

The Journal of

Allergy

VOL. 30, NO. 4

JULY—AUGUST, 1959

ORIGINAL ARTICLES

The Effects of a Ragweed Control Program on Ragweed Pollen Counts

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NEW YORK CITY has been engaged in a program of ragweed control for a number of years. Despite the fact that the ragweed control efforts have fallen far short of the goal of complete or almost complete elimination of ragweed within the city, the program was costly. In 1956, when only 35 per cent of the estimated 9,000 acres of ragweed in the five boroughs of New York City were treated, the approximate total cost of the program was \$92,000.00. There arises the obvious question: "What are the city's taxpayers getting for this money?"

Programs that have emotional appeal and the support of groups of dedicated persons, such as the hay fever sufferers, are most likely to be badly distorted by hunches or theories in the absence of facts. Prominent allergists, as well as some members of the staff of the Department of Health, have been critical of both the basic premises of the ragweed control program and its operation in New York City. Therefore, the Department of Health decided to attempt an evaluation of the New York City program during the summer of 1956.

The study was designed to test two hypotheses, based on the medically accepted dictum that ragweed hay fever is caused by ragweed pollen. First, the study proposed to determine whether the almost total eradication of ragweed in one borough would result in materially lower pollen concentrations in that borough than in the others not so treated. Second, the study was designed to provide information on whether ragweed hay fever sufferers in the treated borough experienced less frequent or less severe symptoms than hay fever sufferers in the other boroughs. The study of ragweed pollen concentrations is the subject of this article. The relationship of control efforts to symptoms will be discussed in a subsequent report.

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Received for publication Dec. 2, 1958.

A third hypothesis, which the study was unsuccessful in testing, was suggested by Dr. Roger P. Wodehouse of the Lederle Laboratories. Laboratory experience had shown that the antigenicity of pollen decreased on exposure to

