

Weather and the grass pollen content of the air

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Summary

Meteorological factors affecting the grass pollen content of the air-streams over London during the period 1961–70 are examined. Seasonal variations in pollen catch are eliminated by translating pollen concentrations into pollen units, and the effect of rain, temperature, sunshine, convection, wind direction and strength examined independently by the adjustment of the other parameters to standard values. Rain-fall of 2 mm or more on the day of observation reduces the pollen count. Wind direction and pollen catch are correlated with the areas of grassland in the 'home counties'. It is shown that airborne grass pollen concentrations are positively correlated with day maximum temperature and hours of bright sunshine when the pattern of pollen release is taken into account. Strong wind and convection decrease pollen concentrations since the pollen cloud is distributed through a deeper layer of air.

Introduction

The symptoms of pollenosis are affected by the weather. It is commonly observed that rain brings relief, and the glare of bright sunshine alone may increase the severity of the sufferer's eye symptoms. Blackley (1873) found the intensity of his own symptoms were related to the numbers of grass pollen grains in the air, and that rain removed pollen from the atmosphere. Cunningham (1873) reported heavy rainfall temporarily diminished the numbers of airborne spores and similar cells, and this was confirmed by Hirst (1953) who also noted the atmospheric concentration of pollens was quickly replenished if the weather became suitable for the rupture of anthers.

Blackley (1873), Hyde & Williams (1944), Hirst (1953) and Hamilton (1959) all recorded high atmospheric pollen concentrations on days with bright sunshine, and Hyde & Williams (1944) observed a low rate of pollen deposition from the air on sunless days. Hirst (1953) reported low concentrations in the air at night and during cool damp weather, and Hamilton (1959) reports an inverse correlation between grass pollen counts and relative humidity.

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The season when pollen occurs in the air is climatically determined. Hyde (1952) who considered spring rainfall and soil moisture important, found the June grass pollen catch did not accord with expectations based on rainfall in April and May. Davies, Denny & Newton (1963) report that in Liverpool in 1961, the curve for air-borne grass pollen rose 9 days later than that for London, and the season was 9 days shorter than London's. It was later reported (Davies, 1969b) that the earlier development of high concentrations of grass pollen in the air of London, as compared with Liverpool and in Glasgow, was associated with more rapidly rising values of accumulated temperature. Finding atmospheric spore and pollen concentrations at Davos were lower than in London, Davies (1969a,b) suggested this was at least in part due to the climatic features of valleys which are characterized by atmospheric stability at night and high convection during the day producing a rapid dilution of the locally generated spore clouds.

The purpose of this paper is to describe an investigation into the meteorological factors affecting the mean daily concentrations of grass pollen in the air over Central London. The work is based on a 10-year record of grass pollen concentrations (Table 1) measured at the site and by the methods described by Davies *et al.* (1963).

Table 1. Mean daily concentration of grass pollen per cubic metre of air over London

Month	Day	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
May	1	—	—	—	—	—	—*	10	—	—	—
	2	20	—	—	—	20	10	—	—	10	—
	3	—	—	—	10	50	10	—	—	30	—
	4	—	20	—	—	—	10	—	—	20	—
	5	—	—	—	—	—	—	10	—	30	—
	6	—	—	—	10	10	—	—	—	—	—
	7	—	—	—	—	10	—	—	—	60	—
	8	10	—	—	10	30	—	10	—	60	—
	9	—	—	—	—	10	10	—	—	—	—
	10	10	—	—	—	—	—	—	—	—	*
	11	—	—	—	—	10	10	—	—	—	—
	12	20	—	—	20	20	—	—	—	—	—
	13	—	—	—	—	10	20	—	—	10	—
	14	10	—	—	10	10	10	—	—	—	—
	15	—	—	—	—	—	20	—	—	—	—
	16	10	—	—	20	—	—	—	—	—	—
	17	—	—	—	10	—	10	—	10	—	*
	18	10	—	—	10	—	10	10	10	—	—
	19	—	10	—	10	—	—	—	—	—	—
	20	10	—	—	10	—	20	—	—	—	—
	21	—	10	—	—	—	—	—	—	—	—
	22	20	10	—	—	—	20	—	—	—	*
	23	40	—	10	50	—	—	—	—	—	—
	24	20	10	—	—	—	10	—	—	10	—
	25	—	—	—	40	10	—	—	—	—	—
	26	10	—	10	10	—	—	10	—	—	—
	27	—	—	10	—	—	20	20	—	—	—
	28	—	—	—	60	—	10	—	—	—	20
	29	—	—	—	40	—	10	—	—	20	—
	30	—	—	10	30	—	40	—	—	—	—
	31	20	—	—	10	—	—	10	50	—	10

