

# EARLY FORESTS OF DELAWARE COUNTY, OHIO<sup>1</sup>

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## ABSTRACT

Data from two land surveys were utilized to reconstruct the original forest composition of a county in central Ohio. The 1832 survey divided the county into 12 townships consisting of 5 sections approximately 2.5 miles on a side. Corners were determined by recording the name, bearing, diameter, and distance from a survey point or corner, of pairs of trees. The dominant (per cent basal area) trees were beech (35.7 per cent), white oak (16.0 per cent), sugar maple (15.7 per cent), and red oak (14.0 per cent). Other components of the forest vegetation (in decreasing order of basal area) were white ash, hickory, black oak, American elm, basswood, soft maple, blue ash, black ash, red elm, and buckeye. A second survey, completed in 1835, subdivided the sections into smaller parcels with trees recorded at 200- to 500-ft intervals. Four of these sections are described from the eastern, central, and western parts of the county. In addition to the species listed in the 1832 survey, 10 additional species were recorded. Weed trees such as black locust and honey locust were not mentioned in either survey. Analysis of pair distances and stem diameters indicates that the forests of 1832 and 1835 were probably straight-stemmed and tall. It is not probable that these forests were second growth, although it is quite likely that some selective cutting had taken place.

## INTRODUCTION

Studies of forest history in Ohio are complicated by the fact that very little of the original forest can be found today. The early settlers ruthlessly cleared the landscape, not only for wood for homes and space for farms, but also to provide clearings as a defence against Indian attacks. According to Sears (1942), more than 90 per cent of Ohio was forested at the time of settlement. By 1880, less than 25 per cent was in forest and by 1942, approximately 17 per cent of the land was forested. Chapman (1944) concurs, estimating that nearly 95 per cent of Ohio was forested in 1788, and that only 14 per cent of the land remained in forest by 1944.

In many instances it is not possible to obtain much information about the original vegetation of an area except in published notebooks of early travellers, who were usually content with rather general descriptions. Ohio, however, is fortunate in this respect, for in 1786, the Geographer of the United States, Thomas Hutchins, instituted a new system of land surveying, employing for the first time the device of land sections, one mile square. As Paul Sears (1926) puts it, ". . . This empirical device was hailed as a great American invention, although the State of Ohio has since been found to possess a curved surface in common with the rest of the earth . . ." The sudden "S" curves in many of Ohio's secondary roads are a consequence of the necessary adjustment of the survey to the inflexible rules of spherical geometry.

The system consisted of laying out land sections one mile square, and locating the corners by recording the bearing, distance, and diameter of pairs of trees. Since the corner trees constituted a permanent record, the biological value of the system more than compensates for the geometrical inadequacies of the method.

Delaware County is located near the center of Ohio (Lat. 40°15'N, Long. 83°5'W.), and includes portions of the Virginia Military Bounty Lands (west of the Scioto River) and the U. S. Military Lands. The Virginia Military Lands were never surveyed systematically, and the 1795 Survey of the U. S. Military Lands included only a few stations in Delaware County (Sears, 1926).

The following paper presents data abstracted from the records available in

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the County Court House in Delaware, Ohio, and is based on the county survey in 1832 by James Eaton, and on data from an 1835 survey of four smaller land parcels within the county. I am indebted to Mr. John Tilton for the construction of the protractor used to calculate the distance between pairs of trees and for collecting the data for the 1832 county survey. It should also like to acknowledge the helpful assistance of Miss Elisabeth Stull for analyzing the records of the 1835 survey. My sincere thanks to Dr. Jane L. Forsyth of the Geological Survey for assistance in the characterization of the glacial features of Delaware County, Ohio (fig. 2).

