other gentlemen. There is evidence of the storm being formed in the Atlantic about 150 miles S. of Nova Scotia, on Oct. 10th, and that at noon on the 13th there

was a considerable disturbance about 600 miles W. of Galway. At that time there were scarcely any instrumental indications in the British Isles of the coming storm, the barometer was falling at Valentia, but not rapidly, and at some of the western English stations it was rising. The curves of barometric fluctuation show very plainly the advance of the depression from W. to E., for, while at Valentia the minimum occurred at 2 a.m. on the 14th, on the east coast of Norfolk it is recorded that it did not occur till 4 p.m. This fact, coupled with others, seems to indicate an easterly progression of the barometric minimum, at nearly 40 miles per hour. As far as the sea is concerned, the chief force of the gale was felt in the afternoon of the 14th, in the German Ocean, and there the great loss of life and destruction to shipping seems mainly due to the exceptionally violent squalls which were peculiar to this gale, as well as to the extremely sudden manner in which the wind increased to hurricane force. The afternoon became quite darkened by the salt water blown into the air, so that it was impossible to see a ship's length ahead. The barometric chart for 9 a.m. on the 14th, showed that the pressure in the North of England was an inch lower than in the the south, and nearly two inches lower than in the South of France. The area over which injury was produced was very large, and, although not without precedent, it was happily rare. The record of 56 lbs. per square foot at the Royal Observatory, Greenwich, was the highest ever registered in that locality, and close by 35 trees were blown down in the park, and 15 ft. blown off the top of a spire which had been erected about 40 years, the stone of which shows no sign of decay, and which had retained its position almost, if not wholly, by the gravity of its mass. The general opinion seems to be that the structural damage over the greater part of the country was by no means unprecedented, and in the greater part of Ireland, and the S.W. of England, was not even of an unusual character; but along the east coast, and in the east Midlands, the damage was excessive, and, on the N.E. coast, unprecedented. In Scotland the destruction of trees was enormous.

Mr. J. Wallace Peggs, C.E., F.M.S., read a paper on "The Structural Damage caused by the Gale as indicative of Wind Force," and remarked that since the Tay Bridge disaster attention had once more been directed to the subject of wind pressure. He suggested that a conference of delegates from societies specially interested in the subject should be held, who should make experiments and carefully consider the whole question of structural damage by wind.

GALE OF NOV. 26TH—28TH.

AN extreme barometric depression passed across the North of Scotland (sea level pressure below 28 inches) on the 27th, and a very heavy gale prevailed over large portions of the British Isles. Damage does not seem to have been nearly so general as on October 13th-14th, but in various localities, especially in North Staffordshire, considerable destruction of buildings took place.

KEW OBSERVATORY.

To the Editor of the Meteorological Magazine.

SIR,—In a brief notice of Kew Observatory in the last number of the *Meteorological Magazine*, you mention that it is maintained partly by the Royal Society and partly by the Meteorological Council.

The Royal Society contributes nothing from its own funds to this observatory, but acts merely as a trustee of an endowment by the late Mr. Gassiot, whose munificent devotion to science ought not to be forgotten. When the British Association withheld its grant from the Observatory, and it was likely to perish, he supported it for several years, and was so convinced of the service it rendered to science, that he determined to secure its permanence after his death, and made this endowment nearly £500 a year.

I am sure you will agree with me in thinking that an act of enlightened generosity such as this, should be generally known, that the honour it deserves may be given to his memory.—Yours truly,

T. R. ROBINSON.

Observatory, Armagh, 3rd December, 1881.

[We are delighted to insert this well-merited tribute from Dr. Robinson, and glad that, while we had bound ourselves to "reproduce as faithfully as we can the statements of Dr. Hellmann," Dr. Robinson's letter enables us to remind our readers of Mr. Gassiot's splendid donation of £10,000.]—ED.

THE PREDICTED SEVERE WINTER.

To the Editor of the Meteorological Magazine.

DEAR SIR,—I see in the last number of your Magazine a letter from a correspondent predicting another severe winter. Such forecasts seem to me very uncertain and unsatisfactory, especially when grounded on such reasons as he gives. The fall of snow in October may have some little bearing on the question, but that the weather 41 years ago can have anything to do with that of the present time, I cannot believe. Then again, what can the fact that there was more rain in August in England than in Scotland have to do with the coming winter; coincidence alone does not imply connexion.

We have had now three severe winters in succession, and these have all been preceded by an unusual amount of northerly winds. These I take to have been not merely signs, but also the cause of the severe weather that followed, by bringing down on us a polar atmosphere. This year we had some threatening weather in October, but lately we have had so much warm strong south-westerly wind, that I hope we are about to have a milder season.

Your correspondent gave it as his opinion last year, that we were about to have a winter not much below the average. Here it was 2°·5 below the mean of 10 previous years.—Yours respectfully,

S. KING.

Elswick Lodge, Nov. 27th, 1881.

SUPPLEMENTARY TABLE OF RAINFALL IN NOV., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	4·71	XI.	Carno, Tybritle	7·45
,,	Margate, Acol	2·19	,,	Corwen, Rhug	5·05
,,	Littlehampton	3·65	,,	Port Madoc	6·29
,,	St. Leonards	2·78	,,	Douglas.....	5·22
,,	Hailsham	4·26	XII.	Carsphairn	12·12
,,	I. of W., St. Lawrence.	4·10	,,	Melrose, Abbey Gate...	4·44
,,	Alton, Ashdell.....	5·57	XIV.	Glasgow, Queen's Park.	5·03
III.	Great Missenden.....	3·29	XV.	Islay, Gruinart School..	5·65
,,	Winslow, Addington ...	3·30	XVI.	Cupar, Kembach.....	4·07
,,	Oxford, Magdalen Col...	3·15	,,	Aberfeldy H.R.S.	...
,,	Northampton	2·91	,,	Dalnaspidal	11·03
,,	Cambridge, Beech Ho...	1·52	XVII.	Tomintoul.....	2·89
IV.	Harlow, Sheering	2·59	,,	Keith H.R.S.	1·82
,,	Diss	1·60	XVIII.	Forres H.R.S.	1·94
,,	Swaffham	2·26	,,	Strome Ferry H.R.S....	10·34
,,	Hindringham	2·24	,,	Lochbroom	7·53
V.	Salisbury, Alderbury...	4·20	,,	Tain, Springfield.....	2·50
,,	Calne, Compton Bassett	4·19	,,	Loch Shiel, Glenfinnan.	16·30
,,	Beaminster Vicarage ...	7·33	XIX.	Lairg H.R.S.	3·39
,,	Ashburton, Holne Vic..	11·75	,,	Altnabreac H.R.S.	...
,,	Langtree Wick	5·46	,,	Watten H.R.S.	1·69
,,	Lynmouth, Glenthorne.	6·92	XX.	Fermoy, Glenville	6·87
,,	St. Austell, Cosgarne...	5·37	,,	Tralee, Castlemorris ...	6·01
,,	Taunton, Fullands	2·82	,,	Cahir, Tubrid	5·07
VI.	Bristol, Clifton	4·32	,,	Tipperary, Henry St....	4·64
,,	Ross	3·74	,,	Newcastle West*	...
,,	Wem, Sansaw Hall.....	2·87	,,	Kilrush	4·16
,,	Cheadle, The Heath Ho.	3·54	,,	Corofin	5·86
,,	Coundon	2·87	XXI.	Kilkenny, Butler House	...
VII.	Melton, Coston	2·35	,,	Carlow, Browne's Hill..	3·92
,,	Horncastle, Bucknall...	2·66	,,	Killsallaghan	...
VIII.	Macclesfield Park	3·71	,,	Navan, Balrath	2·87
,,	Walton-on-the-Hill.....	2·85	,,	Athlone, Twyford	5·00
,,	Broughton-in-Furness ..	8·23	XXII.	Mullingar, Belvedere ...	4·04
IX.	Wakefield, Stanley Vic.	2·17	,,	Ballinasloe	6·17
,,	Ripon, Mickley	5·67	,,	Clifden, Kylemore	16·76
,,	Scarborough.....	1·81	,,	Crossmolina, Enniscoe..	8·81
,,	Mickleton.....	4·91	XXIII.	Carrick-on-Shannon ...	4·80
X.	Haltwhistle, Unthank..	3·87	,,	Dowra	3·22
,,	Shap, Copy Hill	12·31	,,	Rockcorry.....	4·27
XI.	Llanfrechfa Grange	7·70	,,	Warrenpoint	5·12
,,	Llandovery	6·35	,,	Newtownards	3·17
,,	Solva	4·05	,,	Carnlough.....	...
,,	Castle Malgwyn	8·67	,,	Bushmills	3·44
,,	Rhayader, Nantgwillt..	9·07		Buncrana	4·40