* Underestimated counts due to malfunction of sampler.

Table 1. (cont.)

Month	Day	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
June	1	—	—	10	20	10	30	10	—	10	10
	2	20	—	10	—	—	20	—	30	20	10
	3	40	20	—	40	10	30	—	20	10	40
	4	80	—	—	30	—	40	10	—	—	40
	5	110	—	—	190	10	40	—	—	—	30
	6	210	20	—	140	10	20	—	20	—	10
	7	90	20	10	80	30	160	10	10	10	40
	8	40	30	20	350	—	90	—	10	60	50
	9	90	10	40	450	—	100	—	70	80	100
	10	110	50	50	510	10	320	40	70	60	90
	11	110	—	110	200	130	80	—	30	80	70
	12	20	10	380	210	140	170	50	80	80	90
	13	110	60	—	40	170	110	50	80	80	60
	14	320	50	—	70	220	310	80	100	70	20
	15	350	70	220	410	90	200	90	100	90	90
	16	270	70	50	720	—	20	210	20	—	30
	17	120	120	10	420	180	70	30	150	10	40
	18	340	90	20	—	130	180	240	350	60	60
	19	260	40	50	40	250	110	130	190	40	90
	20	210	30	220	70	240	50	120	10	40	160
	21	150	170	130	70*	70	120	210	120	40	150
	22	210	260	170	—*	10	40	20	20	70	250
	23	260	270	100	100	30	50	—	50	10	50
	24	290	120	60	270	130	70	—	—	240	—
	25	220	40	20	300	40	50	40	40	90	90
	26	60	80	170	80	160	30	50	40	110	200
	27	20	110	80	280	210	60	50	20	60	130
	28	220	130	10	60	410	220	110	60	180	40
	29	250	220	—	340	50	130	30	200	200	30
	30	80	140	40	240	80	300	180	100	190	10
July	1	60	130	70	180	10	210	50	10	270	10
	2	40	220	10	220	50	170	30	60	140	20
	3	110	70	40	110	80	90	60	20	100	10
	4	30	10	10	40	—	110	—	10	130	80
	5	60	20	50	100	20	10	120	60	—*	10*
	6	80	70	—	30	10	30	60	10	—	40
	7	140	190	50	180	—	30	110	30	60	110
	8	70	180	80	90	10	50	20	40	10	20
	9	110	40	100	20	60	30	90	20	20	10
	10	70	10	—	30	60	150	120	—	30	20
	11	—	10	10	100	10	100	80	20	110	10
	12	50	20	20	10	—	50	40	30	90	10
	13	20	80	20	290	110	30	30	10	70	70
	14	20	—	30	110	110	40	20	20	60	—
	15	—	—	—	70	—	30	10	—	20	10
	16	—	20	90	60	10	—	40	10	100	10
	17	10	60	10	50	10	—	50	20	40	50
	18	40	60	—	80	90	30	40	10	70	80
	19	30	10	40	10	100	—	10	80	10	—
	20	20	40	30	30	10	20	30	20	20	—
	21	50	10	—	—	20	20	40	20	10	20
	22	—	20	110	10	50	70	30	70	50	20
	23	10	30	50	40	—	20	10	10	30	40
	24	10	30	—	50	20	—	70	—	60	—
	25	40	90	10	70	—	—	10	10	30	—

Table 1. (*cont.*).

