The Fernley Observatory, Southport : report and results of observations for the year 1920 / Borough of Southport Meteorological Department.

County Borough  *of Southport.*

METEOROLOGICAL DEPARTMENT.

THE FERNLEY OBSERVATORY, SOUTHPORT.

REPORT,

AND

RESULTS OF OBSERVATIONS,

FOR

THE YEAR 1920;

BY

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"Visiter" Printing Works, Southport.

1921.

The Fernley Observatory, Southport.

REPORT OF THE METEOROLOGIST, FOR THE YEAR 1920.

I.—STATIONS AND EQUIPMENT.

The various Structures and Instruments were maintained during the year in a generally satisfactory condition; small, essential, repairs being executed whenever necessary. But all larger works and renewals, that could possibly be postponed, were deferred until some appreciable reductions in the rates of wages of skilled workmen, and in the prices of materials, should have occurred. It will not, however, be practicable to delay one or two of these matters beyond the autumn of 1921.

The large Wind Vane which actuates three of the instruments at Hesketh Park, having been made of aluminium and become seriously corroded, a new Vane, of the " streamline " pattern designed in the Royal Aircraft Factory during the War, and recently adopted by the Meteorological Office as the standard form, was, upon the advice of the then Director, Sir Napier Shaw, D.Sc., F.R.S., obtained, and erected at the Park, in April, 1920. It was especially constructed to suit our installation, by Messrs. Negretti & Zambra, of London; and has proved very satisfactory, being at once sensitive and steady.

In December, an additional clock and drum were attached to the older of the two Dines Pressure Tube Anemometers at the other and more exposed, Marshside, Anemograph Station, in order that a spare record may be obtained daily, to enable any defects in the various regular records to be made good. This was necessitated by an arrangement for the supply of daily autographic charts to the Ribble Navigation Committee at Preston, which will be mentioned in a subsequent paragraph; and a more elaborate addition and alteration to the Direction part of the apparatus at Marshside was being arranged at the close of the year, in the same connection. The cost of these improvements will be defrayed out of payments receivable by me from the Preston Corporation.

On November 25th, the Atmospheric Pollution observation-stations, in Hesketh Park, and on the Moss near Woodvale, were officially Inspected by Dr. J. S. Owens, C.E., the Secretary of the Advisory Committee on that subject to the Meteorological Office. In a subsequent Report, Dr. Owens expressed his complete satisfaction with the sites, and with the efforts made to secure accurate records. Some difficulties arising from a weathering of the enamel of the Deposit Gauges, and from the effects of strong winds at the Moss, are being dealt with. In the former case, successive coatings of Duroprene varnish have been given to the basins, as a temporary measure, but the Public Analyst, Mr. Herbert E. Davies, M.A., B.Sc., reports that this material appreciably contaminates the water, in some respects; new basins or gauges, of some acid-proof and weather-proof material, will be essential shortly—as soon as the Advisory Committee have decided upon the material and pattern. On the other hand, I have every reason to believe that the *effects of wind* will be overcome by the adoption of a Nipher shield—of appropriate size and form.

II.—THE WEATHER OF THE YEAR, 1920.

As stated in last year's Report, the outstanding feature of 1919 had been a remarkable prevalence of winds from the north-westward, their total duration then surpassing that of those from any other direction, and being quite unprecedented locally, since the commencement of autographic records in 1898. The year (1919) had therefore been very cool; with a notable rarity of thunder—only once before at all equalled; and a corresponding low *Intensity* of Rainfall, the absence of heavy rains in short periods being striking.

During the year 1920, conditions were almost completely reversed. The duration of the north-westerly group of winds fell from 1583 hours in the previous year, to only 757 hours, the deficiency in 1920 being even more remarkable than the excess in the preceding year, nothing in any way approaching it being on record. At the same time, 1919 excesses of northerly and north-easterly winds, were also replaced in 1920 by larger deficiencies.

The dominant feature of the weather of the year now under review, was an exceptional prevalence of winds from the southern half of the compass, and these were of a very moist type. Had it not been for a trying—although healthy—coolness of July and August, 1920 would have ranked as one of our warmest years. But it was the dullest on record; and, unfortunately, some of the most cloudy months occurred in the summer. Not unnaturally, in consequence, the relative Humidity of the Air was very high; while Evaporation was deficient in *every* month. Thunder was of pretty frequent occurrence; and the previous year's absence of heavy showers was not repeated.

The first seven months were generally wet, some of them exceptionally so. The rainfall of the spring quarter far surpassed any such previously experienced during 50 years' local observations. Most of the remainder of the year, however, [after July], although dismal or humid, was far from rainy. The total precipitation for the twelve months only exceeded the normal by an-inch-and-a-quarter. Scarcely a trace of snow was experienced at Southport. The underground-water level was rather low at the commencement of the year, and abnormally low in December; but it was unusually high from April to September.

So far as foliage and vegetation were concerned, the spring was the earliest within living memory. Growth was extremely rank—the only setback being due to a cold gale on May 3rd, which occasioned great damage to fruit and other trees; but many July wild-flowers, and most butterflies, and several other insects, scarcely appeared. The season, nevertheless, was remarkably prolonged, a number of trees being in full leaf until Armistice Day (November 11th).

III.—MAIN FEATURES OF THE MONTHS OF 1920.

January.—This month was characterised by a rather striking continuance of the open and unsettled southerly to westerly weather which had prevailed during December, 1919. The mean temperature was $2\frac{1}{4}$ degrees above the average. The only cold spell occurred during the first week. Wind movement was very considerable; and the prolonged and notable deficiency of easterly airs was further accentuated. The normal January rainfall was exceeded by 22 millimetres. Fortunately, there was a small excess of sunshine—three hours. Ozone was abundant. Gales occurred on no fewer than nine days, and occupied 44 hours; but seriously destructive force was not attained. Some trace of frost was recorded in the open on 10 nights, but it extended to the shade on four dates only. Hail fell on five days. A little snow was experienced on the 28th. Fog formed on the morning of the 23rd.

February.—The final month of "winter" proved even milder than either December or January had been, its mean temperatures exceeding the normal by nearly four degrees. It formed, too, the ninth consecutive month with a deficiency of hours of easterly wind. There were, however, rather frequent and extensive variations of temperature. Some maximum readings of the shaded thermometer were very high, though not quite unprecedented locally. A humid, and at times hazy, atmosphere; a somewhat high barometer; very little frost, and a total absence of snow, were the other principal features. Sunshine, rainfall, and ozone were almost exactly normal; and wind-speed and evaporation, nearly so. Gales occurred on four days, and occupied 36 hours. Ground-frost was only experienced on five nights. Some hail fell on the 11th. Fog prevailed on the early mornings of the 5th and 22nd.

March.—This was an extremely dull, mild, and wet March, and formed the fourth consecutive month having a great deficiency of northerly to easterly winds and an almost continuous prevalence of open weather. It actually constituted the tenth successive month with a shortage of due-easterly airs. The mean temperature was practically 45 degrees, or 3½ degrees above the average. The duration of sunshine scarcely amounted to 100 hours, being 22 hours below normal. Rain fell on 22 days, or seven more than usual; and the total exceeded 3¾ inches, which was more than 1½ inches above the average. Strong-gales occurred on the 12th, and during the night of the 15th to 16th. There was only once (*viz.*, on the 8th) the slightest frost in the shade; on six other nights there were traces of ground frost. None of the rather widespread snowfalls of the month extended to Southport. Showers of hail, however, were reported on four days. Fog was confined to the early morning of the 22nd. Brilliant aurora occurred during the night of the 22nd to 23rd. A thunderstorm was experienced about midnight on the 30th to 31st.

April.—This was by far the dullest April on record. It had also a lower mean barometric pressure, smaller mean daily and extreme monthly ranges of temperature, and a greater number of rain-days, than any previous April since the Observatory was established in 1871. With the exception of the corresponding month of 1882, it had also the largest rainfall. Relative humidity was high; and evaporation exceptionally small. A pronounced spell of true easterly winds occupied most of the second week—the first occurrence of the kind since May, 1919. Mean temperature exceeded the average by 0·7 degree. There was only a single instance of ground-frost. The duration of sunshine, however, scarcely amounted to 93 hours, and was no fewer than 82 hours below the average, and 24 hours less than the smallest previous total for April (*viz.*, in 1913). The entire earlier half of the month did not yield quite a dozen hours of sunshine. Rain fell on so many as 25 days, or 12 more than the normal number, and four more than the largest previous number in any April. The total precipitation was 4·07 inches, exceeding the average by 2·27 inches—the largest monthly plus deviation during the year. Slight thunderstorms occurred on the 3rd and 28th; a brief gale on the 27th; and a slight fall of hail on the 30th.

May.—This was a most unusual month for the end of spring, strong south-westerly and westerly winds predominating (as throughout last winter), and the resulting mild, damp, atmosphere yielding a considerable excess of rainfall, and several dull days. The night temperatures were high, and there was no frost; but the amount of evaporation was small. The mean temperature exceeded the normal by two degrees. There was, however, a deficiency of 25 hours of sunshine. Rain fell on 19 days, or 5 more than the average number; and the total amount reached fully 3½ inches, which implied a surplus of an inch and a half. It was the sixth successive month producing an excess of rainfall. The ground water stood at a high level. Wind movement surpassed the normal by no fewer than 87 miles per day. Gales occurred on the 3rd, 13th, 18th, and 19th; and altogether

occupied 28 hours. That on the 3rd occasioned much damage to trees and fruit crops. Hail fell on the 4th and 8th. A little thunder, followed by distant lightning, terminated the hottest day (the 25th), the maximum temperature of which had been 79·4 degrees. On the afternoon and night of the 29th, however, two severe thunderstorms were experienced; but no serious damage was done, and the accompanying rainfalls only amounted, together, to nine-tenths of an inch.

June.—A prolonged spell of easterly wind—double the normal aggregate duration for June from that direction—occupied half the month (following the first three days). Afterwards, south-westerly weather returned; and the W.N.W. breezes usually so predominant at Southport in summer, were greatly in defect. After the 10th, there was a considerable amount of rainfall, and the month added another to the long series of wet ones which began last December. The mean temperature was 0·7 degree above the average; but there were 26 fewer sunny hours than usual, and an excess of 0·33 inch of rainfall. Wind-speed was normal. The amount of evaporation was again small. Thunder was heard on the 11th, 12th, 13th, 16th, 17th, and 18th; on the 12th and 18th moderate thunderstorms developed, but there was nothing of a serious character, at Southport.

July.—The south-westerly winds, which had to so remarkable an extent dominated the weather since the beginning of the previous winter, were greatly in evidence during July, their duration being nearly three times the normal, while less than a third of the usual hours of the typical north-westerly breezes of summer were experienced, their deficiency being the largest since 1871. The month was, accordingly, abnormally wet, and it was the dullest July, locally, since sunshine recorders were introduced. Temperature, therefore, was very equable, and the daytime cool, with, in fact, no maximum reading above 66 degrees. Owing, however, to the cloudy nights, the mean temperature was not more than 2·1 degrees below the average. The air was humid, the ground-water level exceptionally high, and the total evaporation the smallest on record for July. Fortunately, ozone was abundant. The duration of sunshine amounted to only 127 hours, or 82 hours less than the normal. Rain fell on 24 days, or nine more than usual; and the total quantity was 4·73 inches, or 1·68 inches above the 45 years' average. Exactly as much fell only six years ago, and during the inclement 'seventies and 'eighties larger falls were frequent. Those, however, (excepting 1871), were principally caused by thunderstorms. This July (1920), even moderate thunder only occurred twice, and the peculiarity of the month lay in its cloudy character, and in the winter type of rainfall it yielded, the total raining hours being 102, whilst the largest previous number for July was only 70 (in 1909). The month was the eighth consecutive one yielding an excess of rainfall. Butterflies, and several other forms of insect life, appeared to have perished almost completely.