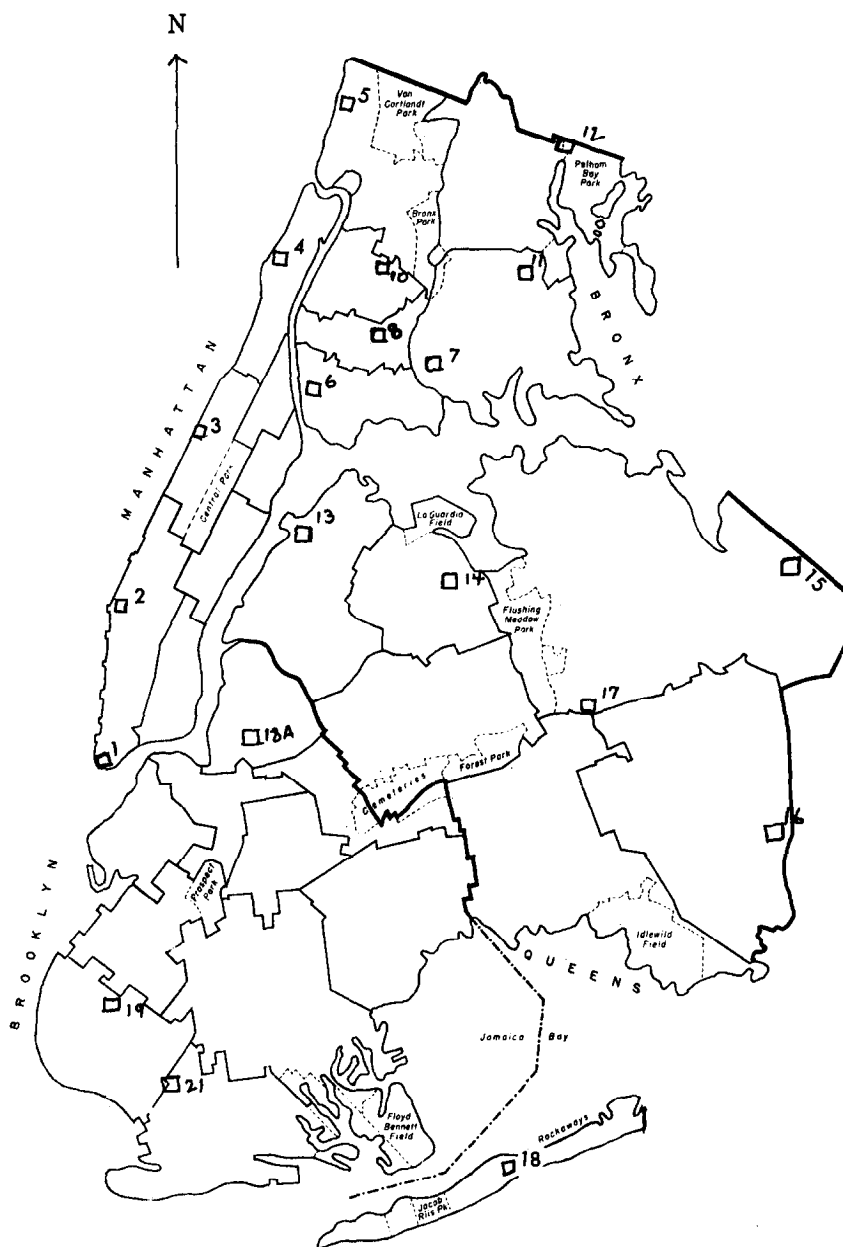


Fig. 1.

atmospheric conditions and with age as measured in days. On the basis of these laboratory findings, the hypothesis was advanced that pollen transported for considerable distances by wind currents and subjected to periods of drying

or wetting loses antigenic potency. If this assumption were correct, a grain of pollen from a neighborhood plant would be a much more potent producer of symptoms than a grain of pollen that had been wind-borne over many miles. Unfortunately, the study was not able to collect and supply Dr. Wodehouse with enough material to decide this question of antigenicity.

METHOD

New York City covers an area of 319 square miles: 41 in the Bronx, 80 in Brooklyn, 22 in Manhattan, 119 in Queens, and 57 in Richmond. Because only one pollen collecting station was established in Richmond, data from this borough were not included in the analysis.

In 1956 the Bronx was estimated to have 2,000 acres of ragweed; Brooklyn, 2,500 acres; Manhattan, 35 acres; and Queens, 2,660 acres. An intensive program of ragweed eradication was undertaken in the Bronx, while "token" programs were carried out in the other boroughs. Treatment, begun on June 20, consisted of spraying with 2, 4-D. The "token" program in Manhattan succeeded in spraying 100 per cent of the very limited ragweed acreage in that borough. In the Bronx, 97 per cent of the ragweed acreage was treated; in Queens, 31 per cent; and in Brooklyn, 6 per cent.

TABLE I. LOCATION OF TWENTY-ONE RAGWEED POLLEN COLLECTING STATIONS IN FOUR BOROUGHES OF NEW YORK CITY IN AUGUST AND SEPTEMBER, 1956

STATION NO.	BOROUGH	LOCATION
1	Manhattan	Old Slip and South St.
2	Manhattan	303 Ninth Ave.
3	Manhattan	150 West 68th St.
4	Manhattan	600 West 168th St.
5	Bronx	6 Peret St.
6	Bronx	349 East 140th St.
7	Bronx	661 Prospect Ave.
8	Bronx	1309 Fulton Ave.
10	Bronx	1826 Arthur Ave.
11	Bronx	2527 Globe Ave.
12	Bronx	4109 White Plains Ave.
13	Queens	12-26 31st Ave.
14	Queens	34-33 Junction Blvd.
15	Queens	44-01 244th St.
16	Queens	254-20 Union Tpke.
17	Queens	90-37 Parsons Blvd.
18	Queens	67-10 Rockaway Beach Blvd.
18A	Brooklyn	88 India St.
19	Brooklyn	186 Grove St.
20	Brooklyn	7918 Third Ave.
21	Brooklyn	1601 Avenue S

A number of pollen collecting stations were established in each borough. Seven stations were established in the Bronx, six in Queens, and four each in Brooklyn and Manhattan. The location of the stations is recorded in Table I and Fig. 1. Slides were collected according to the gravimetric method of Durham.

Arrangements were made for the daily collection of slides from each of the stations, but because of administrative difficulties only 84 per cent of the

daily counts from the total of twenty-one stations were obtained. In Brooklyn, 78 per cent of the slides were collected and read; in Manhattan, 81 per cent; in Queens, 86 per cent; and in the Bronx, 87 per cent. The percentage of the total possible daily pollen counts actually obtained in the stations of the Bronx and Queens was significantly* higher than in Brooklyn and Manhattan. A more detailed record of the percentage of daily pollen counts obtained appears in Table II.