* Record destroyed, along with part of house, by gale on night of 23rd.

NOVEMBER, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No of Nights below 32° In shade.	On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	2·75	+ ·31	·55	24	16	62·5	5	31·9	1	1	6
II.		Maidstone (Hunton Court)	2·62	— ·28	·78	26	20	...	...	...	...	...	...
,,		Strathfield Turgiss	3·05	+ ·30	·66	26	20	63·7	5	31·2	30	3	13
III.		Hitchin	2·14	— ·47	·54	26	18	59·0	5	30·0	1	2	...
,,		Banbury	3·23	+ ·52	·69	26	21	59·0	12	28·0	1	4	...
IV.		Bury St. Edmunds (Culford)	1·98	— ·85	·44	25	14	61·0	4,5	31·0	17†	...	...
,,		Norwich (Cossey)	2·18	— 1·13	·39	26	15	64·5	5	29·5	1	2	5
V.		Bridport	5·75	...	·74	4	21	58·0	7	25·0	29	4	...
,,		Barnstaple	4·26	+ ·11	·52	16	21	63·0	5	33·0	2	...	...
,,		Bodmin	6·77	+ 1·45	·91	30	26	63·0	9	35·0	29	0	2
VI.		Cirencester	4·47	+ 1·49	·80	27	20	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	3·74	+ ·30	·80	30	22	59·0	4, 13	31·0	1	3	3
,,		Tenbury (Orleton)	3·33	+ ·47	·47	26	20	62·8	13	28·8	18	2	5
VII.		Leicester (Town Museum)	2·35	...	·44	26	20	60·2	13	31·0	1, 18	2	5
,,		Boston	2·43	+ ·06	·49	4	15	56·0	10	33·0	1‡	0	...
,,		Grimsby (Killingholme)	2·23	— ·87	·43	25	18	58·0	4,5	33·0	1	0	...
,,		Mansfield	2·81	+ ·09	·35	3	20	61·1	13	31·0	18	2	5
VIII.		Manchester (Ardwick)	...	...	...	...	...	...	...	...	...	...	...
IX.		Wetherby (Ribstone)	2·91	+ ·15	·81	27	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	10·75	+ 5·00	2·25	27	24	56·0	14	28·0	17	2	...
X.		North Shields	1·30	— 2·15	·32	26	14	61·5	14	27·5	18	2	2
,,		Borrowdale (Seathwaite)	16·73	+ 4·91	1·65	18	26	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	5·36	+ 1·16	·67	26	24	...	...	...	...	...	...
,,		Haverfordwest	6·38	+ 1·04	1·00	27	19	58·9	9	30·0	28	1	1
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	3·06	— ·85	·63	30	16	62·8	8	35·3	1	...	...
XII.	SCOTLAND.	Cargen	7·38	+ 3·47	·91	27	23	56·2	14	28·2	18	2	...
,,		Hawick (Silverbut Hall)	4·25	+ 1·04	·71	26	19	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	6·61	+ 3·06	·85	24	26	...	...	...	...	...	...
XV.		Kilmory	8·59	+ 3·23	·71	30	26	...	...	25·0	18	2	...
,,		Appin (Airds)	9·08	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	9·85	...	1·19	22	28	...	...	...	...	...	...
XVI.		Loch Leven	4·20	+ ·65	·60	5*	16	...	...	...	...	...	...
,,		Arbroath	3·28	+ ·13	·47	30	17	59·0	14	30·0	18	1	...
XVII.		Braemar	6·80	+ 3·03	·84	26	26	57·2	14	23·3	18	6	23
,,		Aberdeen	2·70	...	·41	21	22	59·0	14	32·0	17§	2	...
XVIII		Portree	14·55	+ 6·18	1·24	20	27	...	...	...	...	...	...
,,		Inverness (Culloden)	3·73	+ 1·03	·68	23	12	60·0	14	31·0	1	0	17
XIX.		Dunrobin	2·80	...	·55	16	14	60·7	14	30·0	18	1	...
,,		Sandwick	3·04	— 1·40	·35	21	26	58·0	14	34·2	18	0	1
XX.	IRELAND.	Cork (Blackrock)	7·57	+ 2·96	1·49	29	26	58·0	9, 10	29·0	25‖	2	...
,,		Dromore Castle	7·18	+ 2·57	·79	2	25	63·0	9	32·0	2	1	...
,,		Waterford (Brook Lodge)	5·13	...	·59	26	25	65·0	20	31·0	28	3	...
,,		Killaloe	4·33	...	·64	27	24	63·0	3	27·0	26	3	...
XXI.		Portarlington	3·07	+ ·67	·57	27	22	58·5	11	31·0	25	1	...
,,		Monkstown	2·73	...	·66	27	16	65·0	14	33·0	18¶	...	2
XXII.		Galway	7·26	+ 3·49	1·04	27	27	60·0	13	36·0	29	...	...
XXIII.		Waringstown	3·98	+ 1·27	·75	30	23	62·0	14	28·0	25	1	8
,,		Londonderry	...	...	..	...	...	...	...	...	...	...	...
,,		Edenfel (Omagh)	3·33	+ ·28	·35	26	26	59·0	4	27·0	25	7	...

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

* And 12, 27. † And 29. ‡ And 18, 30. § And 18. ‖ And 28. ¶ And 28, 29.

METEOROLOGICAL NOTES ON NOVEMBER.