#### METHODS

Each tree listed by the surveyor was located from his plot map, and the location, bearing, diameter of the tree, and distance from the sample point were copied

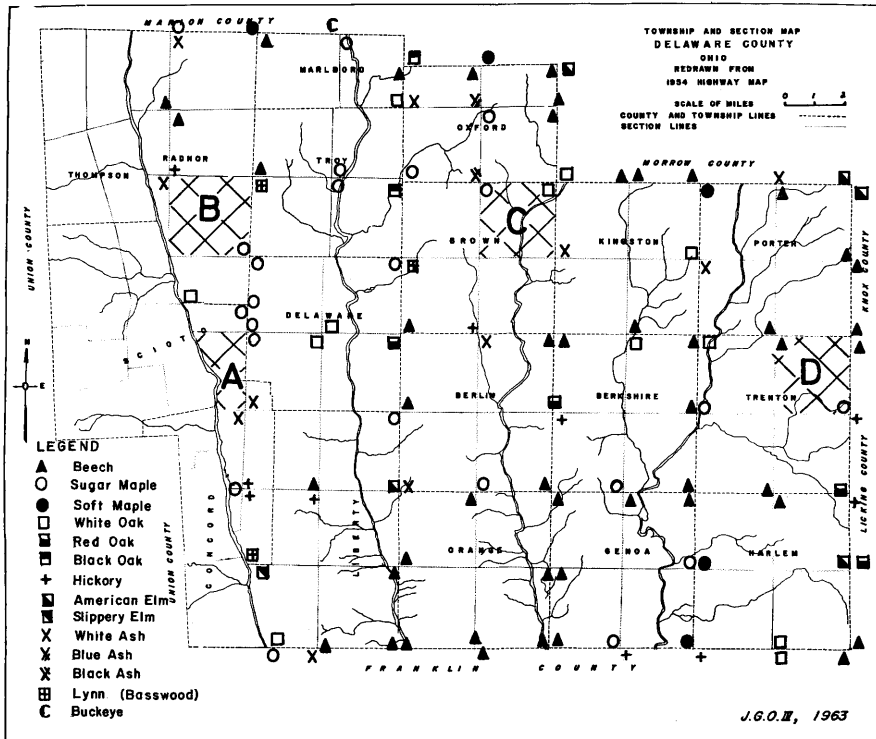


FIGURE 1. Distribution of bearing trees in 1832 Survey of Delaware County. Sections A, B, C, D (cross-hatched) are from 1835 Survey and are described in the text.

onto special data sheets. A large protractor was constructed, the arms of which could be set to the bearings of the trees recorded by the surveyor. Each arm was calibrated in links (since all distances were given by the Surveyor in links), and the distance between trees could be read directly (in links or in feet) by use of a calibrated scale placed between the two points representing the individual trees.

Because of the fact that the surveyor used the same trees at common corners, the data sheets were marked for "inside" and "outside" the townships where two or more corners were determined by the same trees.

Although Cottam and Curtis (1956) give a method for determining the density or number of trees per acre from survey data, application of these techniques to

vegetation sampling in the Great Smoky Mountains do not give comparable results with quadrant data (Shanks, 1954). For this reason, the average distance between trees, which is derived directly from the surveyor's records, is presented (table 4) and will serve as an estimate of the density of the vegetation, since the average distance between trees will be small in densely forested areas (Troy Twp., 19.7 ft) and greater in more open vegetation (Harlem Twp., 33.2 ft). These data will be discussed in a subsequent portion of this paper.

VEGETATION RECORDS PRIOR TO 1832

Sears' (1926) classic study of the Natural Vegetation of Ohio was based on the initial land parcel surveys recorded in the office of the Auditor of State in Columbus, Ohio. Only seven stations were recorded for Delaware County (from the U.S. Military Land Survey of 1795). The 14 trees represented included