TABLE II. PERCENTAGE OF TOTAL POSSIBLE DAILY POLLEN COUNTS OBTAINED

DATE	BRONX	BROOKLYN	MAN-HATTAN	QUEENS	FOUR BOROUGHES
August					
1-10	81.4	85.0	92.5	85.0	85.2
11-20	90.0	77.5	87.5	88.3	86.7
21-31	93.5	92.5	79.5	95.4	89.6
September					
1-10	81.4	75.0	85.0	78.3	80.0
11-20	88.6	85.0	77.5	86.7	85.2
21-30	88.6	62.5	62.5	78.3	75.7
August and September	87.4	78.3	80.7	85.5	83.8

The incompleteness of pollen count data presented some difficulties in borough comparisons. On those days on which no pollen counts had been made in any of the collecting stations in a borough—and this occurred on only three days in Brooklyn—obviously no comparisons could be made between the pollen counts of that and other boroughs. For other days on which only partial data were available, the missing counts were estimated on the basis of the actual counts on that day in the other collecting stations in the borough and the general relative magnitude of the counts of these other stations to the counts obtained in the station for which the estimate was being made.

These estimates are admittedly crude. In defense of their use, it can be said that (1) necessity dictated some such treatment of the data; (2) estimated counts constituted only 15 per cent of the total counts and therefore did not greatly influence the results obtained; and (3) the general method of using an average of counts from a number of collecting stations in a borough is, at best, no more than a crude index of pollen concentrations in that locality. A different location of collecting stations in the borough might very well have yielded different results. Really valid data for any area of this size can be obtained only by employing many more collecting stations located throughout the area on a random or representative basis. If ragweed hay fever, rather than pollen concentrations themselves, is the ultimate objective of the study, then consideration must be given to concentration of population as one of the variables in choosing a representative sample. The Department of Health was not prepared to undertake an extensive study of this nature but felt that the method used, crude as it is, might still yield revealing information for the purposes of this study.

*Throughout this article an occurrence that could be attributed to chance less than one time in twenty is considered significant.

RESULTS

Data from twenty-one collecting stations in New York City (excluding the borough of Richmond) showed no ragweed pollen during the first week of August. Small amounts of pollen were reported for the first time from one of the stations in the city on August 8. After this date an increasing number of stations began to report pollen, so that the average ragweed pollen counts for the city tended to build up somewhat irregularly until counts of 1 pollen grain per square centimeter on August 14 and 2 grains per square centimeter on August 16 were reached (Table III, and Fig. 2). The first minor peak occurred on August 17, when the average count rose to 6; the count then declined somewhat irregularly to 2 on both August 22 and August 23.

RAGWEED POLLEN COUNTS IN NEW YORK CITY, excluding RICHMOND

Average of twenty-one collecting stations.

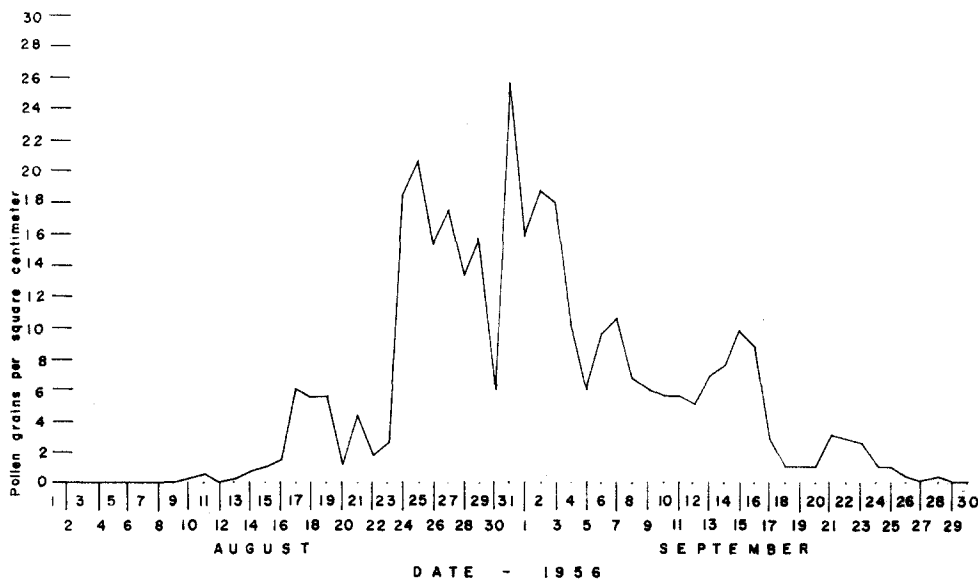


Fig. 2.

The first major peak occurred on August 24 with an abrupt rise of the count to 19. On August 25 the count was 20. It then fell in an irregular, steplike fashion and reached a low of 6 on August 30.

The highest count of the season, 26, occurred on August 31. This was a sharp rise from the day before and was followed by a rather sharp fall to 16 on September 1. The count then remained at about this level on September 2 and 3, showed a steep decline on September 4, and reached 6 grains per square centimeter on September 5.