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

ENGLAND.

HITCHEN.—A most extraordinary month, the warmest November in our record; mean temp. 6° above the average of 30 years; furious gale on the 27th and the lowest bar. reading ever recorded here.

BANBURY.—High wind on 8 days, especially on 26th and 27th, accompanied by a very low bar., L on 22nd and 27th; S on 1st.

CULFORD.—The month was exceedingly fine and mild, with frequent high winds.

COSSEY.—A genial month with a great deal of sunshine, favourable for agricultural pursuits; heavy gale on 27th and 28th.

BODMIN.—The warmest November on record here, mean temp. 52°·2.

CIRENCESTER.—A fine mild month.

WOOLSTASTON.—A singularly warm month; mean temp. 51°·5, a remarkable depression of the bar. occurred on the 26th and 27th.

ORLETON.—On the morning of the 1st the Highlands were all covered with S, but none fell afterwards and there were very few frosty nights. The weather was generally very warm and showery with much wind. On the evening of the 26th the bar. fell to 28·600 in. (uncorrected) and remained nearly stationary for more than 20 hours, accompanied by R and great wind. The mean temp. of the month was more than 6° above the average of 20 years, and was nearly 1°·5 above that of October.

BOSTON.—The weather during the month was of a most unusual character, bright sunshiny days and mild temp. taking the place of fog and cold. The temp. was nearly 7° above the average, and higher than that of any November of the preceding 20; wind entirely from S.; very heavy gale on the 26th & 27th, the bar. standing at 28·80 in. for 24 hours.

GRIMSBY.—Very fine, and unusually pleasant weather for the season; scarcely any fog; frequent gales; temp. much above the average. Bar. below 29 inches for 36 consecutive hours on 26th and 27th, L at night on 27th.

MANSFIELD.—The month was remarkable for its mildness and for beautiful spring-like days; high winds occurred frequently, and a continuous gale on the 26th and 27th.

ARNCLIFFE.—A month of mild weather with unusually heavy rainfall; TS on 26th.

WALES.

HAVERFORDWEST.—A month of storm, heavy floods and extreme mildness; very stormy and wet from 20th to end of month. T, L, H, on the 22nd; heavy gales on 16th, 20th, 22nd, and from 25th to 28th, the last seeming to equal in violence the gale of October 14th, and lasted much longer. Bar. readings (corrected):—25th, 9 a.m., 29·745 in.; 9 p.m., 29 675 in. 26th, 9 a.m., 29·603 in.; 9 p.m., 28·748 in. 27th, 9 a.m., 28·736 in.; 9 p.m., 28·810 in. 28th, 9 a.m., 29·418 in.; 9 p.m., 29·645 in.

LLANDUDNO.—The month was remarkable for its repeated heavy gales and the mildness of the temp., the latter being more than 5°·5 above the average; TS on 22nd at 11·30 p.m.

SCOTLAND.

CARGEN.—The most stormy month we have had for many years; the gales on the 22nd, 26th, and 27th, were very destructive; on the 22nd, the highest tide for 15 years occurred, breaking many embankments on the Frith below Dumfries and doing much damage. Mean temp. 46°·6, 5°·4 above the average, L on 16th, 20th, 22nd, and 23rd.

HAWICK.—Snowstorm with high wind on 1st; gales on 15th, 16th, 21st, 25th, 26th, and 27th. The river Teviot in higher flood on the 27th than it has been since 1846, causing from £2,000 to £3,000 worth of damage to factory property. The month passed almost without frost.

QUINISH.—A very mild, wet, and stormy month; during a fearful gale on the night of the 21st, the tide rose between 3 and 4 feet above ordinary spring tides, doing immense damage.

ABERDEEN.—The first half of the month was unusually mild, the temp. being abnormally high for the time of the year; the latter half was very unsettled, with strong S.W. gales. Rainfall somewhat below the average; aurora and L each seen on two nights.

PORTREE.—A wet stormy month; a very strong gale from S.W. began at 10 p.m. on 21st, and continued with more or less violence until 10 p.m. on 22nd, accompanied by showers of S, H, and R, and loud T and vivid L; the T and L continued at short intervals till midnight on 25th.

CULLODEN.—Very mild, strong gales frequent, heavy S on the night of the 21st, and L on several other nights.

SANDWICK.—The temp. was so high that vegetation was still proceeding till checked by the storms of 20th and some following days. There were gales of 40 to 50 miles an hour on 1st, 2nd, 3rd, 21st, and 30th, and of 60 miles or more on 20th, 22nd, and 26th; the strongest was on 22nd, from 11 to 12 a.m., when it was 68 miles; T and L on 22nd. Aurora on 15th, 18th, 19th and 29th.

IRELAND.

DROMORE.—The stormiest month on record; a succession of gales with short intervals between; fine trees blown down and houses unroofed in every direction, and the gable of an old castle, that had stood for three centuries, blown down. Mean temp. 50°·3.

WATERFORD.—Prevailing winds, S. to S.W.; several heavy gales. L on four days.

KILLALOE.—Temp. unusually high, the mean (48°·8) being 5°·4 above the average of five years. Frequent gales and TSS.

MONKSTOWN.—From the 1st to 15th, the weather was exceedingly fine and warm, with very little R; but the remainder of the month was wet and stormy, three distinct strong south-westerly gales occurring on 16th, 22nd and 27th; the latter continued with unabated violence for nearly thirty hours, during which time the bar. fell to and stood steadily at about 28·420 in.

WARINGSTOWN.—Wet and very stormy, no such succession of gales remembered; much damage done by that of the 21st.

THE AUTUMN AND WINTER OF 1881-2.

To the Editor of the Meteorological Magazine.

SIR,—The following statements in connection with the past two months may perhaps interest some of your readers:—

(1) November has been more than 3° warmer than the previous month of October was. (2) October was (45°·3) the coldest at Greenwich since 1817. (3) Last month was the warmest November there (48°·7) since 1852. (4) The Greenwich tables only show two instances in previous years of the mean temp. of November exceeding that of October, viz., in 1817 and 1852. In the former year October was 45°·0, and November 46°·9; and in the latter year October was 47°·9, and November 48°·9. (5) In each case the following February was decidedly cold. I do not expect that February, 1882, will prove an exception to this. Last December was very mild, and February, 1881, not much colder than usual, so that the whole winter of 1880-81, was not greatly below the average. The coming winter, on the whole, will probably be less cold than last winter was, but still, I believe, somewhat colder than the average.—Yours, &c.,

GEORGE D. BRUMHAM.

Barnsbury, Dec. 3rd, 1881.

SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXCII.] JANUARY, 1882. [PRICE FOURPENCE, or 5s. per ann. post free.

LE VERRIER AS A METEOROLOGIST.

THE mental power of Le Verrier was such that it may be said of him, without fear of contradiction, that he would have been as great as a physicist, chemist, or geologist, as he was as an astronomer; on the present occasion we consider him solely as a meteorologist, and in doing this we have referred chiefly to his own published documents, but are more particularly indebted to a *résumé* by M. Brault, of the French Hydrographic Office, published in M. Mascart's splendid Annals of the Paris Meteorological Office, and upon whose *résumé* this article is mainly based.

