THE STRUCTURE OF SELECTED DECIDUOUS FORESTS IN SOUTHERN CHESTER COUNTY, PENNSYLVANIA

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CALL PLOT LOCATIONS — location of plots

compare 1965

ABSTRACT

During the course of nine years of field studies done by undergraduate ecology classes at West Chester State College, considerable data on forest structure has been collected. This report is a summary of these results and a discussion of the possible significance of the data.

INTRODUCTION AND METHODS

Since 1964, the ecology classes at West Chester State College have done considerable work as part of their course requirements on structure of forests of southern Chester County, Pennsylvania. This paper is a presentation of some of the data from these studies.

I have personally checked the quantitative counts in the field both during and at the end of each study, plot by plot. Also, to eliminate taxonomy as a major problem in this fieldwork, I have made all species identifications where necessary and have interpreted the species for all dead stems. As a result of these efforts and the efforts by the students to achieve accuracy, I feel the data is valid and does warrant publication. It was intended in the design and conduct of these studies that the data be used for serious interpretation by other students of the vegetation of Chester County.

All stands were located on reasonably undisturbed sites and were at least 8,000 square meters in area. The study plots in the earlier studies were 20 x 20 meters square. In more recent studies, a 10- x 40-meter plot was used which proved more satisfactory in picking up stand crown cover variability on slopes. The study plots were located by using a randomized grid. The plots are numbered in the tables of this paper according to their plot number on the grid. The crown cover of all trees over 20 feet in height was mapped. Understory trees over 20 feet in height and crown cover overlap were indicated by dotted lines on the map. Percent crown cover by species was easily calculated from these maps which were drawn on graph paper on the site. Area of crown cover overlap or of understory species was not included in the summary data. Height measurements on a given plot were determined by laying out a 20-foot section of tape and interpolating to a given prominent limb or crotch that became the height indicator for the plot.

Stem counts were made by species in the 5- to 20-foot height class on the entire 20- x 40-meter plot. This did not include stems of species over 20 feet in height. Stem counts for the 1- to 5-foot height class were made on one of four 10- x 10-meter square subplots established on each 10- x 40-meter plot. This subplot was selected at random. All major stems at indicated height were counted. For some shrubs, this could mean several stems from one root system.

Standard common names are used in this study with accompanying latin names for reference in the tables. The taxonomy follows *Gray's Manual of Botany*, by Merritt L. Fernald, 1950.

RESULTS AND DISCUSSION

Stands on Phyllite Ridges. Three stands were studied on phyllite ridges, a rock closely related to schist, in southern Chester County known as the South Valley Hills. They are designated the Frazier stand, the Downingtown stand, and the Exton stand. All three stands are located on part of the same ridge system from three to five miles apart in an east-west direction south of U. S. Route 30. Each stand represents a different slope aspect and history.

All are on xeric sites with Chestnut Oak dominating on two of the sites, Frazer and Exton (Tables 1 and 3) and Scarlet Oak on one site, Downingtown (Table 2). Flowering Dogwood and Maple-leaf Viburnum dominate the understory of all three stands, though less so on the south-facing slope at Exton. See the 1- to 5- and 5- to 20-foot height classes for each stand. Blueberries were well represented on both north and south facing upper slopes. Both the Exton and Frazer stand showed evidence of ground fires resulting in the charing of the basal bark of many of the trees. The recent fire in the Frazer stand will be discussed in some detail.

The Exton stand appears to be reasonably stable as indicated by fairly uniform distribution and number of crown species in the understory. The Downingtown stand may undergo change over a period of time, 75-150 years, as indicated by differences in the understory sapling and seedling species as compared to the crown species. Only two Scarlet Oaks were recorded on four 20- x 20-meter square plots in the sapling age group (Table 2). The four trees in the 1- to 5-foot height class which were recorded on only one plot suggest localized reproduction. Successful local reproduction also suggests the possibility that as the stand matures and the crown begins to open up, Scarlet Oak could increase in the reproductive strata due to changes in local environmental conditions, particularly light intensity in the understory. Thus, Scarlet Oak may continue to dominate the site in spite of poor evidence of reproduction under present conditions. The fact is that Scarlet Oak is there as the dominant species and appears to have been there from all field indications for a long time. Though dominant in the other two stands on phyllite, it does not appear that Chestnut Oak will be a major component in the Downingtown stand in the forseeable future due to a lack of an adequate seed source nearby. According to the number of trees recorded in the sapling strata and their distribution on the plots, White Oak, Tulip Tree, and American Beech will increase in crown cover in future years. Red Maple will be primarily an understory tree.

The extremely brushy nature of the understory of the Downingtown stand may indicate sprouting due to frequent ground fires in the past. (See the total stem counts, Table 2.) However no significant ground fires have been recorded on the study area for the last 30 years. Burning woods "for improvement" appears to have been a common local practice many years ago.

