

# Pollen and Mold Spores

## An Atmospheric and Field Survey in Los Angeles

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■ *A two-year survey of pollen and mold spores by the gravity slide method revealed that there are no clear-cut tree, grass or weed pollen seasons in California.*

*Pollen counts should be correlated with field studies to distinguish the various plants whose pollen have a similar appearance.*

*Spores of Alternaria and Hormodendrum, whose importance in allergic disease of the respiratory tract has been well established for many years, were found all during the year. More hormodendrum spores were collected than the total of all other pollens combined.*

IN COMMENTING on the cause of hay fever, Elliotson<sup>3</sup> in 1831 stated that the affliction "certainly . . . does not depend upon the hay . . . but upon the flower of the grass, and probably upon the pollen."

Forty years elapsed before Blackley<sup>1</sup> gave conclusive experimental proof that grass pollen is the cause of "summer catarrh." He observed that these pollens, when injected subcutaneously, produced a reaction similar to that of the common scratch test. Blackley was the first to take a pollen count by means of coated glass slides. He even sent them aloft on kites to determine the pollen dispersal at various altitudes.

Since that time, allergists all over the world have been making "routine" pollen counts. They have devised various methods to check the accuracy of these counts, and to evaluate them in terms of their clinical significance. Small<sup>7</sup> combined pollen

counts with botanical surveys, he even mounted slides on his car to check the atmosphere pollen in various areas of Southern California.

Several years ago one of us<sup>6</sup> did a field survey of giant ragweed (*Ambrosia trifida*) in Iowa City, Iowa, finding 146 acres of ragweed growing in a city with a total area of 3,315 acres. During the subsequent fall pollen season, 10 sampling sites were selected to determine the local dispersal of ragweed pollen. Standard samplers were placed six feet above the ground and pollen counts on them were compared with those from a centrally located sampler 75 feet above the ground. It was found that the samples obtained at the centrally located site were representative of the pollen counts at ground level.

### Materials and Methods

The present study covered a period of a little over two years beginning in August 1962, and ending in September 1964. The standard technique for atmospheric pollen sampling by the gravity slide method was used. It is approved by the American Academy of Allergy, and has been used in reporting pollen studies since 1946.<sup>2</sup>

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Microscopic slides coated with a thin film of vaseline were exposed for 24 hours in a standard gravity sampling device. The sampler designed and described by Durham<sup>2</sup> has been in general use for many years.

Slides were exposed daily in Huntington Park, California, from August 1962 through September 1964, and at a second sampling site at the Los Angeles County General Hospital from July through September 1964. At both stations the sampler was located on the roof, free of obstructions to cross-currents of air.

All the pollen grains and mold spores on two square centimeters of slide area were counted without staining. The result is reported in terms of one square centimeter of slide area per 24 hours.

Daily climatological data was available from the weather bureau. The average monthly temperature during the period of this study was 65°F, with a variation of 55° to 77°. Winds were mainly westerly at an average speed of six miles an hour. The average amount of sunshine was 77.5 per cent, with a variation from 52 to 96 per cent. The relative humidity averaged 45, with a range of 24 to 56. The total rainfall during the first year of the study was 8.38 inches and during the second year it was 7.93 inches, compared with a normal yearly total of 14.68 inches.

In conjunction with the pollen counts, we made frequent field surveys to observe the current flora and correlate the observations with pollen counts. This is very helpful in Southern California where there are large numbers of wind-pollinated plants, many of which can only be identified as to families on the basis of their pollen structures.

Chart 1 shows the pollination times of the most important plants whose pollen was found on our slides during this study. The number in parentheses signifies the total yearly count per square centimeter of slide area. A glance at this graph will show that Southern California, unlike other areas of the United States, does not have clear-cut tree, grass or weed seasons. In Southern California we have seen walnut pollen as early as January in some years. The peak incidence occurs in April. The most common species are *Juglans regia*, an English walnut that at one time was widely cultivated in groves, and *J. californica*, which is a native tree. Oak pollen, which also has its peak incidence in April, is the most abundant of all pollens seen on the slides. *Quercus agrifolia* is the most important species of oak in this area.

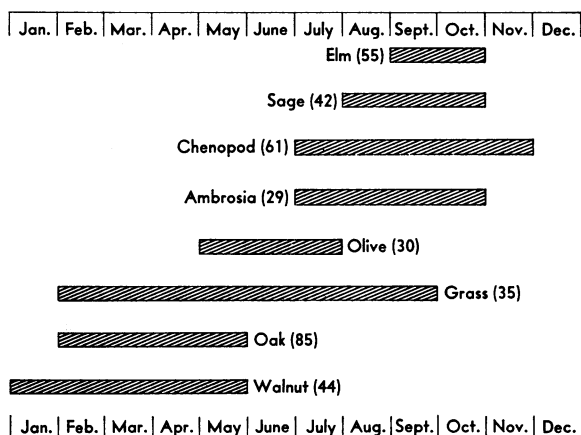


Chart 1. Pollination times and yearly total of pollens per square centimeter of slide area. Data collected from August 1962 through September 1964.