Precision was his strong point; and he knew what was the fruit of long patience, but he never exercised it except upon the grandest questions; while occupied with problems affecting the whole universe, his thought was at ease, and he took pleasure in studying in their minutest details, the motions of those immense spheroids in whose company, so to speak, he passed his life.

It may easily be conceived, that to such a vast mind, the study of the general movements of the atmosphere would offer considerable attraction. Meteorology, he said, is the science of the future, and if it has not yet become developed as it should be, it is because we have paid too much attention to details instead of to general laws.

"The history of the sciences shows us that the examination of the phenomena of nature should always commence with those which take place on a grand scale, and are not affected in their general results by a thousand secondary causes."

It was in this sense that Le Verrier viewed meteorology, and he did not think it unworthy of himself to prepare the harvest to be reaped in the future. In his *Historique des Enterprises Météorologiques de l'Observatoire*, a quarto volume of 78 pp., he has explained his views of the way in which the principal questions of meteorology should be attacked, both with regard to storm warnings, climatology, and general meteorology.

As pointed out in the article upon "Meteorology in France," in the number for March 1881, of this Magazine, one of Le Verrier's chief

contributions to meteorological science, was the establishment of warnings for seamen and agriculturists. In fact, he may be said to have created meteorological telegraphy on the basis on which it is generally adopted in almost all civilized countries, and although not the first to publish synoptic charts, he gave them that definite character which they have assumed at the present day.

Until 1854 Le Verrier was chiefly occupied with the reorganization of the meteorological observations at the Imperial Observatory (which up to this time had dealt only with its own records), and the number of daily observations was increased from four to six. As soon as this service had been placed upon a more satisfactory footing, he turned his attention to more serious questions, and on the 16th February, 1855, he presented to the Emperor the famous proposal which led to the creation of a general system of meteorological telegraphy in Europe.

On the 19th of the same month he communicated to the Academy various charts showing the condition of the atmosphere over the continent. At this point he met with various difficulties in the realization of his projects, and these obstacles hampered his progress more or less until the day of his death. "I had only thought," he said, "of the difficulties inherent to the scientific side of the question, without foreseeing the embarrassments of every kind which have been constantly opposed to us, and against which we have to combat even to day." The opposition with which he had to struggle may be gathered from the following remarks written in 1857 :—"There are some men who do, and let do; there are others who don't do, but let do; the worst kind, and unfortunately the most numerous, are those who don't do, and who will not let do." Although the system originally established in France for giving warning of storms was based upon giving notice merely of actual facts (see *Met. Mag.* above referred to), yet Le Verrier subsequently recognised the insufficiency of this method in the following remarks :—"Experience has shown that our Channel and ocean coasts are often first struck by the storm, whence it results that a system of warnings which only operates when the storm has been already observed at some place, would leave something to be desired for our own shores." And he complained that Admiral FitzRoy, whose co-operation he highly valued, was enabled to out run him in the actual prognostication of storms because FitzRoy obtained that public support in England which France denied to Le Verrier. In fact, until quite recently, the storm signals were hoisted at the French semaphores in pursuance of warnings sent from London.

But, notwithstanding opposition, Le Verrier advanced with slow steps, and took advantage of every opportunity which offered itself, and from 1857 to 1864 he continued to increase the number of reporting stations over all Europe, and to extend his system of telegraphing notices of actual storms to all French ports and to various institutions abroad.

Meteorological telegraphy being firmly established in France, Le Verrier was able to turn his thoughts to the extension of his observations to the North Atlantic. He had long felt the important bearing which observations at sea possessed on the meteorology of Europe, and their close connection with the subject of storm warnings. He accordingly on 29th January, 1864, addressed a circular to the Chambers of Commerce requesting that observations might be made at sea. He says, "Unfortunately our charts embrace only Europe, which is not sufficient. They contain nothing of what is occurring on the surface of the ocean, and this is to be the more regretted since most of the storms which attack us seem to take their origin in those parts." This was the starting point of his great *Atlas des mouvements généraux de l'atmosphère* (1864-5), from which we extract the following remarks :—"At the commencement of a similar work it would have been difficult, if not impossible, to get all the observations made simultaneously. This is a point which is to be desired, and which can only be realised at a more or less distant period. It is, in fact, of the first importance that the charts of the *Atlas Météorologique* should present the atmospheric conditions over the Atlantic ocean at one instant of time, in order that we may be able to follow their variations from one day to another. When it is seen that the observations are really utilized, it will not be impossible to ask observers to arrange their hours of observation so that there may always be one that corresponds to 8h. Paris time."

If we replace in the last phrase, 8h. Paris time by 7h.35. Washington time, we find identically the proposal made by General Myer at the Meteorological Congress at Vienna.

Le Verrier left a large number of letters referring to Climatology. Of these we will only refer here to one dated August 16th, 1864, relative to the study of thunderstorms. This letter plainly showed that it was the realisation of a general plan which Le Verrier pursued in the midst of so many difficulties of detail :—"The study of Meteorology has not led in the past to the theoretical and practical results on which we thought we could reckon. But this cannot be wondered at. Too much attention has been paid to details, while the grand laws of the movements of the atmosphere are scarcely suspected. . . . Thunderstorms which travel over considerable distances, sometimes the whole length of France, are generally of only narrow breadth ; they would pass between the chief places of a department without being observed, and their march, their violence and their extent would remain unknown, and their study would be, as in the past, impossible. Hence the indispensable necessity for multiplying observers. If the *Councils General* would consent to take in hand this grand enquiry in each of the cantons, we should soon arrive at complete and important results."

This appeal resulted in the establishment of a very extensive system of thunderstorm and rain stations, amounting in 1878 to 1069 in number, and agricultural warnings were subsequently organized

over the whole of France. In this work much assistance was rendered by the *Association Scientifique de France.*

Thus, generally speaking, Le Verrier treated Meteorology under all its principal aspects and indicated the best routes to follow. We have not entered into details as to the great extensions made by M. Mascart in the lines Le Verrier originally laid down as these are generally referred to in the article in the *Meteorological Magazine* above mentioned. His plans were gigantic, and if he had been able to deal with Meteorology solely in his office, as he did with Astronomy, he would have made giant strides in all questions relating to the former science. But these grand questions require a legion of workers. If genius alone had sufficed, said M. Brault, Le Verrier could have conducted not only the Meteorology of France, but that of the whole world.

J. S. HARDING.

REORGANIZATION OF THE METEOROLOGICAL DEPARTMENT OF INDIA.