The Frazer stand was partially burned just previous to the 1968 study (Table 1). Evidence of the effect of a hot ground fire can easily be seen in the data, especially the 5-20-foot height class. As is indicated by stem damage in Table 1 and by observed charing of the bark, plots 7 and 20 were in an area of severe heat and plot 35 somewhat less so. Plots 23, 34, and 41 were outside the burn area. All understory woody species in the burn area were susceptible to damage by the hot ground fire with no evidence of any species present possessing superior fire-resistant qualities. Field evidence and local history as mentioned in the foregoing suggests that these species have been subjected to repeated ground fires over the last 100 years and that

TABLE 1

Phyllite Ridge, North Facing Slope, Frazer, Pennsylvania

Percent crown cover estimated by mapping leafless crown on 20- x 20-meter plots, located at random, April 1968

Plot number	7	20	23	34	35	41	Sum of crown cover by species on six plots
Total percent covered	46	84	40	86	72	78	
Black Birch *Betula lenta*			10	15	12	62	104
Flowering Dogwood *Cornus florida*		2			1		3
Red Maple *Acer rubrum*	1	3	4	1	5	5	19
Chestnut Oak *Quercus prinus*	30	42	22	54	18	7	173
Scarlet Oak *Quercus coccinea*	6	14		3	2		25
Hickory *Carya sp.*		1					1
Tulip Tree *Liriodendron tulipifera*		16		3		2	21
Black Oak *Quercus velutina*	6	6	4	6	20	2	44
Red Oak *Quercus rubra*	2			4	13	1	20
White Oak *Quercus alba*	1				1		2

Total number of trees and shrubs present in the 5- to 20-foot height class on each 20- x 20-meter plot. The numbers in parentheses are the number of the toal that were dead.

Plot number	7	20	23	34	35	41	Total number stems
Black Birch *Betula lenta*	18 (18)	37 (37)	7	25 (1)	33 (7)		120
Flowering Dogwood *Cornus florida*	8 (8)	24 (24)	4	3	23 (13)	8	70
Red Maple *Acer rubrum*	5 (5)	9 (9)	10	5	38 (6)	20	87
Chestnut Oak *Quercus prinus*	5 (5)	3 (3)	5			4	17
Scarlet Oak *Quercus coccinea*		2 (2)					2
Hickory *Carya sp.*	1 (1)		1	6		8	16
Tulip Tree *Liliodendron tulipifera*				3	11		14
Red Oak *Quercus rubra*				3		10	13
American Chestnut *Castanea dentata*		11 (11)	6	3 (1)	2 (2)	3 (1)	25
Black Cherry *Prunus serotina*		8 (8)		1			15
Sassafras *Sassafras albidum*	1 (1)						1
Maple Leaf Viburnum *Viburnum acerifolium*	17 (17)		38	11	46 (8)	46	158
Wild Grape *Vitis sp.*					3		3
Tall Blueberry *Vaccinium corymbosum*						1	1

TABLE 1 (continued)

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead.

Plot number	7	20	23	34	35	41	Total number stems
Black Birch *Betula lenta*	12 (4)	51 (8)		7	16 (1)		86
Flowering Dogwood *Cornus florida*		14 (4)	5		2	1 (1)	22
Red Maple *Acer rubrum*	5 (1)	55 (12)	1	14	61 (12)	10	146
Chestnut Oak *Quercus prinus*	10 (5)	1	10	4		3	28
Scarlet Oak *Quercus coccinea*	8			1			9
Hickory *Carya sp.*	3	1	1		1	3	9
Tulip Tree *Liriodendron tulipifera*	2	2 (2)		16 (2)	4 (1)		24
Black Oak *Quercus velutina*	6 (6)		9				15
Red Oak *Quercus rubra*				3		4	7
American Chestnut *Castanea dentata*		9	2				11
Black Cherry *Prunus serotina*			7			5	12
Sassafras *Sassafras albidum*	4	1				1	6
Maple Leaf Viburnum *Viburnum acerifolium*	25 (9)	16 (1)	35	48	75 (15)	147	346
Wild Grape *Vitis sp.*			3		2		5
Blueberry *Vaccinium vacillans*	11			18	4	110	143
Pinkster Bush *Rhododendron nudiflorum*			30				30
Black Raspberry *Rubus occidentalis*		27 (1)				6	33
White Ash *Fraxinus americana*						1	1

TABLE 2

Phyllite Ridge, East Facing Slope, Downingtown, Pennsylvania

Percent crown cover estimated by mapping leafless crown on 20- x 20-meter plots, located at random, October 1965.

Plot Number	1	3	9	15	
Total percent covered	60	60	53	50	Sum of crown cover by species on four plots
Black Oak *Quercus velutina*	8		10	30	48
Scarlet Oak *Quercus coccinea*	30	60	10	20	120
White Oak *Quercus alba*	22		20		42
Tulip Tree *Liriodendron tulipifera*			6		6
Red Maple *Acer rubrum*			5		5
American Beech *Fagus grandifolia*			2		2

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TABLE 2 (Continued)

Total number of trees and shrubs present in the 5- to 20-foot height class on each 20- x 20-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	1	3	9	15	Total number stems
Scarlet Oak *Quercus coccinea*		1	1		2
White Oak *Quercus alba*			12	3	15
Tulip Tree *Liriodendron tulipifera*	1	10			11
Red Maple *Acer rubrum*	3	9	6	14 (1)	32
American Beech *Fagus grandifolia*	4	1	3		8
Maple-leaf Virburnum *Viburnum acerifolium*	52	4	6	81	143
Sassafras *Sassafras albidum*	2	4		6 (1)	12
Flowering Dogwood *Cornus florida*		55 (2)	108	6	171
Hickory *Carya* sp.				5 (2)	5
Black Gum *Nyssa sylvatica*	38				38
Mountain Laurel *Kalmia latifolia*	1				1
Arrow-wood Viburnum *Viburnum dentatum*			3		3
American Chestnut *Castanea dentata*	2	2			4
Wild Grape *Vitis* sp.		3			3

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead.