Month	Day	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
August	26	10	—	50	20	—	—	80	—	40	—
	27	20	—	—	10	—	—	—	—	10	—
	28	30	40	10	20	20	40	40	—	20	20
	29	20	40	30	30	10	—	30	10	—	—
	30	40	30	10	20	—	—	—	20	30	10
	31	—	50	20	40	40	—	10	10	10	60
	1	50	40	—	10	20	—	30	—	—	10
	2	10	—	—	10	—	—	10	—	—	10
	3	20	20	—	—	30	—	10	—	10	—
	4	10	20	—	50	10	40	—	—	20	20
	5	—	—	30	—	10	10	10	—	10	—
	6	—	20	—	20	30	—	—	10	10	—
	7	20	—	10	10	10	10	—	—	10	10
	8	10	—	—	—	10	20	—	—	10	—
	9	—	—	10	20	—	—	—	—	—	*
	10	10	40	—	30	—	20	—	—	10	—
	11	—	—	—	10	20	—	—	10	—	—
	12	10	10	—	—	20	20	—	—	—	—
	13	—	—	—	20	—	—	10	—	—	—
	14	—	10	—	—	10	10	10	—	—	10
	15	40	—	10	—	20	10	10	—	—	—
	16	—	10	—	—	30	30	20	—	—	10*
	17	20	—	—	—	10	20	—	—	*	10
	18	—	10	10	—	30	—	10	—	—	—
	19	10	10	—	—	—	20	10	—	—	—
	20	—	—	—	10	—	—	70	20	10	—
	21	—	—	10	10	—	—	10	10	10	—
	22	—	20	10	30	—	—	20	—	—	—
	23	—	10	20	—	—	—	—	—	—	—
	24	—	20	—	—	—	—	20	—	—	—
	25	10	—	—	10	—	—	20	—	—	—
	26	10	10	—	10	—	—	—	—	—	—
	27	10	—	—	10	—	—	—	—	—	—
	28	10	—	10	—	—	—	10	—	—	—
	29	20	10	—	—	—	10	—	—	—	—
	30	40	—	—	10	—	—	—	—	—	10
	31	10	—	—	—	—	—	—	10	*	—

Analysis of daily pollen counts and meteorological factors

In any study on the pollen content of the air, the principal biological factor to be considered is the pattern of pollen release throughout the season, a pattern which is modified on a day-to-day basis by the existing weather. This seasonal pattern can be referred to as the 'pollen phase'. The meteorological factors in approximate order of relative importance are rainfall, wind direction, day maximum temperature (which has a high negative correlation with day relative humidity), sunshine, wind force and convection.

As pollen counts were only available from one site in London, it was considered that a comparable degree of accuracy (or inaccuracy) would be obtained with data from one meteorological sample, namely the observations from Kew. Kew data was reinforced in two respects: the general wind direction for the day, divided into four main categories, north-east, south-east, south-west and north-west was deduced from

consideration of synoptic weather maps, only a relatively few days being left in the 'calm or light variable wind' category; the rainfall for the day and the previous night and day was assessed by reference to observations in the quarter from which the air was blowing into London.

The effect of rain

It has been observed that pollen concentrations are reduced by rain, and Blackley (1873) reported 'a fall of rain manifested itself at once, and so rapidly was the effect produced that often a fall of 5 or 10 min duration would, for a time, completely clear the air of pollen as well as of every other kind of solid matter'. Since no pollen is discharged into the air when the grass is wet, the numerical significance of rainfall was investigated by comparing the release pattern after rain with the 'general pattern'.

A simple classification of the daily counts* into low, 0-40; moderate, 50-140; high, 150-290; extreme, 300 or above, was used to establish a 'general pattern' after the start of the season in June and in July.