ALTHOUGH somewhat tardy in bearing fruit, the report of the Famine Commission is not likely to be without its results. The Government of India have, at length, called upon the Meteorological Reporter for an expression of his views as to the measures he would advise, with reference to the better collection and utilization of knowledge concerning the meteorology of this country. In response to this communication, Mr. Blanford has advocated an extension of the system at present in vogue by the addition of certain observatories at selected points, and has asked for personal help in the shape of a more complete office establishment. Hitherto, it has been usual to issue a daily report from the Calcutta Meteorological Office, compiled from statements telegraphed from eighty-four stations, twenty-four of which are only in use during the rainy season. A second class of daily reports is also published by the Meteorological Reporter of the Government of Bengal, relating to the state of the coast of that Presidency. The information having been duly collected in these offices is distributed for the benefit, not of the public at large,—except that portion which can be reached by the aid of the newspapers,—but of certain local officials and offices in or near Calcutta. It is not surprising, therefore, that as an essential to the production of that improved cognizance of meteorological conditions which Government would fain see amongst their officers, one of the first points pressed by Mr. Blanford should be that it is desirable to more freely communicate the results attained. To accomplish this, he suggests that daily reports, with elucidatory remarks attached, be published, and transmitted by post to all officials within one or two days' distance of Calcutta; and that a summary of these be sent by telegraph to all local Governments for communication to the public through the newspapers. To more efficiently illustrate facts, he would advise that a chart be lithographed daily. The additional stations he would wish established are seven in number, namely, three for Madras, situated at Cuddapah, Kurnool, and Rajahmundry, one in Assam, and three in the Himalayas. The Government of India have consented to his proposals, as far as regards the establishment of more stations, and the mode of distribution of information; they, however, object to incur any expense with respect to the issuing of a chart, as this would involve the purchase of plant, and the entertainment of skilled workmen. An assistant to Mr. Blanford is to be allowed, who will assume charge of the office during his absence or illness, and will, at other times, inspect stations, and instruct observers. The logs of ships arriving

in the Hooghly will be regularly examined, with the object of collecting facts concerning marine meteorology. Investigation of solar physics, with reference to the assumed relation of variations of sun spots and fluctuations of rainfall, will be continued by a special subordinate stationed at Leh, in Cashmere.

Altogether, meteorology in India is likely to be placed on a better footing than formerly, and intelligence on the subject will be more readily gained than hitherto by all classes. We do not, however, see that much utility will result from the proposed practice of causing each station throughout the country to telegraph its reports to Calcutta, so that they may be brought into form for re-transmission to local Governments. All useful ends might be met by telegraphic statements from various stations being published daily by the head of the Department in the Presidency concerned, copies being sent by telegraph to the Meteorological Reporter, who should give his data and deductions, derived from the whole of the Observatories in India, at least once a week. Under the present system, we have to wait at least a fortnight in the town of Madras for a report of the state of the season at our very doors. The latest Weekly Season Report published by Mr. Blanford, in the *Gazette of India*, is dated the 1st instant, and records the state of the crops, the fall, or want of rain during the last week of October. Meteorological information soon becomes stale, and the concentration of information in Mr. Blanford's office, and its dissemination thence is well calculated to magnify that office, but it militates against the utility to the public of the information when it is communicated. If all meteorological information in this Presidency were communicated by the Madras Meteorological Superintendent to the Madras newspapers immediately on its receipt, instead of being forwarded to Mr. Blanford, it would be comparatively easy to discover errors in reports. There are few things that one forgets so quickly as the state of the weather. For most practical purposes, weather reports that are three weeks old are of no value to the public at large, though they may be useful for statistical purposes. It is of comparatively little interest, or importance, to people in the Madras Presidency to learn what was the state of the season in the Punjab, or *vice versa*, three weeks ago; and though it is desirable that the reports for the whole of India should be collected together and made public, it is still more desirable, that the interim publication locally of provincial reports, should not be delayed by official circumlocution.

No provision appears to have been made to secure European superintendence of the local observatories. Formerly, Zillah Surgeons at certain stations obtained a monthly allowance for supervising the work of observers: but, in a fit of economy, Government withdrew this, still, however, regarding these officers as responsible, although meteorological science is but remotely connected with their profession. Of course, men may be found, who, taking an interest in this subject, may think worthy the trouble involved in looking after the necessary details; still, turning out on a wet or cold night to see that the observer is present at the correct time is not enticing, and would stand more chance of its regular performance if remuneration for extra duty were offered. Hence, after the abolition of the allowances, the heads of the Meteorological Department probably did not feel much astonished when they found that readings reached them that were of no value, and stultified their whole work. It is easy in an Indian climate to concoct a set of readings of instruments founded upon the average of previous days. Why then should the timorous native, lantern in hand, run the risk of getting himself bespattered with mud, or bitten by snakes, when it would be much more comfortable to be present at his friend's *tamash*? Can he not guess to the minutest fraction how his instruments should stand; and if he does not hit it off quite correctly, who will be the wiser? Data that are not thoroughly trustworthy are worse than useless—they are positively mischievous; and if their correctness can be questioned, for what possible use is it to have gone to any expense in the matter. We do not imply that shirking work amongst observers is anything but an exceptional offence, still its possibility should be guarded against, and the only way to do

this is to make them directly subordinate to some local official who is paid for his trouble of exercising supervision. Disregarding, however, this phase, it is a fact not to be forgotten that the class of men employed, albeit that they understand how to read their instruments, are occasionally so little aware of the theory of their use, or the ends sought after, that the state in which they are kept, or mode of disposal in relation to surrounding objects, not infrequently annuls the value of their observations. Hence the necessity of frequent inspection by a skilled and interested officer, and we do not think if Government mean to take up the subject seriously, that they would find money better spent in restoring the old scale of allowance to local Superintendents of Meteorology, than in increasing the office establishment of the Meteorological Reporter.—*The Madras Mail*, Nov. 15, 1881.

GALE OF DECEMBER 17TH-18TH.

To the Editor of the Meteorological Magazine.

SIR,—Another tremendous gale, blowing hard all day yesterday; got worse in night, reaching its height about 6 a.m. Wind W. and sky clear at 9 a.m., but force not moderating till afternoon. Rainfall ·67in. in old gauge, ·72in. in Snowdon; high rim giving greater difference even than on Nov. 26th. ·86in. fell on 9th; the three days, 8th, 9th, and 10th, giving 1·59 in., and renewing the floods. There has fallen 6·53in. in 28 days since November 17th, of which 5·95in. fell in 23 days since November 24th.—Yours very truly,

J. E. MACE, Jun.

Tenterden, Kent, 18th December, 1881.

To the Editor of the Meteorological Magazine.

SIR,—The gale on the 18th inst. having been exceptionally severe, I send you a short account of it, with a table of observations for the 17th and 18th.

The morning of the 17th was threatening; rain fell from 11.15 a.m. to 5.40 p.m., and again from 7.40 p.m. to 3.25 a.m. on the 18th; followed by showers, accompanied with snow, at 8 and 8.45 a.m., and hail at 2.35 and 4.52 p.m. (on the 18th). The wind blew a strong gale from S.W. from noon to 2 p.m. on the 18th, but lulled to a fresh breeze from 7 to 10 p.m., and then increased rapidly to a tremendous gale from 11 p.m. to 3.20 a.m., on the 18th, attaining a velocity of 60 miles in the hour from 2 to 3 a.m., and reaching a rate of 100 miles per hour in some of the terrific gusts, which did much damage to roofs, trees, &c. The above velocities are the greatest yet registered by my Robinson's anemometer, since its erection in December, 1878. The subjoined table shows the great variations in the barometer and temperature experienced during the gale. The actual min. of the barometer was 28·892 in. at 3.10 a.m.; the rise which followed it was very sudden, amounting to ·108 in. in 20 minutes; whilst the temperature fell rapidly from a max. of 52°·7 about 3.10 a.m., to a min. of 36°·2 before 9 a.m., accompanied by a strong W.N.W. wind. 0.65 in. of

rain fell in the 24 hours ending 9 a.m. on the 18th, and the total velocity of the wind for the same period was 859 miles.

