AEROPALYNOLOGICAL STUDY IN SANFORD WOODLOT, MICHIGAN STATE UNIVERSITY, EAST LANSING, MICHIGAN, U.S.A.

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ABSTRACT

The primary objective of this study is to know the response of various weather factors on pollen production and dispersal. As the mean daily temperature increases, the pollen production increases correspondingly. The average wind velocity of the day does not seem to be a significant factor in this study, since the pollen trap was kept in the middle of the Woodlot. The frequency of pollen capture was more on a cloudy and/or rainy day than on a calm, cool and sunny day.

INTRODUCTION

The work on aeropalynology has been summarised in a chapter by GREGORY (1973). In the U.S.A. such works were performed by JANSEN (1966), RAYNOR (1971 a,b), RAYNOR *et al.* (1970) and WRIGHT (1953).

The Sanford Woodlot of Michigan State University is the area located immediately south of Red Cedar River (Fig. 1), and it covers an area of about 35 acres. The forest is a climax community, and is represented by Beech-Maple type of community which inhabits southern Michigan. A simple Durham type pollen sampler, which has a microscopic slide held horizontally between two 9 inches discs of tin (DURHAM, 1946), was used in this study. The pollen sampler was kept in the middle of the southern part of the Woodlot. The glass slides pasted with silicone grease were changed every morning at 8.00 a.m. from 10th April, 1973 to 10th May, 1973. The daily maximum and minimum temperatures, and wind velocity were recorded. The meterological data like cloudy, rainy or sunny days were also noted. The pollen atlas of HYDE AND ADAMS (1958), and pollen and spore key of KAPP (1969) were used for the identification of pollen and spores.

MATERIAL AND METHODS

Each day, the collected pollen were treated after washing from the slide with acetolysis method (ERDTMAN, 1960) before examining under microscope. The record of all the pollen recovered was kept, and their numbers and types were noted (Tables 1 and 2). Some of the important conclusions are tested statistically. The area of pollen retrieval in this study is the area of the Sanford Woodlot, which covers 35 acres of land.

STATISTICAL ANALYSIS

The quantitative data available for temperature and wind velocity and number of pollen recovered per day were statistically treated. The correlation coefficient 'r' is calculated for pollen production with temperature and wind velocity by the following formula :

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2) \cdot (N\Sigma Y^2 - (\Sigma Y)^2)}}$$

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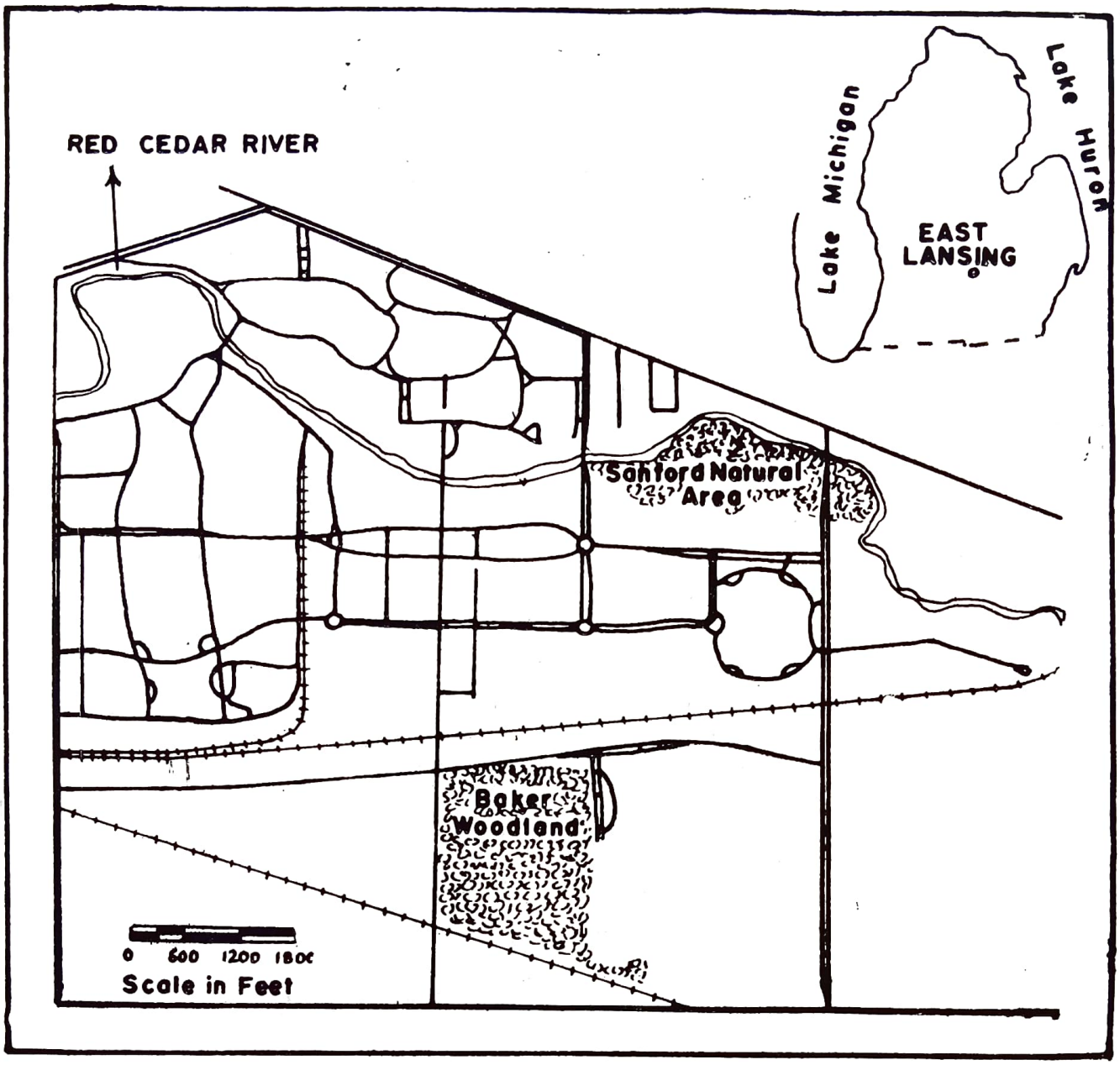

Fig. 1. Campus map of Michigan State University (East Lansing).

where, X and Y are variables, and

N is the number of pairs of observations.