Plot number	1	3	9	15	Total number stems
Scarlet Oak *Quercus coccinea*		4			4
White Oak *Quercus alba*			2		2
Tulip Tree *Liriodendron tulipifera*		8			8
Red Maple *Acer rubrum*	1	8 (1)	3		12
Maple-leaf Viburnum *Viburnum acerifolium*	70	96 (3)	156	110	432
Sassafras *Sassafras albidum*		1			1
Flowering Dogwood *Cornus florida*		8	61	1	70
Black Gum *Nyssa sylvatica*	6				6
Mountain Laurel *Kalmia latifolia*	1			5	6
Arrow-wood Viburnum *Viburnum dentatum*				1	1
Chestnut Oak *Quercus prinus*				2	2
Blueberry *Vaccinium vacillans*		5		1	6
Black Cherry *Prunus serotina*		3			3

TABLE 3

Phyllite Ridge, South Facing Slope, Exton, Pennsylvania

Percent crown cover estimated by mapping leafless crown on 10- x 40-meter plots located at random, April 1970.

Plot number	2	5	11	19	25	Sum of crown cover by species on five plots
Total percent covered	54	60.6	66.5	56.5	83	
Chestnut Oak *Quercus prinus*	12	25	52	9		98
Black Oak *Quercus velutina*	6	13	0.5	19	9	47.5
Scarlet Oak *Quercus coccinea*	28	13	9	24		74
White Oak *Quercus alba*	4	9	1	1		15
Red Oak *Quercus rubra*			5		40	45
Tulip Tree *Liriodendron tulipifera*					19	19
American Beech *Fagus grandifolia*	2	0.3		2	8	12.3
Red Maple *Acer rubrum*					1	1
Hickory *Carya* sp.	1	0.3		2	2	5.3
White Ash *Fraxinus americana*					4	4
Flowering Dogwood *Cornus florida*	1			0.5		1.5

Total number of trees and shrubs present in the 5- to 20-foot height class on each 10- x 40-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	2	5	11	19	25	Total number stems
Chestnut Oak *Quercus prinus*	19 (6)	9 (1)	5	4 (3)		37
Black Cherry *Prunus serotina*	2 (1)	1				3
Black Oak *Quercus velutina*	9	2	6	2		19
Red Oak *Quercus rubra*		1	5 (3)		6	12
Scarlet Oak *Quercus Coccinea*	17 (2)	10	15 (5)	2		44
American Chestnut *Castanea dentata*	1 (1)	11			3	15
American Beech *Fagus grandifolia*	1	3	52	10 (1)	64	130
Blue Beech *Carpinus caroliniana*					7	7
Tulip Tree *Liriodendron tulipifera*					1	1
Black Gum *Nyssa sylvatica*	12 (2)	2 (2)	21 (2)	3		38
Red Maple *Acer rubrum*	1	6 (2)	7	19 (1)	13	46
Poplar *Populus* sp.				4 (4)		4
Hickory *Carya* sp.	24	17 (3)	3	10	5	59
Maple leaf Viburnum *Viburnum acerifolium*		8		3		11
White Oak *Quercus alba*	2 (1)	2 (1)	2			6

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TABLE 3 (Continued)

Plot number	2	5	11	19	25	Total number stems
White Ash *Fraxinus americana*					2	2
Flowering Dogwood *Cornus florida*	9	4		33 (4)	9 (2)	55
American Hazelnut *Corylus americana*					22	22

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead

Plot number	2	5	11	19	25	Total number stems
Chestnut Oak *Quercus prinus*	11	18 (2)		7 (1)		36
Black Cherry *Prunus serotina*	1	2				3
Black Oak *Quercus velutina*		6 (1)		6		12
Red Oak *Quercus rubra*			3			3
Scarlet Oak *Quercus coccinea*	8		10 (2)	8		26
American Chestnut *Castanea dentata*	1	1			4	6
American Beech *Fagus grandifolia*	2	1	5	3	8	19
Blue Beech *Carpinus caroliniana*					4	4
Black Gum *Nyssa sylvatica*	5	1	1			7
Red Maple *Acer rubrum*		2	1	2	31	36
Hickory *Carya* sp.		6		1		7
Maple Leaf Viburnum *Viburnum acerifolium*				5	22	27
Flowering Dogwood *Cornus florida*		1				1
Blueberry *Vaccinium vacillans*	122	11	45			178
Sassafras *Sassafras albidum*		5				5
Pinkster Bush *Rhododendron nudiflorum*	32		11			43

they represent a community of woody plants that have the capacity to survive fire. The ability to sprout from the living roots after the top has been killed appears to be characteristic of these species.

The presence of Black Birch as a significant dominant in the crown of the Fraser stand is of particular local interest. It is the only stand in southern Chester County where I have found this to be true. In northern Chester County, it appears to be a common successional species. I would suspect it is a relic of former cooler conditions in our area related to changes in climate following the pleistocene.

All three stands at one time included American Chestnut as a member of the crown cover as indicated by old Chestnut stumps and an occasional living Chestnut sprout. See especially the data in the 5- to 20- and 1- to 5-foot height classes of all three stands. With the elimination of American Chestnut as a significant component of these xeric forests due to the Chestnut blight, it appears that they have now become primarily oak forests. Variations occur from site to site resulting from local conditions and stand history, but the major dominants in various combinations on these Phyllite ridges will continue to be primarily Chestnut Oak, Scarlet Oak, and Black Oak into the forseeable future. White Oak and Red Oak will contribute to the oak dominance but to a lesser extent.