August.—This was the first comparatively dry month since November, 1919, and more than half the rain that did fall came on one day—the 4th—not so much as even 5 millimetres being measured on any other occasion. So dry an August

rarely occurs on the Lancashire coast. But the air was even cooler than it had been during July, and—exactly as in that month—the maximum thermometer never rose above 66 degrees. The ground was decidedly less cool than the air. The equability of temperature was exceptional, cloudy conditions continuing, and winds from westerly points prevailing almost continuously up to the 25th. The concluding six days were occupied by a spell of fine, quiet, autumnal weather, mainly easterly. The barometer was fairly high, and steady. Humidity was normal; but evaporation was again restricted, and the subsoil water remained at a high level, only falling a few inches, notwithstanding the absence of rainfall. The mean temperature of the complete month was only 56·7 degrees, or 2·4 degrees below normal. There were but 148 hours of sunshine, or 37 fewer than usual. This latter deficiency was, however, much less than that of the previous month. Only 1·46 inches of rain fell, or 2·11 inches less than the average. There was no trace of frost; neither were there any gales or even high winds. Some lightning, thunder, and hail, occurred on the afternoon of the 19th. Fog prevailed on the early morning of the 29th. The large deficiency of south-easterly and southerly winds, and excess of all westerly ones, gave rise to a good surplus of ozone.

September.—In several respects this proved to be one of the most normal months of the year; rainfall, sunshine, air mean temperature and equability, all differing little from their respective averages. But calms were very frequent, the atmosphere was unusually humid, the amount of evaporation correspondingly small, and the remarkable deficiency of due easterly winds, of the last two or three years, very decidedly augmented. Winds from the warmer half of the compass greatly predominated, without producing any excess even of air temperature, and the ground and lakes were distinctly colder than usual. In other words, the sunless summer and the exceptionally wet year had left their mark. Clouds were still rather prevalent, 129 hours of sunshine being the aggregate recorded, which implied a small deficiency of 13 hours. The rainfall amounted to 3·15 inches compared with a normal of 3·01 inches; and rain fell on just half the days of the month—or on one more than usual. Neither gales nor thunderstorms occurred; and fog was confined to the early mornings of the 24th and 25th. In the vicinity of the coast there was no frost—even on the grass; although wind movement was 50 miles a day below the average. Foliage and gardens remained unusually green.

October.—This was the driest, most easterly, and yet most humid October in the 50 years over which the local records extend, and it was also one of the calmest. The earlier half of the month was warm to very warm, but the remainder much colder, particularly at night. The daily range of temperature was considerable. The sunniness of most of the last ten days was remarkable. From the 7th to the 30th, measurable rain only fell twice. Rain-days numbered nine, as compared with a normal of 18. The total rainfall was only 1·13 inches, or so much as 2·63 inches below the average, and 0·20 inch below the amount for the driest previous October (*viz.*, that of 1915) in the 50 years. Easterly winds

prevailed during 274 hours, and south-easterly during 355 hours, the normal values being exceeded by 171 hours, and 193 hours, respectively. These figures taken together, and the easterly considered alone, are alike quite unprecedented. The more than three years' general deficiency of easterly winds was thus terminated with almost startling abruptness. The high mean humidity of the air was even more unusual, though less important; the mean at 9 a.m. was 93 per cent. of complete saturation, or 8 per cent. above normal, and 3 per cent. above the highest previous value for October. Wind movement was 114 miles a day below the average. Mean air temperature was 2·0 degrees above normal, but there was no excess in the ground. The surplus of sunshine was 13 hours. Ground-frost occurred on nine nights. Gales were absent, and sea winds and ozone nearly so. A slight thunderstorm was experienced on the 2nd, and some fog on the 27th.

November.—After four cold easterly days, a very warm spell of south-westerly weather set in, and this continued till the 17th, subsequent to which a persistent south-easterly current was experienced, warm generally, but cut into in the middle by a very cold snap, lasting from the 21st to the 24th. There were scarcely any winds from all the northerly points, but in spite of the great prevalence of those from the southern semi-circle, the month was a thoroughly dry one. It was, however, hazy, and unhealthy, with a large deficiency of ozone. The mean temperature of the air exceeded 45 degrees, and was a couple of degrees above the average. The ground was, relatively, much cooler. Only 50 hours of sunshine were experienced, or seven fewer than usual. The total rainfall, however, barely amounted to 1·40 inches, and was 1·76 inches below the 45 years' average for November. Yet the normal evaporation was not reached, the air being humid, and often stagnant, and the sunlight being weakened by haze. Frost occurred in the shade on the 22nd, 23rd, and 24th; and upon the grass on seven nights. A west-south-westerly gale occupied 31 hours on the 15th to 16th. Hail fell on the 16th. Fog formed on the 5th, 22nd, and 23rd. There was no thunder.

December.—After a few mild opening days, which included the single gale of the month, a spell of exceptionally cold weather set in on the 8th, and continued (with only a couple of days' intermission) until the 23rd. Unusually warm conditions then returned, and occupied the final week. The wintry period was remarkably calm; and throughout the entire month the predominant feature was the rarity of winds from westerly points, and the great prevalence, instead, of light airs from the north-east, east, and south-east. In consequence, the atmosphere was hazy and humid, practically no evaporation occurred, and there was a decided deficiency of ozone. Actual cloudiness, however, was not great, the rainfall was less than usual, and there was a normal duration of sunshine. The subsoil water level remained very low during most of the month, but was rising rapidly at its close. The mean temperature of the complete month was half a degree below

the average. There was a shortage of 0·63 inch of rainfall. Wind movement was so much as 125 miles per day below the normal. The total hours of bright sunshine exactly equalled the average. A strong to whole gale, from south-west, veering to north-west, occupied 24 hours on the 3rd to 4th, and contained at least one momentary gust at the rate of 84 miles per hour. Frost occurred on 14 days; with absolute minimum temperatures of 19 degrees in the screen, and 12 degrees over the snow, both on the 13th. Fog was unusually prevalent from the 8th to the 10th. Only trivial amounts of snow and hail fell (on two days each).

IV.—EXTREMES, AND MEANS OR TOTALS, FOR 1920.

Barometric Pressure.—The greatest Air Pressure, at sea level, during the year, was 1039·3 millibars (or 30·69 inches of mercury), on February 5th, at 10 a.m. The least was 971·5 millibars (or 28·69 inches of mercury), on January 11th, at 7-30 p.m. The mean Pressure for the entire year, (corrected for diurnal variation), was 1014·3 millibars, or merely 0·5 millibar above the local normal from 45 years' observations.

Air Temperature.—The highest Temperature of the Air, (at the standard height of four feet above short grass, and in a Stevenson-Screen), was 79 degrees Fahrenheit (or 299 degrees on the Absolute-Centigrade scale), on May 25th. The lowest was 19 degrees Fahr. (or 266 a.), on December 13th. The mean temperature of the warmest entire civil-day (*i.e.*, the mean of 24 separate hourly values, ending at midnight), was 65·8 degrees, on May 25th. That of the coldest day was 26·3 degrees, on December 13th. The greatest difference between the mean temperatures of any two consecutive civil-days was an increase of 12·0 degrees, from December 23rd to 24th. The greatest Range of Temperature, in the Screen, within one day, was 28 degrees, on both May 24th and June 9th.

The Mean Temperature of the complete year, (derived from the daily maximum and minimum temperatures), was 49·2 degrees, or 1·0 degree above the 45 years' average.

Ground, etc., Temperatures.—The highest and lowest 9 a.m. Temperatures of the Hesketh Park Lake water, and of the Ground at various depths below the surface, were as follows:—

Lake-water, 6 ins. below the surface	65°·1	May 26th & June 23rd	33°·1 Jan. 6th.
Ground, 1 foot ,, ,, ,,	65·8	July 20th	33·8 Jan. 5 & 7.
,, 4 feet ,, ,, ,,	61·2	Var. dates in July & Aug.	39·4 Jan. 9-11.
,, 10 ,, ,, ,, ,,	56·1	Aug. 27th & Sept. 5—6	43·8 Feb. 6—29.
,, 20 ,, ,, ,, ,,	51·2	Oct. 30th	47·1 Ap. 20—27.

The greatest thickness of Ice on the Lake was 1·0 inch, from December 17th to 20th.

The lowest Temperature on the Grass was 12 degrees Fahrenheit (or 262 degrees Absolute), on December 13th, over a slight covering of snow.

Sunshine.—The greatest Duration of Sunshine, on one day, was 14·9 hours, on June 5th. The total duration for the year, however, was only 1277 hours, or 279 hours less than a 20 years' local average, and the smallest annual value yet recorded at Southport.

Wind.—The highest Speed of the Wind for one hour, on the coast at Marshside, was 58 miles (or 26 metres per second), on December 3rd, for both 1 p.m. and 3 p.m.; the Direction was W. by S., and W. by N., respectively. The rate during the strongest gust was 84 miles per hour (or 38 metres per second), at 3 p.m. on the same occasion, the Direction being W. by N. The largest Wind Movement in one civil day was 1009 miles, on December 3rd, from a mean Direction of W. by S.

The mean Speed of the Wind for the entire year was 15·1 miles per hour (or 6·8 metres per second), which was 0·6 mile per hour below the average.

The several Wind Direction Duration aggregates for the year, and their deviations from normal, were as follows:—

	Total Hours.	Difference from the Average.		Total Hours.	Difference from the Average.
N.	404	− 190	S.	1155	+ 157
N.E.	441	− 209	S.W.	1486	+ 294
E.	1174	+ 107	W.	1590	− 125
S.E.	1827	+ 411	N.W.	757	− 445

The deficiency of north-westerly winds shown above was very remarkable, being not merely without precedent, but amounting to little less than double the largest previous annual deficiency from that direction, (which occurred in 1904). There can be no doubt that this result is intimately connected with the also unprecedented sunlessness of 1920.

Rainfall.—The heaviest aggregate Rainfall, in one "rainfall day" (*i.e.*, 24 hours beginning at 9 a.m., L.M.T.), was 0·93 inch, by the 8-in. gauge, (23·8 millimetres, by the 5-in. gauge), on June 11th. The greatest similar "day's" *Duration* of Rainfall, was 19·5 hours, on April 9th.

The Total Rainfall for the complete year was 34·08 inches, by the 8-in. gauge, (864 millimetres, by the 5-in. gauge); or 1·24 inches above the normal deduced

from 45 years' observations. Days with Rain numbered 209, or 21 more than usual.

Evaporation.—The largest amount of Evaporation in one day, from a 3-ft.-square tank in the ground, was merely 0·15 inch, on June 23rd. The year's total was only 12·87 inches, or no less than 3·15 inches below the average; every single month showed a deficiency.

Phenomena.—Snow was almost absent, even minute quantities only falling on 3 days. Except during December, there was also a great general rarity of serious Frosts. After May, Gales, too, were exceptionally infrequent. Thunder, however, occurred on 16 days, or 4 more than the normal number. Fog was reported on 14 days; but for the present Meteorological Office definition of this phenomenon, no average for past years is yet available.

V.—MISCELLANEA.