A computer programme was written to calculate the value of 'r' for the following parameters.

Y =total numbers of pollen grains
XI =maximum daily temperature
X2 =minimum daily temperature
X3 =mean daily temperature
X4 =wind velocity.

The calculation of the value of 'r' was done for 'Y' against X1, X2, X3 and X4 on IBM 370/145 computer of Institute of Petroleum Exploration, Dehra Dun. The following values of correlation coefficient were obtained.

Y with variable X1 = 0.386
Y with variable X2 = 0.395
Y with variable X3 = 0.404
Y with variable X4 = 0.182

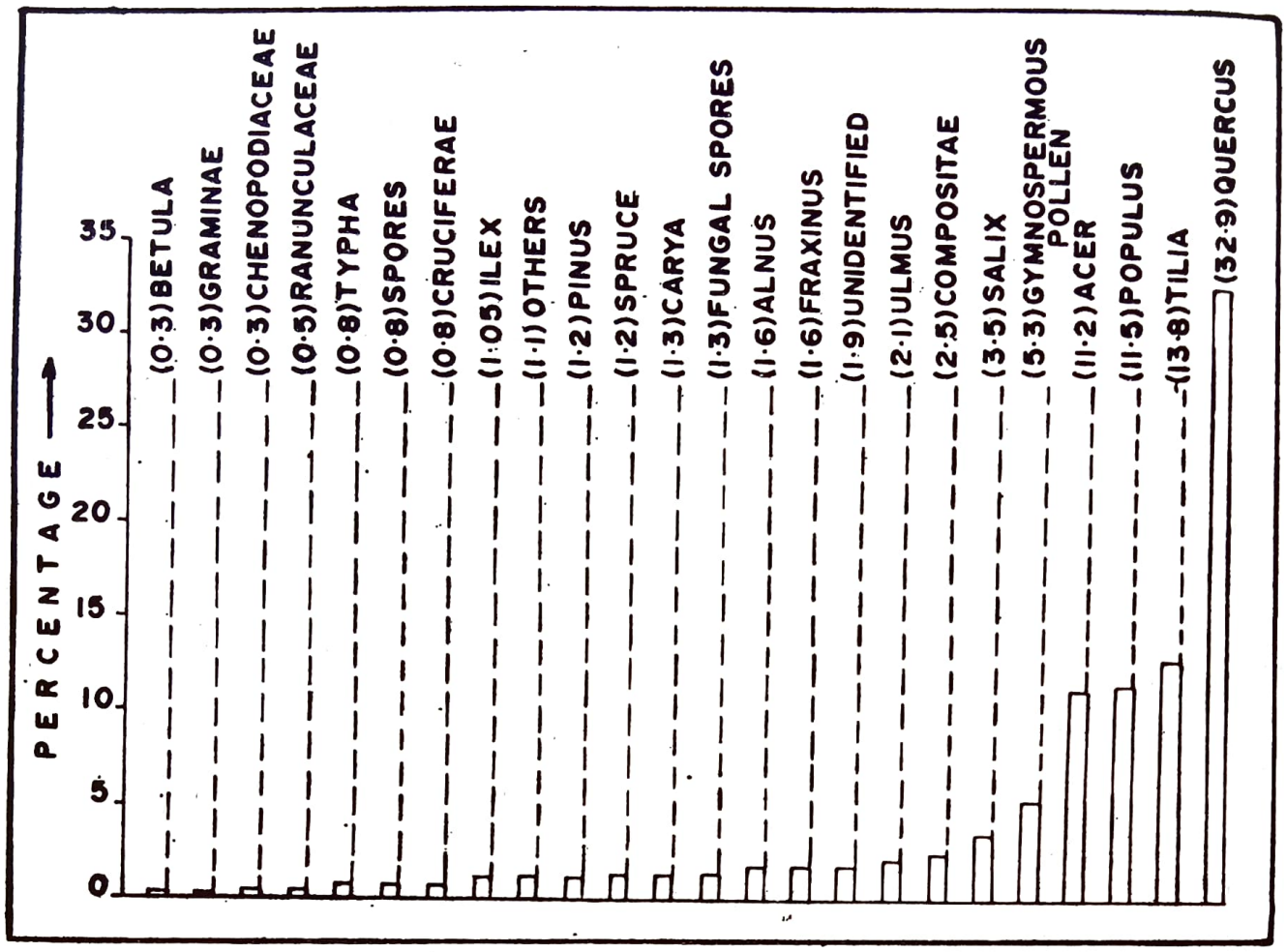

Fig. 2. Percentage representation of different pollen and spores.