Yours sincerely,

EDWIN E. GLYDE.

Kirkham, Babbacombe, Torquay, Dec. 23, 1881.

Date.	Hour. G. M. T.	Bar. cor. to 32° and sea level.	Temperature.		Wind.		Weather.
			Dry Bulb.	Wet Bulb.	Direction.	Force (0–12)	
		in.	°	°			
Dec. 17.	9.14 a.m.	29·380	44·3	42·5	W.S.W.	5	C.M.
,,	2 p.m.	29·187	50·4	49·8	S.W.	9	O.D.G.
,,	4 p.m.	29·198	50·9	50·3	W.S.W.	8	O.D.G.
,,	6 p.m.	29·254	50·0	49·0	W.S.W.	6	O.
,,	9.14 p.m.	29·237	46·8	46·6	W.S.W.	5	O.D.
,,	11 p.m.	29·113	51·6	51·2	S.W.	10	O.Q.
,,	12 p.m.	29·061	51·2	50·5	S.W.	10	O.R.Q.
Dec. 18.	1 a.m.	29·021	51·0	...	S.W.	11	O.R.Q.
,,	2 a.m.	28·949	51·9	51·3	S.W.	11	O.D.Q.
,,	3 a.m.	28·895	52·6	52·0	S.W.	11	O.D.Q.
,,	3·30 a.m.	29·000	49·8	48·2	W.N.W.	6	O.
,,	4 a.m.	29·095	43·7	42·1	N.W.	5	C.B.
..	9·14 a.m.	29·481	38·8	37·5	W.N.W.	5	B.Q.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday, the 21st inst., at the Institution of Civil Engineers, Mr. G. J. Symons, F.R.S., President, in the chair. The following gentlemen were duly elected Fellows of the Society:—H. P. Bell, F. B. Edmonds, T. C. Evans, S. L. Fox, J. J. Gilbert, M. Henry, J. B. McCallum, J. Parry, and B. C. Wainwright.

The papers read were:—(1) "The Rainfall of Cherrapunji," by Prof. J. Eliot, M.A., F.M.S. Cherrapunji is notorious for its excessive rainfall, larger in amount than that of any other place, as far as is at present known. Cherrapunji is a small Indian station, situated in the south-west of Assam, on a small plateau forming the summit of one of the spurs of the Khasia hills. These hills rise on the south with exceeding abruptness, and have the Bengal plains and lowlands at their base. Cherrapunji stands on the summit of one of these hills, at an elevation of about 4,100 feet. The hill on which it is situated rises precipitously from the lowlands of Cachar and Sylhet, which are barely 100 feet above sea level. During the S.W. monsoon the lower atmospheric current advancing across the coast of Bengal, has a direction varying between S.S.W. and S.E. in lower and central Bengal. In thus advancing almost directly towards the hills of Western Assam, the mountain ranges cause a very considerable

deflection of the current; one portion is forced upwards as an ascending current, with a velocity directly dependent upon the strength of the current in the rear, and upon other conditions which need not be enumerated. The rapid diminution of temperature which accompanies expansion due to ascensional movement of air, is usually followed by rapid condensation in the case of a moist current such as the S.W. monsoon current. The normal annual rainfall in Cachar and in the plains of northern Bengal, is about 100 inches. The average annual rainfall of Cherrapunji is 493 inches, or nearly five times that at the foot of the hills on which it is situated. The rainfall of Cherrapunji is due to the presence, in the hills, of a vast mechanical obstruction, which converts horizontal air motion into vertical air motion.

(2.) "On the Meteorology of Cannes, France," by Dr. W. Marcet, F.R.S., F.M.S. This is a discussion of the observations made at this celebrated health resort during the six winter seasons ending 1880.

(3.) "Report on the Phenological Observations, 1881," by the Rev. T. A. Preston, M.A., F.M.S.

GALE OF NOVEMBER 15TH.

To the Editor of the Meteorological Magazine.

SIR,—The storm that was predicted from America to reach the British coast between the 14th and 16th inst., visited Shap and neighbourhood in all its strength. The early part of the 14th was mild with a heavy fog, followed by a clear afternoon. At an early hour on the 15th clouds began to gather and the wind began to blow; rain commenced about 2 p.m.; from that time till 9 a.m. on the 15th, 1·11 inches fell.

The 15th was the roughest day I can remember; rain came down at times in sheets of water, 1·35 inches fell during the day. The gale was awful; but I am glad to say no harm was reported in this district, further than a few branches broken off trees. I am told on good authority that Swindale beck and the river Lowther, at Keld, have not been known to be so large for many years. The valley facing our house was like a lake all day on the 16th.—Yours, &c., J. HOGGARTH.

Copy Hill, Shap, 19th November, 1881.

EARLY SPRING.

In the lanes south of London it seems already spring. Dandelions are to be found in flower, and the sheathes of the pointed arum are pushing up, some even unrolling. On the briars there are young leaves, the chaffinches call, larks soar, and thrushes sing. The chorus of thrushes in the early morning is very pleasant to listen to, the wood is full of their voices. As for elder-bushes, they had opening leaves in December, so had the woodbine, and on the last day of the year there were buttercups, avens, and white nettle in flower, so that up to the present there has been no winter. The above refers to a clay and cold soil; much greater progress is reported from warmer localities.—*Times, January 12th*, 1882.

SUPPLEMENTARY TABLE OF RAINFALL IN DEC., 1881.