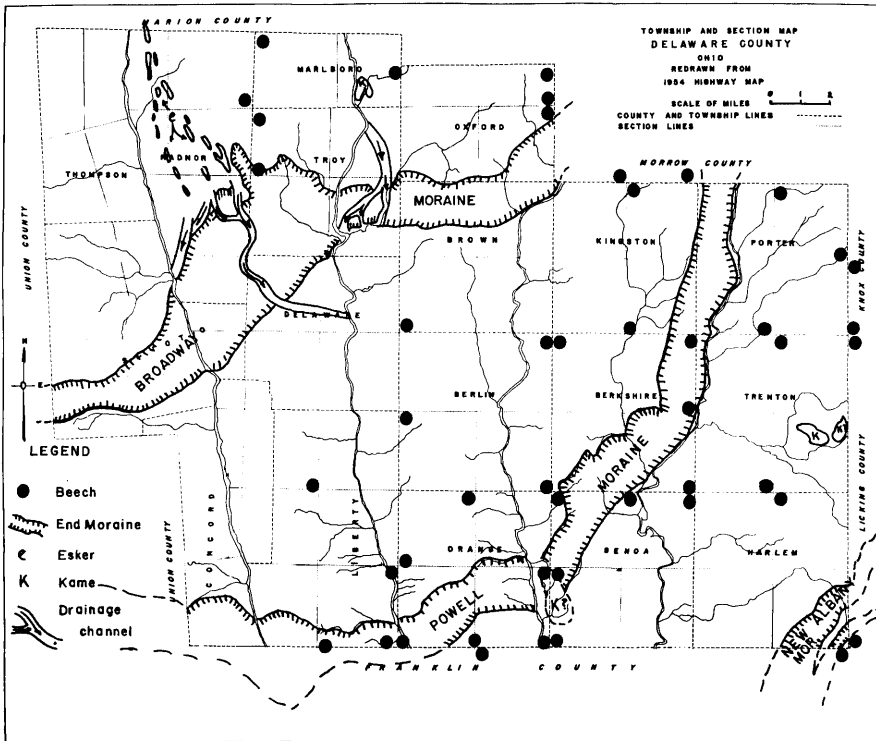


FIGURE 2. Distribution of beech in relation to the glacial features of Delaware County. (Glacial features by J. L. Forsyth.)

6 oak, 4 beech, and 4 ash. A map of the original forest vegetation of Ohio (Chapman, 1944) shows all of Delaware County as "Beech-maple."

VEGETATIONAL RECORDS—1832 SURVEY

Of the 250 trees listed for Delaware County in the township survey, only 123 different trees were tallied. The rest were common to more than one boundary. At the bottom of table 1 is a summary of these data for the whole county. The names of the trees are presented as the surveyor recorded them, with the exception of the old form "Lynn" which may be a corruption of "Lime" or "Linden." The

trees are listed in order of frequency and show that almost 60 per cent of the trees recorded were beech and sugar maple. Beech was listed in 15 of the 17 townships in the survey and made up 35.7 per cent of the total basal area of all the trees recorded. Sugar maple, which was found in 12 of the 17 townships, made up 15.7 per cent of the total basal area. The oaks (red, white, and black) and the hickories collectively constituted 35 per cent of the basal area of the species recorded for Delaware County. White ash, which was found in 8 of the 17 townships, only contributed 5.4 per cent of the total basal area.

The distribution of the trees recorded in the Survey is shown in figure 1. Each tree is shown in the quadrant listed in the survey records, otherwise the figure is not to scale. The absence of vegetational records west of the Scioto River marks the boundary with the Virginia Military Bounty Lands, which were not part of the original Delaware County survey. It can be seen that there was apparently a concentration of beech along a northeast-southwest line in the eastern part of the county. Figure 2 shows the relationship of the beech distribution in Delaware County to the major glacial features of the county. It is obvious that

TABLE 1  
*Percent basal area by species for each township*  
*Total basal area, frequency, and average diameter of trees (DBH)*  
*Delaware County—1832 survey (excluding duplications)*

