

SYMONS'S MONTHLY METEOROLOGICAL MAGAZINE.

CXC.]

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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
	<hr/>
	£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 150 ft. 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 Astronomical 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 meteorological 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, Tybrite	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.					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.					
				Dpth	Date.								
								Deg.	Date.	Deg.	Date.	In shade.	On grass.
		inches	inches.	in.									
I.	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	...	...	...	...	...	...
III.	Strathfield Turgiss	1.61	- 1.13	.77	22	10	...	...	...	...	...	...
IV.	Hitchin	2.26	+ .08	.70	13	17	58.0	11	25.0	16*	7	...	
V.	Banbury	2.47	- .29	.77	13	19	60.0	11	25.0	17	5	...	
VI.	Bury St. Edmunds (Culford)...	2.69	+ .52	.63	13	20	61.0	11	24.0	30	9	...	
VII.	Norwich (Cossey).....	2.83	+ .50	.80	13	21	60.0	2	27.5	17	3	12	
VIII.	Bridport	1.80	...	.52	22	14	62.0	11	17.0	31	...	...
IX.	Barnstaple.....	2.94	- 2.51	.69	26	14	65.0	1	27.0	31	...	...
X.	Bodmin	4.96	- 1.31	1.12	23	14	65.0	8	27.0	31	2	6	
XI.	Cirencester	2.04	- 1.20	.78	13	7	...	...	...	...	...	...
XII.	Church Stretton (Woolstaston)	2.82	- 1.78	1.13	13	15	60.0	3	...	...	...	...
XIII.	Tenbury (Orleton)	3.00	- .24	.99	13	19	62.5	1, 11	24.0	17	7	11	
XIV.	Leicester (Town Museum) ...	2.81	...	1.01	13	16	51.9	...	39.6	...	...	...
XV.	Boston	2.54	+ .51	.58	13	18	58.0	11	31.0	17	1	...	
XVI.	Grimsby (Killingholme)	2.36	- .29	.71	13	18	59.0	11	32.0	17†	0	...	
XVII.	Mansfield	3.10	+ .10	.64	13	20	59.5	2	28.6	17	4	10	
XVIII.	Manchester (Ardwick).....	...	...	...	...	...	...	...	...	...	...	...
XIX.	Wetherby (Ribstone)	3.14	- .22	1.05	15	10	...	...	...	...	...	...
XX.	Skipton (Arncliffe)	5.81	- 1.45	1.77	13	21	59.0	1	20.0	30	6	...	
XXI.	North Shields	3.26	+ .75	.74	13	20	60.2	11	25.5	31	5	6	
XXII.	Borrowdale (Seathwaite).....	6.82	- 9.73	3.02	13	16	...	...	...	...	...	...
XXIII.	Cardiff (Ely)	3.63	- 1.60	.87	22	12	...	...	...	...	...	...
XXIV.	Haverfordwest	3.42	- 3.03	1.18	13	14	60.0	11	20.0	30	5	10	
XXV.	Aberystwith (Goginan) .....	...	...	...	...	...	...	...	...	...	...	...
XXVI.	Llandudno.....	2.42	- 2.17	1.00	13	13	60.0	1	30.6	30	1	...	
XXVII.	Cargen	2.33	- 3.38	1.11	13	11	63.8	1	24.0	31	4	...	
XXVIII.	Hawick (Silverbut Hall)...	2.70	- .47	.95	13	14	...	...	...	...	...	...
XXIX.	Douglas Castle (Newmains)..	3.19	- 1.75	1.10	13	15	...	...	...	...	...	...
XXX.	Kilmory	3.55	- 4.77	.82	13	14	...	...	26.0	16	6	...
XXXI.	Appin (Airds)	3.00	...	...	...	...	...	...	...	...	...	...
XXXII.	Mull (Quinish)	3.84	...	1.36	13	14	...	...	...	...	...	...
XXXIII.	Loch Leven	4.00	- .31	1.20	13	13	...	...	...	...	...	...
XXXIV.	Arbroath	3.43	+ .36	1.34	13	15	61.0	1	30.0	17	2	...	
XXXV.	Braemar	6.54	+ 2.06	1.05	14	24	61.5	1	23.2	17	7	16	
XXXVI.	Aberdeen	3.75	...	1.21	14	21	63.0	1	28.0	16	2	...	
XXXVII.	Portree	4.73	- 4.83	1.68	10	13	...	...	...	...	...	...
XXXVIII.	Inverness (Culloden)	3.36	+ 1.07	.83	10	9	65.0	1	33.3	25	0	16	
XXXIX.	Dunrobin	3.22	...	.70	13	15	61.8	7	32.0	17	1	...
XL.	Sandwick	3.44	- .85	.62	10	20	59.1	1	35.6	16	0	2	
XLI.	Cork (Blackrock).....	6.35	+ 1.61	1.75	31	14	68.0	2, 3	26.0	29	4	...	
XLII.	Dromore Castle	7.72	...	2.45	13	15	66.0	8	30.0	27†	3	...	
XLIII.	Waterford (Brook Lodge) ...	3.56	...	.85	21	13	65.0	...	26.0	30	3	...
XLIV.	Killaloe	3.56	...	1.52	13	13	65.0	2	26.0	16*	5	...	
XLV.	Portllington	2.30	- 1.17	.81	13	12	61.5	1	29.5	16	4	...	
XLVI.	Monkstown	3.23	...	.97	22	17	64.0	11	27.0	31	2	2
XLVII.	Galway	2.94	- 2.08	1.16	13	15	62.0	1, 2, 3	24.0	30	3	...	
XLVIII.	Waringstown	3.72	+ .11	.97	13	16	65.0	1	21.0	29	5	8	
XLIX.	Londonderry.....	3.71	...	1.40	13	17	63.0	1	30.0	31	1	6	
L.	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; TS 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 $51^{\circ}1$.

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 otherwise 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 $3^{\circ}5$ below the average.

BOSTON.—Temp. of the month $2^{\circ}5$ 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 $\frac{1}{4}$ 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. $45^{\circ}\cdot5$, 3° below the average ; 117 hours of sunshine, a little below average ; severe gale on 14th.

SILVERBUT HALL.—A terrible storm of wind, E, 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 E, S, and E 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 $50^{\circ}\cdot8$; 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 $28\cdot445$ 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.

THE RAINBAND IN SPECTROSCOPE OF MODERATE DISPERSION.