For the following eleven days, from September 6 to and including September 16, the count varied between 5 and 10. From September 17 on, the

TABLE III. RAGWEED POLLEN COUNTS AND WEATHER CONDITIONS IN NEW YORK CITY,
EXCLUDING RICHMOND, IN AUGUST AND SEPTEMBER, 1956

DATE	WIND DIRECTION (1)	WIND VELOCITY (2)	TEMPERATURE (3)	HUMIDITY (4)	PRECIPITATION (5)	NEW YORK CITY, EXCEPT RICHMOND (6)	BRONX (7)	BROOKLYN (8)	MANHATTAN (9)	QUEENS (10)
<i>August</i>										
1	S	7.8	76	76	0	0	0	0	0	0
2	N	11.2	73	60	T*	0	0	0	0	0
3	N	9.1	71	66	0	0	0	0	0	0
4	SW	11.0	72	62	0	0	0	0	0	0
5	E	8.3	67	82	0.13	0	0	0	0	0
6	NE	8.1	68	96	0.70	0	0	0	0	0
7	NE	10.2	73	91	T	0	0	0	0	0
8	W	12.8	78	84	0	0.1	0	0	0.5	0
9	SW	13.5	80	70	0	0.1	0	0	0.5	0
10	W	15.3	80	89	0.05	0.3	0	0.2	0	0.8
11	W	13.5	78	67	0	0.4	0.6	0	0	0.7
12	SW	10.3	80	77	T	0.1	0.3	0	0	0
13	SE	9.5	75	71	0.07	0.3	0.3	0.8	0	0.3
14	W	15.0	77	90	0	0.8	0.9	1.0	1.0	0.3
15	W	9.0	80	64	0	0.9	0.9	1.0	0.5	0.8
16	S	8.0	80	60	0	1.6	1.3	3.5	1.2	0.8
17	S	6.0	81	86	0	6.0	6.0	10.8	4.0	4.2
18	S	12.8	81	74	0.10	5.4	6.9	2.5	5.8	5.3
19	NW	17.7	80	91	T	5.4	8.4	2.5	5.2	3.8
20	NE	7.8	68	56	0.23	1.0	1.7	0.5	0.8	0.5
21	NE	5.1	63	92	0.97	4.3	7.3	1.0	7.5	0.8
22	SE	9.6	66	86	0	1.8	2.4	1.8	0.8	1.7
23	SE	12.0	66	78	0	2.5	4.1	1.2	1.0	2.3
24	NW	15.2	70	81	0	18.6	17.9	18.5	11.8	24.0
25	W	11.3	68	64	0	20.4	14.3	29.5	14.0	25.7
26	SW	10.0	69	69	0	15.3	19.0	†	11.2	13.7
27	SW	8.7	74	76	T	17.6	17.1	11.2	26.5	16.5
28	W	14.4	79	81	0.56	13.3	11.3	12.0	13.8	16.2
29	S	10.7	77	90	0.01	15.4	10.7	17.8	13.2	20.7
30	E	9.2	72	96	T	5.9	6.7	5.2	5.8	5.3
31	SE	11.9	76	97	0.03	25.5	27.7	26.8	13.0	30.3
<i>September</i>										
1	SE	11.8	75	94	0.01	15.7	18.6	20.0	10.5	12.8
2	SE	9.7	76	95	0.06	18.5	23.7	20.0	13.5	14.7
3	N	8.3	75	84	0	17.8	18.1	20.0	14.8	18.0
4	S	6.9	75	82	0	10.1	12.4	4.0	7.2	13.3
5	S	7.2	77	96	0	6.1	9.6	3.2	5.2	4.5
6	S	11.4	75	92	0.46	9.6	9.7	4.5	6.2	15.0
7	NW	14.5	66	81	0.01	10.4	12.9	6.5	7.0	12.3
8	NW	16.5	63	64	0	6.7	7.9	0.8	6.5	9.3
9	NW	18.0	57	69	0	5.9	5.6	0.8	6.8	9.2
10	S	10.0	59	70	0	5.5	4.4	4.8	4.8	7.8
11	S	13.9	62	72	0	5.6	4.9	4.0	7.2	6.3
12	S	11.2	69	78	0	5.0	5.9	4.2	4.8	4.7
13	SE	13.3	70	91	0	6.7	6.1	5.0	6.2	8.8
14	W	16.4	77	88	T	7.5	5.4	7.0	3.8	12.7
15	NE	9.4	64	71	0.43	9.8	11.1	11.5	3.8	11.0
16	NE	10.5	65	97	0.05	8.8	5.4	11.5	4.0	14.0
17	W	11.2	69	100	0.03	2.8	2.9	1.0	2.2	4.2

(Continued on next page.)