Township	Beech	Sugar maple	White oak	White ash	Hickory	Red oak	Black oak	American elm	Lynn (Basswood)	Soft maple	Blue ash	Red elm	Buckeye	Black ash	Σ basal area
Harlem	9.4	—	12.8	—	—	58.7	—	6.5	—	12.8	—	—	—	—	1206.3
Trenton	16.2	19.9	60.0	—	—	—	—	—	—	—	—	—	—	—	696.5
Porter	58.4	—	—	2.1	—	—	—	10.0	—	26.2	—	—	—	—	568.6
Genoa	75.2	24.6	—	—	—	—	—	—	—	—	—	—	—	—	1134.2
Berkshire	26.5	7.9	—	—	11.4	53.9	—	—	—	—	—	—	—	—	988.4
Kingston	41.8	—	20.3	36.2	—	—	—	—	—	—	—	—	—	—	546.6
Orange	93.8	—	—	—	—	—	—	6.2	—	—	—	—	—	—	1182.2
Berlin	40.5	6.3	—	16.6	—	30.4	—	—	—	—	—	6.3	—	—	1251.0
Brown	13.9	17.6	48.8	—	7.8	—	—	—	12.2	—	—	—	—	—	1452.3
Oxford	38.9	7.1	—	10.3	—	—	14.3	10.3	—	—	14.0	—	—	4.6	1093.2
Liberty	45.3	27.6	—	10.0	6.9	—	—	10.0	—	—	—	—	—	—	1134.2
Delaware	—	33.1	27.6	—	—	39.8	—	—	—	—	—	—	—	—	1142.2
Troy	16.0	32.1	39.6	—	—	—	4.9	—	7.1	—	—	—	—	—	1583.5
Marlboro	5.8	7.0	7.0	—	—	—	12.1	3.0	—	—	—	—	3.0	—	408.2
Concord	—	—	—	31.8	69.1	—	—	—	(Partial survey)	—	—	—	—	—	456.6
Scioto	—	*(only tree recorded in partial survey)													
Radnor	14.9	33.6	—	31.1	9.6	—	—	—	9.6	—	—	—	—	—	519.7
Thompson	—	(No survey record)													
Σ Basal area (%)	34.4	15.1	15.4	6.2	4.3	13.5	1.9	2.9	2.2	2.0	1.0	0.5	0.1	0.3	15376.2
Frequency	41.7	15.7	8.7	8.7	7.6	6.0	2.7	2.7	2.2	1.1	1.1	0.6	0.6	0.6	
Ave. diam. (DBH)	12.7	11.4	14.0	10.5	14.0	23.6	10.0	10.0	13.5	14.0	14.0	8.0	4.0	10.0	

most of the beech encountered in the survey was concentrated along the Powell moraine with scattered occurrences on the till plain on either side of the moraine. The small segment of the New Albany moraine in southeastern Harlem township also supports a pair of beech trees. The relation of the beech to the Broadway moraine is somewhat more vague. The relationship of beech to the moraines was pointed out by Sears (1926) who noted almost pure stands of beech on many of the moraines in eastern Ohio.

Basswood ("Lynn" in the Survey) occurs only in the central and western part of the county. Three specimens were recorded, which indicates that the tree must have been fairly common in the stands of this part of the county. Black oak appears only in the north central part of the county, in the flat till plain of Marlboro, Troy, and Oxford township. Sheets (1922) lists communities of white oak-black oak in northwestern Kingston Township.

Table 1 shows the percent basal area of each species by townships and includes only those trees located within township boundaries, thereby excluding duplication. It is quite obvious that oak, hickory, and elm were rather minor constituents of the woodlands included in the survey. Lynn (basswood), which occurred in three of the townships, was found in association with sugar maple in Brown Twp. and with beech in Troy and Liberty Twps. Beech appears to have been dominant in 7 of the 18 townships and occurred in 14 of them. Sugar maple achieved co-dominance in only two townships, with beech in Genoa Twp., and with white oak in Troy Twp.

