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THE RECENT FLOODS IN WESTERN EUROPE.

WE find ourselves in an unpleasant difficulty with respect to this subject, because it is contrary to our wish to put forward incomplete work, and on the other hand it is quite impossible for us to discuss thoroughly a question which involves the examination of all the rain and river records of Central and Western Europe. Yet it would scarcely be right to allow, what seem to have been amongst the greatest floods of the present century, to pass without notice. We console ourselves with the certainty that among the many Germans who are competent to grapple with the question, one or more is sure to undertake it, and to treat it with the exhaustiveness characteristic of his countrymen. We therefore proceed first to give a series of notes, as much condensed as possible, of the damage done; then (on page 181) a brief epitome of them, and a table of daily rainfall in parts of Austria, Germany, Belgium, and France, around those which have suffered most.

BERLIN, DEC. 28.

The *Rhine* province is threatened with a repetition of the late destructive inundations, and every hour brings intelligence of increasing danger. At *Cologne* this morning, about 10 o'clock, the river was 21 ft. deep, and gaining $2\frac{1}{2}$ in. per hour. The quays were flooded, and several streets were already under water. A telegram from *Neuwied*, at noon, announced a general panic, caused by the unprecedentedly rapid rising of the *Rhine*, which it is feared would exceed the limit reached a week or two since. At *Mannheim* the *Neckar* had risen 18 ft. since the 26th, and burst its banks, flooding and devastating that neighbourhood. The quays and low-lying streets of *Frankfort-on-the-Maine* were covered this morning, and the stream was fast increasing in volume. At *Cassel* the *Fulda* is in the same condition. Since yesterday the *Lake of Constance*, through which the *Rhine* flows, had risen from 3.43 to 3.67 metres (11 ft. 3 in. to 12 ft.), and at *Waldshut* the depth of the river is 5.60 metres (18 ft. 4 in.). Five bridges, one of them a pontoon, have been destroyed, and several embankments have already been burst. All the right tributaries of the *Rhine* are reported to be deeply flooded.

According to a later telegram, the bridge at *Lörrach*, in the *Wiesen* district, was swept away, with about 20 persons who were crossing it, most of them being drowned. An attempt to pass a train over a flooded line from *Appenweier* to *Kork* resulted in the unrailing of the engine, and the death of one and the wounding of several passengers. Most of the railway lines near *Mannheim* have already been rendered useless.

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WIESBADEN, JAN. 2.

The floods, which already far exceed all previous ones since 1784, are still increasing. After a slight fall last night the *Rhine* is to-day rising 2 in. hourly. The *Upper Neckar* and the *Main* are also rising rapidly. The principal scene of devastation is from *Rastadt* to *Worms*, where the entire *Rhine Valley* forms a great lake, in some places 20 miles broad, with a strong current of 15 ft. per second (10 miles an hour!) In seven villages on the *Ried Plains* near *Worms*, 500 houses have been destroyed, and entire streets swept away. Pioneers with boats rescue the people from the roofs of the churches. The loss of life is yet unknown, but is certainly serious. Nearly all the cattle are drowned. The refugees are sheltered in schools and churches. The sappers are cutting dams to draw off the back water. *Mayence* is still free from water, by the enormous efforts of the soldiers and firemen. A temporary railway has been built for the rapid transport of materials for embankments. At *Lorch* a landslip is imminent. The inhabitants are leaving their homes. *Neuweid* is again completely submerged. The *Dusseldorf* market square is flooded. The rains continue.

VIENNA, JAN. 2.

The rain continues, and the waters are still rising. The villages along the *Danube* just above *Vienna* are flooded. The greenhouses stand in the water, so that fruits and vegetables are floating in masses down the river. Military aid has been required. The long dykes in the *Prater* are in a bad condition. Many cellars are filled with water. In one suburb the people have been dislodged in great numbers. Under the great bridge on the quay the *Danube* is 4 metres (13 ft.) higher than the normal standard. News from *Linz* announces a continual increase of the water there. Immense masses of water are expected to reach *Vienna* at midnight, and it is feared that they may destroy the dykes on the left bank. *Stockerau* was in great danger last night. Many hundred head of game have been drowned, as well as deer, pheasants and innumerable herds of cattle. A railway guard on an exposed point perished with his wife and six children. In *Freisenheim* most of the inhabitants are sheltered in the church, school, and town hall, every other house having fallen in; but many inhabitants have been drowned. *Oppau* is worse off. Rarely before has Europe witnessed such disastrous floods.

THE HAGUE, JAN. 2.

The whole of the North-Eastern portion of *North Brabant* is completely under water. Hundreds of families have been driven from their homes, and are houseless, and obliged to camp out in the neighbouring districts.

WIESBADEN, JAN. 3.

Bad news from *Worms* is still arriving. From the *Ried* districts, near *Worms*, at least 10,000 persons are homeless, and in danger of starvation. The neighbouring towns are crowded with refugees. There are 3,000 at *Ludwigshafen*, 2,000 at *Mannheim*, and 2,000 at *Worms* lodged in the schools and churches. A steamer, with 100 sappers and miners, left *Mayence* to-day for *Worms*. The situation at *Mayence* is extremely critical. More dykes are broken in the vicinity. The soldiers are building additional embankments. Sixteen steam pumps are working day and night, including several locomotive fire engines. The inhabitants are much excited. The *Bingen* station is flooded. The island of *Niederwerth*, below *Coblentz*, is entirely submerged. The inhabitants, with their cattle, have retired to the garrets of the houses.

VIENNA, JAN. 3.

The railway along the *Danube* is under water, as also half the *Prater*. One half of *Linz* is flooded. The firemen and soldiers spent the night on the bridge with torches, as a telegram from *Ottensheim*, three miles higher up, announced that the bridge of boats had been torn away with several persons upon it. The bridge left *Ottensheim* at nine and reached *Linz* at half-past ten. When it passed under the arches with a thundering noise its speed was very great.

The persons on it managed to run it on shore, after having spent the greater part of the night in terrible danger. No English post has reached *Vienna* to-day, the *Rhenish* railways being everywhere damaged by the floods. Sad news reaches us from those parts. In every village the houses are falling in. Churches and schools are the only places of shelter, and even these are not always safe. Still, people remain as long as they can in the upper storeys, because a great number of thieves are prowling about in boats, and, entering the houses by windows, steal all they can lay their hands on. From the higher *Danube* and its affluents there is better news. The water is gradually subsiding. But lower down, and through *Hungary*, the effect of the pressure above is severely felt. In *Pressburg* the bridge of boats has been removed, as it was in danger of being carried away. In *Pesth* and *Buda* the water has everywhere covered the lower quays.

GENEVA, JAN. 3.

Part of the line between *Geneva* and *Bellegarde* is washed away. Direct railway communication with *France* and *Italy* is temporarily suspended.

BADEN-BADEN, JAN. 4.

Dreadful accounts keep coming in from the flooded districts, and it is to be feared that not only is the loss of property very severe, but also of human lives. In *Frankenthal*, *Oppau*, *Edigheim*, *Moersch*, *Bodenheim*, *Roxheim*, and *Studernheim*, more than 500 houses have fallen in, and over 9,000 people are roofless. During the flood these villages seemed like little half-swamped islets in a raging inland sea. In one place, 50 head of cattle and horses were seen up to their necks in water, and benumbed with cold and fright. The village of *Edigheim* may be said simply to have been washed off the face of the earth. From the village of *Oppau* 30 persons were rescued with difficulty in a large boat, but such a storm of wind arose that the craft was upset against two trees, and only one life was saved. In one village near *Mannheim* the flood was so grievous that some unprincipled persons formed the design of piercing a dam, which would have relieved them, but have flooded the town. The design was discovered in time, and military with loaded muskets were posted along the threatened spot, with orders to shoot if need be.

PARIS, THURSDAY, JAN. 4.

The *Seine* is now dangerously high, its present rise being even greater than that recorded a few days ago. Several houses in the suburbs have been completely swept away, and numerous accidents are reported. Serious disasters are feared.

MACON, THURSDAY, JAN. 4.