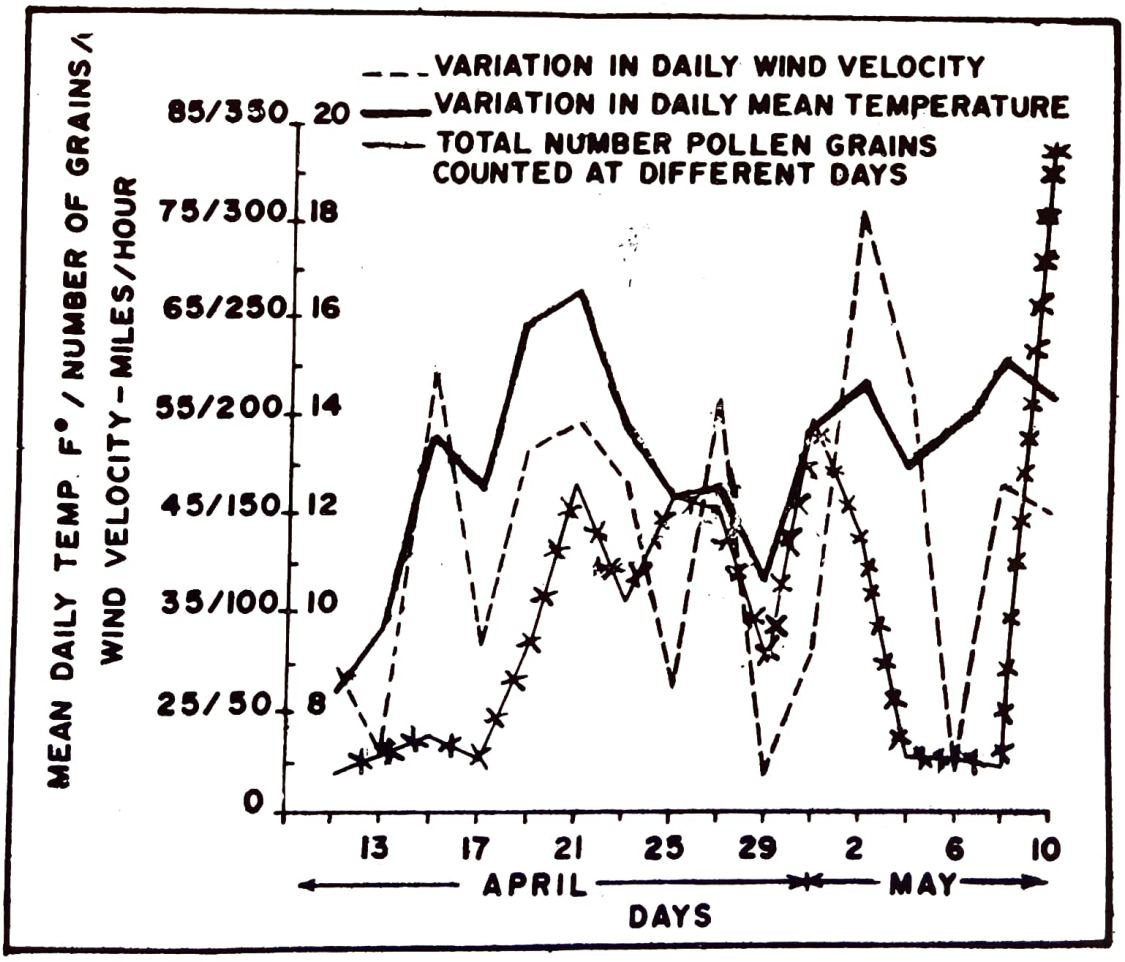

Fig. 3. Correlation of weather data on pollen fall.

Table 1—Total and individual pollen/spore count for different dates.

Date	Total number of grains	Populus	Quercus	Tilea	Ulmus	Acer	Pinus	Spruce	Salix	Ilex	Gymnosperm-ous Pollen	Betula	Alnus	Fraxinus	Graminae	Compositae	Cruciferae	Carya	Ranunculaceae	Spores	Chenopodiaceae	Typha	Fungal Spores	Unidentified	Others
11th April	21	2	3	1	2	..	..	1	..	..	1	1	3	..	..	3	..	..	..	..	..	..	..	1	..
13th ..	27	3	..	..	7	3	1	..	..	1	..	..	2	..	..	2	1	..	..	..	1	..	..	1	3 (Plantago) 2 (Aquifoliaceae)
15th ..	31	1	1	..	2	2	2	1	3	2	..	1	3	..	1	4	2	1	..	1	2	..	..	1	1 (Lythraceae) 1 (Juglandaceae)
17th ..	31	6	..	..	4	2	..	..	2	3	..	2	1	..	3	4	..	..	..	..	1	..	2	1	..
19th ..	84	11	15	..	4	5	1	..	1	..	..	1	..	1	..	1	..	1	2	3	1	14	4	15	1 (Taxus), 2 (Liliaceae), 1 (Taraxacum).
21st ..	167	63	22	12	..	21	8	..	23	..	1	..	..	..	..	3	..	..	5	..	..	..	9	..	..
23rd ..	106	46	19	31	..	4	..	..	1	..	2	..	..	..	..	1	..	..	..	..	..	..	2	..	..
25th ..	161	35	34	57	5	19	3	..	1	..	2	..	..	..	..	1	..	..	..	..	..	..	4	..	..
27th ..	151	7	22	42	4	13	..	..	4	4	21	..	14	2	..	3	..	..	1	1	..	..	1	..	6 (Crab Apple)
29th ..	75	..	20	13	1	4	1	..	4	..	18	..	1	1	..	1	1	..	..	..	..	..	1	8	1 (Caryophyllaceae)
30th ..	201	4	92	24	4	25	3	..	7	2	16	..	1	3	1	8	1	1	..	3	..	..	..	5	..
2nd May	140	..	63	13	..	11	..	..	4	4	12	..	1	8	1	8	7	8	..	..	..	..	..	..	..
4th ..	29	..	12	1	1	5	..	4	1	..	1	..	..	2	..	..	..	2	..	..	..	..	..	..	..
6th ..	29	1	18	2	..	5	..	..	..	1	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..
8th ..	24	..	9	6	..	5	..	..	1	..	..	..	..	..	..	..	1	..	..	2	..	..	..	..	..
10th ..	346	7	202	22	..	58	..	14	6	..	9	..	..	10	..	3	1	11	..	3	..	..	..	..	..
Total ..	1617	186	532	224	34	182	19	20	58	17	87	5	26	27	6	42	14	24	8	14	5	14	23	32	18
Percentage	100	11.5	32.9	13.8	2.1	11.2	1.2	1.2	3.5	1.05	5.3	0.3	1.6	1.6	0.3	2.5	0.8	1.3	0.5	0.8	0.3	0.8	1.3	1.9	1.1

