

TORREYA

Plant Communities of Hutcheson Memorial Forest Based
on Shrub Distribution

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I. Introduction

Hutcheson Forest (formerly known as Mettler's Woods) is located on the gently rolling Piedmont of New Jersey. It is an old oak forest which has been preserved with relatively little disturbance. Compared with other forest stands in this part of the country, it has progressed farther in successional development. This led Bard (1952) to say that it "approximates climax." The variable but slight and consequent inefficiency of soil drainage in certain areas reminded Braun (1950, p. 253) of the oak-hickory forest of the Illinoisan till plain. "A type of oak-hickory forest which occurs frequently on the very gently rolling to flattish surface of the Piedmont Lowland is related to high water table. . . . The aspect is similar to that of the Illinoisan till plain forest of the Western Mesophytic Forest region."

Throughout most of the woods the drainage has a dominant influence on the vegetation pattern. Most of the forest is well drained. The poorly-drained portions lie at each end of the forest. A stream, bordered by extensive areas of poor drainage, flows through the eastern section. A small ditch supplements the drainage in the western end. The vegetation associated with well-drained areas is strikingly different from that of poorly-drained areas. Within each, poorly drained or well drained, species composition of the various layers, except for the shrub layer, is remarkably uniform. In contrast such a uniformity does not always exist in the shrub layer. It is with these differences in the shrub layer that this study is concerned.

The objectives of this study are threefold: (1) to prepare a map of the forest utilizing shrubs as indicators, (2) to emphasize the value of employing shrubs in mapping mature forests, and (3) to lay a foundation upon which future studies may be made.

History

Hutcheson Forest is part (65 acres) of an original 1500-acre tract purchased in 1701 by a group of Dutch farmers. This particular section had remained in the possession of the same family from that date until it was purchased and given to Rutgers University. For some reason, the proprietors preserved this fragment from being cleared for agricultural or other purposes since colonial days. If the forests which existed prior to colonization are to be considered as "virgin," then Hutcheson Forest qualifies in this respect.

It has been shown by Buell, Buell, and Small (1954) that fires were relatively common in Hutcheson Forest, occurring at approximately 10-year intervals, before and during early colonial days. Such profound disturbance induced by Indians would seem to preclude the use of the adjective "virgin," meaning undisturbed by human activity, to the colonial forests of this area.

Storms have caused considerable damage to the vegetation in the forest. Numerous trees have fallen during storms and a few others have had top damage. The majority of these has remained in the forest to decay and return to the soil. This is evidenced by numerous logs present in various stages of decomposition. Since storms are a part of the natural environment, the designation "virgin" cannot be denied a forest because it has been damaged by storms. The major alteration is presented when fallen trees are removed. Unfortunately, there were 299 such trees removed after a storm in 1950, and several logging trails remain as evidence. Also, a selective cutting practice of removing an occasional storm-damaged tree prior to 1950 was maintained by the previous proprietor. The western two acres of the forest were cut over in 1872 and cultivated until 1890 (T. H. Mettler, personal communication).

This history of disturbance leads one to question any designation of Hutcheson Forest as a true virgin forest. On the other hand, the 63-acre tract which has not been cut over but has had some fallen and storm-damaged trees removed is as near a virgin forest as exists on the Piedmont of New Jersey today.

II. Methods

The location and extent of the shrub types were determined by reconnaissance. After determining the areas that had distinctly different shrub dominants in the shrub layer, mapping was initiated. Reference points were spaced at 100-foot intervals along the periphery of the forest. Measurements were made from these points along parallel compass lines that extended perpendicularly into the forest until the boundaries of the shrub type under consideration had been determined. All measurements were plotted to scale on outline maps. The points determined by these measurements formed the basis for outlining the vegetative units.

Shrubs could be used in mapping only the mature forest, because in the adjoining young woodlots the shrub layer has not developed to a point where it is a distinct stratum. Such areas were mapped on the basis of physiognomy. In the case of the surrounding fields, a number was assigned for reference.

The size and per cent of area occupied by each shrub type were calculated from the map with the aid of a planimeter. All sizes and percentages given in the text have been rounded to the nearest whole number with the exception of those below a value of 1.

Nomenclature follows Gray's Manual, eighth edition (Fernald, 1950) unless authority is given.

III. Results

Eight distinct shrub types (Fig. 1) based on patterns of shrub distribution are recognized in Hutcheson Forest. They range in area from 51 acres (79%) to 0.1 (0.2%). Four of them are restricted to well-drained sites. Throughout the well-drained areas there is a species similarity among the trees, both of the canopy and under-story, and likewise among the herbs and the bryophytes. Only in the shrub layer are there pronounced differences in species composition. This is equally true of the poorly-drained sites.