Publication of Statistical Results.—The necessary daily, weekly and monthly Returns were supplied, without interruption, to the Meteorological Office, and results derived from them appeared regularly in the official *Daily*, *Weekly*, and *Monthly Weather Reports*, the *Annual Supplement to Daily Readings*, etc., the *Meteorological Magazine*, and *British Rainfall*. The daily "Health Resort" information was also published in a number of London and provincial morning newspapers; and, during the summer months, an additional telegram was despatched to the Meteorological Office, earlier in the day, to enable information to be inserted in *evening* newspapers.

The results of the observations of Atmospheric Pollution, prepared by the Public Analyst, Mr. Herbert E. Davies, B.Sc., F.I.C., were forwarded monthly to the Advisory Committee on that subject, and were published in the *Lancet*, and in the Annual Report of the Committee. Special Tables have again been kindly prepared for my present Report, by the Superintendent, Dr. J. S. Owens, C.E., and are given on pages 28 and 29. The pollution at the Southport stations, under several heads continued to be very light.

The issue of this Report for 1919 was published in two editions, and the copies of the official one were distributed by the Meteorological Office, in accordance with the conditions of the Grant-in-aid.

Locally, a service of early, popular, monthly weather summaries, in advance of the more formal and detailed ones (which were continued as usual), was commenced for the *Southport Visiter*, and the *Southport Guardian*; and the weekly ones were extended. Monthly reports were also supplied to some leading, distant magazine Editors.

Ribble Estuary Anemograms.—In the spring, an arrangement was made with the Ribble Navigation Committee of the Preston Corporation (the local Port Authority), for the permanent supply to that body of daily, original, Wind Direction and Velocity Anemograms, from the autographic instruments at the Marshside Anemograph Station. The latter therefore becomes, in effect, a joint station of the Air Ministry, the Southport Corporation, the Preston Corporation, and the Marshside Fishermen's Association; and its recently-proposed removal to some part of the Birkdale-to-Formby coast is abandoned. It will, however, require to be well refitted, in 1921. [At the time of going to press, this work is in progress.]

Educational Astronomical Facilities.—The public were admitted to the Astronomical Observatory, during January, February, November, and December, on two evenings weekly, and during March, on three evenings per week. Most of the nights chosen in January, and all of those in November and December, however, proved either largely or completely overcast. In February and March, on the other hand, the Observatory was at times inconveniently crowded. The total number of persons admitted, exclusive of private parties, was 115. The Astronomical instruments are in good condition; but the building badly requires repainting, both inside and out.

Extra-Routine Work.—An examination of a long series of yearly MEAN TEMPERATURES OF WINTER (December to February, inclusive), at London, reduced to the present hourly-mean standard at Greenwich, (in the collection, &c., of which, Mr. C. E. P. Brooks, M.Sc., kindly rendered me material help), showed that the five-year periodicity was well marked in those data, and that its length, during the last 1¼ centuries, lay nearly midway between 5·0 and 5·1 years, with a slight lengthening tendency. The next minimum is due about 1921. The amplitude is practically double that obtained by Captain D. Brunt, M.A., from *whole-year* temperatures; the reason being that easterly winds, and clear anticyclonic weather, —as Mr. W. Marriott pointed out many years ago—whilst greatly depressing surface-temperature in winter, actually increase it in summer.

It is desirable that it should be clearly understood that this 5- to 5·1-year sine curve has been the most persistent periodicity of the order of a few years found in wind-direction, temperature—in this case for several centuries, rainfall, and some other meteorological elements, in this country—especially in England, N.W. There is here no temperature or rainfall cycle of 5·6 years (the so-called half-sunspot period). And Douglass has shown that even the sunspot period itself, so strikingly shown in the tree-rings of the Baltic Sea area, can barely be traced in those from the south of England. The conclusions arrived at by my father (the late Joseph Baxendell, F.R.S., F.R.A.S.), published mostly in the 'sixties, that Greenwich was almost a neutral, or " nodal," point in regard to sunspot effects on terrestrial meteorology, whereas at St. Petersburg these were

especially pronounced, have been well confirmed. On the other hand, Greenwich statistics—of various elements—are proving most useful in establishing the 5-year periodicity.

But the 5-year cycle of unknown cause, though seemingly the most persistent, in England, is not alone. For long stretches of time, in certain elements, others also of the order of a few years, and of amplitudes which cannot be disregarded, have been operative; and, in analysing the London winter temperatures for more than 120 years, a term of 3·09 years has been found, which has a quite surprising amplitude, and the minima of which coincide with many of the greatest historic frosts. In Lancashire rainfall this also appears, but the latter element has yielded another, apparently more marked, term, which is being further investigated (with the assistance of Mr. Charles Baxendell) at the time of writing this page. All wind-direction and temperature cycles affect rainfall, but it is also much influenced by one or two others not distinctly in evidence in the former elements *in England*. The last-mentioned periodicity has now, for half-a-century, been probably the chief of these; and its length, both during that time at Southport, and through 90 years' observations at Bolton, has been 2·85 years. It is, however, doubtless identical with the important " C " cycle of Sir William H. Beveridge's *latest* work, and the corresponding term announced by Arctowski, Bigelow, and Hansen & Nansen. Sir William's " B " cycle is my 5- to 5·1-year one, so persistent in several meteorological elements. His (continental) " A " cycle (4·37 years) appears (feebly) in Southport Rainfall, *but the phases are here reversed*. Another periodicity which I find to have been very pronounced in Lancashire rainfall is one of nearly 2·4 years. Like my father's 20-month cycle, however, this one scarcely appears to have been operative during the last decade or two. Generally speaking, they both were most active when the 2·8-year one, and Mr. C. E. P. Brooks' 2·2-year one, were least so. There are some indications that they are now coming into force again. The dependability of the 5-year term, however, differentiates it from all others in England of the order of a few years, with the partial exception, perhaps, of that of rather more than 3 years.

Staff.—Mr. Alfred Goodwill, who in the autumn entered upon his 20th year of service at the Observatory, performed his duties diligently and conscientiously, and kept the many instruments in his care in good working order. Mr. William Halsall made a reliable deputy observer; and Mrs. F. France continued, with regularity, the old-established records near Birkdale Station. The at-least part-time services of a research computer are greatly needed; a cousin has latterly rendered me, voluntarily, a good deal of assistance in that direction.

JOSEPH BAXENDELL.

The Fernley Observatory,
Southport, England;
July 12th, 1921.

SOUTHPORT METEOROLOGICAL OBSERVATORY.

TABULATED

RESULTS OF OBSERVATIONS

MADE DURING

THE YEAR 1920.

Tabular Meteorological Statistics, 1920.

Air Pressure.

Barometer, and Standardised Barograph, Results.

1920.	MEAN PRESSURE. At M. S. L., & Gravity of Lat. 45°. Mean at 9 a.m. and 9 p.m.	MEAN PRESSURE. At M. S. L., & Gravity of Lat. 45°. Mean of 24 Hours.*	Difference from the Average. (At 9 a.m. and 9 p.m.).	Mean of Daily Observed Oscillations.†	Difference from the Average.	Absolute Extremes of Pressure. ‡ At M. S. L., & Gravity of Lat. 45°. Highest. Height.	Highest. Date.	Lowest. Height.	Lowest. Date.
	INCHES.	MILLIBARS.	INCH.	INCH.	INCH.	MILLIBARS.		MILLIBARS.	
January ...	29·805	1009·1	−0·169	0·412	+0·153	1037·9	5*th*	971·5	11*th*
February	30·142	1020·4	+ ·206	·230	− ·015	1039·3	5*th*	1001·2	10, 15
March ...	29·850	1010·7	− ·050	·337	+ ·102	1036·6	3*rd*	971·6	15*th*
April	29·675	1004·8	− ·257	·218	+ ·022	1023·1	23*rd*	980·6	15*th*
May	29·997	1015·7	− ·001	·260	+ ·096	1034·2	4*th*	990·5	2*nd*
June	30·032	1016·8	+ ·030	·119	− ·030	1029·7	23*rd*	1005·4	29*th*
July	29·875	1011·7	− ·093	·212	+ ·062	1026·4	19*th*	995·6	23*rd*
August ...	30·102	1019·2	+ ·165	·130	− ·040	1033·7	29*th*	994·9	5*th*
September	30·022	1016·4	+ ·023	·170	− ·005	1027·8	22*nd*	994·2	18*th*
October ...	29·977	1014·6	+ ·075	·144	− ·076	1029·6	25*th*	987·8	31*st*
November	30·037	1016·8	+ ·131	·217	− ·034	1032·7	22*nd*	988·9	1*st*
December	29·985	1015·2	+0·118	0·284	+0·007	1035·5	5*th*	981·4	22*nd*
Year	29·958	1014·3	+0·015	0·228	+0·020	1039·3 (30·69‖)	FEB. 5*th*	971·5 (28·69‖)	JAN. 11*th*

* From Observations at 9 a.m., 3 p.m., and 9 p.m.; corrected for Diurnal Variation.
† From Observations at 9 a.m. and 9 p.m. only.
‡ At any time during the 24 hours. ‖ Inches of Mercury.

Air Temperature.

Stevenson-Screen Results.

1920.	Mean Daily Max.* Temp.	Mean Daily Min. † Temp.	Mean Temperature. Mean of Daily Max. & Min.	Mean Temperature. Mean of 24 Hourly Values.	Difference from the Average. (Mean of Max. & Min.)	Mean Daily Range of Temperature.	Difference from the Average.	Absolute Extremes of Temperature. Highest. Temp.	Highest. Date.	Lowest. Temp.	Lowest. Date.
	°	°	°	a.‡ 200+	°	°	°	°		°	
January...	45·7	36·3	41·0	78·2	+2·3	9·4	+1·1	55	17*th*	25	6*th*
February	48·1	38·6	43·4	79·2	+3·8	9·5	+0·2	59	18*th*	30	5*th*
March ...	50·0	39·8	44·9	79·8	+3·4	10·2	−0·9	61	30*th*	31	8*th*
April	50·7	42·1	46·4	80·7	+0·7	8·6	−4·8	57	18*th*	37	9*th*
May	59·1	46·3	52·7	84·3	+1·9	12·8	−1·1	79	25*th*	38	10*th*
June	64·5	50·0	57·3	86·8	+0·7	14·5	+0·9	73	16,17,18	39	9*th*
July	61·7	52·9	57·3	86·8	−2·1	8·8	−3·1	66	10,15,31	47	27*th*
August ...	61·3	52·0	56·7	86·4	−2·4	9·3	−2·8	66	17*th*	44	19,20,30
September	61·4	49·2	55·3	85·6	−0·1	12·2	−0·4	71	12*th*	40	23*rd*
October ...	57·4	44·5	51·0	83·1	+2·0	12·9	+1·7	70	5*th*	32	19*th*
November	49·5	41·1	45·3	80·4	+2·1	8·4	−1·1	58	14*th*	27	22*nd*
December	43·3	35·0	39·2	77·2	−0·5	8·3	−0·3	55	2 & 31	19	13*th*
Year	54·4	44·0	49·2	82·4	+1·0	10·4	−0·9	79 (299‡)	MAY 25*th*	19 (266‡)	DEC. 13*th*

* 24 hours beginning at 9 a.m. ‡ Absolute or Kelvin scale of degrees.
† 24 hours ending at 9 a.m.
NOTE.—For Number of Days with FROST, and Lowest Monthly Temperature on the Grass, *see* Table headed "Miscellaneous Observations."

Ground Temperatures; Insolation; and Radiation.