Lower slope dominance under more mesic conditions is well illustrated by plot 25, Table 3. Here Red Oak, Tulip Tree, American Beech, and White Ash are significant crown species.

Stands on a Baltimore Gneiss Ridge. The south campus of West Chester State College includes a wooded Baltimore Gneiss ridge approximately 100 feet in height and nearly a half a mile long on campus. It is oriented in a general northeast-southwesterly direction. Different portions of this ridge have been sampled since 1965 and are here referred to by the date of sample, for example, the 1967 stand, the 1971 stand, etc.

The 1970 and 1965 stands (Tables 4 and 5) represent samples taken on the upper slope of the ridge. The 1967 stand (Table 6) was sampled on the lower slope of the ridge. All three of these stands were on a northwesterly facing slope. The 1971 stand (Table 7) was on a south-facing slope that had been somewhat disturbed by having several large trees removed within the last ten years.

The upper northwesterly facing slopes were dominated in

TABLE 4

Baltimore Gneiss, Northwest Facing Slope
South Campus, West Chester State College 1970

Percent crown cover, estimated by mapping leafless crown on 10- x 40-meter plots located at random, November 1970.

Plot number	3	5	9	10	11	19	Sum or crown cover by species on six plots
Total percent covered	99	83	86.2	73	85	90	
Black Oak *Quercus velutina*	24	23	59	34		8	148
Red Oak *Quercus rubra*		8	3	4		20	35
American Beech *Fagus grandifolia*		4	4	2	74	21	105
Hickory *Carya sp.*	10	11		3	2	1	27
Norway Maple *Acer platanoides*		16	1	2	6	2	27
White Oak *Quercus alba*	47	21	3			3	74
Black Gum *Nyssa sylvatica*				1		6	7
Flowering Dogwood *Cornus florida*				1	1	3	5
Red Maple *Acer rubrum*			1		1		2
Tulip Tree *Liriodendron tulipifera*			12	26	1	21	60
Sassafras *Sassafras albidum*			0.2			5	5.2
White Ash *Fraxinus americana*			3				3
Princess Tree *Paulownia tomentosa*	18						18

Total number of trees and shrubs present in the 5- to 20-foot height class on each 10- x 40-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	3	5	9	10	11	19	Total number stems
Flowering Dogwood *Cornus florida*	67 (3)	88 (2)	74 (9)	109 (13)	32 (2)	15	385
American Beech *Fagus grandifolia*	13	10	41 (1)	35 (2)	16	22	137
Spice Bush *Lindera benzoin*		1	1 (1)			3	7
Viburnum *Viburnum* sp.		4	38	1	2	20	65
Black Cherry *Prunus serotina*		3	2	4		1	10
Wild Grape *Vitis* sp.		1			1		2
White Ash *Fraxinus americana*	5 (2)	9 (3)	2 (1)		11 (1)		27
Red Oak *Quercus rubra*	1	2					3
Norway Maple *Acer platanoides*	1	2		7	8	12	30
Red Maple *Acer rubrum*	2	1				1	4
White Oak *Quercus alba*		2					2

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TABLE 4 (Continued)

Plot number	3	5	9	10	11	19	Total number stems
Hickory *Carya* sp.		3		2 (1)		2 (1)	7
Blue Beech *Carpinus caroliniana*	1		5 (1)	12	3 (1)	44	65
Morrow Honeysuckle *Lonicera morrowi*				3			3
Slippery Elm *Ulmus rubra*				1			1
Red Hawthorn *Crataegus* sp.	1			1			2
Black Haw *Viburnum prunifolium*			1 (1)	2		2	5
Sugar Maple *Acer saccharum*	1					3	4
Black Gum *Nyssa sylvatica*		1			10	3	14
Alternate Leaf Dogwood *Cornus alternifolia*		1					1
American Bittersweet *Celastrus scandens*		1					1
Witch Hazel *Hamamelis virginiana*	4						4

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10- x 10-plot located at random. The numbers in parentheses are the number of the total that were dead.

Plot number	3	5	9	10	11	19	Total number stems
Flowering Dogwood *Cornus florida*	4	3	11 (1)	5 (1)	1 (1)	33	57
American Beech *Fagus grandifolia*		3 (1)	5	3	4	2	17
Spice Bush *Lindera benzoin*	2 (1)	20		1		1	24
Viburnum *Viburnum* sp.	98	91	168	64	14	25	460
Bird and Black Cherry *Prunus avium, Prunus serotina*		1	1	2			4
White Ash *Fraxinus americana*	5	2 (1)	2			4	13
Norway Maple *Acer platanoides*	1						1
Red Maple *Acer rubrum*		1		2 (1)		1	4
Hickory *Carya* sp.				1			1
Blue Beech *Carpinus caroliniana*			1	1		3	5
Black Haw *Viburnum prunifolium*			2	3		1	6
Alternate Leaf Dogwood *Cornus alternifolia*						1	1
Witch Hazel *Hamamelis virginiana*	12						12
Common Elderberry *Sambucus canadensis*	1						1
Japanese Honeysuckle *Lonicera japonica*			10				10
Black Gum *Nyssa sylvatica*					4		4
Virginia Creeper *Parthenocissus quinquefolia*	1						1

TABLE 5

Baltimore Gneiss, Northwest Facing Slope, South Campus, West Chester State College, 1965

Present crown cover estimated by mapping leafless crown on 20- x 20-meter plots located at random, April 1965.