Table 2 shows the degree of association of species named as pairs in the survey.

TABLE 2  
*Pair Frequency—1832 survey*

Beech—Beech	27
Beech—Sugar maple	8
Beech—Red oak	6
White oak—Sugar maple	6
Red oak—Hickory	4
Hickory—Sugar maple	4
White oak—White oak	4
White oak—White ash	4
White oak—Beech	3
Basswood—Beech	3
Sum of other pairs	19
Sum of pairs anal.	94
Sum of possible pairs	105

Beech-beech pairs were recorded at 27 sampling stations, and beech-sugar maple at 8 of the survey points. Of the 105 combinations possible with the 14 species, 31 different combinations were recorded in 94 pairs. It is to be hoped that this beech-skewed distribution is a measure of the vegetational structure and not simply a reflection of the preference of the surveyor for beech trees! Transeau's (1930) map of the original vegetation in the vicinity of Columbus, Ohio, includes parts of Concord, Liberty, Orange, and Genoa townships in southern Delaware County. Of 27 vegetation types shown, 18 are listed as "Beech-maple," 6 as "Swamp Forest," and 3 as "Oak-Hickory."

#### SIZE OF TREES IN EARLY DELAWARE COUNTY FORESTS

Table 3, which shows the average diameter of trees listed in the 1832 survey, is an attempt to determine the size of the trees which were common in the early forests. Of the major components of the county forests, beech, sugar maple, white oak, white ash, hickory, and red oak, the oaks attain the greatest diameters. White oaks and red oaks in the 20- to 30-inch-diameter class were found on the till plain between the Broadway and Powell moraines. The beeches, which are concentrated along the Powell moraine ridges, range from 11 to 16 inches in diameter.

It is not possible from measurements of stem diameters alone to determine whether the trees were tall and straight-stemmed, or young trees, or whether they grew in open stands or closed canopy forests.

Fortunately, this dilemma can be resolved in part by considering the average distance between pairs of trees in each township (table 3). Although a detailed consideration of the relationship between canopy height and distance between pairs of trees will be presented in a subsequent paper, it is sufficient to note here that the average distance between trees in the best woodlands of Delaware County today is 25 to 30 ft. Young stands, with small trees, on the other hand, give pair distances averaging 15 to 20 ft apart. Open, grazed woodlands with broad-crowned trees have average pair distances of more than 30 ft.

If these data are representative, it can be inferred that much of Delaware County was covered by forests which resembled the best woodlands to be found in

TABLE 3  
*Average stem diameter and average distance between pairs  
Delaware County—1832 Survey*

Township	Average dist. between pairs	Beech	Sugar maple	White oak	White ash	Hickory	Red oak	Black oak	American elm	Lynn (Basswood)	Soft maple	Blue ash	Red elm	Buckeye	Black ash
Harlem	33.2	13.0	—	14.5	—	—	30.0	—	10.0	—	—	—	—	—	—
Trenton	26.7	10.8	10.0	18.0	—	—	—	—	—	—	—	—	—	—	—
Porter	28.9	11.1	—	—	14.0	—	—	—	6.0	—	14.0	—	—	—	—
Genoa	32.6	14.0	12.0	—	—	—	—	—	—	—	—	—	—	—	—
Berkshire	27.7	11.4	8.0	—	—	12.0	18.0	—	—	—	—	—	—	—	—
Kingston	26.1	11.4	—	24.0	12.6	—	—	—	—	—	—	—	—	—	—
Orange	28.9	13.9	—	—	12.0	—	—	—	10.0	—	—	—	—	—	—
Berlin	27.3	13.2	15.0	—	11.5	—	16.5	—	—	—	—	—	10.0	—	—
Brown	26.0	14.0	11.3	30.0	13.5	12.0	—	—	—	15.0	—	—	—	—	—
Oxford	21.8	11.2	14.0	—	12.0	—	—	12.0	12.0	—	—	14.0	—	—	8.0
Liberty	23.8	14.1	16.0	—	14.8	12.6	—	—	12.0	—	—	—	—	—	—
Delaware	20.7	—	11.6	20.0	14.0	—	24.0	—	—	—	—	—	—	—	—
Troy	19.7	15.3	13.6	12.0	—	—	8.0	—	—	13.5	—	—	—	—	—
Marlboro	20.0	12.7	6.0	6.0	—	—	—	10.0	4.0	—	—	—	—	4.0	—
Concord	(14.9)	—	—	—	9.0	14.0	—	—	—	—	(Partial survey)	—	—	—	—
Scioto	(28.4)	—	11.0	—	—	—	—	—	—	—	(Partial survey)	—	—	—	—
Radnor	23.9	16.4	14.3	—	14.0	8.0	—	—	—	—	12.0	—	—	—	—
Thompson	—	—	—	—	—	—	—	—	—	—	(No survey record)	—	—	—	—