A. SHRUB TYPES OF WELL-DRAINED AREAS

The four types of the well-drained sites occupy 82 per cent of the forest.

1. Maple-leaved Viburnum (*Viburnum acerifolium*) Type.

Maple-leaved viburnum constitutes the principal shrub type in the forest (79%) as well as being the dominant shrub on the well-drained sites (95%). Only three small areas of the well-drained portion are occupied by shrubs other than maple-leaved viburnum.

The forest layers above the maple-leaved viburnum consist of an understory tree layer about 35 feet high and a canopy layer that reaches a height of about 95 feet. Between the understory and canopy are frequent trees, either younger trees of the canopy species or species of normally smaller stature. The canopy is for the most part essentially continuous stratum except in the vicinity of wind-throws. White oak (*Quercus alba*), black oak (*Q. velutina*), and red oak (*Q. rubra*) are the dominant species. They comprise by far the major proportion of the total canopy cover. The remaining is contributed mainly by red hickory (*Carya ovalis*) and shagbark hickory (*C. ovata*). White ash (*Fraxinus americana*) and beech (*Fagus grandifolia*) reach the canopy but more commonly, along with sugar maple (*Acer saccharum*), red maple (*A. rubrum*), Norway maple (*A. platanoides*), and sweet cherry (*Prunus avium*), contribute to the discontinuous substratum between the understory and the canopy.

The understory layer, which is very pronounced, attains a height of about 35 feet and consists of a continuous layer of flowering dogwood (*Cornus florida*). Interstices are infrequent except in the vicinity of wind-throws. Openings in the understory due to blow-downs are less frequent than in the canopy. Frequent young individuals of canopy species occur with the dogwoods. True understory species other than dogwood are extremely rare.

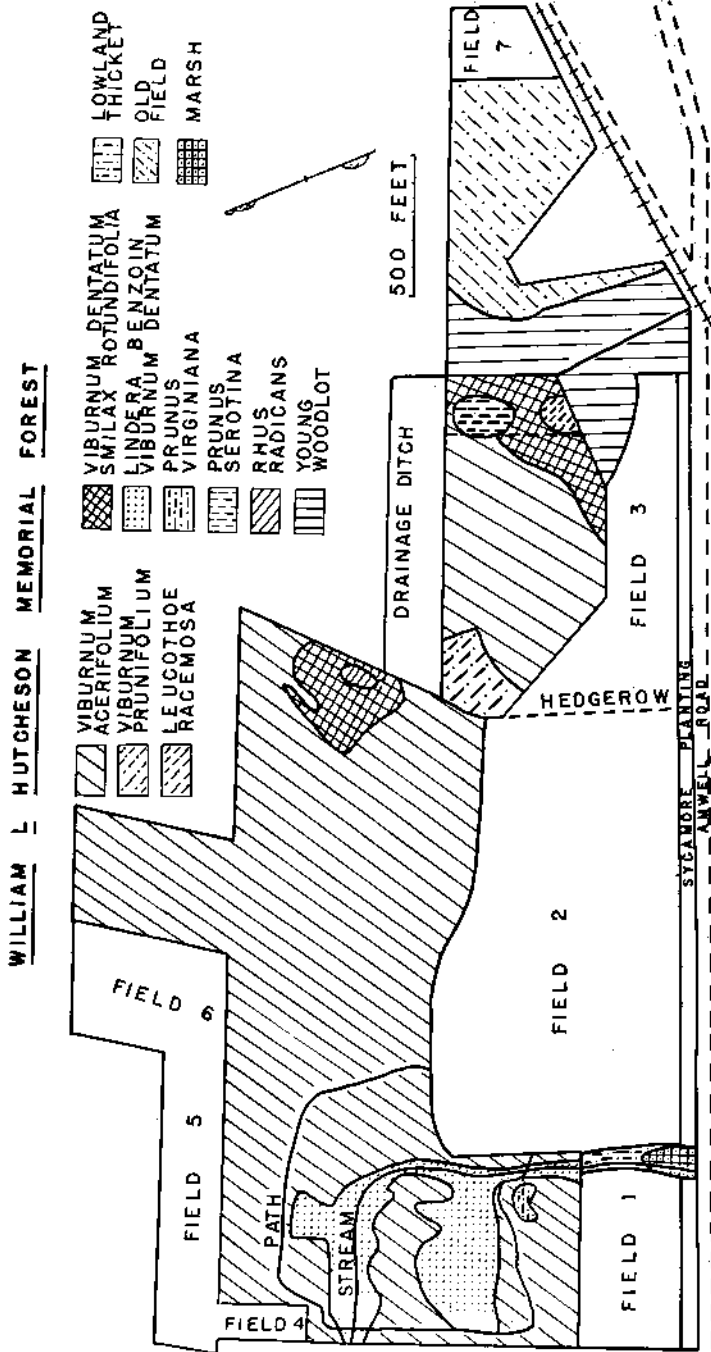


FIG. 1. Map of Hutcheson Memorial Forest showing patterns of shrub dominance within the forest and showing the adjacent communities. The dashed line that bisects the westernmost *Viburnum dentatum-Smilax rotundifolia* type delimits a two-acre tract that was cleared in 1872.