The percentage distribution for this 'general pattern' was:

	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Extreme</i>
June (after start)	29.4	42.5	21.2	6.9
July	68.8	28.0	3.2	0

In May and before the June start two-thirds of the days gave zero counts.

Rain between 06.00 and 18.00 hr

In the May and pre-start June period there were forty-seven occasions with 2 mm or more of rain. These were associated with thirty-eight zero counts against a general expectancy of thirty-one.

In the post-start June period there were thirty-two occasions with the following distribution:

	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Extreme</i>
Actual	22	8	1	1
Expected	9.4	13.6	6.8	2.2

and with a chi-squared value of 24.6 and 2 degrees of freedom this is clearly a significant result.

For the thirty-nine occasions in July the result was

	<i>Low</i>	<i>Moderate</i>	<i>High</i>
Actual	36	3	0
Expected	26.8	10.9	1.3

and with a chi-squared value of 10.1 and one degree of freedom this is also significant.

It is therefore reasonable to regard days with 2 mm or more of rain as in a class apart; and it is noteworthy that this amount of precipitation is slightly lower than the daily amount of evaporation from a wet grassed surface.

Rainfalls of 5 or 10 mm or more the previous day, previous night and previous 36 hr were similarly investigated and it was found that rainfall prior to 06.00 hours on the day in question had no effect on the mean daily pollen count.

* Mean number of grass pollen grains per cubic metre of air.

Effect of wind direction

Since it appeared desirable that daily comparisons should not be made without some consideration of the seasonal total, the daily pollen counts were translated into 'pollen units' by dividing the count by the seasonal total in 1000 units. In this manner the pollen potential of the season was mainly eliminated and each of the 10 years could be treated on a comparable basis.

Before attempting to specify a pattern of pollen release it is appropriate to try and remove the effect of wind direction. The distribution of grassland around London is irregular. Examination of the June returns Agricultural Statistics England and Wales, published annually by H.M.S.O., showed that in the 'home counties' the percentage grassland was as follows:

	1961	1968	Mean
NW (Bucks. + $\frac{1}{2}$ Herts.)	46	40	43
NE (Essex + $\frac{1}{2}$ Herts.)	24	18.5	21
SE (Kent)	36	32	34
SW (Hants. and Surrey)	39	37	38

Taking the south-west wind potential as a standard, this suggests that pollen catches from a north-west wind are likely to be about 10% higher, from the north-east 40% lower, and from the south-east 25% lower (taking into account the fact that the fetch from the sampling site to Kent covers a long stretch of built-up area).

This theoretical estimate may be confirmed by reference to the actual post-start June data. If all the days with 2 mm of rain or more, with sunshine less than 2 hr, and with a day maximum below 18°C are omitted, then the average pollen unit for each value of day maximum temperature increased at a rate of approximately 4 units per °C.

With the days' units then adjusted to a base of 24°C and the results averaged with respect to wind direction, the following results were obtained; north-west, 48; north-east, 30; south-east, 37.5; and south-west, 45; which is not inconsistent with the theoretical results.

A value for calm days is difficult to ascribe, but a medium adjustment of 20% lower than south-west appears to be reasonable.

Pollen release pattern

With the 'pollen unit' data for June and July adjusted each day to a south-west wind direction standard by the values deduced above, it becomes possible to find an approximate release pattern. It is not possible to do this on a calendar day basis, because of the variation in the start from year to year. The proportion of the seasonal total which had already been released was therefore chosen as a reference base; and in terms of pollen units, this effectively is the percentage already released before the day in question. The pollen units were averaged over 5% zones with the results given in Table 2 and illustrated in Fig. 1.

It may be assumed that within each 5% range there is a similar distribution of meteorological variables such as temperature wind and sunshine, and that errors will be removed by the graphical smoothing.

Using the smoothed figures, all 'pollen unit' data may be adjusted to the mean of 20 units so that the effect of phase can be removed.