Up to yesterday evening the waters of the *Saone* and *Doubs* had risen considerably, inundating several villages. Thirty-two houses have fallen in at *Longepierre*, on the *Doubs*, through their lowest storeys being submerged. Several streets in *Chalons* and *Macon* are under water. The shops are closed, and considerable damage has been done. The floods commenced subsiding this morning.

VIENNA, JANUARY 4.

The mails did not arrive yesterday from either *Paris* or *London*. As regards the direct line to *Paris*, *viâ Munich* and *Strasbourg*, the route was changed on the 31st ult., and a notice was published by the railway authorities informing the public that as, owing to the floods, communication between *Vienna* and *Paris*, *viâ Stuttgart* and *Carlsruhe*, was interrupted, the evening express would go *viâ Munich*, *Lindau*, *Romishorn* and *Bâle*, and a midday express *viâ Passau*, *Bingen*, and *Metz*, to *Paris*.

The condition of the river has not greatly changed, and causes considerable apprehension. In some places a slight falling of the water has been noticed, and for various reasons a hope is entertained that the worst is past.

In consequence of the floods, the railway bridge between *Tulln* and *Absdorf* has been carried away, and the traffic between *Vienna* and those places has been stopped. All through *Hungary*, the *Danube* and its affluents are gaining,

and partial floods have occurred. No great damage, however, is reported. At *Pesth*, as the water is still rising, and in some cases, owing to the delay in blocking up the sewers, has got into the cellars, a special protection committee has been formed.

BERLIN, JAN. 4.

According to a telegram from *Cologne*, the *Rhine* had only risen an inch and a half since yesterday evening, and immense quantities of drift of all kinds were floating past. At *Mayence*, on the other hand, it has fallen a little, but the general danger and distress are still very great. Thousands of poor people are roofless, and churches and other public buildings have been thrown open to shelter them, while food is supplied by the public authorities.

MANNHEIM, JAN. 4.

The state of things here almost defies description. The town appears to stand on an island in the midst of a vast sea. From the Observatory, as far as the eye can reach in either direction, there is an immense expanse of waters extending to the horizon. The whole of the *Pfalz*, or *Palatinate*, seems to be under water. At *Mannheim* at *Ludwigshafen*, and throughout this part of the *Neckar* and *Rhine* districts, the loss of property, including houses as well as furniture and domestic animals, is incalculable. At *Ludwigshafen*, where the population and soldiers have been working day and night to strengthen the embankment, all efforts have proved in vain. The great *Rhine* dam gave way before the rushing waters yesterday morning, and the lives of hundreds were therewith placed in the highest peril. Up to noon, however, four hundred and forty children had been saved by help of boats, which took them from the falling houses. A hundred and fifty sick persons, who were bed-ridden, were also rescued by a steamer. From the environs of *Ludwigshafen* upwards of 2,500 persons have had to seek shelter in the town, and are now housed there. The number of houses swept away or ruined by the inundation is unprecedented. The village of *Friesenheim* is entirely deserted, and sixty-eight houses there are destroyed. One-third of the inhabitants of *Oppau* have had to abandon their homes and seek shelter elsewhere. On Tuesday there were five hundred in the church and four hundred in the school-house. No fewer than one hundred and twelve houses have been destroyed at that place; sixty houses have fallen in at *Edigheim*, and forty at *Mörsch*. The condition of the large number of persons who have been rescued, and are now under shelter, is one of the deepest distress.

Many small towns on the *Danube* are three feet deep in water. The whole district south of *Pesth* is flooded. 75,000 acres of cultivated land are entirely submerged. In one place near *Worms*, thirteen persons who had taken refuge on the roof of a house were drowned when the house fell. The total loss of life is estimated at from sixty to seventy.

VIENNA, JAN. 5.

As yet the water has fallen but little. From higher up the river, however, accounts come of a lowering in the level, and the danger has therefore considerably diminished. There is a possibility that one or other of the embankments may give way; but, as all the weaker parts have been looked to, this is not very much to be feared. In *Pressburg* the lower streets are flooded. At *Pesth*, though the water is high, there is still no danger.

BERLIN, JAN. 5.

The news from the *Rhine* is rather better to-day. At *Cologne* the river is falling slowly, and a similar report comes from *Mayence*, where the water yesterday stood as high as it was in November. Cold, dry weather has now set in, and it is hoped that the worst has been reached; but the damage already done is enormous, and the distress among the inhabitants of the inundated districts is terrible.

GENEVA, JAN. 5.

The floods are abating, but very slowly. The plain between *Monthey* and *Martigny* is still under water. Most of the roads in the *Valais* are either blocked by earthslips, or severed by water. The *Sembrancher Tunnel*, in the

valley of *Entremont*, is blocked by an earthslip, and at *Nendaz*, in the same canton, several properties, consisting of meadows and vineyards, have been utterly destroyed by a great earthslip. The *Lake of Geneva* is now higher than it was ever before known to be at this time of the year. On December 30th its height was 92 centimètres (3 ft.) above its normal winter level, and only 10 centimètres (4 in.) below the *maximum* level of the summer of 1880. During the next two months, the spring floods will, in all probability, be more disastrous than those of last week; and the lakes and rivers of *Central Europe*, fed by the snows which are now accumulating in such enormous quantities on the *Alps*, bid fair to be next summer fuller than they have yet been in the memory of man.

BERLIN, JAN. 7.

From *Cologne*, *Coblentz*, *Mayence*, and other places it is announced to-day that the *Rhine* has fallen considerably since last night, and that much more favourable weather is now setting in. The Grand Duke of Baden is exerting himself to the utmost in the inundated districts, directing the distribution of relief and superintending precautionary measures.

VIENNA, JAN. 7.

Since yesterday morning the water has fallen more than one mètre (3 ft. 3 in.) and as the accounts from higher up the river report a similar fall, and fine, frosty weather has set in, the danger of a flood here is considered over, and the committees of rescue have been dissolved in the suburbs. Lower down the river, though there is also some fall, the effect has not yet been much felt. In *Pressburg* the *Danube Quay* and a lower suburb are still flooded, while in the country over 30,000 acres are calculated to be under water. It is feared that considerable damage will be done to the crops.

VIENNA, JAN. 8.

As far down as *Vienna* the water all over *Hungary* is steadily falling, but in the *Pesth* district it has been rising, though slowly. For the last few days bad accounts have been coming from *Raab*, lying on the river of the same name at some distance from the *Danube*, and this morning, in spite of the efforts made to strengthen it, a portion of one of the dikes gave way, and a suburb has been flooded to the depth of a mètre (3 ft. 3 in.) No casualties occurred. According to the latest accounts, the water was still rising. The *Theiss*, on the contrary, is rather low, as there the cooler weather has prevented the melting of the snow.

COLOGNE, JAN. 11.

The city is again free from water. As an illustration of the dimensions assumed by the late floods, it has been calculated that the surface inundated between *Mannheim* and *Bingen* alone, measured about 660 square kilomètres (255 square miles), or 120 (45 miles) less than the whole area of the *Lake of Constance*.

VIENNA, JAN. 11.

The *Pesther Lloyd* furnishes details of the inundation of *Raab* and its neighbourhood, supplied by one who has visited the scene. He estimates the flooded district at 12 German square miles (265 square miles). Two of the villages, *Revfalu* and *Pathaza*, are completely destroyed. The water has undermined the houses, mostly built of sun-dried bricks, and but few of them remain standing. The church and some houses about it, lying rather high, have escaped. The population, being mostly engaged in shipping, and having plenty of boats, were able to escape in time to *Raab*. They have, however, in many cases, lost all their property. A good portion of the live stock was saved, and they, with the human fugitives, are housed in schools, barracks and the seminary. In every quarter the ladies have established soup kitchens. In all about 30 villages have been partially or totally flooded, while the number of the homeless refugees is estimated at 10,000.

From an examination of the above notes it appears that flooding has occurred on nearly all the principal European rivers—on the

Danube, the Rhine, the Rhone, and the Seine, and, as usual, it has been the low-lying cottages which have suffered most.