the county today. The greatest pair distances were found in the southeastern part of the county (Harlem and Genoa townships) where the trees averaged 33.2 and 32.6 ft apart. In Harlem Township, the largest (diameter) beech, soft maple, and red oak trees to be found in the county were recorded. This is consistent with broad-crowned thick-stemmed growth habits common to open stands with wide spacing. Sheets (1922) noted remnants of prairie associations in Harlem Township.

Delaware, Troy, and Marlboro townships show the densest stands, 20.7, 19.7, and 20.0 ft respectively (excluding Concord Twp. in which only six trees were recorded). The dominant trees of each township, moreover, have stem diameters of greater than 12 inches, which may indicate that these were the densest stands of trees in the county.

It is not possible to determine whether these trees were part of the original forest, or if they represent a regeneration forest. The presence of basswood trees of considerable size is inconsistent with intensive cutting (on the other hand, these few trees could be all that was left of an earlier and more extensive distribution of basswood). Perhaps the best argument for considering most of these trees to represent an original vegetation is the fact that a consideration

of growth rates and stem diameters makes it apparent that if these are regeneration forests, cutting must have taken place 80 to 100 years previously. Although it is not impossible that extensive logging operations were conducted between 1750 to 1770, intensive settlement of Delaware County did not begin until about 1820 (Hubbard, 1943).

FOREST COMPOSITION—SECTIONAL SURVEYS—1835

The county survey of 1832 provided data about the vegetation of the county based on pairs of trees spaced about  $2\frac{1}{2}$  miles apart. Later land surveys divided these sections into smaller parcels, ranging from 100 to 400 acres. From the 1835 section survey on file at the Delaware County Engineers Office, four complete sections were selected from the partial section surveys available (shown as the shaded areas A, B, C, and D in fig. 1). Depending upon the size of the subdivisions, this survey provides records of approximately 60 trees at 200- to 500-ft intervals in each section. All of the species of the 1832 Survey except blue ash and black ash were found, and in addition, 10 more species were included, making a total of 24 tree species recorded from Delaware County.