Table 2.

Pollen already released	Mean pollen units	Graphically smoothed
0- 5	5.7	6
5-10	18.8	19
10-15	32.5	30
15-20	40.2	36
20-25	32.8	39
25-30	33.6	41
30-35	44.0	41
35-40	34.3	39
40-45	38.7	37
45-50	30.4	34
50-55	22.5	31
55-60	36.0	28
60-65	29.2	25
65-70	20.0	22
70-75	20.4	19
75-80	12.8	15
80-85	9.2	12
85-90	10.9	9
Mean 20		

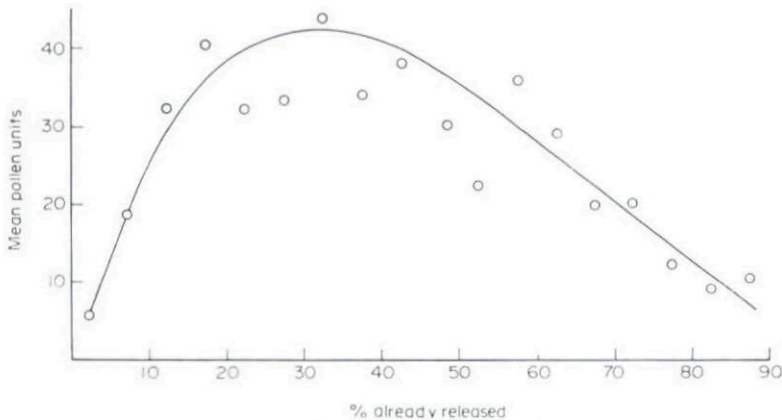


Fig. 1. The seasonal release of grass pollen shown as the 'pollen phase' in terms of the percentage already released before the day in question.

Effect of maximum temperature

If the pollen counts (on days with less than 2 mm rain) are converted to 'pollen units', adjusted to a south-west standard wind direction, and adjusted for pollen release phase in the above manner, the results can be averaged with regard to maximum temperature as shown in Table 3.

These figures are illustrated in Fig. 2, which suggests that despite the high linear correlation throughout the range, an adjustment to a standard maximum temperature of 22°C can be made by a factor of 2.5 units per °C below 22 (minimum 14) and of 1.5 units per °C above 22 (maximum 30).

Table 3.

Day maximum	Mean adjusted units
14	1.5
15	4.0
16	3.2
17	7.3
18	9.2
19	13.3
20	15.3
21	19.4
22	20.1
23	28.2
24	25.3
25	24.0
26	25.8
27	29.5
28 or above	31.0

The correlation between these two sets of figures is 0.97.

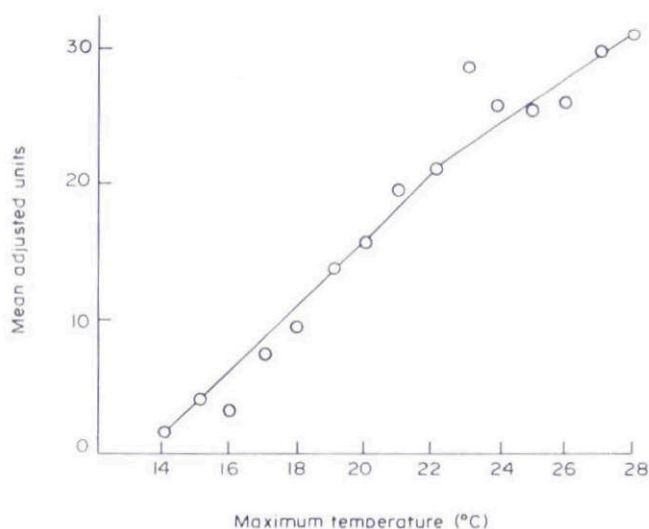


Fig. 2. Maximum daily temperature and the airborne grass pollen concentration for the day in mean adjusted pollen units.

This does not contradict the 4 units per °C quoted previously as that refers to unadjusted units.