If we look carefully at the course of these rivers, we find that they all have their origin, or flow within a radius of 100 miles round Strasburg, and our present impression is that the floods were due chiefly to exceptional condensation on the mountain ranges of the Jura, the Vosges and Schwabia, and to a slight degree to similar falls on Thuringia and the Hartz mountains. There is only one fact which does not seem very easily explained by the theory of an excessive rainfall on the mountain ranges of West Central Europe, which we have advanced, viz., the flooding of Raab.

Raab is a small town on a river of the same name which rises not very far from Grätz, and flows into the Danube between Vienna and Buda Pesth. We do not quite understand why this river was flooded, unless it arose from the enormous current in the Danube damming back the waters of the tributary which, by the bye, flows through very level and low-lying ground. But the rain returns from Vienna and Trieste agree in suggesting that no exceptional rain seems likely to have occurred over the Raab watershed. Hence we come back to the idea that its flow (perhaps slightly greater than usual) was obstructed by the unusual level of the Danube, and so the water "backed up" and flooded the little town of Raab.

Rainfall in Western Europe, Dec. 24, 1882-Jan. 4, 1883.

Date.	Austria.		Germany				Belgium	France.			England
	Vienna	Prague	Munich	Carls- ruhe	Cassel	Ham- burgh	Brussels	Nancy	Lyons	Paris	London
Dec. 24	...	...	·08	...	...	·08	·35	...	...	·04	·07
25	·16	...	·32	·32	·04	·08	·39	?	·08	·04	·52
26	·39	·24	·51	1·18	·91	...	·71	·63	·04	·22	·21
27	·75	·24	·20	·67	·35	·24	·28	·35	...	·06	·07
28	...	·24	...	...	·39	·04	...	...	...	·01	·01
29	...	...	...	·04	·20	·24	·20	·04	...	·06	·20
30	·04	·08	·04	·12	·55	...	·20	·04	?	·04	·44
31	·28	·08	·35	·55	·20	...	·51	·20	·39	·43	·21
Jan. 1	·32	·51	·35	·04	·20	·32	·04	...	...	·01	·09
2	·39	...	·08	·32	·43	·08	·24	?	...	·02	·02
3	·04	·04	·16	...	·16	...	·04	·08	·04	·02	...
4	...	...	·04	·04	..	...	...	...	...	...	·03
Totals	2·37	1·43	2·13	3·28	3·43	1·08	2·96	1·34 ?	·55 ?	·95	1·87

The ? denotes that the amount for that station on that date has not been published.

There does not seem anything very exceptional in the above values, but we must remember that nearly all these stations are in comparatively low-lying cities, whereas the real cause of the rise of rivers is almost always to be found in the highlands, whence they take their origin, whether the specific cause be rain, or the rapid melting of snow, or the two causes combined. A rainfall of $3\frac{1}{4}$ inches in ten

days is probably not a frequent occurrence either at Cassel or Carlsruhe ; but, considering the high temperature prevailing during the period, we expect to hear that at the mountain stations the fall was much heavier ; and although nothing has been said upon the subject, we should not be astonished if the rain was warm enough and heavy enough to be appreciably augmented by melting snow off some of the lower mountains. This is, however, speculation, which may meet the fate that not unfrequently attends such efforts.

THE RECENT MILD WEATHER.

To the Editor of the Meteorological Magazine.

SIR,—Will you kindly allow the following to appear in your Monthly Record. The figures show the mean temperatures recorded here for the seven days ending January 1st. Thermometers in Stevenson stand 4 ft. above the ground :—

Date.	Mean Temperature.	Excess over average 1814-73.
1882.—December 26	51°·2	+ 13°·4
„ 27	52°·9	+ 15°·3
„ 28	52°·5	+ 15°·0
„ 29	52°·2	+ 14°·8
„ 30	50°·7	+ 13°·4
„ 31	50°·3	+ 13°·1
1883.—January 1	53°·0	+ 15°·8
Mean of Week	51°·8	+ 14°·4

Such a succession of warm days in December is almost without precedent. Having carefully examined Mr. Jas. Glaisher's Tables of "The Mean Temperature of every day since 1814," I find *but two instances* of seven consecutive days in December giving so high a mean temperature, viz. :—

In 1848, Dec. 7—13	mean temp.	52°·9
„ 1856 „ 6—12	„	52°·3

I am, Sir,

Yours respectfully,

G. T. GWILLIAM.

Bayswater, Jan. 2nd, 1883.

[We are indebted to Mr. Gwilliam for calling attention to the late exceptionally warm period, and in order to make the comparison rigorously perfect add, a few other values.

In the first place, Mr. Gwilliam's observations being made (quite rightly) in a Stevenson stand are not strictly comparable with Mr. Glaisher's mean values, which were obtained from readings on a Glaisher stand ; and secondly, Bayswater and Greenwich Observatory undoubtedly differ slightly in temperature. The mean temperature for Greenwich computed precisely, as was formerly done by Mr. Glaisher, is given for each day in the Registrar-General's Weekly Reports. Comparing them with the above values we shall see the

difference between the Stevenson screen at Bayswater and the Glaisher screen at Greenwich.

DATE...	Dec. 26	27	28	29	30	31	Jan. 1	MEAN.
Bayswater.....	51.2	52.9	52.5	52.2	50.7	50.3	53.0	... 51.83
Greenwich.....	51.1	53.9	52.8	51.8	50.9	50.3	53.7	... 52.07
Bayswater.....	+1	-1.0	-3	+4	-2	0	-7	... -24

We were not prepared for the above result, viz., that the mean temperature in a Stevenson screen at Bayswater is $\frac{1}{4}$ of a degree colder than on the Glaisher stand at Greenwich.

We next submit two other comparisons, viz., the recent temperatures at Greenwich with (1) the mean of the sixty-year period worked up by Mr. Glaisher, and (2) with the means deduced by Sir George Airy, F.R.S., from the Greenwich photographic record, 1847-68.

DATE.....	Dec. 26	27	28	29	30	31	Jan. 1	MEAN.
Greenwich, 1882-3...	51.1	53.9	52.8	51.8	50.9	50.3	53.7	... 52.07
„ 1814-73...	37.8	37.6	37.5	37.4	37.3	37.2	37.2	... 37.43
Excess	13.3	16.3	15.3	14.4	13.6	13.1	16.5	... 14.64
Greenwich, 1882-3...	51.1	53.9	52.8	51.8	50.9	50.3	53.7	... 52.07
„ 1847-68...	39.1	39.0	38.8	38.7	38.5	38.3	38.1	... 38.64
Excess	12.0	14.9	14.0	13.1	12.4	12.0	15.6	... 13.43

Thence finally we learn not merely that Mr. Gwilliam's inferences are correct, but also how markedly higher are the mean temperatures of the winters 1847-68 than those of the earlier period 1814-73, a feature to which Mr. Glaisher long since called attention. On the other hand, we must not forget that since both these averages were compiled, we have had several extremely cold winters in succession, the addition of which to the 1847-68 period might possibly lower it to a nearer agreement with 1814-73. —ED.]

RAIN AND DALTON GAUGES.

To the Editor of the Meteorological Magazine.

SIR,—Having had a percolation gauge in continuous operation for rather more than six years, I think that the results may be of interest to some of your readers.

In past generations it was the common opinion that the rain-clouds were supplied with their water from the neighbouring seas. The old agricultural reporters of the counties often spoke of a certain quantity of rain coming with the west or south-westerly wind from the Atlantic Ocean, and again so much being brought by an east wind from the German Ocean. They obviously attached little significance to what is termed a drying wind or a sunny day, or perhaps thought that the evaporation from the soil in the shape of aqueous vapour passed into space, and was never heard more of. The washer-woman, though a capital judge of a drying day when suspending her wet clothes, would take no account of what became of the moisture which disappeared in the process of drying.

Without evaporation and capillary action in the soil, with the

same amount of rainfall, our rivers would flow to the sea with more than double their present volume of water. We have for many years kept a record of the rainfall, and also a gauge filled with soil to the depth of 2½ ft. This soil consists of earth of a medium water-holding power, and what water percolates downwards through that soil is measured monthly. The following are the results for 1882 :—

1882.	Rainfall.	Percolation.	
	in.	in.	Per cent.
January	1·45	1·20	83
February	1·60	0·80	50
March	1·10	0·75	68
April	3·00	1·30	43
May.....	1·23	0·67	54
June	2·20	0·45	20
July.....	3·57	1·83	51
August	1·75	0·14	8
September	2·07	0·83	40
October	5·10	2·35	46
November	3·20	2·16	67
December	2·15	2·02	94
Total	28·42	14·50	52

It will be seen that almost one-half of the rainfall passed again upwards into the atmosphere in an imperceptible form.