1920.	Mean Underground Temperatures at 9 a.m.				Difference from the Average.		Mean Daily Max. Temps. in Sun.			Mean Excess of Blackened bulb *in Vacuo* over Bright bulb *in Vacuo*.	Mean Nightly* Min. on Short-Grass or Snow.
	1 foot.	4 feet.	10 feet.	20 feet.	1 foot.	4 feet.	Blackened bulb *in Vacuo*.	Bright bulb *in Vacuo*.	Black-glass bulb in Open Air		
	°	°	°	°	°	°	°	°	°	°	°
January ...	37·9	40·5	44·5	48·88	+0·7	−0·8	62·2	51·3	48·4	10·9	32·5
February...	40·0	41·3	43·8	47·96	+2·3	+1·0	74·6	57·4	52·8	17·2	34·9
March	43·2	43·3	44·1	47·39	+2·6	+1·6	89·5	64·1	57·5	25·4	35·6
April	47·5	46·8	45·5	47·14	+1·4	+1·4	94·0	67·3	60·7	26·7	39·0
May.....	55·1	52·1	47·7	47·24	+1·6	+1·3	106·9	77·8	69·7	29·1	42·7
June	60·9	57·9	51·0	47·81	+0·6	+1·7	113·2	84·6	76·4	28·6	46·2
July.....	62·1	60·2	53·8	48·74	−1·6	+0·4	109·6	81·0	73·2	28·6	50·8
August.....	61·3	60·7	55·6	49·82	−1·3	+0·1	107·5	80·5	72·7	27·0	48·1
September	56·7	58·1	55·8	50·74	−1·2	−0·3	102·3	77·5	71·2	24·8	44·4
October ...	50·0	53·6	50·5	51·17	−0·3	0·0	82·8	67·0	62·8	15·8	37·6
November	43·7	47·6	51·8	51·14	+0·4	−0·4	68·0	56·3	54·0	11·7	36·5
December	38·1	42·9	48·9	50·66	−0·8	−0·9	52·7	46·5	45·4	6·2	30·5
Year	49·7	50·4	49·4	49·06	+0·4	+0·4	88·6	67·6	62·1	21·0	39·9

* For the period of 15 hours ending at 9 a.m.

Sunshine; Cloud; and Ozone.

1920.	SUNSHINE. *Per* Campbell-Stokes Recorder.					CLOUD.				OZONE.	
	Total* Bright Sunshine.	Difference from the Average.	Most Sunshine in One Day.		Number of Sunless Days.	Mean Amount.			Difference (at 9 a.m.) from the Average.	Mean Daily Amount. †	Difference from the Average.
			Amount.	Date.		9 a.m.	3 p.m.	9 p.m.			
	HOURS.	HOURS.	HOURS.			0 to 10.	0 to 10.	0 to 10.	0 to 10.	0 to 10.	0 to 10.
January ...	47	+ 3	5·5	15*th*	8	7·7	7·9	7·1	+0·2	3·8	+0·5
February...	70	− 1	9·4	21*st*	6	7·8	7·0	6·0	+0·2	3·2	+0·1
March	100	−22	10·1	8*th*	3	7·2	6·5	7·3	+0·4	3·4	−1·0
April	93	−82	11·5	29*th*	6	8·3	7·6	8·0	+1·9	4·7	+0·4
May.....	186	−25	14·8	20*th*	3	6·6	6·4	5·5	−0·3	4·2	+0·4
June.....	185	−26	14·9	5*th*	0	6·1	6·8	6·4	−0·6	3·4	−0·7
July.....	127	−82	13·5	19*th*	5	8·5	7·4	8·5	+1·4	4·4	+0·6
August	148	−37	12·2	13*th*	2	7·9	5·6	6·8	+0·7	4·3	+0·9
September	129	−13	11·1	10*th*	3	7·2	6·2	5·1	+0·4	2·5	−0·5
October ...	107	+13	9·0	10*th*	4	6·7	5·8	5·8	−0·5	0·6	−1·9
November	50	− 7	6·0	5*th*	8	6·9	6·9	7·8	−0·4	1·7	−1·6
December	35	0	6·5	4*th*	16	7·4	7·5	7·7	−0·2	2·1	−0·9
Year.....	1277	−279	14·9	JUNE 5*th*	64	7·4	6·8	6·8	+0·3	3·2	−0·3

* For the expression of these values in the form of Daily Means, *see* p. 23.
† The test-papers are changed at 9 a.m.

Humidity; and Wind Velocity.

1920.	HUMIDITY. Vapour Pressure. 9 a.m.	3 p.m.	9 p.m.	Relative Humidity. 9 a.m.	3 p.m.	9 p.m.	Difference of Hum. (at 9 a.m.) from the Average.	VELOCITY OF THE WIND. *Per* Dines Recording Pressure Tube Anemometer. Mean Daily Movement. *	Difference from the Average †	Absolute Extremes. For one Hour.	Date.	In a Gust.	Date.
	MILLI-BARS.	MILLI-BARS.	MILLI-BARS.	%	%	%	%	MILES.	MILES.	MILES.		MILES PER HR.	
January...	7·6	8·0	7·7	88	84	86	0	493	+ 63	56	11*th*	77	11*th*
February..	8·3	8·6	8·2	89	79	88	+ 2	425	+ 13	50	1*st*	66	1*st*
March ...	8·7	8·9	8·5	85	77	87	+ 1	401	− 3	52	12*th*	70	12*th*
April	9·0	9·1	8·9	83	77	86	+ 4	403	+ 12	39	27*th*	50	27*th*
May	11·2	11·1	11·0	79	71	84	+ 3	418	+ 87	54	3*rd*	73	3*rd*
June	12·6	12·8	12·7	74	68	83	− 2	332	− 2	30	29*th*	45	29*th*
July	13·1	13·3	13·0	82	76	84	+ 4	364	+ 24	35	13*th*	46	13*th*
August ...	12·7	13·1	12·7	80	74	85	0	334	− 18	31	6*th*	40	6 & 18
September	13·0	13·0	12·8	87	73	89	+ 6	292	− 50	31	17*th*	43	9*th*
October ...	11·3	12·3	11·0	93	78	92	+ 8	252	−114	28	3 & 31	46	3*rd*
November	8·9	9·1	9·1	89	82	87	+ 1	342	− 56	46	15*th*	68	15*th*
December	7·4	7·5	7·3	90	85	88	+ 2	292	−125	58	3*rd*	84	3*rd*
Year	10·3	10·6	10·2	85	77	87	+2	362	− 14	58 (26‡)	DEC. 3*rd*	84 (38‡)	DEC. 3*rd*

* For equivalent values in Metres per Second, *see* p. 25. ‡ Metres per Second.

† The Averages used have been adjusted to apply to existing conditions.

NOTE.—For Number of Days with, and Duration of, GALES, *see* Table headed "Miscellaneous Observations."

Wind Direction.

1920.	DIRECTION OF THE WIND. From the Hourly Tabulations of the Curves from the Baxendell Recording Anemoscope. Duration Percentages. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Difference from the Average. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
January ...	5	3	4	17	18	25	23	5	− 2	− 1	− 5	− 4	+ 5	+ 6	+ 4	− 3
February...	5	3	3	27	14	24	20	4	− 2	− 4	− 6	+ 6	+ 1	+ 8	+ 3	− 6
March	4	4	4	16	19	18	18	17	− 5	− 6	− 7	+ 3	+ 7	+ 2	0	+ 6
April	8	7	15	13	14	7	22	14	+ 1	− 3	+ 3	+ 2	+ 5	− 6	0	− 2
May.....	2	3	16	13	9	25	27	5	− 4	− 7	− 2	+ 1	0	+14	+10	−12
June	2	5	29	14	8	16	15	11	− 4	− 4	+14	+ 3	0	+ 7	− 7	− 9
July.....	8	3	5	13	12	28	24	7	+ 3	− 2	− 6	+ 3	+ 5	+18	− 5	−16
August.....	6	4	10	6	5	17	31	21	0	− 1	− 1	− 7	− 5	+ 5	+ 5	+ 4
September	3	5	6	23	17	11	21	14	− 4	− 2	−10	+ 4	+ 7	+ 2	+ 3	0
October ...	1	4	37	48	6	2	1	1	− 5	− 5	+23	+26	− 8	− 9	−13	− 9
November ..	1	4	14	34	18	17	10	2	− 8	− 3	+ 3	+15	+ 5	+ 4	− 8	− 8
December ..	11	15	17	26	17	6	5	3	+ 5	+10	+ 6	+ 3	+ 1	−10	−10	− 5
Year.....	5	5	13	21	13	16	18	9	− 2	− 2	+ 1	+ 5	+ 2	+ 3	− 2	− 5

Rainfall Amount.

1920.	TOTAL RAINFALL.*			DAYS WITH RAIN.†			GREATEST DAILY FALL.†			TOTAL* RAINFALL NEAR BIRKDALE STATION.
	8-inch Standard Gauge.	Difference from the Average.	5-inch Snowdon Gauge.	0·01 Inch or more. (8-inch Gauge.)	Difference from the Average.	1 Millimetre or more. (5-inch Gauge.)	Amount by 8-inch Gauge.	Amount by 5-inch Gauge.	Day of Month.	
	INCHES.	INCHES.	MILLIMETRES.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	INCHES.	MILLIMETRES.		INCHES.
January ...	3·48	+0·85	88	22	+ 5	19	0·50	12·7	10*th*	3·41
February...	2·10	+0·01	54	17	+ 2	10	0·68	17·1	19*th*	2·11
March	3·83	+1·61	98	22	+ 7	19	0·76	19·4	24*th*	4·06
April	4·07	+2·27	102	25	+12	20	0·58	14·6	9*th*	4·38
May	3·57	+1·48	90	19	+ 5	15	0·90	23·0	29*th*	3·67
June	2·62	+0·33	66	13	0	10	0·93	23·8	11*th*	2·69
July.....	4·73	+1·68	120	24	+ 9	18	0·74	18·8	25*th*	4·80
August.....	1·46	−2·11	38	12	− 5	7	0·81	20·3	4*th*	1·78
September..	3·15	+0·14	80	15	+ 1	13	0·62	15·9	30*th*	3·47
October ...	1·13	−2·63	29	9	− 9	8	0·29	7·4	31*st*	1·33
November..	1·40	−1·76	35	14	− 4	7	0·53	13·1	14*th*	1·48
December...	2·54	−0·63	64	17	− 2	11	0·54	13·8	24*th*	2·32
Year.....	34·08	+1·24	864	209	+21	157	0·93	23·8	JUNE 11*th*	35·50

* From 9 a.m. on the 1st of each month, to 9 a.m. on the 1st of the succeeding month.
† 24 hours beginning at 9 a.m.

Rainfall Duration, etc.; Evaporation; and Water Levels.