Effect of sunshine

The units of days with less than 2 mm rain, adjusted for wind direction (base south-west), pollen phase (base 20) and maximum temperature (base 22°C) were then examined with respect to hours of bright sunshine with the results shown in Table 4.

These figures are illustrated in Fig. 3, which suggests that an adjustment to a

Table 4.

Hours of sunshine	Mean adjusted units
0	16.6
1	17.3
2	22.6
3	17.7
4	17.6
5	20.2
6	22.0
7	20.2
8	23.6
9	20.2
10	24.0
11	24.2
12	24.5
13	23.6
14	28.3
15	27.2

Correlation between these two sets of figures is 0.86.

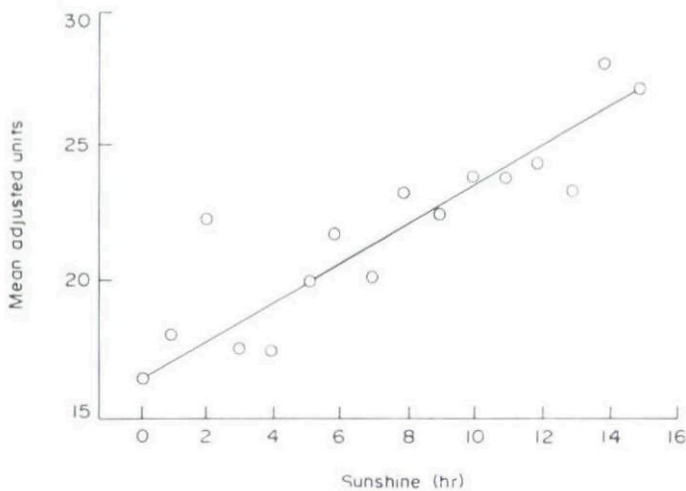


Fig. 3. Daily sunshine and the airborne grass pollen concentration for the day in mean adjusted pollen units.

standard of 7 hr sunshine can be made by an approximate factor of 1 unit per hr of sunshine (added when below 7, subtracted when above).

Effect of wind and convection

The extent of convection was judged by the reporting of large cumulus or cumulonimbus clouds at the mid-day Kew observation.

The mid-day wind speed in knots at Kew was also taken as representing the wind strength over the main pollen catch period.

Table 5.

Wind speed	Mean adjusted units	
	Days with little or no convection*	Days with considerable convection†
0-2	32.2	24.6
3-5	25.0	22.4
6-8	23.0	20.8
9-11	21.5	19.3
12-14	18.4	19.6
15-17	18.8	19.0
18-20	(18.2)	(20.0)

* Correlation -0.94. † Correlation -0.87.

The 'pollen units' on non-wet days, adjusted for wind direction, 'pollen phase', maximum temperature and sunshine were then averaged over 8 knot wind ranges with the results given in Table 5. (Since there were very few occasions with wind in the 18-20 knot range, this mean is incomparable with the remainder.)

It may be concluded that the pollen count is appreciably lower on days with most wind and most convection, and that this is a result of the dispersion of the released pollen throughout a deeper layer of air so that the catch near the surface is reduced.

As the wind strength effect may have been removed in part by the sunshine adjustment, the above analysis was repeated on units adjusted for pollen phase, wind direction and temperature only, with results given in Table 6. This data is illustrated in Fig. 4.

The approximate adjustment for wind speed was chosen to be 1 unit per knot on low convection days, and a quarter unit per knot for strong convection days. The standard for adjustment was selected as 8 knots and winds over 16 knots were counted as 16.

Revised pattern of pollen release

With adjustments having been selected for wind direction, maximum temperature,

Table 6.

Wind speed	Mean adjusted units (sunshine omitted)	
	Little or no convection*	Considerable convection†
0-2	31.2	22.5
3-5	25.8	20.5
6-8	24.7	19.5
9-11	21.1	18.4
12-14	19.2	19.0
15-17	18.7	17.7
18-20	(18.4)	(17.3)

* Correlation -0.94. † Correlation -0.97.