TABLE 4  
*Frequency-percent basal area from 4 township sections—1835 survey*

Species	Frequency				Per cent basal area			
	Trenton	Brown	Radnor	Scioto	Trenton	Brown	Radnor	Scioto
Beech	57.1	20.4	—	8.8	32.1	10.6	—	11.0
Sugar maple	8.1	12.2	20.8	19.3	5.0	8.7	12.9	24.9
White oak	10.2	26.6	9.5	10.5	49.2	56.3	17.8	49.5
White ash	6.1	6.1	11.3	7.0	3.0	1.9	9.9	4.3
Hickory	2.0	10.2	13.3	12.3	0.1	4.5	6.9	12.5
Red oak	2.0	2.0	—	1.8	0.5	8.2	—	10.8
Black oak	—	—	3.8	—	—	—	2.9	—
American elm	4.1	4.1	16.8	8.8	4.6	2.6	39.1	7.4
Lynn (Basswood)	—	—	5.7	1.8	—	—	4.5	3.8
Soft maple	6.1	4.1	—	8.8	1.1	1.8	—	7.6
Blue ash	—	—	—	—	—	—	—	—
Black ash	—	—	—	—	—	—	—	—
Red elm	—	—	5.2	—	—	—	—	3.7
Buckeye	—	4.1	3.8	1.8	—	1.0	1.1	2.6
Ironwood	—	2.0	1.9	—	—	0.2	0.2	—
Cherry	4.1	—	1.9	—	2.1	—	1.0	—
Dogwood	—	—	6.5	—	—	—	0.8	—
Box elder	—	—	3.8	—	—	—	0.4	—
Hackberry	—	4.1	—	—	—	1.5	—	—
Hornbeam	—	—	1.9	—	—	—	0.1	—
Sassafras	—	—	—	3.5	—	—	—	0.2
Sycamore	—	2.0	—	—	—	0.6	—	—
Black walnut	—	2.0	—	—	—	2.0	—	—
Cedar	—	—	—	2.0	—	—	—	§

§Diameter of Cedar in Scioto Twp. not recorded.

Table 4 lists the frequency and percent basal area of the species found in the four township sections. Beech was found in three of the four sections, but contributed significantly to the basal area only in the easternmost sections, the NE  $\frac{1}{4}$  of Trenton Township. White oak, white ash, sugar maple, and American elm were found in all of the sections. White oak was dominant (% BA) in three of the sections, being replaced by American elm in Radnor. Sugar maple was more prominent in the two western sections (Radnor and Scioto) than in the eastern

part. The NE  $\frac{1}{4}$  of Brown Township had one 36-inch red oak and two hackberries which attained the respectable size of 10 and 12 inches DBH. Brown Township also included a 30-inch beech tree. More than 80 per cent of the basal area in the section of Trenton Township analyzed was in beech and white oak, with only 7 other species recorded. The other sections were much more diverse with 13 or 14 species included. The sections from Trenton and Brown Townships can be classed as white oak-beech, whereas it is less easy to generalize about the other communities. The high basal area of American elm in Radnor is surprising, in view of its low incidence throughout the county as a whole (table 1). The section from Scioto Township consisted principally of white oak and sugar maple, with some hickory and red oak.

#### SUMMARY

The study reported in this paper is part of a more general research program directed toward filling the gap between forest history data obtained by conventional field methods and pollen analysis. Data from two land surveys are presented. The 1832 Survey divided the county into 12 townships consisting of 4 sections approximately  $2\frac{1}{2}$  miles on a side. Corners were determined by recording the name, bearing, diameter, and distance from a survey point or corner of pairs of trees. The 1832 survey showed that the dominant (as percent basal area) trees in Delaware County were beech (35.7 per cent), white oak (16.0 per cent), sugar maple (15.7 per cent) and red oak (14.0 per cent). Other components of the forest vegetation (in decreasing order of basal area) were white ash, hickory, black oak, American elm, basswood, soft maple, blue ash, black ash, red elm, and buckeye.

A second survey, completed in 1835; subdivided the sections into smaller parcels with pairs of trees recorded at 200- to 500-ft intervals. Four of these sections are described, from the eastern, central, and western parts of the county. The picture of the vegetation which emerges from this study is similar to that from the larger survey, but provides more detail, due to the closer sampling interval. The 1832 survey included 14 species, whereas the 1835 survey included 12 of these species, plus 10 additional species not recorded in the first survey.

Analysis of average pair distances and stem diameters indicates that the forests of 1830 and 1835 were probably straight-stemmed and tall. It is not probable that these forests were second growth, although it is quite likely that high-grading, or selective cutting, had taken place. Weed trees such as black locust and honey locust were not mentioned in either survey.

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