Plot number	15	32	36	40	47	70	Sum of crown cover by species on six plots
Total percent covered	63	63	57	65	70	46	
Black Oak *Quercus velutina*	23	7	15	5	50	6	106
Tulip Tree *Liriodendron tulipifera*	17	17	1	20	15	15	85
Blue Beech *Carpinus caroliniana*					3		3
Hicko(y *Carya* sp.	3	7	20	7	2	1	40
White Ash *Fraxinus americana*	8	12	3			4	27
Slippery Elm *Ulmus rubra*	7	13					20
Red Maple *Acer rubrum*	5						5
American Beech *Fagus grandifolia*			6	4		4	14
White Oak *Quercus alba*			9			1	10
Norway Maple *Acer platanoides*				7			7
Flowering Dogwood *Cornus florida*		7	3	4			14
Black Gum *Nyssa sylvatica*				4			4
Sassafras *Sassafras albidum*				1			1
Red Oak *Quercus rubra*				13		16	29

Total number of trees and shrubs present in the 5- to 20-foot height class on each 20- x 20-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	15	32	36	40	47	70	Total number of stems
Black Oak *Quercus velutina*					2		2
Blue Beech *Carpinus caroliniana*	2						2
Hickory *Carya* sp.			4		2 (1)	1	7
White Ash *Fraxinus americana*			5 (1)				5
Slippery Elm *Ulmus rubra*		1					1
Maple *Acer* sp.	3	1 (1)					4
American Beech *Fagus grandifolia*	2	11 (11)	7 (5)		7	3 (1)	30
White Oak *Quercus alba*					2		2
Flowering Dogwood *Cornus florida*	7	17 (16)	56 (23)	15	38 (3)	45 (12)	171
Cherry *Prunus* sp.	2		12				14
Spice Bush *Lindera benzoin*		4 (4)	1				5

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TABLE 5 (Continued)

Plot number	15	32	36	40	47	70	Total number of stems
Viburnum *Viburnum* sp.		3 (3)		3			6

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead

Plot number	15	32	36	40	47	70	Total number of stems
Tulip Tree *Liriodendron tulipifera*					2		2
Blue Beech *Caprinus caroliniana*					1		1
Hickory *Carya* sp.	3	1		1 (1)			5
White Ash *Fraxinus americana*		8				12	20
Slippery Elm *Ulmus rubra*		7					7
American Beech *Fagus grandifolia*		1		3 (3)		17	21
Flowering Dogwood *Cornus florida*	30	18	5 (2)	125 (75)	28	5	211
Cherry *Prunus* sp.		2	3	3 (1)	4	18	30
Red Maple *Acer rubrum*		5				8	13
Norway Maple *Acer platanoides*				2 (2)			2
Sassafras *Sassafras albidum*		1					1
Spice Bush *Lindera benzoin*	12	26	7	23			68
Viburnum *Viburnum* sp.	19	40	34	25 (4)		109	227
Wineberry *Rubus phoenicolasius*		2					2
Witch Hazel *Hamamelis virginiana*						23	23
Greenbrier *Smilax rotundifolia*	1						1
Japanese Barberry *Berberis thunbergii*					2		2
Blackberry *Rubus allegheniensis* complex	1						1

the crown cover by the xeric species, Black Oak, while the lower slope 1967 stand was dominated by more mesic site species, Tulip Tree and Red Oak. The south facing slope was dominated by Tulip Tree with a considerable portion of hickory in the crown cover. The relationship of Tulip Tree to dry sites conditions will be discussed later.

A general dominance by Flowering Dogwood and Maple-leaf Viburnum was evident in the understory of all the stands. Spice Bush was present on many sample plots often in considerable numbers. Its presence on this generally well-drained slope is thought to be related to seepage patterns and bedrock contours that result in a series of small catchment basins on the slope. The effect is a series of mini-swamp habitats, which are rich in moist site herbaceous species as well as providing a habitat for Spice Bush.

After observing former fence lines, traces of old wagon roads, old home sites, the size and growth forms of the dominant trees on the ridge and the forest community structure, the following interpretation of the present forest cover is proposed.

The 1965 upper slope stand was dominated in the crown cover by Black Oak with considerable Tulip Tree (Table 5). Tulip Tree increases as a dominant on the lower slope in the same general area (Table 6). The general aspect of this forest is even-aged, about 100 years old except on the upper slope. Here several old, very large Black Oak (36 inches, D.B.H.) remained from an earlier forest. The result of the sampling is, therefore, a forest crown cover dominated by these large Black Oaks with Tulip Trees coming in vigorously in areas of the upper slope between the large trees. It is now one continuous forest.

Tulip Tree is an important successional tree species in portions of Chester County with a large representation in young forests. However, it appears to decrease in importance as the forest matures and begins to prepetuate itself naturally. In mature forests, it appears to be found on more mesic sites, but as a successional species, it competes very well on open dry sites even on the driest sites in Chester County on quartzite ridges.

If the large oaks on the upper slope had been removed, opening the site completely, Tulip Tree would have probably dom-

TABLE 6

Baltimore Gneiss, Lower Slope, Northwest Facing Slope, South Campus, West Chester State College, 1967.

Percent crown cover estimated by mapping crown on 20- x 20-meter plots located at random, July 1967.