DISCUSSION

It is clear from Fig. 3 that weather changes have important bearing on pollen release. The changes in the mean temperature of the day and wind velocity are plotted against the total pollen count for alternate days.

These curves show that mean daily temperature seems to have more direct effect on pollen fall than the effect of the wind velocity. This is evident from the fact that correlation coefficient of pollen release for mean temperature is 40 per cent and for wind velocity only 18 per cent. This poor correlation with wind velocity is probably due to the fact that the pollen were collected in the middle of the Woodlot. The velocity of the wind is more effective on the margins of the forest than in the middle part. Another factor for these poor correlation coefficient values with both temperature and wind velocity is probably due to inadequate days of observation.

On cloudy and/or rainy days pollen count was higher than on sunny days (see Table 2), it is because rains follow a relatively higher temperature of the air, and during the rains it is generally windy. Sunny days were normally cool and calm. The present study agrees with the work of Wright (1953) who counted more pollen on windy days than on calm days.

Table 2—Weather data and total count of grains

Date	Temperature (F°)			Total No. of grains counted	Weather (Sunny, Cloudy or Rain)	Average Wind (Miles/hr) Velocity
	Max.	Min.	Mean			
11th April	39	15	27	21	Sunny	8.8
13th	43	24	33.5	27	Sunny	7.1
15th	67	39	53	31	Sunny	14.9
17th	60	35	47.5	31	Sunny	9.4
19th	73	57	65	84	Cloudy	13.3
21st	72	64	68	167	Cloudy/Rain	13.9
23rd	67	42	54.5	106	Sunny	12.7
25th	59	35	47	161	Sunny	8.5
27th	55	41	48	151	Cloudy	14.2
29th	49	27	38	75	Sunny/Cloudy	6.8
30th	66	43	54.5	201	Cloudy/Rain	9.2
2nd May	72	46	59	140	Cloudy/Sunny	18.3
4th	56	34	45	29	Sunny	14.7
6th	66	33	49.5	29	Sunny	6.8
8th	69	54	61.5	24	Cloudy/Rain	12.6
10th	69	45	57	346	Cloudy	12.0

The present pollen spectrum shows remarkable absence of the pollen of *Fagus grandifolia* which is a common tree of the Woodlot, and of *Platanus occidentalis*, a common tree in the university campus. The absence of *Fagus grandifolia* seems to be related to its flowering time, which is in late May. The present study was carried out only up to 10th May, which perhaps could be the reason of absence. There are no *Platanus occidentalis* in the Woodlot, and their absence may be due to two reasons, firstly its pollen are heavy to travel longer distances, and secondly pollen would not enter the Woodlot because of the filtering effect of the forest.