TABLE III. CONT'D

DATE	WIND DIRECTIONS (1)	WIND VELOCITY (2)	TEMPERATURE (3)	HUMIDITY (4)	PRECIPITATION (5)	NEW YORK CITY, EXCEPT RICHMOND (6)	BRONX (7)	BROOKLYN (8)	MANHATTAN (9)	QUEENS (10)
18	W	18.4	60	73	0	1.1	1.3	0.2	2.2	0.8
19	SE	16.0	61	66	0	1.0	0.7	1.0	1.2	1.3
20	NW	18.5	55	93	0.20	0.8	0.3	0.8	1.2	1.2
21	SW	11.1	52	79	0	2.9	3.1	2.8	2.8	2.7
22	SW	9.8	59	67	T	2.8	2.3	+	2.8	3.3
23	SW	10.7	71	78	0.09	2.6	3.4	+	2.2	2.0
24	NW	12.1	65	91	0.12	1.0	1.3	0.2	1.5	1.0
25	NW	11.5	61	72	0	1.0	0.4	0.5	0	2.7
26	NE	7.9	56	80	0	0.2	0	0.2	0	0.7
27	NE	11.9	53	69	0.38	0.1	0.1	0	0	0.2
28	NE	11.8	54	80	T	0.3	0	0.2	0.2	0.7
29	N	9.5	63	77	0	0.1	0	0	0	0.5
30	SW	10.9	59	93	0	0.1	0	0	0	0.2

- (1) = Prevailing winds during the twenty-four-hour period.
(2) = Average velocity in miles per hour during twenty-four-hour period.
(3) = Daily mean temperature.
(4) = Daily mean humidity.
(5) = Precipitation in twenty-four hours.
(6) = Average ragweed pollen count of twenty-one collecting stations.
(7) = Average ragweed pollen count of seven collecting stations.
(8) = Average ragweed pollen count of four collecting stations.
(9) = Average ragweed pollen count of four collecting stations.
(10) = Average ragweed pollen count of six collecting stations.
*T = Thunderstorm.

†No information available from any Brooklyn collecting station on this day.

count varied between 1 and 3 until September 26, when it reached 0 once again, although an occasional station reported finding small amounts of pollen.

If the period of significant ragweed pollen concentrations is considered to have extended from August 17 through September 16, a period when, with three exceptions, average daily pollen counts for the city were 5 or higher, the prevailing winds blew in from the Atlantic Ocean (that is, from the south or southeast) on fifteen days during the period. On the remaining sixteen days the prevailing winds came from New Jersey, Westchester, Connecticut, and Long Island. On ten days winds were from New Jersey to the west, southwest, and northwest; on five days they came from Westchester and Connecticut to the north and northeast; and on one day the prevailing winds were from Long Island to the east.

The average pollen count on the fifteen days when the prevailing winds blew into New York City from the Atlantic Ocean was 9.3, whereas it was 10.5 on the other sixteen days when the winds reaching New York City came from the direction of neighboring land areas. The difference in means was not statistically significant. On the ten days on which the prevailing winds came from New Jersey on the west, southwest, and northwest the average pollen

count was 12.1, but the difference between this count and the count on the days on which the prevailing winds came from the Atlantic Ocean was again without statistical significance.

Furthermore, the highest average pollen count was obtained on a day when the prevailing winds were from the southeast, the next highest on a day when the prevailing winds were from the west, and south or southeast winds prevailed on four of the ten days with the highest pollen counts.