The proportion of filtration in winter is much more than in the summer months, as may well be understood, and much also depends upon the character of the soil, whether porous or retentive. The third main factor is the state of the weather.

The following is the rainfall and filtration at our station in the past six years :—

Year.	Rainfall.	Percolation.	
	in.	in.	Per cent.
1877.....	26·35	12·19	46
1878.....	25·52	11·62	46
1879.....	27·91	15·57	56
1880.....	30·80	17·89	58
1881.....	25·30	12·60	50
1882.....	28·42	14·50	52
Mean ...	27·38	14·06	52

In these six years it will be seen that about one-half of the rainfall has been evaporated.

At Hemel Hempstead Mr. Dickinson found the average of eight years percolation through 3ft. of soil to be 42·4 per cent. of the total rainfall.

Dalton gauges of various depths are in operation at Rothamsted, from which it is found that the moisture in the soil is drawn up from considerable depths. One gauge is 5 ft. deep.

DAVID ROBIE.

Bedford, 10th January.

HAIL STORMS IN GERMANY, 1882.

To the Editor of the Meteorological Magazine.

SIR,—It may interest Col. Ward to know that a severe hailstorm visited Schwalbach on the 30th May last, accompanied by stones not unlike those which fell at Ober Grainau. The day was fine in the early part, but clouded in the afternoon, and at 6.40 p.m. the storm came.

The stones fell with considerable violence, bounding up some 18 inches on turf, and three to four feet on the stone balcony.

The sizes and shapes were very variable, and from sketches which I made, I give the particulars of some in eighths of inches: No. (1), egg-shaped, $\frac{3}{8}$ by $\frac{2}{8}$; (2), irregularly round, $\frac{3}{8}$; (3), round, with one flattened side, $\frac{5}{8}$ by $\frac{4}{8}$; (4), round, $\frac{5}{8}$; (5), egg-shaped, 1 in. by $\frac{5}{8}$; (6), a truncated cone, like a Minie rifle ball, but convex at base, $1\frac{1}{8}$ in. by 1 in.; (7), an irregular mass, something like Col. Ward's No. 2, $1\frac{1}{8}$ in. each way. Nos. (1) to (6) were mostly of true hail-stone look; No. (7) seemed more like a cake of ice, and is marked in the sketch "conglomerated." That the storm was heavy on the hills towards Schlangenbad was shown by the torrent of water which soon ran through the streets of our little watering-place, carrying away freshly-made parterres, filling the *quelle*, &c. The storm was followed at 7.40 by some of the finest cloud scenery I have ever seen. In the W. heavy long dark streaks of rain-cloud, mixed with a few lighter openings, lay on the horizon. As these were traced upwards they resolved themselves into rounder and bolder forms, until overhead there hung a perfect canopy of festooning, semi-balloon shapes,* of a lurid ochreous tint, and seemingly ready to burst. They did not do so, and a quarter of an hour later they were quickly dissolving into clouds of a more cirrus type, apparently tilted at an angle of 45°, and drifting rapidly from S. to N. These were met by others flying in a horizontal direction from N. to S., while scattered among both were irregular masses of very dark clouds, with fringed and fibrous edges, suggestive of electric repulsion. All this was accompanied by nearly every colour of the spectrum, little patches of blue sky being contrasted with red, yellow, violet, and even, here and there, green tints. I obtained two sketches of the forms in pencil; nothing but a Turner's brush could have given a true idea of the colours. A similar storm was reported at Berlin the day before.

J. RAND CAPRON, F.M.S.

Guildown, January 6th, 1883.

* Clouston's Pocky-cloud.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, AUG., 1882.

STATIONS. (Those in italics are South of the Equator.)	Absolute.				Average.				Absolute.		Total Rain.		Aver.
	Maximum.		Minimum.		Max.	Min.	Dew Point.	Humidity.	Max. in Sun.	Min. on Grass.	Depth.	Days.	
	Temp.	Date.	Temp.	Date.									
	°		°		°	°	°	0-100	°	°	inches		
England, London	80·8	6	45·0	31	70·6	52·7	51·7	72	128·3	40·2	1·48	12	6·4
Cape of Good Hope ...	83·5	...	35·9	...	67·3	45·7	48·3	77	...	...	2·47	6	3·5
Mauritius.....	75·5	19*	59·4	12	73·7	65·2	59·1	71	...	...	1·53	20	5·6
Calcutta.....	91·5	4	75·4	20†	87·3	77·5	77·9	88	156·5	72·7	10·87	25	8·2
Bombay.....	86·2	20†	75·3	6	84·5	77·2	75·3	83	146·2	71·2	3·36	23	8·4
Ceylon.....	86·9	28	72·3	18	84·6	76·7	72·2	74	155·0	70·0	2·28	14	7·1
Melbourne.....	73·1	24	34·1	11	57·8	43·8	43·2	78	123·2	27·9	2·11	16	7·0
Adelaide.....	71·7	24	38·0	13	59·6	45·1	45·1	76	135·5	29·5	3·38	21	6·5
Wellington.....	60·0	26	36·0	18	51·5	41·8	...	...	111·0	30·0	7·79	19	...
Auckland.....	62·9	6	35·6	20	58·4	45·7	45·1	78	...	31·0	3·12	16	7·0
Falkland Isles.....	47·0	22	29·9	14	41·0	33·5	35·7	93	107·2	23·8	2·00	22	7·1
Jamaica.....	92·2	27	71·2	17	88·4	73·6	73·0	79	...	64·1	1·56	...	5·4
Barbados.....	84·0	var.	70·0	9	83·0	73·0	72·3	76	156·0	69·0	2·37	16	6·0
Toronto.....	86·9	7	46·8	20	76·0	59·2	60·8	76	145·0	42·4	2·51	14	6·1
New Brunswick, S. John	82·0	3	44·0	27‡	67·1	53·1	54·3	82	...	...	1·89	4	4·5
Cape Breton, Sydney...	84·5	5	47·0	30	71·6	56·1	57·8	83	...	...	5·48	16	6·4
Newfoundlnd, S. John's	...	...	...	...	...	...	...	...	...	...	...	...	...
Manitoba, Winnipeg...	90·1	27	41·0	31	80·0	53·7	60·2	77	142·0	...	1·51	7	2·2

* And 20.

† And 25.

‡ And 21.

§ And 28.

REMARKS, AUGUST, 1882.

Mauritius.—Rainfall 63 in. below, and mean temp. 0°·2 above average; mean pressure, 30·190 in., extremes 30·343 in., and 29·884 in.; mean hourly velocity of wind 12·3 miles, extremes 29·9 miles, and 1·7 miles; prevailing direction E.S.E.

C. MELDRUM, F.R.S.

Colombo.—Thunderstorms occurred on 1st, 2nd, 3rd, and 4th. J. H. SYMONDS.

Melbourne.—Mean pressure and temp. both slightly below average, amount of cloud and rainfall above it; prevailing direction of wind N.; strong breezes occurred on five days; L on 1st, H showers on 6th, dense fog on 19th, 22nd, and 27th, hoar frost on 11th and 15th, heavy dew on four days.

R. L. J. ELLERY, F.R.S.

Adelaide.—Weather on the whole mild and seasonable; mean temp. about 0°·7 above that of previous years; rainfall also above the average, but mean pressure was below it.

C. TODD.

Auckland.—Weather variable; rainfall not excessive, and many fine days; wind mostly moderate, often very light, chiefly from S. and S.W. Clematis indivisa (first spring flower) bloomed on 9th, first oak leaves seen on 13th.

E. B. DICKSON.

BARBADOS.—Mean pressure slightly below average; mean temp. (77°·2) same as the average; prevailing wind N.E., average velocity 10 miles per hour, the extremes being 14·6 miles and 3 miles. The rainfall was below the average, and the evaporation was 35° per cent. above it. Two days were overcast; TS on 17th.