Plot number	6	11	14	21	38	39	40	43	Sum of crown cover by species on 8 plots
Total percent covered	90	63	90	75	68	80	90	99	
Tulip Tree *Liriodendron tulipifera*	50	21	3		50	57	14	8	203
Red Oak *Quercus rubra*	20	15	67				32		134
Black Oak *Quercus velutina*	1	6		59	3		8		77
Red Maple *Acer rubrum*	3	3	3		6	17	4	24	60
American Beech *Fagus grandifolia*	15	3				6	23	8	55
White Ash *Fraxinus americana*		6	7		3		3	27	46
White Oak *Quercus alba*		3			3			24	30
Hickory *Carya* sp.		6		10			6	8	30
Slippery Elm *Ulmus rubra*			10						10
Scarlet Oak *Quercus coccinea*				6					6
Black Gum *Nyssa sylvatica*	1				3				4

Total number of trees and shrubs present in the 5- to 20-foot height class on each 20- x 20-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	6	11	14	21	38	39	40	43	Total number stems
White Ash *Fraxinus americana*	2	7 (2)	1	2 (1)	7		9 (3)	6	34
Red Maple *Acer rubrum*	5	6	3	1	4 (2)	2 (1)	9 (6)	3	33
Hickory *Carya* sp.	1	1	1	2				1	6
American Beech *Fagus grandifolia*	4	16	16	39	5 (2)	2	1	1	84
Tulip Tree *Liriodendron tulipifera*		10				1		1	12
White Oak *Quercus alba*			2					2	4
Black Oak *Quercus velutina*				11				2 (1)	13
Flowering Dogwood *Cornus florida*	6	51	4 (2)	27	8 (5)	19 (7)	30 (21)		145
Blue Beech *Carpinus caroliniana*		3	1	1	1	4 (4)	1 (1)		11
Black Cherry *Prunus serotina*		10		1	2		3 (1)		15
Arrow-wood Viburnum *Viburnum dentatum*	1	2	2				2		7
Black Gum *Nyssa sylvatica*	2	1	1		8 (2)				12
Maple-leaf Viburnum *Viburnum acerifolium*	1				13				14
assafras *Sassafras albidum*	1 (1)	2			9 (2)				12
Red Mulberry *Morus rubra*		3	3		3				9

(Continued on next page)

TABLE 6 (Continued)

Plot number	6	11	14	21	38	39	40	43	Total number stems
Wild Grape *Vitis* sp.					2				2
Spice Bush *Lindera benzoin*	3		3		3				9
Norway Maple *Acer platanoides*	8	3	2						13
Slippery Elm *Ulmus rubra*	2	3	1						6
Red Hawthorn *Crataegus* sp.		1							1
Virginia Creeper *Parthenocissus quinquefolia*	1								1
Scarlet Oak *Quercus coccinea*				1					1

Total number of trees and shrubs, present in the 1- to 5-foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead.

Plot number	6	11	14	21	38	39	40	43	Total number stems
Maple-leaf Viburnum *Viburnum acerifolium*		8	39	29	93	19	18	12	218
American Hazelnut *Corylus americana*								1	1
Black Gum *Nyssa sylvatica*			1		22	10		2	34
Flowering Dogwood *Cornus florida*	5	11	6	21 (1)		12	5		60
Blue Beech *Carpinus caroliniana*		1		2	5		1	4	13
White Ash *Fraxinus americana*	6	6	1	7	6	1			27
Norway Maple *Acer platanoides*	20			3					23
American Beech *Fagus grandifolia*		3			6	12			21
Arrow-wood Viburnum *Viburnum dentatum*			6	1		1			8
Red Maple *Acer rubrum*	8	19			12	1	7		47
Black Haw *Viburnum prunifolium*			1			1			2
Black Cherry *Prunus serotina*		5		4			2		11
White Oak *Quercus alba*			2				2		4
Black Oak *Quercus velutina*							3		3
Red Mulberry *Morus rubra*	1				3 (1)	1		1	5
Sassafras *Sassafras albidum*					6 (1)				6
Red Oak *Quercus rubra*			1		2				3
Hickory *Carya* sp.		3	1		3				7
Spice Bush *Lindera benzoin*			5		10				15
Slippery Elm *Ulmus rubra*	21	1	1						23
Tulip Tree *Liriodendron tulipifera*		1							1

TABLE 7

Baltimore Gneiss Ridge, South Facing Slope
South Campus, West Chester State College, 1971

Percent crown cover, estimated by mapping crown on 10- x 40-meter plots located at random, March 1971.

Plot number	3	6	12	28	29	Sum of crown cover by species on 5 plots
Total percent plot covered	61	80	45.3	50	64.5	
Hickory *Carya* sp.	9	5	13	13	57	97
Tulip Tree *Liriodendron tulipifera*	31	60	10	18	1	120
White Oak *Quercus alba*					3	3
American Beech *Fagus grandifolia*		1	5		3	9
White Ash *Fraxinus americana*					0.5	0.5
Slippery Elm *Ulmus rubra*				14		14
American Chestnut *Castanea dentata*				5		5
Red Oak *Quercus rubra*	10	14	17			41
Flowering Dogwood *Cornus florida*	2					2
Black Oak *Quercus velutina*	9					9
Black Gum *Nyssa sylvatica*			0.3			0.3