RAGWEED POLLEN COUNTS IN
THE BRONX

Average of seven collecting stations

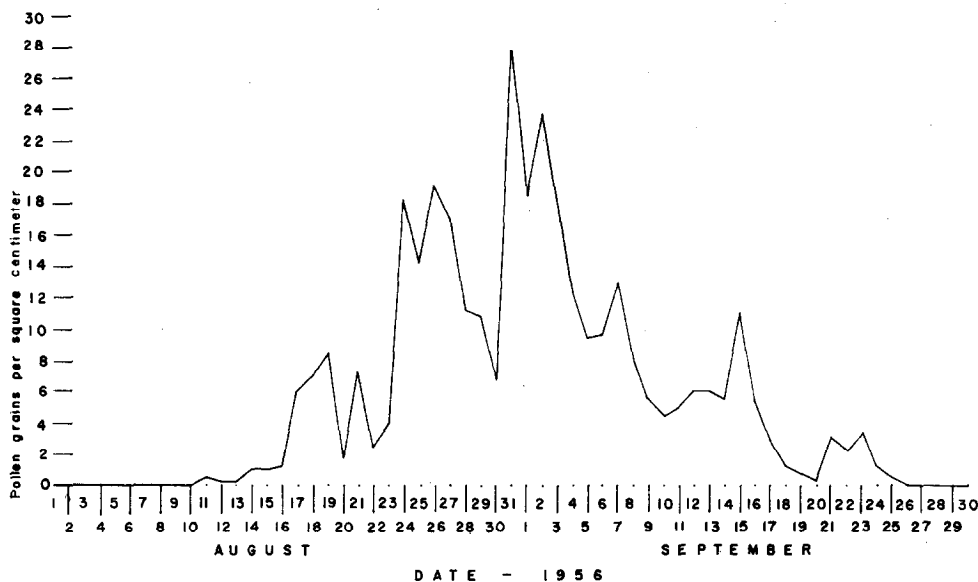


Fig. 3.

Another way of looking at this problem is to relate the prevailing winds to the occurrence of an increase or decrease in pollen count from that of the previous day. Eight of the fifteen days on which winds were southerly or southeasterly showed an increase in pollen count over the previous day, while seven showed a decrease. On the sixteen days when the winds blew into New York City from the surrounding land areas, the counts rose over that of the previous day on seven days, fell on eight days, and showed no change on one day.

Contrary to expectations, there is no evidence from the data accumulated in New York City in the summer of 1956 that winds reaching New York City from neighboring land areas were associated with any higher concentrations of ragweed pollen in the city than winds blowing in from the Atlantic Ocean. Wind velocity, temperature, humidity, and rainfall also could not be shown to have any correlation with the ragweed pollen counts. A continuing study over a number of seasons would be necessary, however, before statements about the absence of such relationships could be made with any assurance.

The average daily pollen counts in four boroughs of New York City are shown in Table III and are presented graphically in Figs. 3, 4, 5, and 6. While there are many differences among the four boroughs in the detailed configurations of the graphs, their general shapes are quite similar.

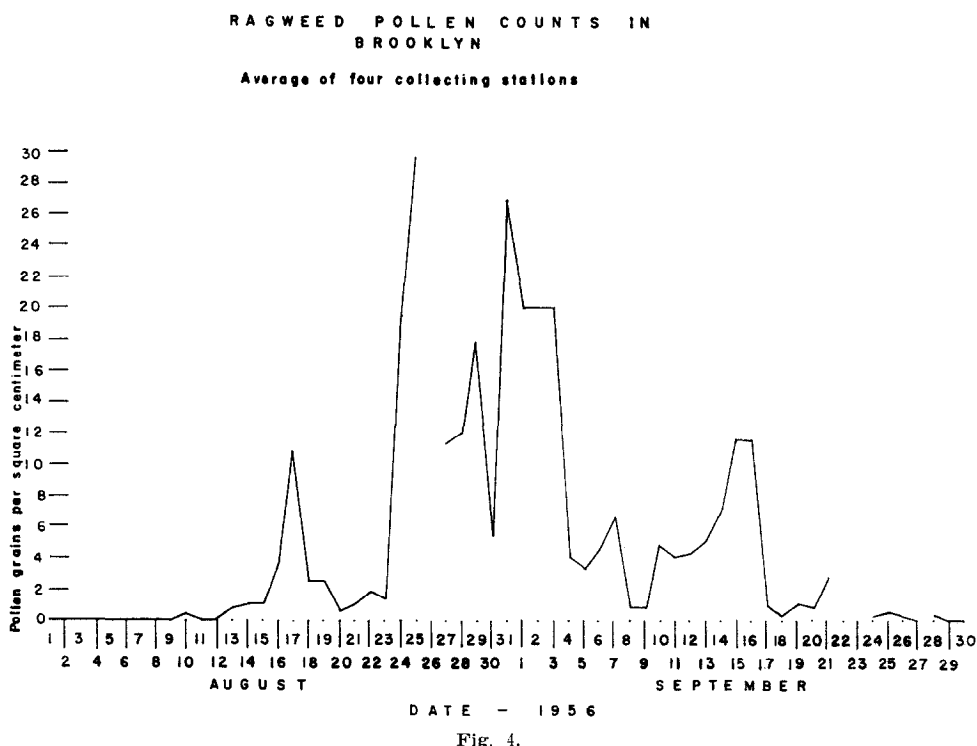


Fig. 4.