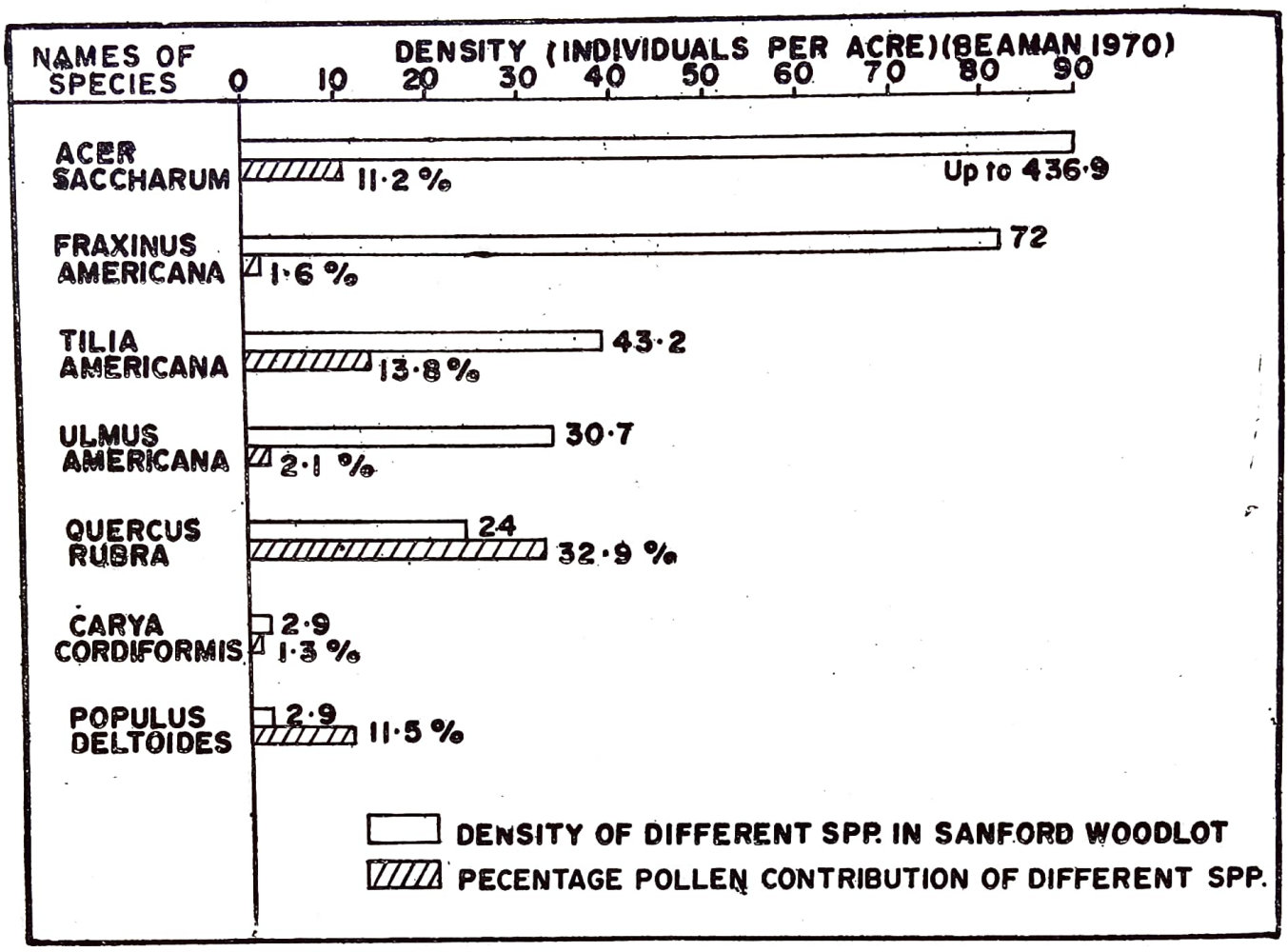

Fig. 4. A comparison of density and pollen production of different species.

Different plants have different rates and amounts of pollen and spore production. This is evident from Figure 4, where a correlation is shown between the density of seven important trees of the Woodlot (from BEAMAN, 1970) and their contribution to total pollen production. It shows *Acer saccharum*, *Fraxinus americana*, *Tilia americana* and *Ulmus americana*, with much less pollen production than *Quercus rubra* and *Populus deltoides*. In the case of *Fraxinus americana* the representation may be false because they are very sensitive to acetolysis. During the process of acetolysis either they are destroyed or change shape which is hard to identify. The percentage representation of different pollen and spores in the total pollen recovered for the period of study is shown in Fig. 2.

The flowering time of various species is different. This is demonstrated in figures 5 to 8, where pollen count on different days is plotted for *Populus deltoides*, *Quercus rubra*, *Tilia americana*, *Acer saccharum*, *Ulmus americana*, *Salix* sp., Compositae and Gymnosperms. This reflects a variation in flowering time for different plants and also their pollen production rates under similar weather conditions. It was found that the last week of April