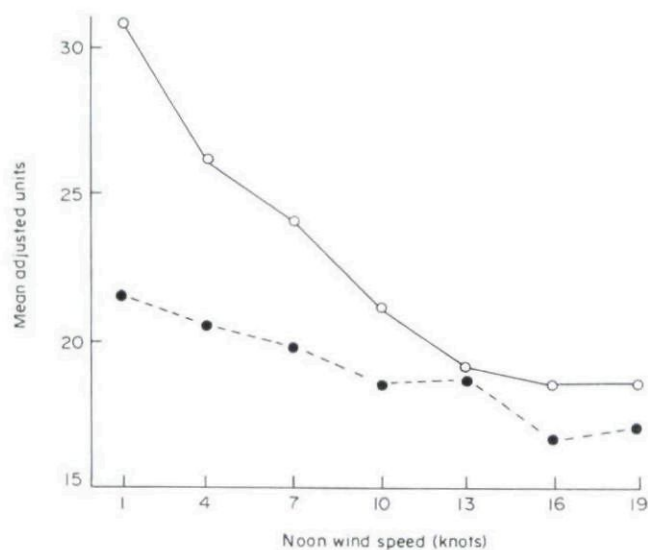


Fig. 4. Effect of wind speed and convection on the grass pollen content of the air. Solid line, no convection; broken line, convection.

Table 7.

Pollen already released		Mean adjusted units (rain below 2 mm)		Mean adjusted units (rain 2 mm or more)	
%	Total occasions	actual	smoothed	Total occasions	smoothed
0-5	48	11.0		2	
5-10	49	20.6	18.6	2	25.6
10-15	17	33.8	27.1	1	34.0
15-20	16	40.5	36.6	2	27.7
20-25	16	36.3	39.0	3	26.9
25-30	16	40.0	41.1	2	21.2
30-35	14	47.9	42.2	1	21.2
35-40	10	37.9	41.6	1	15.5
40-45	14	37.8	36.5	4	24.5
45-50	12	33.7	33.5	3	24.0
50-55	21	30.5	32.4	4	30.2
55-60	15	40.5	31.5	4	26.0
60-65	16	29.1	29.4	2	28.4
65-70	20	25.0	25.5	1	18.7
70-75	25	23.5	19.2	5	15.9
75-80	36	13.2	16.0	6	16.5
80-85	49	14.4	14.1	4	17.6
85-90	44	14.6	12.4	4	16.7
90-95	77	9.8	10.7	14	15.5
95-	21	5.8		5	

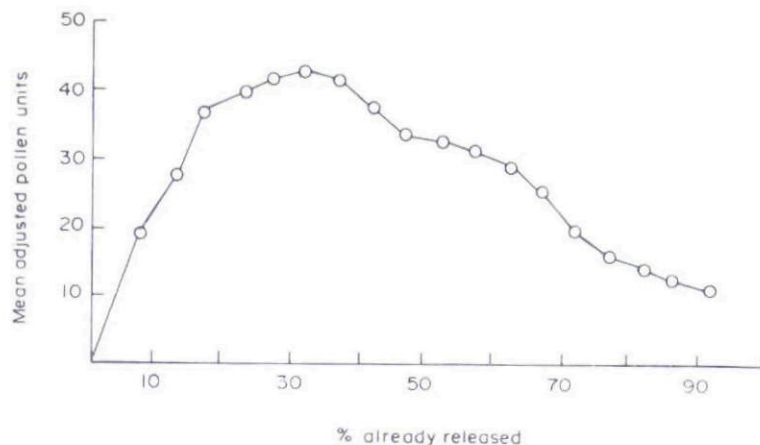


Fig. 5. The 'pollen release pattern' after adjustments to standard wind direction, maximum temperature, sunshine, wind force and convection.

sunshine, wind force and convection, and these applied to the observed pollen units a reappraisal can be made of the pollen release pattern with the results (using numerical smoothing) for June and July, shown in Table 7 and Fig 5.