1920.	DURATION AND INTENSITY OF RAINFALL.					EVAPORATION.		MEAN LEVEL‡ OF SUBSOIL WATER.		Difference from the Average (at Hesketh Park.)
	Total Duration of Rain.*	Greatest Daily Duration.†		Mean Rate per Rainfall Hour.	Difference from the Average.	Total, by 3ft. sq. Tank.	Difference from the Average.	At Hesketh Park.	At Birkdale. §	
		Aggregate.	Date.							
	HOURS.	HOURS.		INCH.	INCH.	INCHES.	INCHES.	INCHES.	INCHES.	INCHES.
January ...	71·0	8·2	10*th*	0·049	+0·009	0·01	−0·02	38·2	30·1	+4·1
February...	61·3	15·9	19*th*	·034	− ·007	0·17	−0·05	34·7	31·4	+1·9
March	83·0	11·7	24*th*	·046	+ ·009	0·62	−0·11	34·5	32·4	+1·8
April	109·1	19·5	9*th*	·037	− ·004	1·22	−0·51	30·4	28·5	−4·0
May.....	87·7	12·1	5*th*	·041	·000	2·04	−0·38	30·8	31·4	−6·4
June.....	43·7	7·2	11*th*	·060	+ ·005	2·72	−0·34	35·6	32·3	−5·8
July	102·3	13·8	25*th*	·046	− ·010	2·09	−0·80	38·2	32·3	−7·1
August.....	37·6	16·1	4*th*	·039	− ·022	2·13	−0·31	40·6	36·2	−6·7
September..	64·4	9·7	5 & 14	·049	− ·014	1·14	−0·44	43·4	38·9	−4·8
October ...	25·9	6·8	31*st*	·044	− ·011	0·50	−0·08	44·8	38·1	−1·7
November..	24·1	8·6	14*th*	·058	+ ·013	0·22	−0·06	46·4	39·7	+4·2
December..	52·5	8·3	29*th*	0·048	+0·004	0·01	−0·05	47·1	38·6	+9·2
Year.....	762·6	19·5	APRIL 9*th*	0·045‖	−0·002	12·87	−3·15	38·7	34·2	−1·3

* From 9 a.m. on the 1st of each month, to 9 a.m. on the 1st of the succeeding month.
† 24 hours beginning at 9 a.m.
‡ Distances below Well-mouths.
§ Near L. & Y. Railway Station, Birkdale.
‖ Derived from *the year's totals* of Amount and Duration.

Rainfall with Different Wind Directions.

1920.	AMOUNT OF RAINFALL.								DURATION OF RAINFALL.							
	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
	INS.	INS.	INS.	INS.	INS.	INS.	INS.	INS.	HRS.	HRS.	HRS.	HRS.	HRS.	HRS.	HRS.	HRS.
Jan. ...	·19	·10	·05	·68	·81	1·11	·42	·16	4·2	1·0	0·8	17·1	15·5	19·6	7·7	6·1
Feb. ...	·01	·20	·38	·21	·14	·77	·25	·11	1·2	9·4	7·9	6·3	3·5	20·2	9·7	3·1
March.	·16	·29	·20	·40	1·10	·86	·52	·24	5·2	5·2	3·4	9·9	26·9	13·3	7·2	10·0
April ..	·26	·26	·94	·75	·98	·11	·46	·31	5·8	11·5	28·3	17·6	17·3	2·9	15·3	8·0
May ...	·00	·04	·72	·95	·71	·89	·27	·08	0·0	0·8	17·3	18·4	16·2	24·8	12·1	2·4
June...	·00	·07	·55	·98	·36	·45	·10	·00	0·0	1·2	14·7	10·0	5·2	5·2	2·1	0·0
July ...	·89	·22	·42	·71	1·02	·96	·36	·22	16·1	6·1	7·5	23·1	22·1	18·0	8·4	5·4
Aug....	·08	·00	·04	·70	·35	·09	·09	·07	1·2	0·0	1·4	14·5	9·6	4·1	3·3	2·3
Sept...	·00	·03	·08	·56	1·07	·38	·74	·15	0·3	1·1	1·5	11·7	20·3	6·3	19·4	3·2
Oct.....	·00	·07	·24	·42	·09	·10	·18	·00	0·0	1·9	8·5	8·7	1·5	1·1	2·3	0·0
Nov....	·00	·00	·27	·37	·39	·43	·16	·00	0·0	0·0	4·9	9·9	6·3	5·7	1·9	0·0
Dec....	·03	·01	·42	1·07	·69	·11	·17	·04	1·3	0·5	6·3	24·0	12·9	2·7	4·3	0·5
Year...	1·62	1·29	4·31	7·80	7·71	6·26	3·72	1·38	35·3	38·7	102·5	171·2	157·3	123·9	93·7	41·0
	Intensity of Rainfall (Rate per Raining Hour.)								Raining Hours per cent. of Total Hours of each Wind.							
	IN.	IN.	IN.	IN.	IN.	IN.	IN.	IN.	%	%	%	%	%	%	%	%
Year...	·046	·033	·042	·046	·049	·051	·040	·033	8·7	8·8	8·7	9·4	13·6	8·6	5·9	5·4

Miscellaneous Observations.

1920.	OCCASIONAL PHENOMENA.											LOWEST MIN. TEMP. ON GRASS OR OVER SNOW.			MEAN ‖ TEMP. OF H.P. LAKE WATER.
	GALES. *		SNOW.		HAIL. †	THUNDER. ‡	FOG.	ICE.	FROST.						
	Force 8 and above.	Duration of same.	Snowfalls.	Depth of all falls.				On H.P. Lake.	In the Screen	Ground Frost. §	On the Grass.	Fahr.	Abs'l't.	Date.	
	NO. OF DAYS.	HOURS	NO. OF DAYS.	INCHES.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	NO. OF DAYS.	°	a.		°
January ...	9	44	1	0·2	5	0	1	2	4	10	14	18	265	6*th*	38.6
February...	4	36	0	0·0	1	0	2	0	4	5	9	24	269	5 & 24	41·2
March	3	26	0	0·0	4	1	1	0	1	7	10	23	268	8*th*	44·7
April	1	1	0	0·0	1	2	0	0	0	1	3	26	270	17*th*	48·9
May	4	28	0	0·0	2	3	0	0	0	0	3	31	272	1 & 10	56·5
June.....	0	0	0	0·0	0	6	0	0	0	0	0	33	274	9*th*	61·8
July	0	0	0	0·0	0	2	0	0	0	0	0	39	277	27*th*	61·5
August.....	0	0	0	0·0	1	1	1	0	0	0	0	35	275	19*th*	60·8
September..	0	0	0	0·0	0	0	2	0	0	0	0	33	274	23*rd*	56·7
October ...	0	0	0	0·0	0	1	1	0	1	9	9	22	267	19*th*	50·6
November ..	2	31	0	0·0	1	0	3	0	3	7	7	19	266	22*nd*	43·7
December ..	2	24	2	0·4	2	0	3	12	14	14	18	12	262	13*th*	38·3
Year.....	25	190	3	0·6	17	16	14	14	27	53	73	12	262	DEC. 13*th*	50·3

* From the Hourly Tabulations of the Dines Tube Anemograms. † Including "Soft-Hail."
‡ Including both Thunderstorms, and Thunder-only; but *not* Lightning-only. ‖ At 9 a.m.
§ Meteorological Office's definition, *viz.*, Minimum Temperature on the Grass = 30·4 degs. Fahr. or below.

Diurnal Variation

Four feet above Grass, and in

1920.	Midn't	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.
	°	°	°	°	°	°	°	°	°	°	°	°	°
January ..	40·2	40·2	40·3	40·3	40·1	40·0	40·1	40·1	40·2	40·4	41·2	42·3	43·0
February...	41·8	41·8	41·5	41·3	40·9	41·1	41·2	41·2	41·5	42·2	43·1	44·5	45·7
March.....	42·7	42·6	42·3	42·1	41·6	41·5	41·4	41·3	42·0	43·6	45·4	46·9	47·7
April.....	44·3	43·9	43·7	43·6	43·3	43·2	43·3	44·0	45·2	46·3	47·2	47·4	48·0
May.....	49·1	48·8	48·2	47·9	47·9	47·5	48·3	49·7	51·4	53·1	54·6	55·8	56·5
June	52·9	51·9	51·3	50·8	50·5	50·8	52·1	53·9	56·1	58·2	59·9	61·1	61·7
July.....	54·8	54·6	54·3	54·1	53·7	53·7	53·9	54·6	55·9	56·5	58·1	59·0	59·7
August.....	54·2	53·8	53·5	53·3	53·0	52·8	53·0	53·7	55·2	56·7	57·6	58·4	59·2
September.	52·1	51·7	51·1	50·8	50·7	50·7	50·5	50·9	52·3	54·3	56·2	58·2	59·4
October	47·9	47·6	47·0	46·7	46·6	46·3	45·9	46·1	46·8	48·7	50·5	53·0	55·2
November..	44·8	44·7	44·6	44·4	44·3	43·8	43·6	43·5	43·2	44·1	45·2	46·6	47·5
December..	38·9	39·1	38·9	38·7	38·7	38·7	38·4	38·6	38·4	38·4	38·9	39·9	40·8
Year.....	47·0	46·7	46·4	46·2	45·9	45·8	46·0	46·5	47·4	48·5	49·8	51·1	52·0

Diurnal Variation of

1920.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.
	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.
January	...	...	...	...	...	2·8	7·9	8·5	8·4
February	...	...	...	0·2	1·5	5·2	7·2	9·0	10·7
March	...	...	0·1	3·0	7·0	10·1	11·0	12·7	11·9
April	...	0·1	4·6	7·0	7·8	7·6	7·4	5·9	8·0
May	...	3·4	8·9	12·0	13·8	13·4	13·3	14·8	15·1
June	0·4	4·9	9·8	10·8	13·8	15·8	15·1	14·0	12·9
July.....	...	0·9	3·1	4·8	5·0	7·5	8·7	10·2	9·6
August.....	...	0·2	1·1	5·7	8·0	9·1	10·0	13·7	16·1
September	...	...	0·2	3·5	8·2	11·9	13·3	12·9	13·2
October	...	...	...	0·7	4·3	8·7	10·6	15·0	17·2
November	...	...	...	...	0·2	5·0	8·5	8·7	7·9
December	...	...	...	...	...	2·4	5·0	6·3	6·1
Year.....	0·4	9·5	27·8	47·7	69·6	99·5	118·0	131·7	137·1

of Temperature.

an enlarged Stevenson Screen.

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midn't	MEANS	1920.
°	°	°	°	°	°	°	°	°	°	°	°	°	
43·0	43·1	43·0	42·5	41·9	41·9	42·0	41·7	41·3	40·9	40·6	40·4	41·3	January.
46·3	47·0	46·8	46·1	45·0	44·0	43·3	42·8	42·4	42·1	42·1	41·9	43·2	February.
48·1	48·0	48·0	47·6	46·6	45·5	44·4	44·1	43·7	43·3	42·9	42·6	44·3	March.
48·6	48·8	49·6	49·2	48·3	47·4	46·6	46·0	45·3	45·0	44·5	44·1	45·9	April.
56·7	56·9	57·1	56·4	55·8	54·8	53·7	52·5	51·6	50·8	50·2	49·6	52·3	May.
62·2	62·8	62·3	61·8	61·0	60·0	59·0	57·4	56·1	54·7	53·7	52·8	56·8	June.
59·8	60·1	60·1	60·3	59·8	59·1	58·0	56·9	55·9	55·5	55·0	54·8	56·8	July.
59·8	60·3	60·2	59·9	59·2	58·2	57·2	55·9	55·2	54·7	54·4	53·9	56·2	August.
59·8	60·2	59·8	59·4	58·1	56·7	55·4	54·4	53·8	53·3	52·8	52·4	54·7	September.
56·3	56·5	56·0	55·0	53·3	51·7	50·6	49·5	48·9	48·6	48·4	47·8	50·1	October.
48·0	48·2	47·7	46·8	46·3	46·0	45·7	45·6	45·4	45·3	44·9	44·7	45·4	November.
41·3	41·4	41·2	40·6	40·1	39·7	39·7	39·4	39·2	39·0	39·0	39·0	39·5	December.
52·5	52·8	52·7	52·1	51·3	50·4	49·6	48·9	48·2	47·8	47·4	47·0	48·9	Year.

Duration of Sunshine.