Total number of stems of trees and shrubs in one 5- to 20-foot height class on each 10- x 40-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	3	6	12	28	29	Total number stems
White Ash *Fraxinus americana*	2	18 (1)	20 (4)	34 (1)	17	91
Flowering Dogwood *Cornus florida*	11 (1)	35 (2)	138 (9)	38 (3)	12	234
Blackberry *Rubus allegheniensis* complex		1	6 (1)	44 (19)	49	100
Wineberry *Rubus phoenicolasius*			8	6	6	20
Tulip Tree *Liriodendron tulipifera*	1		2 (1)	4	5	12
American Chestnut *Castanea dentata*				1	2	3
Cherry *Prunus* sp.			17	8	14	39
Sassafras *Sassafras albidum*		6	17 (1)	2	2	27
Black Oak *Quercus velutina*		1			3	4
Spice Bush *Lindera benzoin*	4 (1)	43	80 (4)	92 (5)	48	267
Black Raspberry *Rubus occidentalis*				1	6	7
Wild Grape *Vitis* sp.			4	3	3	10
Norway Maple *Acer platanoides*		6	10	8	6	30
Viburnum *Viburnum* sp.	1	19	2		1	23

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TABLE 7 (Continued)

Plot number	3	6	12	28	29	Total number stems
Black Haw		3		8	5 (2)	16
Viburnum prunifolium						
Morrow Honeysuckle					8	8
Lonicera morrowi						
Red Maple		11		2	1	14
Acer rubrum						
Slippery Elm		5	1	1	1	8
Ulmus rubra						
Red Oak			2		1	3
Quercus rubra						
Virginia Creeper					1	1
Parthenocissus quinquefolia						
Greenbriar				2		2
Smilax rotundifolia						
Box Elder		4	1	1		6
Acer negundo						
Bittersweet				1		1
Celastrus scandens						
Black Walnut				1		1
Juglans nigra						
American Beech	1			2		3
Fagus grandifolia						
Blue Beech		6				6
Carpinus caroliniana						
Hickory		4 (1)	8			12
Carya sp.						
Poison Ivy	3					3
Rhus radicans						
Black Gum			36 (1)			36
Nyssa sylvatica						
Common Elderberry			1 (1)			1
Sambucus canadensis						

Total number of stems of trees and shrubs present in the 1- to 5- foot height class on each 10- x 10-meter plot located at random. The numbers in parentheses are the number of the total that were dead.

Plot number	3	6	12	28	29	Total number stems
Blackberry	143 (51)	14 (3)	29 (5)	20 (8)	85 (34)	291
Rubus allegheniensis complex						
Spicebush	15	35	74 (15)	30 (4)	6 (1)	160
Lindera benzoin						
Black Raspberry			16		20 (1)	36
Rubus occidentalis						
Viburnum	97	88	52		2	239
Viburnum sp.						
Cherry	5		5		2	12
Prunus sp.						
Black Haw	2	3	1	5	1	12
Viburnum prunifolium						
White Ash	3	8	3 (1)	1	6	21
Fraxinus americana						
American Beech					1 (1)	1
Fagus grandifolia						
Wineberry	29 (9)	11 (5)	24 (9)	25 (13)	1	90
Rubus phoenicolasius						
Greenbriar				1		1
Similax rotundifolia						
Flowering Dogwood	15	25	50	6		96
Cornus florida						
Hickory		4	10			14
Carya sp.						
Blue Beech		14				14
Carpinus caroliniana						

(Continued on next page)

TABLE 7 (Continued)

Plot number	3	6	12	28	29	Total number stems
Box Elder *Acer negundo*		3	1			4
Red Maple *Acer rubrum*	19	9				28
Sassafras *Sassafras albidum*	4 (1)		8			12
Black Gum *Nyssa sylvatica*	11		3			14
Privet *Ligustrum vulgare*			95			95
Norway Maple *Acer platanoides*			4			4
Red Oak *Quercus rubra*			3 (1)			3
Wild Grape *Vitis* sp.			2			2

TABLE 8

Ravine (cove) Forest, near Brandywine Creek, Chester County, E. Branch of Brandywine Hillsdale Avenue and Creek Road

Percent crown cover estimated by mapping leafless crown on 20- x 20-meter plots located at random, March 1967.

Plot number	5	10	12	14	Sum of crown cover by species on four plots
Total percent covered	95	82	60	96	
Sugar Maple *Acer saccharum*	25	30	30	39	124
Tulip Tree *Liriodendron tulipifera*	2	12	9	13	36
White Ash *Fraxinus americana*	4	20	12		36
Slippery Elm *Ulmus rubra*			2		2
Hickory *Carya* sp.	5		2	10	17
Flowering Dogwood *Cornus florida*	1		2	15	18
American Beech *Fagus grandifolia*		13		5	18
Blue Beech *Carpinus caroliniana*				7	7
Black Oak *Quercus velutina*	38				38
Red Oak *Quercus rubra*	13	7			20
Red Maple *Acer rubrum*				7	7

Total number of trees and shrubs present in the 5- to 20-foot height class on each 20- x 20-meter plot. The numbers in parentheses are the number of the total that were dead.

Plot number	5	10	12	14	Total number stems
Spice Bush *Lindera benzoin*			15		15
Red Maple *Acer rubrum*	1		4		5

(Continued on next page)

TABLE 8 (Continued)

Plot number	5	10	12	14	Total number stems
American Beech *Fagus grandifolia*		2	4	3	9
Box Elder *Acer negundo*			7	2	9
Blue Beech *Carpinus caroliniana*		2	7	11	20
Flowering Dogwood *Cornus florida*			1	1	2
Sugar Maple *Acer saccharum*	11 (1)	14	3	12	40
White Ash *Fraxinus americana*			2		2
Norway Maple *Acer platanoides*	8 (3)		1	2	11
Slippery Elm *Ulmus rubra*			2 (2)	1	3
Viburnum *Viburnum* sp.			2		2
Privet *Ligustrum vulgare*	1				1
Japanese Honeysuckle *Lonicera japonica*				5	5

Total number of trees and shrubs present in the 1- to 5-foot height class on each 10 x 10 plot located at random.