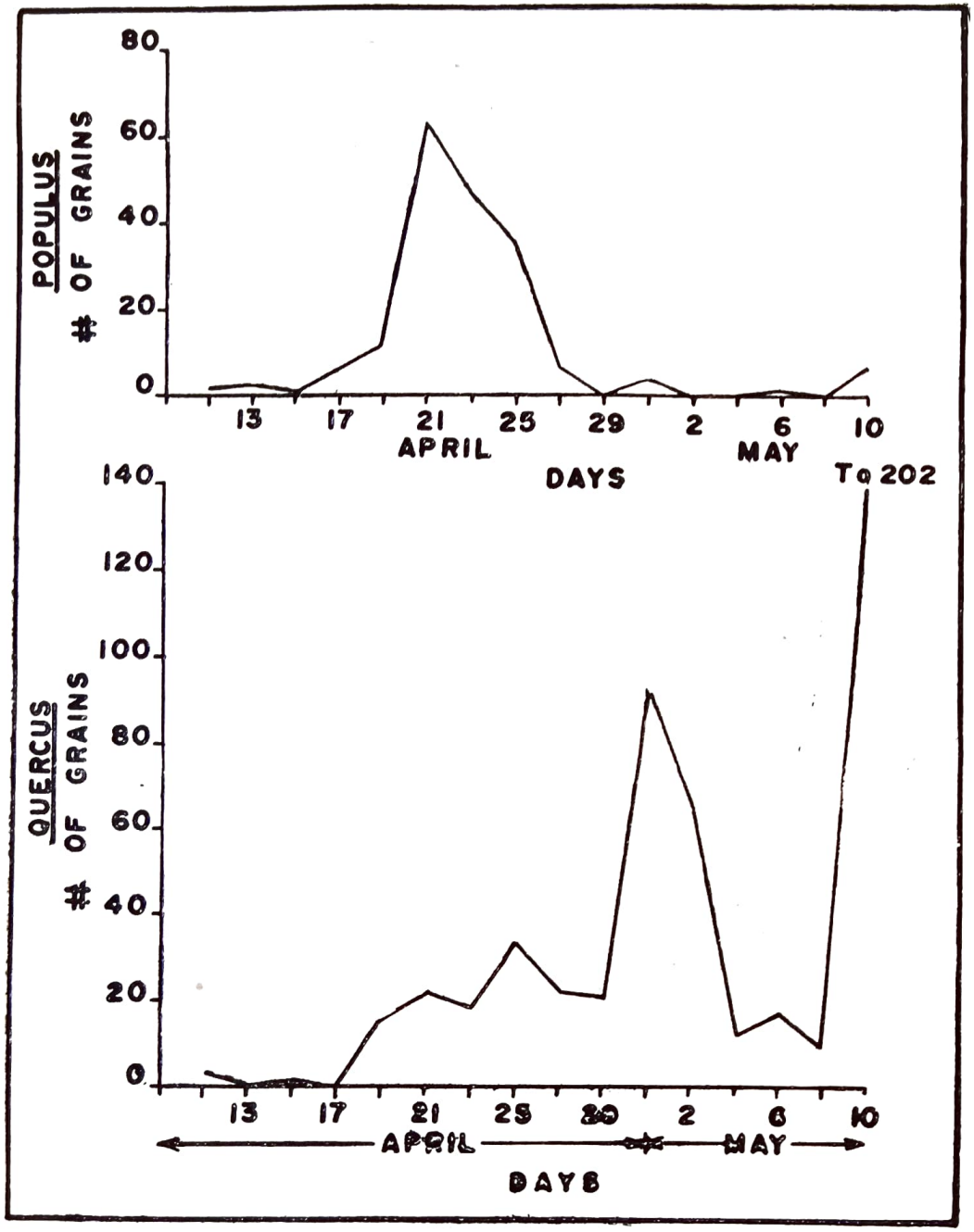

Fig. 5. Number of grains of different species found at different days.

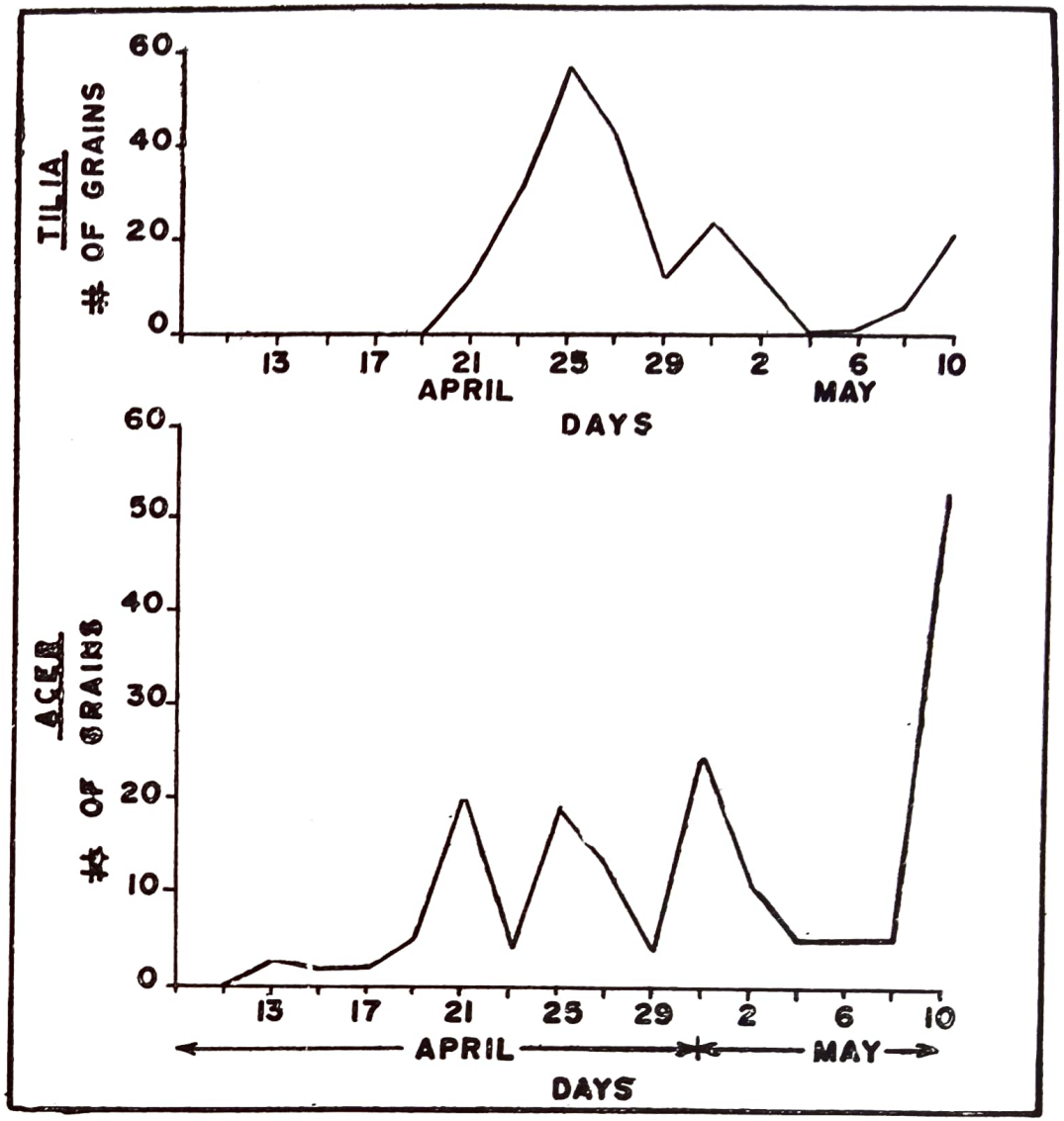

Fig. 6. Number of grains of different species found at different days.