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	MONTHLY TOTALS.	DAILY MEANS.	1920.
Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Hours.	Hours.	
8·7	6·7	3·6	...	...	...	...	...	46·6	1·50	January.
11·6	11·4	7·1	5·4	1·1	...	...	...	70·4	2·43	February.
11·0	8·7	11·3	9·1	3·6	...	...	...	99·5	3·21	March.
8·2	7·9	10·2	7·4	5·6	3·7	1·2	...	92·6	3·09	April.
16·3	17·1	15·0	12·6	12·8	9·4	8·1	0·1	186·1	6·00	May.
15·8	14·7	14·3	14·7	10·0	9·0	7·7	1·6	185·3	6·18	June.
10·3	11·4	11·9	13·2	12·6	11·3	6·4	0·5	127·4	4·11	July.
17·1	15·4	17·1	14·5	11·6	6·1	2·2	...	147·9	4·77	August.
14·5	14·1	14·6	13·5	7·7	1·2	...	...	128·8	4·29	September.
16·1	15·7	13·7	4·7	0·4	...	...	...	107·1	3·45	October.
8·4	8·4	2·6	0·5	...	...	...	...	50·2	1·67	November.
6·0	7·2	1·9	...	...	...	...	...	34·9	1·13	December.
144·0	138·7	123·3	95·6	65·4	40·7	25·6	2·2	1276·8	3·49†	Year.

† From the Year's Gross Total.

Diurnal Variation of the Duration

(At Marsh-

1920.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10a.m.	11a.m.	Noon.
WHOLE YEAR.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.
N.	14·0	19·5	16·0	16·5	16·5	14·5	16·5	20·5	16·0	16·5	14·5	16·5
N.E.	18·0	15·0	14·5	16·5	20·0	19·0	23·0	18·5	22·5	19·0	19·5	17·0
E.	59·5	56·0	64·0	59·0	56·0	60·0	53·0	52·0	40·5	39·0	32·5	29·0
S.E.	86·5	91·0	90·5	100·0	99·5	96·0	102·0	94·5	86·5	81·0	71·5	63·0
S.	51·5	49·0	50·0	45·0	50·0	53·0	50·5	50·0	51·5	43·5	51·5	50·0
S.W.	52·0	51·5	46·5	45·5	40·5	39·5	36·0	41·5	54·0	66·0	71·5	71·5
W.	57·5	55·0	54·0	51·0	51·5	52·0	57·0	58·0	60·5	66·0	70·0	82·5
N.W.	27·0	29·0	30·0	32·5	32·0	32·0	28·0	31·0	34·5	35·0	35·0	36·5

Diurnal Variation

(At Marsh-

1920.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10a.m.	11a.m.	Noon.
	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.
January	20·3	20·6	21·3	21·5	20·5	20·5	20·0	20·1	18·2	18·6	20·4	21·4
February	18·8	18·5	19·0	18·6	19·0	19·1	17·8	17·0	17·3	17·7	18·1	18·9
March	17·4	16·3	16·5	15·4	16·2	17·3	16·5	16·7	17·3	17·4	17·9	18·4
April	16·0	15·9	15·4	16·2	16·5	17·1	17·1	16·9	17·9	18·5	18·9	19·1
May	17·2	16·5	16·4	16·9	17·4	17·7	18·7	19·1	17·9	17·6	18·4	18·3
June	13·4	13·1	13·2	12·9	13·1	13·5	14·1	14·5	14·3	13·5	13·0	13·5
July	13·4	14·3	13·5	13·0	13·6	14·3	14·9	15·4	16·1	17·0	16·7	16·9
August	13·0	13·5	13·3	13·5	13·7	13·0	12·6	12·9	13·8	14·2	14·0	14·4
September	11·9	12·0	12·1	11·6	11·5	11·9	11·3	9·9	11·5	12·6	13·3	14·4
October	10·0	9·9	10·0	9·8	10·0	9·8	10·0	9·8	9·5	9·3	10·5	11·7
November	13·8	15·1	15·2	15·2	14·5	13·8	13·9	13·5	13·4	13·7	14·5	15·5
December	12·7	12·8	12·9	13·3	13·2	13·2	13·1	13·3	12·4	12·0	12·1	12·5
Year	14·8	14·9	14·9	14·8	14·9	15·1	15·0	14·9	15·0	15·2	15·7	16·3

of Winds from Different Directions.

side).

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midn't	Totals.	1920.
Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Hours.	Whole Year.
12·5	13·5	17·5	16·0	18·5	22·5	22·0	19·0	13·5	16·0	19·5	15·5	403·5	N.
19·5	15·5	17·5	18·0	18·5	22·0	17·5	20·0	22·5	15·5	16·0	16·0	441·0	N.E.
34·0	35·5	33·5	35·0	39·5	49·0	55·0	62·0	61·0	57·0	55·0	57·0	1174·0	E.
58·5	57·0	56·0	55·5	58·5	51·0	57·0	59·0	69·0	76·0	80·5	87·5	1827·5	S.E.
45·5	45·0	43·5	47·5	45·0	49·5	44·5	42·0	42·0	51·5	54·5	48·0	1154·5	S.
68·5	69·5	74·5	72·0	69·0	70·0	75·0	72·5	69·5	63·0	59·5	57·0	1436·0	S.W.
86·5	90·5	84·0	80·0	76·5	68·5	66·5	69·5	64·5	62·5	62·0	64·5	1590·5	W.
41·0	39·5	39·5	42·0	40·5	33·5	28·5	22·0	24·0	24·5	19·0	20·5	757·0	N.W.

of Wind Velocity.

side).

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midn't	Means.		1920.
Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Miles per Hour.	Metres per Second.	
21·7	21·5	20·6	18·4	18·6	19·4	20·7	21·8	21·8	22·1	21·9	20·9	20·5	9·2	Jan.
18·7	18·7	18·5	17·9	17·2	16·4	16·2	16·3	16·5	15·9	16·2	16·9	17·7	7·9	Feb.
18·4	17·3	17·3	16·9	16·4	15·4	15·4	15·3	15·7	15·9	16·2	17·4	16·7	7·5	Mar.
19·1	18·4	18·0	17·6	16·9	16·1	15·3	14·6	14·8	15·5	15·4	16·0	16·8	7·5	Apr.
18·6	18·5	18·7	18·2	17·5	17·3	16·5	15·8	15·8	16·7	16·4	16·0	17·4	7·8	May.
14·9	15·2	15·6	15·6	15·6	14·9	14·3	13·5	12·9	12·9	12·6	12·2	13·8	6·2	June.
16·6	16·5	16·5	15·9	16·0	15·2	14·6	15·1	15·2	14·8	14·5	13·9	15·2	6·8	July.
15·0	15·4	15·6	16·2	15·5	14·6	13·5	13·7	13·5	13·3	12·8	12·7	13·9	6·2	Aug.
14·6	14·0	13·6	12·7	12·2	11·6	11·5	11·4	12·5	11·2	11·2	12·0	12·2	5·5	Sep.
12·0	12·2	11·7	11·0	10·8	11·0	10·9	10·4	10·7	10·5	10·2	10·4	10·5	4·7	Oct.
15·2	14·6	14·6	14·9	14·9	14·5	13·7	13·2	13·3	13·3	13·6	14·2	14·3	6·4	Nov.
12·5	11·9	11·3	11·7	11·8	12·0	12·0	11·5	10·9	11·1	10·8	11·4	12·2	5·5	Dec.
16·4	16·2	16·0	15·6	15·3	14·9	14·6	14·4	14·5	14·4	14·3	14·5	15·1	6·8	Year.

Diurnal Variation of

1 foot 6 inches

1920.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.
	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.
January	5·5	4·0	2·4	2·3	3·0	3·3	3·7	3·6	3·4	2·6	3·7	4·1
February	1·0	4·7	4·1	3·0	3·1	4·3	1·9	2·3	2·4	2·9	2·6	0·3
March	2·8	2·3	2·6	4·5	3·3	3·4	5·1	2·8	1·5	0·7	1·1	2·1
April	2·8	2·0	3·2	5·9	7·0	6·2	7·9	9·0	6·2	3·6	3·2	2·7
May	5·2	3·4	2·2	2·2	3·2	4·8	5·2	5·1	4·6	4·1	3·7	2·0
June	3·6	2·6	1·5	1·0	1·0	1·6	1·8	1·0	0·8	0·8	1·1	1·0
July	4·3	5·5	6·9	4·6	3·0	8·2	7·8	5·7	3·4	3·9	2·1	2·7
August	2·6	2·0	3·0	2·7	2·0	1·4	1·5	0·7	0·6	0·6	1·4	0·5
September	3·2	3·9	3·1	4·0	1·8	1·7	3·5	3·5	3·1	1·9	1·2	1·5
October	1·5	1·8	1·9	0·5	1·1	1·4	1·4	1·6	2·3	1·2	0·6	0·9
November	0·0	0·5	0·4	2·7	3·2	1·6	1·2	1·1	0·1	1·3	2·2	1·2
December	3·4	5·4	4·6	3·9	3·9	2·5	1·0	2·7	1·6	0·3	0·9	1·3
Year	35·9	38·1	35·9	37·3	35·6	40·4	42·0	39·1	30·0	23·9	23·8	20·3

Diurnal Variation of

1 foot 6 inches

1920.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.	Noon.
	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches
January	·23	·09	·08	·10	·27	·20	·15	·14	·20	·12	·13	·22
February	·01	·11	·15	·09	·08	·11	·04	·05	·07	·10	·09	·05
March	·18	·09	·13	·10	·05	·13	·18	·22	·04	·03	·05	·06
April	·09	·09	·13	·25	·27	·21	·28	·34	·20	·15	·11	·13
May	·17	·21	·08	·07	·12	·10	·16	·15	·10	·13	·08	·08
June	·10	·04	·04	·05	·02	·03	·05	·12	·05	·04	·03	·17
July	·21	·34	·25	·13	·20	·33	·30	·21	·17	·14	·08	·14
August	·08	·10	·09	·07	·05	·03	·05	·06	·02	·01	·04	·02
September	·08	·11	·05	·15	·04	·06	·08	·10	·17	·10	·07	·07
October	·12	·09	·09	·00	·02	·04	·03	·09	·06	·03	·02	·03
November	·00	·02	·02	·18	·17	·12	·08	·07	·00	·05	·14	·09
December	·17	·32	·30	·26	·19	·07	·04	·07	·05	·01	·01	·03
Year	1·44	1·61	1·41	1·45	1·48	1·43	1·44	1·62	1·13	0·91	0·85	1·09

Duration of Rainfall.

above the ground.

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midn't	Totals.	1920.
Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Total Hours.	Hours.	
5·3	2·0	2·2	1·5	1·7	2·0	1·6	2·4	3·2	2·5	2·3	3·7	72·0	Jan.
1·7	1·6	1·1	1·5	3·7	3·8	3·9	3·0	3·6	2·4	1·1	1·3	61·3	Feb.
2·8	1·7	2·3	4·6	5·6	6·9	5·6	3·1	3·4	3·9	4·6	4·1	81·1	Mar.
3·9	2·7	2·4	3·8	4·2	3·6	4·2	5·1	4·6	3·5	5·2	3·8	106·7	April.
2·5	0·6	3·1	3·7	4·6	3·5	4·2	5·1	5·0	4·2	4·8	5·0	92·0	May.
1·5	0·4	0·6	0·2	1·4	0·5	1·5	1·4	2·1	3·1	3·3	4·6	38·4	June.
2·7	4·1	1·4	2·3	4·0	5·0	6·3	5·4	6·3	3·2	4·1	3·8	106·7	July.
0·7	1·0	1·2	1·0	1·1	1·7	1·5	1·0	1·0	1·7	3·3	2·2	36·4	Aug.
2·0	1·4	0·1	0·9	2·1	2·9	4·6	2·4	2·8	4·2	5·2	2·8	63·8	Sept.
1·0	0·2	0·7	0·0	0·0	1·2	1·7	0·5	0·9	1·0	0·0	0·6	24·0	Oct.
0·2	1·5	1·4	1·9	1·0	1·4	1·5	1·7	1·3	0·8	0·5	0·0	28·7	Nov.
0·5	2·7	2·8	2·2	1·5	1·1	1·4	1·2	1·5	1·3	2·7	2·1	52·5	Dec.
21·8	19·9	19·3	23·6	30·9	33·6	38·0	32·3	35·7	31·8	37·1	34·3	763·6	Year.