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

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger	3·83	XI.	Carno, Tybritle	5·50
,,	Margate, Acol	2·89	,,	Corwen, Rhug	2·37
,,	Littlehampton	3·16	,,	Port Madoc	5·23
,,	St. Leonards	4·28	,,	Douglas.....	4·78
,,	Hailsham	3·55	XII.	Carsphairn	7·62
,,	I. of W., St. Lawrence.	4·71	,,	Melrose, Abbey Gate ...	3·01
,,	Alton, Ashdell.....	3·52	XIV.	Glasgow, Queen's Park.	3·46
III.	Great Missenden.....	4·15	XV.	Islay, Gruinart School..	...
,,	Winslow, Addington ...	4·16	XVI.	Cupar, Kembach.....	2·68
,,	Oxford, Magdalen Col...	2·89	,,	Aberfeldy H.R.S.	...
,,	Northampton	2·89	,,	Dalnaspidal	5·73
,,	Cambridge, Beech Ho...	3·03	XVII.	Tomintoul.....	1·48
IV.	Harlow, Sheering	3·31	,,	Keith H.R.S.	1·39
,,	Diss	3·13	XVIII.	Forres H.R.S.	·99
,,	Swaffham	2·67	,,	Strome Ferry H.R.S....	8·20
,,	Hindringham	2·65	,,	Lochbroom	5·18
V.	Salisbury, Alderbury...	3·35	,,	Tain, Springfield.....	1·49
,,	Calne, Compton Bassett	3·46	,,	Loch Shiel, Glenaladale	15·99
,,	Beaminster Vicarage ...	4·65	XIX.	Lairg H.R.S.	3·47
,,	Ashburton, Holne Vic..	7·01	,,	Altnabreac H.R.S.	2·25
,,	Langtree Wick	5·31	,,	Watten H.R.S.	2·08
,,	Lynmouth, Glenthorne.	5·60	XX.	Fermoy, Glenville	6·59
,,	St. Austell, Cosgarne...	...	,,	Tralee, Castlemorris ...	6·19
,,	Taunton, Fullands	2·77	,,	Cahir, Tubrid	4·74
VI.	Bristol, Clifton	4·15	,,	Tipperary, Henry St....	5·05
,,	Ross	2·38	,,	Newcastle West	4·78
,,	Wem, Sansaw Hall.....	2·38	,,	Kilrush	4·50
,,	Cheadle, The Heath Ho.	2·96	,,	Corofin	6·30
,,	Coundon	2·94	XXI.	Kilkenny, Butler House	..
VII.	Melton, Coston	2·66	,,	Carlow, Browne's Hill..	3·59
,,	Horncastle, Bucknall ...	2·05	,,	Killsallaghan	...
VIII.	Macclesfield Park	3·73	,,	Navan, Balrath	2·86
,,	Walton-on-the-Hill.....	3·29	,,	Athlone, Twyford	3·33
,,	Broughton-in-Furness ..	5·98	XXII.	Mullingar, Belvedere ...	3·42
IX.	Wakefield, Stanley Vic.	2·20	,,	Ballinasloe	3·46
,,	Ripon, Mickley	4·22	,,	Clifden, Kylemore	13·67
,,	Scarborough.....	2·40	,,	Crossmolina, Enniscoe..	7·30
,,	Mickleton.....	3·32	XXIII.	Carrick-on-Shannon ...	3·04
X.	Haltwhistle, Unthank..	4·30	,,	Dowra	...
,,	Shap, Copy Hill	7·96	,,	Rockcorry.....	3·36
XI.	Llanfrechfa Grange	3·98	,,	Warrenpoint	3·27
,,	Llandovery	4·65	,,	Newtownards	3·20
,,	Solva.....	4·43	,,	Carnlough.....	...
,,	Castle Malgwyn	6·67	,,	Bushmills	4·40
,,	Rhayader, Nantgwillt..	7·06		Buncrana	4·06

DECEMBER, 1881.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1870–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Max. Date.	Min. Deg.	Min. Date.	No. of Nights below 32° In shade.	No. of Nights below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	Camden Square	2·47	+ ·30	·71	17	15	53·6	2	28·1	24	9	22
II.		Maidstone (Hunton Court)	2·79	+ ·39	·57	9	16	...	...	...	...	...	...
,,		Strathfield Turgiss	2·66	+ ·64	·56	17	14	53·5	18	19·8	24	13	24
III.		Hitchin	3·58	+ 1·53	1·26	17	17	50·0	2	22·0	23	16	...
,,		Banbury	3·50	+ 1·35	·93	17	23	51·0	2,6	20·0	24	18	...
IV.		Bury St. Edmunds (Culford)	3·36	+ 1·21	1·41	17	17	52·0	2	25·0	23	16	...
,,		Norwich (Cossey)	3·01	+ ·69	·87	17	19	52·0	2	22·0	24	13	...
V.		Bridport	3·49	...	·65	14	17	54·0	2	16·0	23	20	...
,,		Barnstaple	5·70	+ 1·94	1·27	16	20	56·0	2*	...	...	...	...
,,		Bodmin	6·81	+ 1·36	1·32	16	23	54·0	2	28·0	11	10	18
VI.		Cirencester	3·46	+ ·85	1·07	17	14	...	...	...	...	...	...
,,		Church Stretton (Wcolstaston	4·10	+ 1·31	1·26	16	18	51·0	6	27·5	14	14	20
,,		Tenbury (Orleton)	2·59	+ ·08	·74	17	18	54·0	6	22·2	23	14	17
VII.		Leicester (Town Museum)	...	...	...	...	...	...	...	...	...	...	...
,,		Boston	2·42	+ ·35	·50	18	14	51·0	2	22·0	24	8	...
,,		Grimsby (Killingholme)	1·93	— ·50	·44	20	16	50·0	6	25·0	24	7	...
,,		Mansfield	2·58	+ ·05	·52	17	18	50·9	2	21·0	24	10	24
VIII.		Manchester (Ardwick)	...	...	...	...	...	...	...	...	...	...	...
IX.		Wetherby (Ribstone)	3·51	+ 1·30	1·03	17	14	...	...	...	...	...	...
,,		Skipton (Arncliffe)	8·01	+ 2·73	1·44	16	24	49·0	2	19·0	22	...	...
X.		North Shields	1·86	— 1·23	·31	1	18	52·5	25	25·0	23§	15	15
,,		Borrowdale (Seathwaite)	14·92	+ 1·19	2·95	29	25	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	4·71	+ ·80	1·83	17	19	...	...	...	...	...	...
,,		Haverfordwest	5·79	+ ·66	1·11	16	16	54·0	1†	20·7	10	12	15
,,		Aberystwith (Goginan)	...	...	...	...	...	...	...	...	...	...	...
,,		Llanduduo	2·55	— ·30	·75	3	18	56·5	6	30·2	23	4	...
XII.	SCOTLAND.	Cargen	3·83	— ·70	·58	18	16	52·1	3	23·8	23	10	...
,,		Hawick (Silverbut Hall)	2·86	·00	·50	11	18	...	...	..	...	...	...
XIV.		Douglas Castle (Newmains)	5·50	+ 1·41	·80	24	22	...	...	...	...	...	...
XV.		Kilmory	8·05	+ 1·87	1·17	24	22	...	...	20·0	10‖	13	...
,,		Appin (Airds)	6·70	...	...	...	...	...	...	...	...	...	...
,,		Mull (Quinish)	...	...	...	...	...	...	...	...	...	...	...
XVI.		Loch Leven	3·40	— ·26	·80	3	13	...	...	...	...	...	...
,,		Arbroath	2·00	— ·90	·34	13	12	52·0	29	24·0	23	12	..
XVII.		Braemar	2·67	— ·76	·71	2	16	49·9	25	12·2	23	18	30
,,		Aberdeen	1·82	...	·61	1	16	52·0	27‡	24·0	22	12	...
XVIII		Portree	11·89	+ 3·02	2·00	13	26	...	...	...	...	...	...
,,		Inverness (Culloden)	1·22	— ·62	·41	7	6	55·8	25	23·0	23	12	24
XIX.		Dunrobin	2·23	...	·63	18	11	...	...	...	...	...	...
,,		Sandwick	4·92	+ ·53	1·30	14	25	51·8	25	29·3	21	4	14
XX.	IRELAND.	Cork (Blackrock)	6·00	+ 1·24	·92	31	23	53·0	3	18·0	11	17	...
,,		Dromore Castle	8·12	...	1·45	2	23	57·0	13	24·0	11¶	...	...
,,		Waterford (Brook Lodge)	4·27	...	·70	31	18	53·0	27	22·0	11	13	...
,,		Killaloe	6·34	...	·93	2	18	53·0	2	20·0	12**	15	...
XXI.		Portarlington	3·68	+ ·82	·64	2	20	53·0	2	22·0	10	12	...
,,		Monkstown	1·69	...	·22	2, 31	18	..	...	...	...	...	...
XXII.		Galway	4·45	+ ·63	·62	19	23	54·0	6	20·0	11¶	7	...
XXIII.		Waringstown	3·16	+ ·20	·57	13	18	56·0	25	21·0	11††	21	26
,,		Londonderry	3·88	...	·66	13	25	52·0	1,2	22·0	11	7	22
,,		Edenfel (Omagh)	...	...	..	...	...	...	...	...	...	...	...