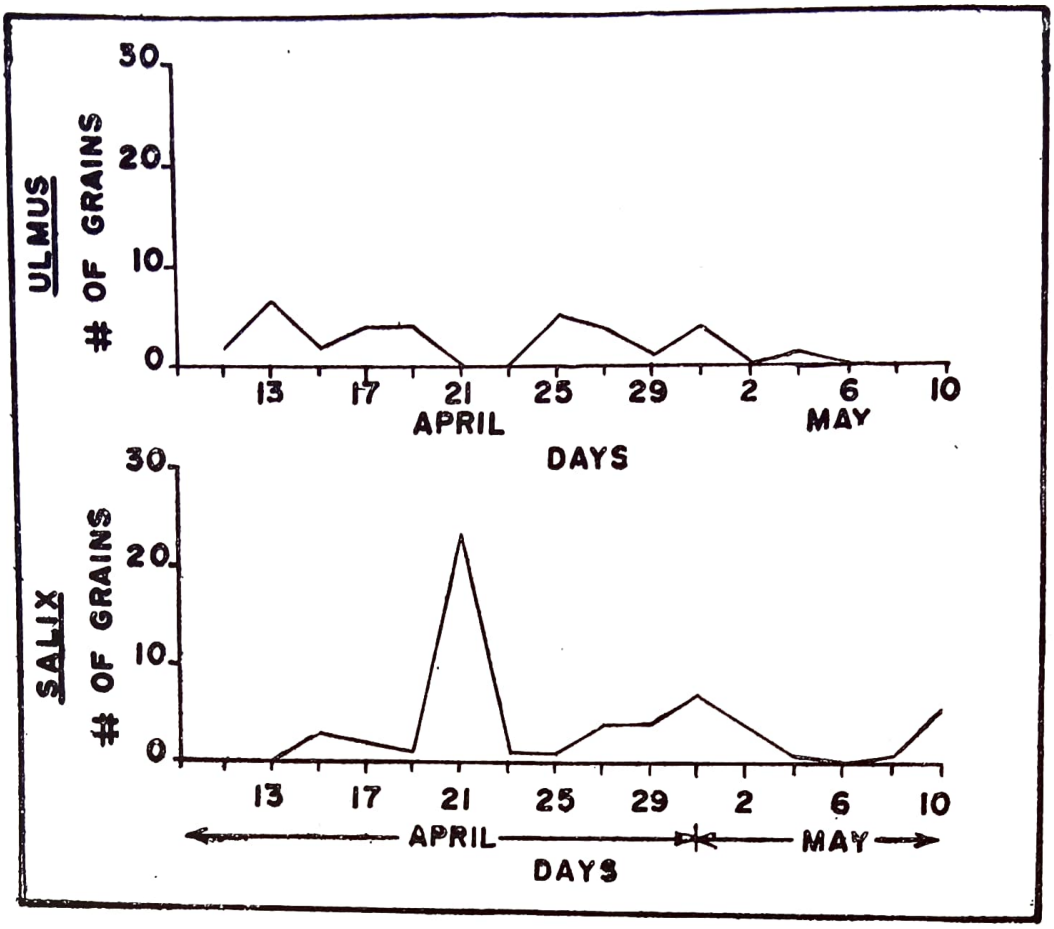

Fig. 7. Number of grains of different species found at different days.

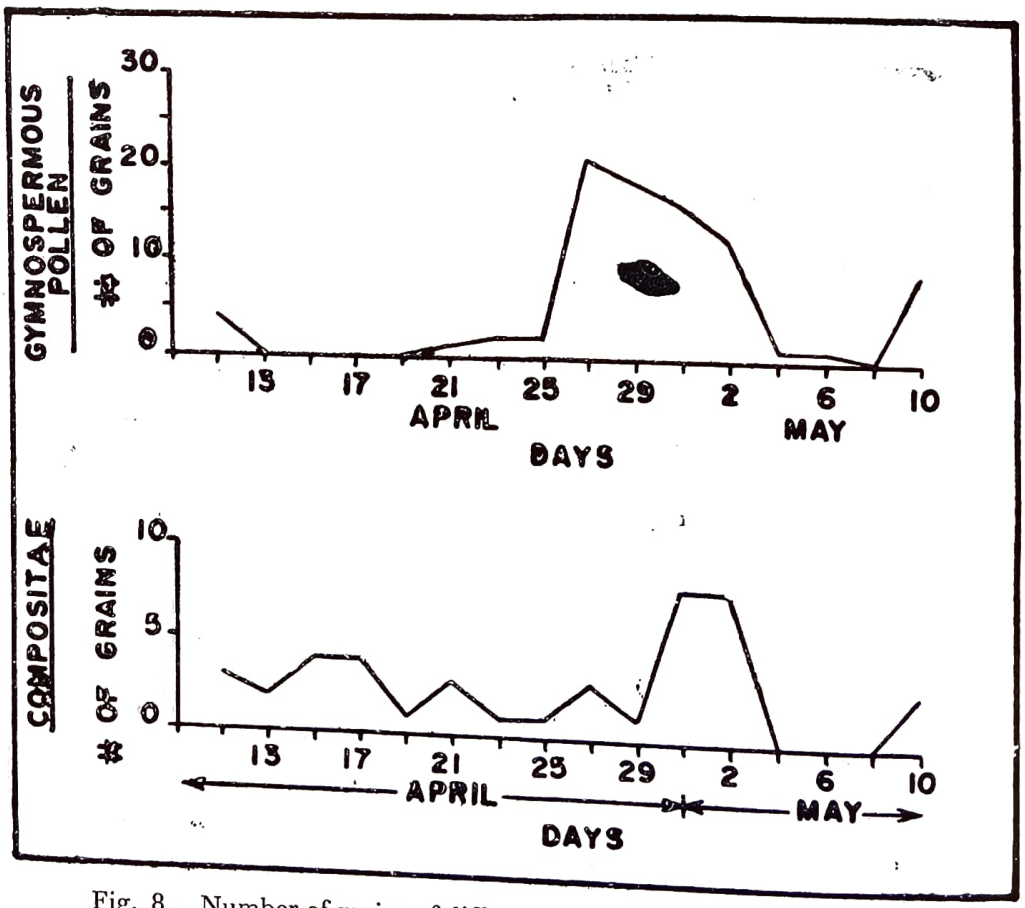

Fig. 8. Number of grains of different species found at different days.

and up to May 4th, pollen production was highest. This is due to warming of weather, and common flowering time of various species. Among herbs and shrubs Compositae seems to be fairly evenly represented, but not so with Cruciferae. The families Ranunculaceae and Caryophyllaceae appear very late and thus poorly represented. The occurrences of the families Lythraceae, Aquifoliaceae, and Liliaceae are scattered and seen only in the second and third weeks of April. The poor representation of these families is due to the fact that they are entomophilous.