Amount of Rainfall.

above the ground.

1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.	Midn't	Totals.	1920.
Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Total Inches	Inches.	
·26	·12	·08	·08	·07	·05	·08	·13	·23	·18	·14	·17	3·52	Jan.
·13	·13	·08	·07	·23	·12	·10	·10	·07	·03	·02	·04	2·07	Feb.
·09	·21	·17	·26	·23	·24	·28	·13	·14	·29	·17	·30	3·77	Mar.
·11	·28	·14	·11	·13	·10	·23	·21	·16	·12	·11	·12	4·07	April.
·11	·00	·09	·19	·39	·14	·18	·17	·16	·09	·37	·32	3·66	May.
·08	·01	·09	·00	·21	·04	·21	·13	·23	·27	·26	·24	2·51	June.
·12	·13	·04	·21	·14	·18	·37	·30	·26	·23	·21	·11	4·80	July.
·04	·03	·05	·05	·04	·10	·06	·06	·04	·08	·18	·07	1·42	Aug.
·07	·05	·00	·03	·11	·10	·22	·11	·15	·41	·29	·39	3·01	Sept.
·04	·01	·04	·00	·00	·14	·17	·03	·01	·03	·00	·01	1·10	Oct.
·00	·10	·05	·10	·02	·06	·06	·15	·06	·07	·01	·00	1·62	Nov.
·04	·28	·09	·05	·14	·10	·10	·04	·06	·02	·04	·06	2·54	Dec.
1·09	1·35	0·92	1·15	1·71	1·37	2·06	1·56	1·57	1·82	1·80	1·83	34·09	Year.

Atmospheric Pollution.

Total Deposit of Each Element of Pollution, expressed in Metric Tons per Square Kilometre.
(All columns, except the two concluding ones, refer to *Hesketh Park*.)

1920.	Rainfall (Per Pollution Gauge.) In Millimetres.	Insoluble Matter.			Soluble Matter.		Total Solids.	Included in Soluble Matter.			Woodvale Moss.	
		Tar.	Carbonaceous, other than Tar.	Ash.	Loss on Ignition	Ash.		Sulphate, as (SO_3).	Chlorine. (Cl).	Ammonia. (NH_3).	Rainfall (per P. Gauge.) In Millimetres.	Pollution. — Total Solids.
January	84	0·03	0·58	1·50	0·96	4·53	7·60	1·19	0·95	0·13	54	4·55
February	56	0·02	0·48	0·56	1·16	1·97	4·19	0·51	0·79	0·08	58	3·85
March	97	0·06	0·58	0·70	1·70	1·94	4·98	0·89	0·87	0·09	87	5·30
April	102	0·05	0·44	0·44	2·55	3·19	6·67	0·70	1·42	0·04	93	5·49
May	95	0·02	0·68	0·96	0·47	5·22	7·35	0·97	2·17	0·09	39	4·91
June	68	0·04	0·82	0·96	2·05	3·58	7·45	0·81	2·05	0·07	78	8·51
July	124	0·08	0·51	0·59	3·41	6·50	11·09	0·98	2·23	0·05	115	9·52
August	41	0·03	0·29	0·35	1·42	3·45	5·54	0·26	1·42	0·02	39	3·88
September	78	0·04	0·65	0·65	1·17	3·31	5·82	0·59	1·10	0·05	86	6·98
October	24	0·04	0·53	0·43	0·60	1·07	2·67	0·34	0·33	0·02	28	3·53
November	34	0·10	0·68	0·77	0·51	2·40	4·46	0·59	0·83	0·02	28	3·29
December	61	0·13	1·33	2·01	1·48	4·29	9·24	1·29	1·28	0·05	39	6·25
Year	864	0·64	7·57	9·92	17·48	41·45	77·06	9·12	15·44	0·71	744	66·06

The Fernley Observatory, Southport.

GENERAL DESCRIPTIVE NOTES FOR 1920.

The principal Meteorological Station of the Fernley Observatory is situated in the eastern portion of Hesketh Public Park, Southport, approximately half-a-mile inland from High-Water Mark. Its Geographical Position is:—Latitude, 53° 39′ 24″ N.; Longitude, 2° 59′ 3″ W. The cistern of the Fortin-Barometer is 42 feet above Mean Sea Level (Ordnance Datum). The rims of the Rain Gauges are one foot above grass, and 38 feet above Mean Sea Level. The Duration of Rainfall is ascertained from the records of Fernley-pattern Recording Gauges.

The Marshside Anemograph Station is situated close to a very open and level portion of the coast, over a mile to the N.N.E. of the Hesketh Park Observatory. A Dines-Baxendell Anemograph is employed there; its head is 62 feet above the ground, and 48 feet above the roof of the hut containing the recording apparatus; it is 80 feet above Mean Sea Level.

Local Mean Time—which is 12 minutes after G.M.T.—is employed for the eye-readings, Local Apparent Time for the Hourly Sunshine values, and Greenwich Mean Time for all the other Hourly results. Summer Time is not used. The Hourly means of Temperature refer to the exact hour. For this element, values are given for both the initial and final midnights; and the monthly means for the 24 hours have been computed according to the formula $\frac{1}{24}\{1 + \ldots + 23 + \frac{1}{2}(0 + 24)\}$.

Atmospheric Pollution.—Comparative Statistics for 1920.

Monthly Means for all Stations having results available for nine or more months of the calendar-year 1920.
In Metric Tons per Square Kilometre.

STATIONS.	Number of Months' Records in 1920.	Mean Monthly Rainfall, (Per the Pollution Gauges.) In Millimetres.	Insoluble Matter.			Soluble Matter.		Total Solids.	Included in Soluble Matter.		
			Tar.	Carbonaceous, other than Tar.	Ash.	Loss on Ignition.	Ash.		Sulphate, as (SO_3).	Chlorine. (Cl).	Ammonia. (NH_3).
Southport:—											
Hesketh Park	12	72	0·05	0·63	0·83	1·46	3·45	6·42	0·76	1·29	0·06
Woodvale Moss	12	62						5·50			
Glasgow:—											
Alexandra Park	12	72	0·10	1·79	2·83	1·84	2·66	9·32	1·25	1·34	0·11
Bellahouston Park ...	12	80	0·14	1·41	2·09	2·66	3·86	10·17	1·33	1·64	0·10
Blythswood Square...	12	87	0·19	2·55	4·83	3·01	4·50	15·10	1·73	1·43	0·20
Botanic Gardens.....	12	83	0·18	1·94	3·62	2·49	3·70	11·94	1·54	1·40	0·14
Richmond Park... ...	12	80	0·18	2·12	3·97	2·19	3·79	12·25	1·62	1·45	0·13
Ruchill Park...	12	94	0·09	1·74	2·75	1·81	3·18	9·58	2·13	1·69	0·11
Queen's Park	12	84	0·16	1·26	2·30	1·66	3·03	8·42	1·15	1·25	0·22
Tollcross Park	12	81	0·26	2·00	3·75	2·17	3·42	11·60	1·48	1·18	0·11
Victoria Park	12	87	0·18	1·92	2·71	2·01	3·79	10·53	1·54	1·37	0·26
Newcastle-on-Tyne	12	53	0·34	3·90	8·01	1·84	3·26	17·24	1·46	0·60	0·12
Kingston-upon-Hull	9	51	0·18	2·29	5·20	1·98	5·29	14·94	2·38	0·69	0·07
Rochdale	12							23·01			
St. Helens	12	83	0·15	2·28	4·00	1·31	6·82	14·56	2·20	1·18	0·05
Birmingham:—											
Aston	10	59	0·08	2·19	6·04	1·21	3·20	12·73	1·48	0·29	0·05
Central	12	61	0·14	4·40	11·58	1·58	4·13	21·92	2·17	0·39	0·10
South Western	12	65	0·02	0·65	1·43	0·82	2·36	5·28	1·04	0·22	0·06
Rothamstead	12	50		0·52	0·77	1·02	1·84	4·15			
London:—											
Meteorological Office.	12	44	0·34	3·11	4·35	2·22	4·73	14·75	0·92	0·93	0·08
Archbishop's Park ...	12	45	0·20	3·27	4·24	1·83	3·16	12·70	1·42	0·87	0·10
Finsbury Park	11	43	0·09	1·11	3·27	1·35	2·25	8·07	0·84	0·79	0·06
Ravenscourt Park....	11	45	0·18	1·59	3·45	1·45	2·38	9·05	1·02	0·90	0·11
Southwark Park	12	43	0·20	2·60	4·45	1·34	2·30	11·09	1·05	0·69	0·10
Victoria Park.....	12	44	0·09	1·52	2·93	1·29	2·11	7·94	0·70	0·89	0·08
WandsworthCommon	12	41	0·15	1·67	2·82	1·53	2·18	8·36	0·83	0·90	0·08
Golden Lane	11	44	0·06	2·95	3·70	1·29	3·69	11·69	1·39	1·13	0·17

GENERAL OBSERVATORY NOTES—*continued from page* 28.

The hourly tabulations have been measured from base-lines drawn automatically on the daily charts of a large Dines Thermograph. Corrections prepared from control eye-readings of standard instruments have been applied. The Hourly statistics of Sunshine, Wind Direction and Velocity, and Rainfall Duration and Amount, all refer to the period extending from 30 minutes before, to 30 minutes after, the exact hour.

The Averages used in the preparation of the Tables on the foregoing pages are for the 45 years 1871-1915, in all cases except the following:—Level of Subsoil Water, 25 years; Underground Temperature *at 4 feet*, Sunshine, and Wind Velocity and Direction, 20 years; *Rate* of Rainfall, and Amount of Cloud at 9 a.m., 15 years; and Evaporation, and Ozone, 5 years only.

Climatology.——Comparative Statistics for the Year 1920.

(Compiled exclusively from Meteorological Office data.)