*Olea europaea* or olive, the other important spring tree pollen, has a peak incidence of pollen in May. Sycamore pollen is found frequently but is of less importance clinically.

Grass pollen was found on the slides from February through September. The counts were low, however, as has been reported in most pollen surveys in California and in other areas of the United States. Nevertheless, the large number of people who have positive skin test reactions and the frequent clinical correlations, leave no doubt as to the importance of grass pollens. The following is a list of grasses which were most commonly found on our field trips:

1. Spring grasses—
  - a. *Cynodon dactylon*—bermuda
  - b. *Avena fatua*—wild oats
  - c. *Bromus rigidus*—broncho grass
  - d. *Lolium perenne* and *L. multiflorum*—English and Italian rye grass
  - e. *Poa annua* and *P. pratensis*—annual Kentucky blue grass.
2. Late spring and fall grasses—
  - a. *Cynodon dactylon*
  - b. *Poa annua*
  - c. *Holcus halepensis*—Johnson grass

Bermuda is the most common grass. It is seen all during the spring, summer and early fall. Johnson grass is commonly seen in large stands as late as December.

Many other species of grasses were found but they are less abundant, produce insignificant amounts of pollen or are not thought to be important clinically.

Pollens of the family *Chenopodiaceae* are found as early as January but do not occur in large num-

bers until July. They reach their peak incidence in August and September. Since the pollen grains of many Chenopods are quite similar, one kind to another, our field surveys were very helpful in determining which of these weeds were pollinating. The following is a list of the Chenopods in their approximate order of appearance of pollen from them in the Los Angeles area:

*Chenopodium murale*—early spring  
*Chenopodium album* (lamb's quarter)—summer  
*Amaranthus retroflexus* (pigweed)—late summer  
*Salsola kali* (Russian thistle)—fall

We again encountered the problem of similarity of pollen structure in the family *Ambrosiaceae*, which includes the following commonly seen weeds:

*Ambrosia psilostachya* (western ragweed)  
*Franseria acanthacarpa* (false ragweed)  
*Franseria bipinnatifida* (no common name)

Their pollen is seen on the slides from July through October, with the peak in September. However, *A. psilostachya* was seen growing as late as January.

*Artemisia*, or sage was found from August through October. The most common of the species is *Artemisia californica* or costal sage.

Pollen of *Plantago lanciolata* or English plantain was found in small numbers during the spring and summer. As is commonly found in this area, the pollen counts do not reflect the large numbers of these plants found growing during these months. Perhaps this is because the amount of pollen produced by one plantain weed is much less than that produced by one of *Ambrosia psilostachya* or *Chenopodium album*.

Elm, *Ulmus parvifolia* and *U. pumila*, the Asiatic or Chinese elm, is the last important pollen in Southern California in the calendar year. It produces a lot of pollen in a short time—September and October—and is the cause of much discomfort to the allergic patient. The clinical importance of elm is well supported by positive skin test reactions.

These pollination times, as we have noted, are subject to variation from year to year, depending upon climatic conditions, which we have discussed elsewhere.<sup>6</sup> Since the pollen seasons in Southern California are not clear-cut, probably desensitization the year around would be of most benefit to pollen-sensitive persons living in the area.

### Fungus Spores

The importance of atmospheric mold spores in clinical allergy has been well established for many years.<sup>4</sup> Again it was Blackley who, in the course of his investigations into the causes of hay fever,

tested the influence of molds. After inhaling spores from penicillium cultures, he felt severe tightness in the chest associated with "bronchial catarrh." In our study, spores of *Hormodendrum* and *Alternaria* were found on slides all during the year. An attempt was made to count the individual spores in all clumps. On the basis of a yearly average, *Hormodendrum* spores were twice as common as *Alternaria*, and were about one and a half times as prevalent as all other pollens combined.

There was no seasonal pattern in the incidence of mold spores, but rather a wide fluctuation from day to day. This was previously reported before by Rooks and Shapiro.<sup>5</sup> At that time, we had the opportunity to study the hourly incidence of these spores, using a volumetric sampler. We found that every day was characterized by abrupt hourly changes in the number of spores.

A comparison of these two spores in terms of a volumetric sampler and a 24-hour gravity slide is interesting. On one occasion, a slide count of 22 *Alternaria* represented 776 spores collected volumetrically, and 22 *Hormodendrum* represented 3,416 collected volumetrically. On another day a slide count of 19 *Alternaria* represented 3,000, and 10 *Hormodendrum* represented 59,700 spores collected volumetrically during the same 24-hour period.

These changing daily ratios indicate that the only interpretation which can be placed on gravity slide spore counts is that they show the two spores were airborne on a given day. They also indicate the extent to which the allergic person is exposed to mold spores all during the year.

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