R. BOWIE WALCOTT.

SUPPLEMENTARY TABLE OF RAINFALL, DECEMBER, 1882.

[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	3·25	XI.	Solva	5·25
„	Margate, Birchington... ..	2·15	„	Castle Malgwyn	5·70
„	Littlehampton	2·75	„	Rhayader, Nantgwillt..	9·23
„	St. Leonards	3·23	„	Carno, Tybrite ..	7·24
„	Hailsham	3·68	„	Corwen, Rhug	4·86
„	I. of W., St. Lawrence.	3·16	„	Port Madoc	8·17
„	Alton, Ashdell	3·27	„	I. of Man, Douglas	4·71
III.	Great Missenden	3·42	XII.	Carsphairn	4·97
„	Winslow, Addington ...	3·28	„	Melrose, Abbey Gate...	6·25
„	Oxford, Magdalen Col... ..	3·20	XIII.	N. Esk Res. [Penicuik]	5·65
„	Northampton	2·74	XIV.	Ayr, Cassillis House ...	4·08
„	Cambridge, Beech Ho... ..	2·43	„	Glasgow, Queen's Park.	4·42
IV.	Southend	2·36	XV.	Islay, Gruinart School..	5·32
„	Harlow, Sheering	2·82	XVI.	St. Andrews, Newton Bk	5·54
„	Diss	4·02	„	Kemback .....	...
„	Swaffham	3·90	„	Aberfeldy H.R.S.	3·70
„	Hindringham	3·78	„	Dalnaspidal	6·79
V.	Salisbury, Alderbury ...	2·85	XVII.	Tomintoul .....	...
„	Calne, Compton Bassett	3·42	„	Keith H.R.S.	3·29
„	Beaminster Vicarage ...	4·88	XVIII.	Forres H.R.S.	3·49
„	Ashburton, Holne Vic... ..	10·54	„	Strome Ferry H.R.S....	6·61
„	Torrington, Langtree W.	8·00	„	Lochbroom	5·00
„	Lynmouth, Glenthorne.	7·85	„	Tain, Springfield	3·62
„	St. Austell, Cosgarne ...	...	„	Loch Shiel, Glenaladale	9·94
„	Taunton, Fullands	3·03	XIX.	Lairg H.R.S. ....	...
VI.	Bristol, Clifton	4·45	„	Forsinard H.R.S.	4·96
„	Ross	3·60	„	Watten H.R.S.	4·52
„	Wem, Sansaw Hall	3·27	XX.	Fermoy, Glenville	5·18
„	Cheadle, The Heath Ho.	6·25	„	Tralee, Castlemorris ...	2·92
„	Worcester, Diglis Lock	2·81	„	Cahir, Tubrid	3·93
„	Coventry, Coundon	3·37	„	Newcastle West	3·47
VII.	Melton, Coston	3·98	„	Kilrush .....	...
„	Ketton Hall [Stamford]	4·16	„	Corofin	3·20
„	Horncastle, Bucknall ...	4·47	XXI.	Kilkenny, Butler House	...
VIII.	Macclesfield, The Park	5·59	„	Carlow, Browne's Hill..	3·46
„	Walton-on-the-Hill	3·80	„	Navan, Balrath	3·43
„	Broughton-in-Furness ...	4·96	„	Athlone, Twyford	3·04
IX.	Wakefield, Stanley Vic.	3·85	XXII.	Mullingar, Belvedere...	3·61
„	Ripon, Mickley	3·96	„	Clifden, Kylemore	7·39
„	Scarborough	3·86	„	Crossmolina, Enniscoe..	5·61
„	East Layton [Darlington]	3·93	XXIII.	Carrick-on-Shannon ...	3·40
„	Middleton, Mickleton ..	7·92	„	Dowra	4·81
X.	Haltwhistle, Unthank... ..	3·67	„	Rockcorry	3·70
„	Carlisle, St. James Rd...	2·22	„	Warrenpoint	4·90
„	Shap, Copy Hill	5·70	„	Newtownards	3·76
XI.	Llanfrechfa Grange	5·46	„	Belfast, New Barnsley..	4·74
„	Llandovery	6·90	„	Bushmills	4·66
			„	Buncrana	5·10

DECEMBER, 1882.

Div.	STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL.					Days on which -01 or more fell.	TEMPERATURE.				No. of Nights below 32°	
		Total Fall.	Differ- ence from average 1870-9	Greatest Fall in 24 hours.		Max.		Min.					
				inches.	inches.	in.		Dpth	Date.	Deg.	Date.	Deg.	Date.
I.	London (Camden Square)	2.51	+ .34	.52	25	16	57.2	27	24.5	12	12	18	
II.	Maidstone (Hunton Court)...	2.37	— .03	.51	7	21	...	...	...	...	...	...
III.	Strathfield Turgiss	2.07	+ .05	.43	30	20	57.2	27	17.5	12	14	18	
III.	Hitchin	2.75	+ .70	.67	30	23	52.0	27 ^b	16.0	10	20	...	
IV.	Banbury	3.19	+ 1.04	.52	7	24	54.0	27 ^c	14.5	12	17	...	
IV.	Bury St. Edmunds (Culford)	3.49	+ 1.34	.90	25	21	56.0	28	16.0	11	15	...	
V.	Norwich (Cossey)	3.77	+ 1.45	.84	7	18	57.0	29	22.0	12	15	18	
V.	Bridport	4.10	...	.48	31	19	...	...	...	...	...	...
V.	Barnstaple	6.81	+ 3.05	1.02	12	23	56.5	31	18.0	11	...	...
V.	Bodmin	7.87	+ 2.42	1.11	17	29	55.0	30	23.0	10	7	10	
VI.	Cirencester	3.79	+ 1.18	.50	29 ^a	23	...	...	...	...	...	...
VI.	Church Stretton (Woolstaston)	3.34	+ .55	.36	25	25	54.5	27	19.0	12	15	18	
VI.	Tenbury (Orleton)	3.18	+ .67	.31	6, 12	24	56.5	27	16.5	11	12	18	
VII.	Leicester	4.28	...	.74	25	23	50.0	28	16.4	12	12	13
VII.	Boston	3.74	+ 1.67	.72	7	21	54.0	29	22.0	12	8	...	
VII.	Grimsby (Killingholme)	4.67	+ 2.24	.91	7	27	53.0	29	22.0	12	12	...	
VII.	Hesley Hall [Tickhill]	3.81	...	.98	8	19	...	...	...	...	...	...
VIII.	Manchester (Ardwick)	4.17	+ 1.64	.94	7	18	52.0	28 ^d	21.0	12	...	...
IX.	Wetherby (Ribstone Hall) ..	3.67	+ 1.46	.64	7	17	...	...	...	...	...	...
IX.	Skipton (Arncliffe)	8.01	+ 2.73	1.30	6	23	50.0	28 ^e	10.0	10 ^g	...	...
X.	North Shields	3.69	+ .60	.42	8	22	54.8	29	19.2	12	17	18	
X.	Borrowdale (Seathwaite)	12.29	— 1.44	2.02	28	22	...	...	...	...	...	...
XI.	Cardiff (Ely)	6.29	+ 2.38	.80	31	24	...	...	...	...	...	...
XI.	Haverfordwest	6.90	+ 1.77	.87	25	23	53.0	28	21.0	10 ^h	11	15	
XI.	Plinlimmon (Cwmsymlog) ..	7.05	...	1.62	25	17	...	...	...	...	...	...
XI.	Llandudno	3.56	+ .71	1.14	25	19	55.2	28	25.5	12	5	...	
XII.	Cargen [Dumfries]	4.77	+ .24	1.56	2	17	52.4	28	18.8	15	16	...	
XII.	Hawick	3.87	+ 1.01	.50	7	22	...	...	...	...	...	...
XIV.	Douglas Castle (Newmains) ..	6.47	+ 2.38	.89	28	19	...	...	...	...	...	...
XV.	Lochgilhead (Kilmory)	7.01	+ .83	1.07	28	19	...	...	14.0	6	20	...
XV.	Appin (Airds)	6.11	...	...	...	...	...	...	...	...	...	...
XV.	Mull (Quinish)	6.08	...	1.26	20	21	...	...	...	...	...	...
XVI.	Loch Leven Sluices	5.10	+ 1.44	1.30	29	15	...	...	...	...	...	...
XVI.	Arbroath	4.77	+ 1.87	.73	23	17	47.0	18	12.0	15	18	...	
XVII.	Braemar	3.31	— .12	.56	16	20	44.3	28	— 8.0	15	21	30	
XVII.	Aberdeen	7.14	...	.65	28	28	48.0	27 ^f	6.0	14	18	...
XVIII.	Skye (Sligachan)	11.27	...	3.11	21	17	...	...	...	...	...	...
XVIII.	Culloden	2.73	+ .89	...	...	...	48.3	28	8.0	9	21	30
XIX.	Dunrobin	5.74	...	.90	9	19	47.7	28	19.0	8 ⁱ	19	...
XIX.	Orkney (Sandwick)	4.72	+ .33	.75	10	24	45.3	31	25.7	8	15	22	
XX.	Cork (Blackrock)	5.31	+ .55	.67	29	20	55.0	27	15.0	9	15	...	
XX.	Dromore Castle	7.80	...	1.00	25	21	59.0	19	21.0	12 ^j	13	...	
XX.	Waterford (Brook Lodge) ..	4.49	...	1.04	11	19	55.0	25	19.0	10 ^k	13	...	
XX.	Killaloe	4.72	...	.68	24	16	55.0	27	15.0	14	13	...
XXI.	Portarlinton	2.44	— .42	.53	24	19	56.0	27	15.5	14	12	...	
XXI.	Dublin (Monkstown) .....	...	...	...	...	...	...	...	...	...	...	...
XXII.	Ballinasloe	3.01	...	.68	24	20	52.0	27	17.0	14	18	...
XXII.	Waringstown	3.24	+ .28	.60	26	16	55.0	27	10.0	13	15	18	
XXII.	Londonderry .....	...	...	...	...	...	...	...	...	...	...	...
XXII.	Omagh (Edenfel)	4.12	+ .72	.73	20	19	52.0	28	13.0	13	21	...	