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

* And 3, 7. † And 2, 3. ‡ And 29. § And 24. ‖ And 11. ¶ And 12. **And 13, 23. †† And 22.

METEOROLOGICAL NOTES ON DECEMBER.

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

ENGLAND.

STRATHFIELD TURGISS.—White and red nettle, creeping buttercup, dandelion, veronica, primroses, groundsell and potentilla all in full flower at the beginning of the month, and honeysuckle in full leaf.

HITCHEN.—On the 17th, 1·26 in. of R fell, the heaviest fall recorded in December, during more than 30 years.

BANBURY.—High wind on five days, fog on 27th, S on 11th and 17th.

CULFORD.—The weather throughout the month was very open, from the 14th to 20th very wet, followed by several hoar frosts; fine and mild at the close. S on 17th.

BODMIN.—Mean temp. 40°·5, 2°·4 below the average of 32 years.

CIRENCESTER.—A mild, genial month.

WOOLSTASTON.—First week of the month unusually mild, several primroses in blossom on the 7th. Mean temp. of the month 38°·2; S on 10th, 2°·37 in. of R fell on 16th and 17th.

TENBURY, ORLETON.—The first week was cloudy and generally warm, with wind. On the 8th the air became clear and frosty, followed by a dense fog and R on the 9th and 10th; the temp. then remained low till the 25th, with many severe frosts and much R from the 16th to the 21st, flooding the rivers; another dense fog occurred on the 23rd and 24th. On the evening of the 25th it became warmer and continued so with only occasional slight frosts till the end of the month. The fluctuations of the bar. were great, the total range being 1·6 in.; the mean temp. was about 1° below the average of the last 20 years.

KILLINGHOLME.—The month was mild and fine, with many pleasant days, but a good deal of fog, equatorial winds prevailing throughout.

ARNCLIFFE.—Very stormy on the 18th.

SEATHWAITE.—S fell on 5 days, H on 3, falls of R exceeding one inch occurred on 6 days.

WALES.

HAVERFORDWEST.—The mild weather which characterised November continued up to the 8th of this month, when the air became much colder, the temp. at times being very low; after the 14th a very stormy period set in with heavy rainfall, the temp. continuing low, finer again from the 21st to the end of the month. A terrible storm of T, L, and H, with R, on 19th; mean temp. below the average.

SCOTLAND.

CARGEN.—The month was mild with the exception of pretty sharp frosts on 13th, 16th, 22nd, and 24th, the weather being generally stormy, dull, and wet. Mean temp. 39°·3, half-a-degree above the average; 52 hours of sunshine, 11 hours below the average.

HAWICK.—A remarkably mild December, several gooseberry bushes in flower during the second week. S on 5 days.

KILMORY.—Dull and showery from 1st to 7th, then frosty till the 13th; the remainder of the month was very unsettled with a good deal of R.

BRAEMAR.—An unusually fine December.

ABERDEEN.—Mild open weather, the prevailing winds being southerly to south-westerly. Rainfall fully an inch below the average. Fresh gale on 6th, H on 11th, aurora on 10th.

PORTREE.—High ground covered with S from 15th to end of month, and a heavy fall all over on 21st, with strong frost; solar halo all the afternoon of the 31st, and lunar halo at night.

CULLODEN.—Month generally fine, but with frequent gales; temperature high.

SANDWICK.—December was remarkably mild, and the plains were never covered with S during the month. There were gales of 50 miles an hour or more on the 6th, 7th, 18th, 24th, and 26th; on the 7th and 18th they were 60 miles an hour. The bar. was as low as 28·290 in. on the 18th.

IRELAND.

DROMORE.—Early part of month cold and stormy, gradually subsiding into fine, mild and open weather. Mean temp. 44°.

KILLALOE.—Frosts frequent; temperature below the average, rainfall above the average. Very tempestuous from 17th to 20th.

WARINGSTOWN.—Weather during the month mild and warm, gales frequent.

LONDONDERRY.—Month on the whole mild, wind principally S.W.

THE COMING WINTER.

A CORRESPONDENT writes to us as follows:—"The past summer has been unusually cold in the Arctic Seas to the eastward of Greenland. The Dutch Arctic exploring ship Willem Barents has been unable to approach Spitzbergen, Novaya Zemlya, or even the Bear Islands, on account of the barrier of ice which has surrounded them. Indeed, the Arctic ice has remained unbroken this summer as far south as a point only ten miles north of Iceland. Now if anyone will refer to one of Keith Johnston's excellent charts of ocean currents, he will find that there is a constant stream of water moving from the East Greenland coast in a southerly direction, and that after following the coast of North America for a considerable distance, it becomes merged in the Gulf Stream. Every one knows that it is to the warmth of this stream that we owe the comparatively mild winters which we enjoy in this country. Manchester is in the same latitude as Labrador, or the Hudson's Bay, at a point 900 miles north of New York, and this fact alone may help the imagination to realise how vast is the benefit which we derive from the ameliorating influence of this great ocean current. Well, it is obvious that when the waters poured into this current from the Polar regions are unusually cold and mingled with icebergs, the Gulf stream is likely to be so much the cooler. And the thought which occurs to me is this: If the past summer has been so cold in the Arctic regions as to prevent the ice from breaking up and floating southward, the cooling effect of the Arctic current upon the Gulf Stream must have been greatly diminished. Hence we are likely to have, I infer, an unusually mild winter. Of course, when the wind is blowing from the east or the north, the tempering effect of this assumed higher temperature of the Gulf Stream must be very small indeed, but it appears to be exceedingly probable that whenever westerly winds prevail, we shall have very mild weather, and that, on the whole, the coming winter is likely to be comparatively warm. I do not profess to be an accomplished or even a very well-informed meteorologist, but the inference which I have drawn from the facts presented to my mind seems so reasonable, that I have no hesitation in seeking to make it public.—*Manchester Guardian.*

END OF VOL. XVI.