	STATIONS.	MEAN TEMPERATURE. The Year.	MEAN TEMPERATURE. January and February.	MEAN TEMPERATURE. July and August.	Mean Daily Range of Temp.	TOTAL RAINFALL. (In both British and Metric Units).		DURATION OF SUNSHINE. Total.	DURATION OF SUNSHINE. Daily Mean.
		°	°	°	°	INCHES.	MILLI-METRES.	HOURS.	HOURS.
	Southport	49·2	42·2	57·0	10·4	34·0	864	1276	3·49
	Other Health Resorts:—								
Scotland.	Banff	47·2	40·0	54·6	11·8	22·4	567	1502	4·10
Scotland.	Nairn	46·4	39·4	54·6	13·7	20·9	530	1397	3·82
Scotland.	Fortrose	47·3	40·5	55·5	11·6	20·7	525	1390	3·80
Scotland.	Montrose	46·9	39·5	54·9	11·6	25·2	640	?1307	?3·57
Scotland.	Carnoustie	47·4	40·1	55·5	11·6	24·3	618	1406	3·84
Scotland.	St. Andrews	47·1	40·3	55·1	12·7	27·0	687	1400	3·83
Scotland.	Oban	48·1	40·9	54·5	10·6	59·1	1499	?1087	?2·97
Scotland.	Helensburgh	47·9	40·5	55·5	11·5	61·2	1553	1029	2·81
Scotland.	Rothesay	47·4	40·8	54·2	10·4	62·7	1591	1125	3·07
Eng., N.E.	Whitby	49·1	42·2	57·3	12·8	22·4	572	1344	3·67
Eng., N.E.	Scarborough	50·2	42·5	58·4	12·0	25·3	644	1302	3·56
Eng., N.E.	Bridlington	48·0	40·6	55·9	12·5	25·3	642	1262	3·45
Eng., N.E.	Skegness	49·6	41·4	57·4	11·5	20·0	508	1530	4·18
Eng., N.W.	Keswick	49·0	42·5	56·2	12·6	57·1	1449	1197	3·27
Eng., N.W.	Morecambe	49·1	40·6	57·3	9·8	36·5	928	1311	3·58
Eng., N.W.	Blackpool	49·4	41·9	57·5	10·5	36·8	937	1269	3·47
Eng., N.W.	Hoylake	50·2	43·8	58·0	11·7	35·8	910	1334	3·64
I.O.M.	Douglas	48·9	42·5	55·5	8·8	47·2	1199	1263	3·45
Wales.	Rhyl	49·9	43·8	57·3	11·2	31·2	793	1364	3·73
Wales.	Colwyn Bay	50·5	44·6	57·3	10·4	38·3	973	1381	3·77
Wales.	Llandudno	50·3	44·7	56·8	10·6	38·3	972	1391	3·80
Wales.	Aberystwyth	50·4	43·8	57·8	9·0	42·1	1070	1233	3·37
Wales.	Tenby	50·9	44·7	57·7	10·5	51·6	1311	1363	3·72
Midlands.	Harrogate	47·5	39·9	55·3	12·3	34·9	888	1196	3·27
Midlands.	Buxton	46·2	39·0	53·7	10·9	47·1	1198	1036	2·83
Midlands.	Leamington Spa	49·4	42·2	57·4	14·6	26·7	681	1172	3·20
Midlands.	Malvern	49·7	42·1	58·0	12·0	31·8	808	1309	3·58
Midlands.	Ross-on-Wye	50·0	43·2	58·4	14·3	28·7	727	1265	3·46
Midlands.	Cheltenham	50·6	43·2	58·6	13·0	27·1	688	1299	3·55
Midlands.	Bath	50·7	44·2	58·4	13·8	31·6	801	1189	3·25
England, E.	Cromer	?49·1	?40·5	?57·3	?	14·2	362	1601	4·37
England, E.	Yarmouth	50·0	41·7	58·6	11·6	21·0	532	1718	4·70
England, E.	Felixstowe	51·0	?42·0	59·9	10·0	20·8	529	?1842	?5·03
England, E.	Clacton-on-Sea	50·6	42·1	59·2	10·6	21·3	540	1673	4·57
England, E.	Southend-on-Sea	51·1	42·5	59·7	?14·2	19·0	484	1615	4·41

Comparative Statistics for the Year 1920—*continued.*

(Compiled exclusively from Meteorological Office data.)

	STATIONS.	MEAN TEMPERATURE. The Year.	MEAN TEMPERATURE. January and February	MEAN TEMPERATURE. July and August.	Mean Daily Range of Temp.	TOTAL RAINFALL. (In both British and Metric Units.)		DURATION OF SUNSHINE. Total.	DURATION OF SUNSHINE. Daily Mean.
Health Resorts *(continued)*:—		°	°	°	°	INCHES.	MILLIMETRES.	HOURS.	HOURS.
England, S.E.	Tunbridge Wells	50·1	42·3	57·9	14·6	25·1	638	1397	3·82
	Margate	52·1	43·8	60·1	10·9	17·8	452	1545	4·22
	Ramsgate	50·6	42·3	58·7	12·0	19·2	489	1695	4·63
	Folkestone	51·8	43·6	59·4	11·0	24·3	617	1623	4·43
	St. Leonards-on-Sea	51·3	43·5	58·9	10·5	26·6	675	1738	4·75
	Eastbourne	51·3	43·9	59·0	10·7	29·8	757	1783	4·87
	Seaford	?	42·8	58·6	?	?	?	?	?
	Brighton	51·3	43·2	59·2	10·4	27·2	692	1569	4·29
	Worthing	51·1	43·1	58·9	11·0	26·5	673	1689	4·61
	Littlehampton	?	?	?	?	?	?	?	?
	Bognor	50·8	43·5	58·5	10·2	29·2	739	1623	4·43
	Selsey Bill	51·6	44·1	59·3	12·0	29·1	738	1670	4·56
	Southsea	51·8	44·0	59·4	11·3	27·5	701	1588	4·34
	Bournemouth	50·6	43·2	58·0	12·6	29·2	742	1564	4·27
I.O.Wight.	Ryde	?	44·7	58·6	?	30·9	784	1483	4·05
	Sandown	51·9	44·5	59·4	10·8	31·9	809	1587	4·34
	Ventnor	52·1	44·7	59·5	9·5	30·1	765	1498	4·09
	Totland Bay	51·1	43·9	58·4	9·6	30·4	771	1578	4·31
England, S.W.	Weston-super-Mare	51·1	44·1	59·0	11·2	34·7	881	1250	3·42
	Ilfracombe	52·1	46·3	58·7	8·1	43·6	1108	1424	3·89
	Bude	51·0	45·0	58·0	11·8	37·2	947	1530	4·18
	Newquay	51·0	45·5	57·5	8·9	37·3	948	1523	4·16
	Weymouth	52·4	45·0	59·9	11·8	29·7	753	1567	4·28
	Exmouth	?	45·2	?	?	24·0	609	1420	3·88
	Teignmouth	52·3	45·8	59·6	11·5	31·8	807	1454	3·97
	Torquay	52·4	45·8	59·3	10·3	33·6	854	1592	4·35
	Paignton	51·6	45·4	58·7	13·0	35·2	895	1533	4·19
	Salcombe	?	?	?	?	35·4	901	1592	4·35
	Plymouth	51·9	45·6	58·4	10·4	35·3	896	1453	3·97
	Fowey	51·5	45·8	57·7	11·5	33·1	841	1521	4·16
	Falmouth	51·4	45·3	57·9	10·8	47·3	1203	1509	4·12
	Penzance	52·6	47·0	58·9	9·2	40·9	1041	1531	4·18
Channel Isles.	Scilly Isles (St. Mary's)	52·6	47·1	58·6	6·8	30·4	774	1565	4·28
	Guernsey (Brooklyn)	52·2	45·8	58·6	9·4	34·1	868	1847	5·05
	,, (Villa Carey)	52·8	45·9	59·3	9·6	32·7	831	1774	4·85
	Jersey (St. Aubin's)*	52·6	45·4	59·9	10·1	26·7	681	1720	4·70

* The Sunshine statistics are for St. Helier's.

Comparative Statistics for the Year 1920—*continued.*

(Compiled exclusively from Meteorological Office data.)

STATIONS.	MEAN TEMPERATURE. The Year.	MEAN TEMPERATURE. January and February	MEAN TEMPERATURE. July and August.	Mean Daily Range of Temp.	TOTAL RAINFALL. (In both British and Metric Units.)		DURATION OF SUNSHINE. Total.	DURATION OF SUNSHINE. Daily Mean.
	°	°	°	°	INCHES.	MILLIMETRES.	HOURS.	HOURS.
Southport	49·2	42·2	57·0	10·4	34·0	864	1276	3·49
Large Towns:—								
England. York	49·1	41·4	57·1	12·4	26·1	663	1081	2·95
Bradford	48·0	40·9	55·8	11·3	39·4	1000	1013	2·77
Burnley	47·7	40·6	55·3	11·9	43·0	1093	1021	2·79
Hull	49·5	41·9	58·3	13·6	25·7	651	?	?
Huddersfield	48·4	41·2	56·4	11·6	41·2	1046	1062	2·90
Bolton	48·7	41·2	56·3	11·3	49·4	1255	806	2·20
Manchester (Oldham Road)	50·1	43·0	57·5	10·8	41·6	1057	852	2·33
,, (Whitworth Park)	?	42·8	57·4	?	39·1	994	842	2·30
Sheffield	49·2	42·2	57·1	11·5	33·8	859	1083	2·96
Nottingham	49·0	41·2	57·2	14·3	25·5	650	1072	2·93
Norwich	50·0	41·4	58·7	14·0	24·0	611	1585	4·33
Birmingham	49·1	41·9	56·8	12·0	31·3	796	985	2·69
London (Westminster)	52·1	44·0	60·1	13·6	21·5	547	1242	3·39
Southampton	50·9	43·6	58·3	13·2	31·6	803	1439	3·93
Wales. Swansea	51·5	44·5	58·9	10·4	57·4	1459	1279	3·49
Cardiff	50·0	43·2	57·6	11·2	45·6	1158	1321	3·61
Notable Stations:—								
Scotland. Aberdeen Observatory	47·1	40·2	54·8	9·2‡	27·4	696	1381	3·77
Edinburgh (Royal Obs.)	47·3	40·4	55·1	10·4	27·5	697	1343	3·67
Glasgow Observatory	48·1	41·0	55·7	9·6‡	43·9	1113	?1025	?2·80
Paisley (Coats Obs.)	48·2	41·0	56·1	12·1	50·1	1273	1112	3·04
Eskdalemuir Magnetic Obs.	44·7	37·0	52·6	13·1	65·0	1652	1115	3·05
England. Lancaster (Gregg Obs.)	48·9	41·2	56·3	10·6	45·9	1166	1098	3·00
Stonyhurst College Obs.	48·6	41·1	56·3	10·5	45·9	1165	1094	2·99
Bidston Observatory	49·5	42·9	56·7	9·7	33·3	846	1256	3·43
Cambridge Botanic Garden	49·7	41·8	57·5	16·9	19·1	487	1514	4·14
Rothamsted Agric'l. Exp. Sta	48·7	40·8	56·6	14·2	25·7	653	1512	4·13
Oxford (Radcliffe Obs.)	50·0	42·8	57·6	13·4	25·5	647	1322	3·61
Benson Aerological Obs.	48·9	41·4	57·0	16·4	22·6	576	...	...
Camden Sq., N.W. (B.R.O.)	51·8	42·7	60·7	15·7†	23·6	599	...	...
Greenwich (Royal Obs.)	51·0	43·0	59·7	16·1†	21·5	546	1449	3·96
Richmond (Kew Obs.)	50·7	43·1	58·9	13·4‡	23·6	601	1295	3·54
S. Farnboro' Aviation M.O.	49·4	41·1	57·5	17·1	24·0	611	1416	3·87
Ireland. Armagh Observatory	48·7	42·2	56·0	12·8	36·3	922	1179	3·22
Dublin (City) *	50·6	44·7	57·4	10·5	34·0	863	1354	3·70
Cahirciveen (Valencia Obs.)	51·0	46·1	57·3	8·0‡	65·0	1651	1193	3·26

* The Sunshine statistics are for Phœnix Park.
† From instruments exposed in Glaisher's, and Airy's, instead of Stevenson's, Screens.
‡ From instruments in North-Wall Screens. That at Aberdeen is also 41 feet above the ground.