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

a And 30. b, c, f And 28. d, e And 29. g, k And 11. h And 12. i And 13. j And 14.

METEOROLOGICAL NOTES ON DECEMBER.

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

ENGLAND.

STRATHFIELD TURGIS.—The month was remarkable for the large number of days on which rain fell, although in no large quantity. The early part of the month was cold and foggy with S, but from the 25th to the end the temp. was abnormally high, the average max. for the week being $54^{\circ}4$ or $16^{\circ}0$ above the average of 50 years.

BANBURY.—A dark and cheerless month, first half cold, with S, and frequent fog; latter half unusually mild and damp; S on seven days; fog on nine days; high wind on four days; T on 26th. Mean temp. $39^{\circ}8$.

CULFORD.—A very unsettled month, R or S having fallen on no less than twenty-one days; unusually mild at the end of the month.

COSSEY.—A dull, wet month; unfavourable to agriculture. River valleys flooded nearly throughout the month.

BODMIN.—The number of rainy days since Sept. 22nd is unexampled, out of 100 days, there have been only ten without R. Average temp. $42^{\circ}8$.

CIRENCESTER.—Cold weather prevailed in the middle of the month, but the remainder was mild with rainfall above the average.

WOOLSTASTON.—A severe spell of cold weather occurred during the first fortnight of the month, with S on six days. Owing to the water-logged condition of the soil from the constant R, much land was still unsown at the end of the month. Mean temp. $37^{\circ}6$.

ORLETON.—The first half of the month was very cold, with a mean temp. below 32° for ten days, and the ground was covered with S after the 6th; the latter half of the month was very warm and rainy, with frequent rough winds, and a low fluctuating pressure. Mean temp. nearly $^{\circ}5$ below the average of 20 years.

LEICESTER.—Very dull and misty, with very little sunshine; rainfall heavy; S on 4th and 13th. Floods in the midlands.

KILLINGHOLME.—The month was wet throughout, the first half cold, the last half mild; farm prospects very gloomy.

ARDWICK.—The early part of the month gave promise of a proper winter month, and on the 6th, nearly one foot of S fell in the evening, but the weather afterwards became warmer and unseasonable, and very wet.

ARNCLIFFE.—Rather more than a foot of S fell on the 5th and 6th.

N. SHIELDS.—Snow fell on eight days. TS occurred on 7th and 9th.

SEATHWAITE.—Severe frost in the second week; rain almost daily after the 13th; weather at the end of the month more like May than December.

WALES.

HAVERFORDWEST.—The first week of the month was wet, with average temp. for the season; but from the 5th to the 14th was severe, with S 3 in. deep on the level, and great gloom; the rest of the month was mild, stormy, and wet, the air during the last week especially relaxing, with foggy atmosphere. S on five days; T with vivid L on 7th.

LLANDUDNO.—A singularly dull and sunless month, with a rainfall more than half-inch above, and a mean temp. 2° below the average; there were four nights of frost from 10th to 13th inclusive, with a slight fall of S on 12th and 13th. Geraniums and other tender plants sustained, but little damage from the frost, though the temp. fell to $25^{\circ}5$. Only 22.6 hours of bright sunshine.

SCOTLAND.

CARGEN.—A very dull and gloomy month; great and sudden variations in temp., on several occasions amounting to 20° , and once to nearly 30° in the 24 hours; only 47 hours of sunshine, 15 hours below the average; mean height of bar. 39.555 in. also below average.

HARWICK.—The snowstorm of the 7th and 8th was the most severe ever experienced here; S lay fully three ft. deep, and trees and shrubs were very

much broken. Severe frost occurred on the night of the 11th, and not a few small birds were found lying dead under the hedges.

BRAEMAR.—The min. temp. on the 15th— $8^{\circ}0$ is the lowest recorded since December 25th, 1860.

ABERDEEN.—A very stormy month, with wind S and H, the rainfall being unusually heavy for December; viz., 4 in. above the average.

SLIGACHAN.—The month was on the whole very seasonable, although we had heavy R on the first four days, and again from the 20th to the end. From 4th to 20th was very fine, with hard frost from 5th to 16th; sheep and cattle doing well.

CULLODEN.—The month was marked by heavy falls of S, fully 14 in. falling in 12 hours on the 6th and 7th, and S was on the ground all through the month; very heavy R on the 28th and 29th; temp. very low during the entire month.

SANDWICK.—December was cold and wet, with much frost and S; during the last nine days there were frequent alternations of frost and thaw; T and L on 10th, and L on the two following nights; aurora on four nights.

IRELAND.

DROMORE.—First part of the month very cold, and frost severe; latter part remarkable for wet and high temp.

WATERFORD.—Rainfall above the average; fog on 8th, 9th, and 19th; S on 6th, 10th, and 11th; L on 7th; T on 11th.

KILLALOE.—Very sharp frost from 8th to 15th; temp very high in the latter part of the month; rainfall, average.

BALLINASLOE.—The first part of the month was fine, with fogs and hard frost from the 5th to 15th, the remainder very mild but wet, causing very considerable floods.

WARINGSTOWN.—A very peculiar frost occurred after the 6th, though not so severe as several we have had of late years. For a whole week the sun never came out sufficiently to thaw the rime on the trees, which was very beautiful, as there was much fog, both by day and night.

EDENFEL.—Hard, settled frost from 4th to 14th, accompanied by thick fog. A sudden thaw followed, accompanied to the end of the month by almost constant rain, and a mean daily temp., reaching 49° on the 28th, the highest mean here for any in December during 20 years.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday evening, the 20th ult., at the Institution of Civil Engineers, Mr. J. K. Laughton, M.A., F.R.A.S., president, in the chair.

Four new Fellows were elected, and Capt. J. de Brito Capello and Mr. W. Ferrel, M.A., were elected honorary members.