Plot number	5	10	12	14	Total number stems
White Ash *Fraxinus americana*				3	3
Japanese Barberry *Berberis thunbergii*				2	2
Poison Ivy *Rhus radicans*				84	84
Norway Maple *Acer platanoides*				2	2
Red Maple *Acer rubrum*				3	3
Spice Bush *Lindera benzoin*			5		5
Sugar Maple *Acer saccharum*		6	7	2	15
Box Elder *Acer negundo*		3	2	7	12
American Beech *Fagus grandifolia*			1		1
Slippery Elm *Ulmus rubra*		2	3	3	8
Viburnum *Viburnum* sp.	3	3	1	1	8
Bitternut Hickory *Carya cordiformis*		2		2	4
Flowering Dogwood *Cornus florida*	1			1	2
Alternate Leaf Dogwood *Cornus alternifolia*	6				6
Red Oak *Quercus rubra*	2				2
Blue Beech *Carpinus caroliniana*				6	6

inated the upper slope also. Evidence for this point of view is suggested by the fact that the crown cover on the drier south facing slope of the 1971 stand (Table 7) is dominated by Tulip Tree.

Since two stands were studied on two portions of the upper northwesterly facing slope in 1965 and again in 1970 and both were dominated by Black Oak (Tables 5 and 4), it would appear that one might look here for further evidence of the relationships of Tulip Tree and Black Oak. However, an old fence line separates the two stands and their history appears to be quite different. In contrast to the even-aged 1965 stand with a few large Black Oak trees and a general Tulip Tree matrix, the 1970 stand is a many-aged, old growth stand. In addition to Black Oak, it includes a considerable representation of American Beech in the crown cover and less Tulip Tree. It represents the best example of a natural mature slope forest in the area. Thus, it may be used as a guideline toward which the other forest communities on the southwesterly facing slope will tend in time. It is near climax for this site in our area.

It is interesting to note in support of the increase in American Beech in the crown cover of this mature forest, that in both of the other southwesterly facing slope forests (Tables 5 and 6) American Beech, though not a major crown species, is the major tree species in the sapling size class. This indicates that with its superior ability to tolerate shade, it should increase considerably in the crown cover of these stands in the future.

The 1971 stand on the warmer south-facing slope (Table 7) shows a considerable representation of hickory in the crown cover in addition to the dominant Tulip Tree. It also shows the results of opening the stand by removing a portion of the crown species. In practical results it resembles a shelterwood cutting in forestry. The seedlings of many shade intolerant tree species are, therefore, favored by the increase in light intensity and related environmental changes. Note the large stem counts for White Ash, Tulip Tree, Cherry, Hickory, and Sassafras. The opening of the stand also resulted in large stem counts of such shrubs as Blackberry and Wine Berry. The large stem count of Spice Bush on the slopes of the ridge was discussed previously.

One of the most interesting problems resulting from this study is the presence and future of Norway Maple. It is seeding in and competing successfully throughout the ridge. Note the considerable number of stems in the 5- to 20-foot height class. It is an excellent example of an exotic tree species entering a reasonably closed natural ecosystem, in spite of some textbook statements, and competing successfully. In fact, from personal observation, it appears to do best on the more undisturbed portions of the slope. If shade tolerant species, such as American Beech and Norway Maple, eventually dominate the ridge forest community as appears likely, in 100 to 200 years, there will be a new type of forest ecosystem, a beech-maple forest, with a dominant European maple species. This would result in a series of interesting interactions and changes related to the litter, soil profile, shrubby understory species, spring herbaceous flora, and a host of other problems.

Since the forest has a protected status in the campus planning as "The Robert B. Gordon Natural Area for Environmental Studies," it is expected that this long-term prediction will have the opportunity of being tested.

One last note concerning this slope forest. Both the 1965 and 1967 sites show the effect of a ground fire that occurred in 1962. A measure of the damage and recovery can be determined by the number of dead stems in the understory height classes. Mature trees were charred at the base but not killed.

A Ravine Forest. The Creek Road ravine forest (Table 8) is unusual in southern Chester County, as natural stands dominated by Sugar Maple are uncommon and local in the area. It represents the most mesophytic site observed by the author in the southern portion of the County. It was first brought to my attention by Dr. Robert B. Gordon of West Chester State College in 1963. The most evident differences between this stand and the other slope forests presented in this paper other than the self-evident species differences may be summarized as follows:

1. It has a more open understory with a considerable reduction in the importance of Flowering Dogwood. This is well illustrated by a comparison of stem counts between the stands.
2. It has a particularly rich spring and early summer herbaceous flora which is not evident except under certain local conditions in the slope forests presented.

Finally, it is worth pointing out that Norway Maple was present on three of the four 20- x 20-meter square study plots in the 5- to 20-foot height class. This is good evidence that it can compete in a forest community dominated by the very shade tolerant Sugar Maple.

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Main points stands out

1914 installed as King
Satan was cast out
Living in last days

XIV