The high 55–60% sample almost disappears in the numerical smoothing (by overlapping triads), but the final curve shows a slight levelling out of the otherwise even decrease after the peak about 30–35%. This may be an accident of sampling, or it may imply a release of pollen from a later maturing variety of grass.

The effect of rain over 2 mm is difficult to interpret owing to the small number of occasions involved, but it is clear that the main reduction effect is confined to the 15–70% range and is of the order of one third to one half.

Discussion

The meteorological factors affecting the grass pollen content of the air over a 10 year period, have each been examined independently by the adjustment of the others to standard values. The amount of pollen in the air varies from season to season and to eliminate this effect in the work described, the daily pollen counts were translated into 'pollen units' by dividing each count by the seasonal total in units of a 1000.

It has been shown that rainfall of over 2 mm or more between 06.00 and 18.00 hours on the day in question, significantly lowers the grass pollen content of the air, and it is noted that this amount of precipitation is slightly lower than the daily amount of evaporation from a wet grassed surface. Rain falls of 4 or 10 mm or more during the day or night previous to 06.00 hr on the day in question, had no effect on the mean daily pollen count.

A theoretical estimate based on the percentages of grassland in the quarters adjacent to London, suggested a south-west wind gave standard or average pollen counts, winds from the north-east and south-east sector lower counts, whilst winds from the north-west produced higher counts. After excluding days with 2 mm or more rain, days with less than 2 hr sunshine and a temperature maximum of 18°C and with the daily 'pollen units' adjusted to a base temperature of 24°C the results when averaged with respect to wind direction gave a good agreement with the theoretical estimates based on the amounts of grassland upwind. This not only indicates the

importance of wind direction on the grass pollen content of the air, but supports the conclusion (Davies, 1969) that the bulk of the spore clouds airborne over London are of an exogenous origin.

With the 'pollen unit' data for June and July adjusted each day to the standard south-west wind direction, a pollen release phase was calculated in terms of the percentage already released before the day in question (Fig. 1). Using smoothed figures (Table 2) the pollen unit data was adjusted to the mean of 20 units to remove the effect of phase. Then, with the daily pollen counts (on days with less than 2 mm rain) converted to 'pollen units' adjusted to a south-west wind standard, and adjusted for pollen release phase, the results were averaged with respect to maximum temperature (Table 3). It was found that an adjustment to a standard maximum temperature of 22°C could be made by a factor of 2.5 units per °C between 22 and 14°C, and by a factor of 1.5 units per °C above 22 to a maximum of 30°C.

The effect of sunshine was examined by taking the pollen units of days with less than 2 mm of rain, adjusted to the standard south-west wind, pollen phase (base 20) and daily maximum temperature (base 22°C) and classifying with respect to hours of bright sunshine (Table 4). These results suggest an adjustment to a standard of 7 hr of sunshine can be made by an approximate factor of 1 pollen unit per hr of sunshine, added when below 7 but subtracted when above.

The effect of wind and convection were studied with the daily pollen units adjusted as above. Convection was judged by the reporting of large cumulus or cumulo-nimbus clouds at the mid-day Kew observation (Fig. 4). It is concluded that the pollen count is appreciably lower on days with most wind and most convection, because the pollen is dispersed through a deeper layer of air than it is on days with little wind and convection. The pollen count is reduced by 1 unit per knot of wind speed in the range from 8–16 knots.

The meteorological parameters described have been calculated with a view to improving the efficacy of forecasts of pollen concentrations. In the past, such forecasts have been simply an informed opinion as to whether the observed concentration would be higher or lower in the next 24 hr, and have been based on an interpretation of a special weather forecast prepared by the staff of the London Weather Centre. The results obtained should represent an advance towards the evolution of numerical forecasts.

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