The following papers were read:—"Popular Weather Prognostics," by the Hon. R. Abercomby, F.M.S., and Mr. W. Marriott, F.M.S. The authors explain more than one hundred prognostics, by showing that they make their appearance in definite positions, relative to the areas of high and low atmospheric pressure, shown in synoptic charts. The method adopted not only explains many which have not hitherto been accounted for, but enables the failure, as well as the success, of any prognostic to be traced, by following the history of the weather of the day on a synoptic chart. The forms discussed are—Cyclones, anti-cyclones, wedge-shaped, and straight isobars. The weather in the last two is now described for the first time. The authors also point out (1), that for use at sea, and other solitary situations prognostics

will never be superseded ; and (2) that prognostics can be usefully combined with charts in synoptic forecasting—especially in certain classes of showers and thunderstorms which do not affect the reading of the barometer.

“Report on the Phenological Observations for the year 1882,” by the Rev. T. A. Preston, M.A., F.M.S. The report stated that the most important feature of the past phenological year was the mild winter. The effect of this upon vegetation was decidedly favourable ; and had it not been for the gales—especially that of April 28th—the foliage would have been luxuriant, and, therefore, free from insect attacks, but the contrary effect has been produced on insect life, for the scarcity of insects, especially butterflies and moths, has been the general remark of entomologists.

Mr. J. S. Dyason, F.R.G.S., exhibited a series of typical clouds in monochrome, and also a series of sketches of clouds in colour made in June, July, and August, 1882.

SUN SPOT PERIODICITY.

The periodicity of sun spots is known to have been discovered by Herr Schwabe, of Dessau, and from personal observations he thought the period ten years. Subsequent researches have proved the phenomenon to be rather complex, and the conclusions arrived at by the *savans* who have studied it do not well agree. Herr Wolf, of Zurich, has recently made a fresh investigation (by a method we need not here describe) of the most complete and certain portion of the observations on record, that extending from 1751 to the present epoch. He deals with 120 years' observations, given in 1,440 monthly averages. His conclusions are these :—(1) There is a period of ten years ; (2) there is a second period of 11 years 4 months ; (3) there is not a period of 12 years, imputable to the action of Jupiter. It further appears that, notwithstanding the great difference of the two periods, the interval from a *minimum* to the following *maximum* is the same for both—viz., $4\frac{1}{2}$ years. Again, as 17 periods of 10 years are equivalent to 15 periods of 11 years 4 months, the complete phenomenon covers 170 years, after which the *maxima* and the *minima* are reproduced in the same order and with the same numerical values.

To have a full idea of the phenomenon, we have to add the other remarkable periodicity, not in the number but in the geographical distribution of the spots, suspected by Mr. Carrington, and brought into clear light by Herr Spörer. It consists in this, that when after a *minimum* the spots commence to re-appear on the sun, they first do so suddenly at high latitudes and are then progressively restrained towards the zones near the equator, till the next epoch of *minimum*. No adequate explanation of these remarkable phenomena has yet been offered.—*Times*, Jan. 4.

[With reference to the above, we shall be glad if some of our astronomical readers will inform us (1) where these new dates of sunspot max. and min. are to be found ; (2) whether they agree with, or differ from the dates previously assigned ; and (3) whether astronomers are prepared to accept them as final and unalterable.—Ed.]

ARRANGEMENTS
FOR THE
SYSTEMATIC OBSERVATION
AND
RECORD
OF THE
RAINFALL OF THE BRITISH ISLES.

COMPILED BY

G. J. SYMONS, F.R.S.,

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SECOND EDITION.

LONDON:
EDWARD STANFORD, CHARING CROSS, S.W.
1882.

Introductory and Historical.—I cannot help this section appearing to be egotistical ; the rainfall organization being entirely my own creation, it is impossible for it to be otherwise.

In the early part of the year 1859 I began collecting copies of records of the fall of rain, and early in 1861 wrote to all the observers of whom I was then aware, and asked them to send me all the records for the year 1860 that they could. I received 168 returns, and printed a table showing the total fall at all those places, being a larger number than had ever been classed together before. This publication gave a stimulus to observers, and from that time onwards their number has steadily increased until it now exceeds 2,000.

The amount of information published has increased even more, for whereas at first I printed only the total annual fall, I now publish essays on various branches of rainfall enquiry, and full abstracts of the most remarkable falls in short periods (ten minutes, half-an-hour, and so on), the heaviest falls in one day, tables of the monthly fall at several hundred stations, and, in short, give all the information which I can collect and which it seems expedient to print.

From the foregoing it will be evident that the compilation of the present annual volume (of which the short title is "British Rainfall, 1882," &c.) is a very serious labour. The mere checking of two thousand returns takes a long time, and so does the due arrangement of the various facts reported, and by no means the least onerous matter is ensuring the accuracy of the printing of the whole.

During the first few years I not only gave my own time gratuitously to the work, but also bore all the cost of postages and of printing. It soon, however, became far too costly for me to bear it all, and my correspondents most kindly offered to share it with me. In 1865 the price of the annual volume was fixed at five shillings, and, although the size and cost of the volume has since so largely increased, that the price to the general public has had to be doubled, observers are still allowed one copy at the old price. There are two reasons for this : (1) Because as the book could not be compiled without the help of observers, they ought to be allowed to have it as cheaply as possible ; (2) Because a small number of the observers (about 300, whose subscriptions are duly published) contribute annual sums varying from one to ten guineas towards the general expenses of the work.

The existing state of matters is, therefore, shortly as follows. There

are about 2000 persons, well spread over England and Wales, Scotland and Ireland, each of whom is, I hope, strictly obeying the rules on page 5. To each of them I send on December 31st each year, blank forms for them to return to me filled with the facts observed by them. At the same time I send a list of the various publications, and invite such pecuniary aid as it may be agreeable to them to send.

I ought, perhaps, to say what becomes of the subscriptions. I will mention some of the outlets. (1) There are nearly a thousand observers whose returns have to be collected, examined, discussed, and printed, who do not contribute sixpence towards the cost thereof. (2) In some localities it is impossible to obtain volunteer observers, and there the observers receive regular salaries. (3) The mass of office work, correspondence, &c., is far beyond what I can myself accomplish; two regular assistants are, therefore, employed, and besides that, considerable sums are paid for extra assistance at times of pressure. (4) The expenditure for printing and postages is very large.

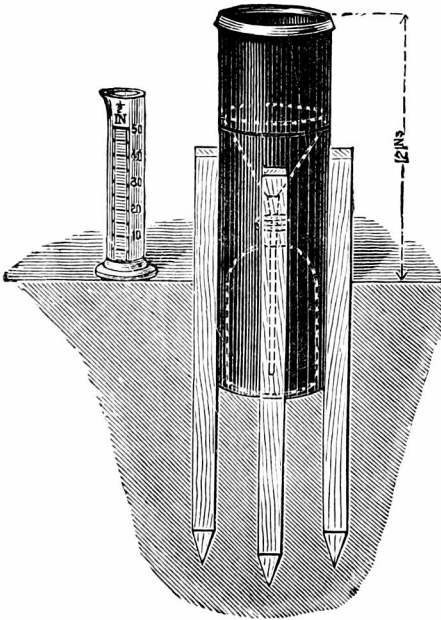
In addition to the annual volume, I publish a monthly periodical, *Symons's Monthly Meteorological Magazine*, giving, in addition to a full chronicle of the progress of meteorology, details of rainfall at about 100 stations. This is sent free to subscribers.

It may, perhaps, be added that it always affords me pleasure to reciprocate as far as possible the assistance which the observers render to me, either by affording them meteorological information, data as to the height of their stations above sea level, or advice as to the purchase of instruments.

In short, the state of the case is this: I have given myself up to the collection of statistics of rainfall—old ones and current ones; I invite everybody to help me, both with observations and funds, and I promise, in return, to render to all my correspondents all the help that is in my power.

Patterns of Rain Gauges, and where to buy them.—This is not a pleasant section to write, for there is considerable jealousy among the manufacturers, and I am almost certain to be accused of favouritism by some one. However, I have never patented any pattern of rain gauge, and, therefore, leave the field open to all.

Upon one point it is necessary to be despotic, viz., that amateurs never try to make their own gauges; they are almost certain to go wrong in some respect, and nothing is more vexing, both to the observers and to myself, than for it to be discovered after observations have been recorded for a long time that the labour of years is vitiated by an inaccurate instrument.