It will be recalled that the major purpose of this study was to determine whether an intensive program of ragweed eradication in the Bronx would reduce atmospheric pollen concentrations in that borough to levels lower than those prevailing in boroughs in which only partial programs of ragweed eradication were carried out. Since the borough of Manhattan had very little ragweed acreage, all of which was treated, the question to be answered was whether ragweed pollen concentrations were any lower in the Bronx, where 97 per cent of the ragweed acreage was treated, than in Brooklyn or Queens, where 6 per cent and 31 per cent of the ragweed acreage, respectively, were subjected to chemical treatment.

Average daily pollen counts in the Bronx and in Brooklyn were compared. Pollen counts were not made in Brooklyn on three of the sixty-one days of the study. Among the remaining fifty-eight days, there were eleven days on which the average pollen counts were the same in both boroughs, twenty-one days on which the counts in the Bronx were lower than those in Brooklyn, and twenty-six days on which the Bronx had higher pollen counts than Brooklyn. If there were no real differences between the boroughs, then the count in the Bronx

would be expected to be higher than that in Brooklyn on half of the days and lower on the other half, with deviation from this exact division on a chance basis. The 26 to 21 ratio actually found falls within this range of chance deviation, so that it can be said that the Bronx did not have lower or higher ragweed pollen counts than Brooklyn during August and September, 1956.

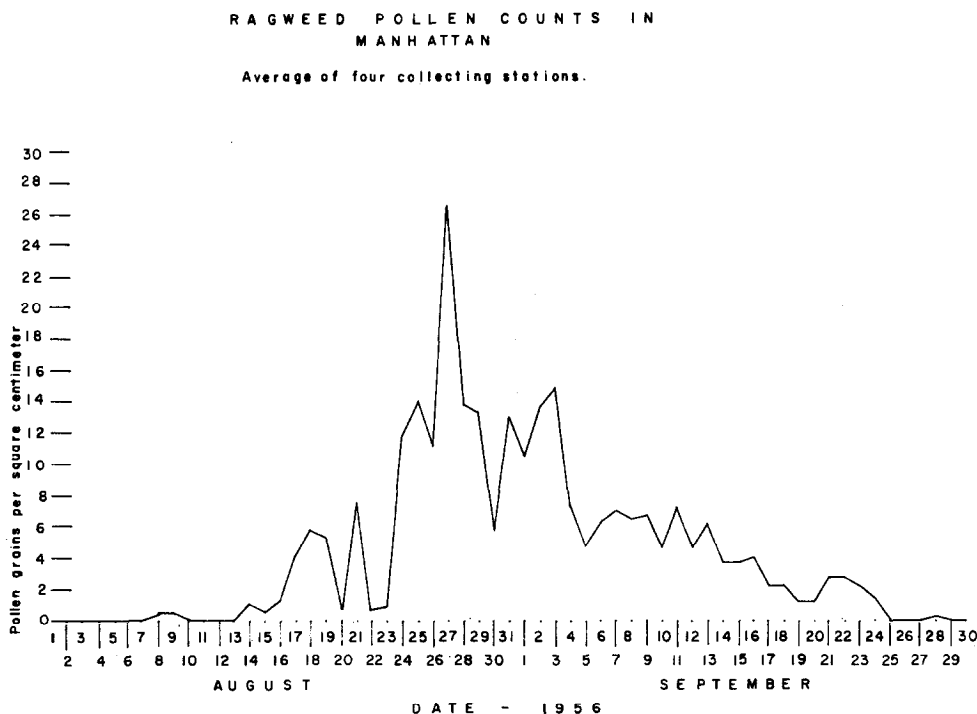


Fig. 5.

Because in this analysis of the total two-month period many days were included at both the beginning and the end of the period on which pollen counts were either 0 or very low, it was thought desirable to make another comparison between the boroughs for the period of moderate to high pollen counts, namely, August 17 to September 16. In this comparison, information was available for thirty days; no counts had been done in Brooklyn on one day. On nineteen days Bronx counts were higher than those in Brooklyn, and on eleven days they were lower. This analysis of the days during the height of the ragweed season yields the same results as the consideration of the total two-month period, namely, there is no evidence to show that the Bronx had consistently lower daily pollen counts than Brooklyn during the 1956 ragweed season.

A similar comparison was made between the Bronx and Queens. For the two-month period, the counts were the same on ten days; the Bronx had lower counts than Queens on twenty-six days and higher counts on twenty-five days. In the thirty-one days between August 17 and September 16, the Bronx had

lower counts than Queens on fourteen days and higher counts on seventeen days. As was the case in the comparison between the Bronx and Brooklyn, the data did not reveal consistently lower daily pollen counts in the Bronx than in Queens.