CONCLUSION

(1) Weather factors like daily temperature and wind velocity have a positive correlation with pollen occurrence.
(2) On cloudy and/or rainy days occurrence of pollen is more than on calm, cool and sunny days.
(3) Different plants have different flowering time and produce different amounts of pollen under the same weather conditions.
(4) Heavy and large pollen do not travel longer distances and thus are underrepresented.
(5) Entomophilous plants are poorly represented in the total pollen spectrum.

ACKNOWLEDGEMENTS

I am grateful to Dr. Aureal T. Cross for various helps and for permission to use his personal library. I thank Mr. Enrique Martinez Hernandez (now at the Institute of Palaeontology, University of Mexico, Mexico City) for helpful discussions. Dr. Ceel Vanderbrink, Meteorologist at Michigan State University provided me with the weather data, and Dr. M. S. Rao of Institute of Petroleum Exploration, Dehra Dun wrote the computer programme. I am thankful to both of them.

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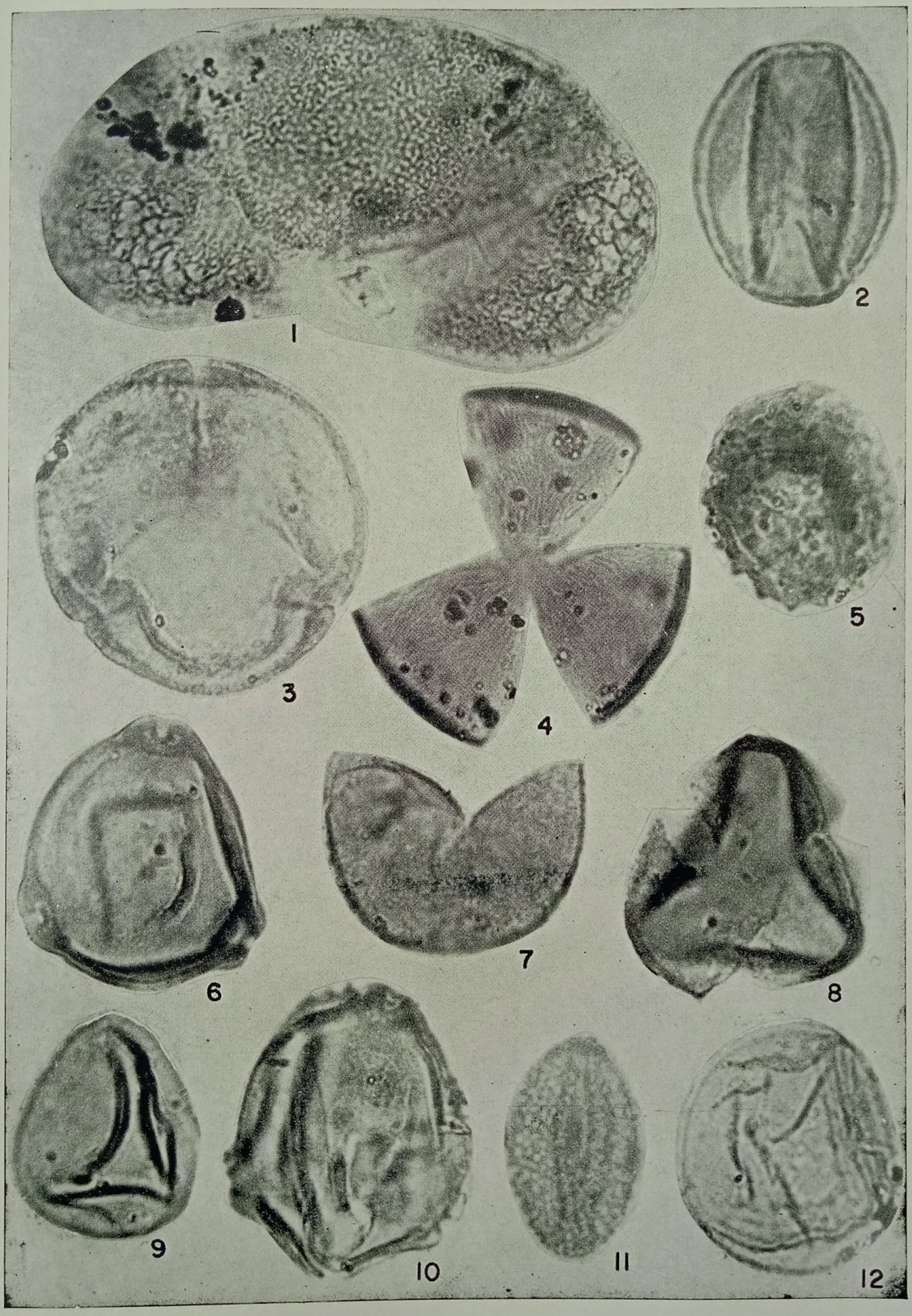
PLATE—I : Some characteristic pollen from Sanford Woodlot.

1. *Abies* sp.
2. *Quercus rubra*
3. *Tilia americana*
4. *Acer saccharam*
5. Compositae pollen
6. *Betula* sp.
7. *Cupressus* sp.
8. unknown pollen
9. *Quercus rubra*
10. *Alnus* sp;
11. *Ilex* sp.
12. *Populus deltoides*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