For use in ordinary localities I think the annexed is the best pattern; it is known as the Snowdon gauge; it is five inches in diameter, is easily fixed by four stakes, as shown; the glass jar when filled up to the top division holds 0·50 in., or half an inch, the bottle holds about three inches of rain, and, of course, in the very rare case of the fall exceeding that, the excess is saved by the can, and must be carefully measured. If made in japanned tin these cost from 16s. to 20s., but they are much stronger, and more durable, if made in copper, when they cost from 21s. to 30s. Negretti's have brought out a very stout pattern, in galvanized iron, at a still lower price.

Where cost is no object, it is, by some, thought better to have a rather larger gauge, viz., eight inches diameter, costing from £2 to £3, but I do not advise it.

Snowdon pattern rain gauges can, no doubt, be obtained from any optician, but it may be convenient to give, in alphabetical order, the names and addresses of a few of the principal makers:—

CASELLA, L., 147, Holborn Bars, E.C.

HICKS, J. J., Hatton Garden, E.C.

NEGRETTI & ZAMBRA, Holborn Viaduct and Cornhill, E.C.

PASTORELLI, F., 10, New Bond Street.

Testing.—Wherever, and of whomsoever, rain gauges may be bought, it is very desirable that the purchaser should insist upon having certificates of their accuracy. Rain gauges are examined, and certificates issued, by Kew Observatory, and by myself, the charge in each case is the same, namely, 2s. 6d.

Blank Forms.—All blank forms required for returns to myself, and additional ones wherever desired, are supplied gratuitously, and even those sold are charged at little more than their actual cost.

Change of Residence.—Each observer is requested to decide upon a specific name for his station, and to notify immediately any change in the position of the gauge or the discontinuance of his record.

SUGGESTIONS
FOR SECURING UNIFORMITY OF PRACTICE AMONG
RAINFALL OBSERVERS.

I.—SITE.—A rain gauge should not be set on a slope or terrace, but on a level piece of ground, at a distance from shrubs, trees, walls, and buildings—at the very least, as many feet from their base as they are in height. Tall-growing flowers, vegetables, and bushes must be kept away from the gauge. If a thoroughly clear site cannot be obtained, shelter is most endurable from N.W., N., and E., less so from S., S.E., and W., and not at all from S.W. or N.E.

II.—OLD GAUGES.—Old established gauges should not be moved, nor their registration discontinued until, at least, two years after a new one has been in operation, otherwise the continuity of the register will be irreparably destroyed. Both the old and the new ones must be registered at the same time, and the results recorded for comparison.

III.—LEVEL AND FIXING.—The funnel of a rain gauge must be set quite level, and so firmly fixed that it will remain so in spite of any gale of wind or ordinary circumstance. Its correctness in this respect should be tested from time to time.

IV.—HEIGHT.—The funnels of gauges newly placed should be 1 ft. above grass. Information respecting height above sea level may be obtained from the Editor.

V.—RUST.—If the funnel of a japanned gauge becomes so oxidised as to retain the rain in its pores, or threatens to become rusty, it should have a coat of gas tar, or japan black, or a fresh funnel of zinc or copper should be provided.

VI.—FLOAT GAUGES.—If the measuring rod is detached from the float, it should never be left in the gauge. If it is attached to the float, it should be pegged or tied down, and only allowed to rise to its proper position at the time of reading. To allow for the weight of the float and rod, these gauges are generally so constructed as to show 0 only when a small amount of water is left in them. Care must always be taken to set the rod to the zero or 0.

VII.—CAN AND BOTTLE GAUGES.—The measuring glass should

always be held upright ; the reading is to be taken midway between the two apparent surfaces of the water.

VIII.—TIME OF READING.—Nine a.m. daily ; if taken only monthly, then 9 a.m. on the 1st.

IX.—DATE OF ENTRY.—The amount measured at 9 a.m. on any day is to be set against the previous one ; because the amount registered at 9 a.m. of, say, 17th contains the fall during 15 hours of the 16th, and only 9 hours of the 17th. (*This rule has been approved by the Meteorological Societies of England and Scotland, cannot be altered, and is particularly commended to the notice of observers.*)

X.—MODE OF ENTRY.—If less than one-tenth ($\cdot 10$) has fallen, the cypher must *always* be prefixed ; thus, if the measure is full up to the seventh line, it must be entered as $\cdot 07$, that is, no inches, no tenths, and seven hundredths. For the sake of clearness, it has been found necessary to lay down an invariable rule that there shall always be two figures to the right of the decimal point. If there be only one figure, as in the case of one-tenth of an inch (usually written $\cdot 1$) a cypher must be added, making it $\cdot 10$. Neglect of this rule causes much inconvenience. All columns should be cast *twice*—once up and once down, so as to avoid the same error being made twice. When there is no rain, a line should be drawn rather than cyphers inserted.

XI.—CAUTION.—The amount should always be written down before the water is thrown away.

XII.—SMALL QUANTITIES.—The unit of measurement being $\cdot 01$, observers whose gauges are sufficiently delicate to show less than that, are, if the amount is under $\cdot 005$, to throw it away, if it is $\cdot 005$ to $\cdot 010$ inclusive, they are to enter it as $\cdot 01$.

XIII.—ABSENCE.—Every observer should train some one as an assistant ; but where this is not possible, instructions should be given that the gauge should be emptied at 9 a.m. on the 1st of the month, and the water bottled, labelled, and tightly corked, to await the observer's return.

XIV.—HEAVY RAINS.—When very heavy rains occur, it is desirable to measure immediately on their termination, and it will be found a safe plan after measuring to return the water to the gauge, so that the morning registration will not be interfered with. Of course if there is the slightest doubt as to the gauge holding all that falls, it must be emptied, the amount being *previously* written down.

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 enclosed. (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.

XVI.—OVERFLOW.—It would seem needless to caution observers on this head, but as not a year passes in which some of our observers do not allow it to happen, it is necessary to call attention to the fact that there does not seem to be any part of the British Isles where 4 inches may not fall in 24 hours. Therefore it is not desirable to purchase any new gauge of which the capacity is less than four inches.

XVII.—SECOND GAUGES.—It is desirable that observers should have two gauges, and that one of them should be capable of holding eight inches of rain. One of the gauges should be registered daily, the other weekly or monthly as preferred, but always on the 1st of each month. By this means a thorough check is kept on accidental errors in the entries, which is not the case if *both* are read daily.

XVIII.—DEW AND FOG.—Small amounts of water are at times deposited in rain gauges by fog and dew, they should be added to the amount of rainfall, because (1) they “tend to water the earth and nourish the streams; and not for that reason only, but (2) because in many cases the rain gauges can only be visited monthly, and it would then obviously be impossible to separate the yield of snow, rain, &c.; therefore, for the sake of uniformity, all must be taken together.”

XIX.—DOUBTFUL ENTRIES.—Whenever there is the least doubt respecting the accuracy of any observation, the entry should be marked with a ?, and the reason stated for its being placed there.

XX.—BREAKAGE.—The Editor has no desire to supply rain gauges or glasses, or in any way to undertake, or interfere with, that which is the business of Opticians; but the continuity and permanent accuracy of the records of his correspondents is to him of such importance, that he deems it advisable to announce that any assistance in his power is always at their service.

LIST OF PUBLICATIONS.

BRITISH RAINFALL,

Cloth, 8vo. 10s. (To Observers, 5s.)

This is the general summary and epitome of the year's work ; it contains a report upon the progress of rainfall investigations, and full records of the rainfall of each year. It is published annually, and all the volumes since 1864 can still be had.

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE,

8vo. 5s. per Annum.

This was established in 1866, to afford a medium for the prompt publication of rainfall statistics, besides which it discusses all branches of meteorology. It numbers among its contributors many of the ablest meteorologists, and circulates in all quarters of the world.

Blank Forms, Diagrams, &c.

Form for Entry of Daily Rainfall	.	.	.	Fcp. folio	3d.
Blank Meteorological Register, with Instructions					
(5th edition) :—For one year	.	.	.	4to.	2s.
For five years	.	.	.	4to.	7s. 6d.
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