An interesting finding, for which we have no ready explanation, is that the comparison between daily pollen counts in the Bronx and Manhattan revealed a significant excess of days with high pollen counts in the Bronx. The

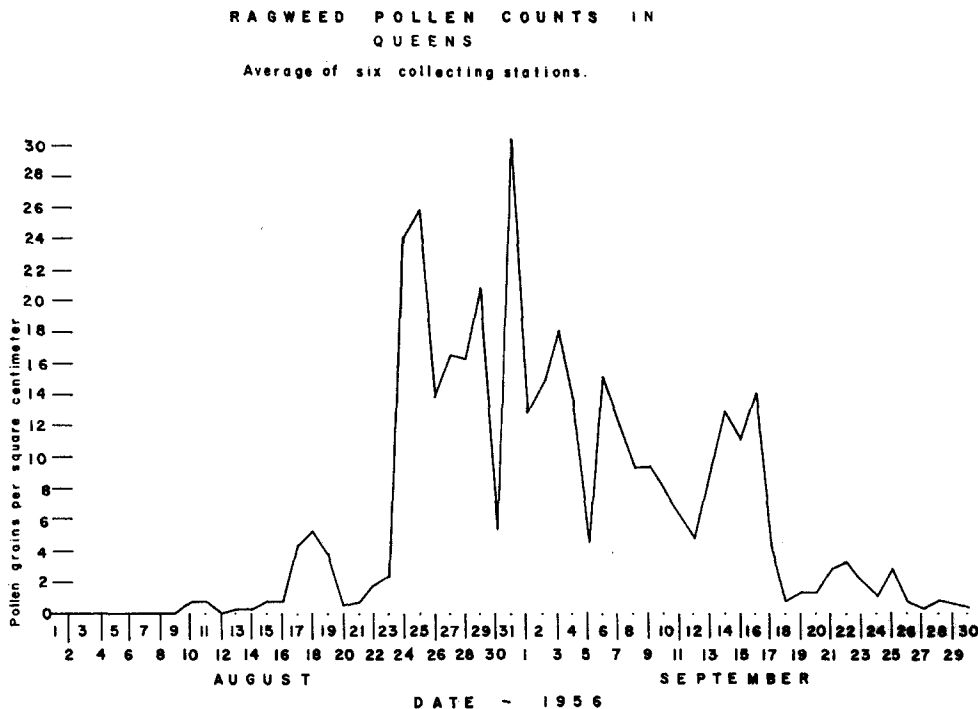


Fig. 6.

entire two-month period showed the same counts in both boroughs on eleven days, lower counts in the Bronx than in Manhattan on seventeen days, and higher counts on thirty-three days. Analysis of the restricted period from August 17 to September 16 showed a comparable significant difference: the Bronx had lower counts than Manhattan on eight days and higher counts on twenty-three days.

A comparison of Queens and Manhattan yielded significant findings of a similar nature. In the sixty-one-day period, the counts were the same in both boroughs on nine days, lower in Queens on seventeen days, and higher on thirty-five days. During the thirty-one-day period at the height of the pollen season, Queens had lower counts on nine days and higher counts on twenty-two days.

However, no significant differences were found between Brooklyn and Manhattan. On just about half the days the counts in Brooklyn were higher and on the other half they were lower than in Manhattan.

SUMMARY AND CONCLUSIONS

A study of ragweed hay fever was conducted by the Department of Health of the City of New York during the summer of 1956 to determine whether a borough-wide program of ragweed eradication would reduce atmospheric pollen concentrations in that borough to lower levels than those in the other boroughs not similarly treated. Ninety-seven per cent of the ragweed acreage in the Bronx, the experimental borough, was treated chemically.

An analysis of the pollen counts at a number of collecting stations in New York City (excluding Richmond) led to the following findings and conclusions:

1. The program of almost complete ragweed eradication in the Bronx did not result in lower daily pollen counts than in other boroughs. This study was not designed to, and did not, answer the question of whether the eradication program produced lower atmospheric pollen concentrations in the Bronx than would have occurred without such a program. It did reveal that, whether or not they were lowered, atmospheric pollen concentrations in the Bronx were still of the same order of magnitude as those prevailing in the boroughs of Brooklyn and Queens, where only "token" programs of ragweed eradication were carried out.

2. Daily pollen counts in New York City (excluding Richmond) were not significantly higher on the days when the prevailing winds came from the direction of neighboring land areas rather than from the Atlantic Ocean. This finding, based on the limited experience of one ragweed season, cannot be considered conclusive. It is contrary to the experience of others and inconsistent with the generally accepted theory that, even in an area where ragweed is generally prevalent, atmospheric concentrations of pollen are nonetheless materially increased by wind-borne pollen from neighboring ragweed-bearing land areas.