Maple-leaved viburnum forms a well-developed shrub stratum that is 3 to 4 feet high. Shrubs other than maple-leaved viburnum are only incidental.

The herbaceous layer is best developed in the early spring before the closing of the canopy. Even though there is a decrease from maximum coverage in early spring to a minimum in late summer, Bard (1952) found that the number of species in the herbaceous flora was greatest in late summer when the cover was the lowest. The herbs can be divided into three groups based on the time of year they initiate growth and their longevity. The first group comprises those plants which begin growth in early spring and deteriorate by mid-summer. May-apple (*Podophyllum peltatum*), spring beauty (*Claytonia virginica*), rueanemone (*Anemonella thalictroides*), and spring cleavers (*Galium aparine*) are the principal species in the spring group. It is this group of species which forms the well-developed spring herbaceous cover. The second group consists of plants which initiate growth in early spring but remain evident until late fall. False Solomon's-seal (*Smilacina racemosa*), Solomon's-seal (*Polygonatum biflorum*), jack-in-the-pulpit (*Arisaema triphyllum*), and *Carex* spp. are the principal species in this group. The third group is comprised of those individuals which begin growth in May and remain evident until late fall. Enchanter's nightshade (*Circaea quadrisulcata*) is the principal species in this group.

The moss layer is the least developed stratum present. Terrestrial mosses are practically absent except on hummocks of old fallen trees, at bases of trees, and along several logging trails (Siburn, 1956). These sites form the only areas with a mineral soil substratum necessary for terrestrial moss growth.

2. Black-haw (*Viburnum prunifolium*) Type.

The forest canopy as well as the dogwood layer where the black-haw type occurs differs from that of the surrounding maple-leaved viburnum type in that it is more open. This aspect is attributable to disturbance associated with the narrowness of the forest. There are several old wind-throws and an old farm road that cuts through at this point. Approximately 2 per cent of the forest is occupied by black-haw.

Stratification is like that of the maple-leaved viburnum area, but species composition differs. The same oaks predominate; red hickory occurs, as well as white ash and sweet cherry. The understory layer consists mainly of dogwood. The shrub layer, predominantly of black-haw is somewhat more open and higher, reaching up to 10 feet in height. The herbaceous layer consists of the same species as in the maple-leaved viburnum type, the major difference being a shift in dominance. Spring-cleavers is the principal herb in the black-haw type. Due to the openness and narrowness of the community, old field herbs are of common occurrence (Bard 1952). Mosses are extremely sparse.

3. Black Cherry (*Prunus serotina*) Type.

The black cherry type occupies 1 per cent of the forest and is entirely situated on the portion that was cleared in 1872. Stratification consists of three definable strata—canopy, shrub, and herb. Scarlet oak (*Quercus coccinea*) is the main constituent of the canopy with black oak and red oak the second and third in importance. A large proportion of these trees is of sprout origin.

The shrub layer is approximately 8 to 10 feet high. It is continuous and quite pronounced as a layer. Although black cherry is a tree species, it forms, in this part of the woods, a low thicket type of growth resulting in this distinctive shrub layer. The individual plants are crooked and terminate in a diffuse branch system.

The herbaceous and moss strata are comparable to that of the maple-leaved viburnum type.

4. Choke-cherry (*Prunus virginiana*) Type.

The choke-cherry area occupies about 0.4 per cent of the woods. The only major difference between it and the maple-leaved viburnum type is in the shrub layer. Choke-cherry forms a well-developed shrub stratum about 5 to 6 feet high with maple-leaved viburnum frequent but overshadowed by the higher choke-cherry.

B. SHRUB TYPES OF POORLY-DRAINED AREAS

Four different shrub types occur on the poorly-drained portions of Hutcheson Forest. They occupy 18 per cent of the woods. These types have a similar physiognomic characteristic: namely, the absence of a definable understory tree layer. Another common feature, with one exception, is the presence of two shrubs as co-dominants.

1. Spicebush-Arrowwood (*Lindera benzoin-Viburnum dentatum*) Type.

The spicebush-arrowwood area is the second largest shrub type in the forest (10%). It is present along the stream and the poorly-drained areas contiguous to the stream.

The canopy over this particular area is sparse, a consequence of wind-throws which resulted from storms in 1950, 1954, and 1955. Approximately 80 per cent of recent wind-throw damage has occurred within this area. This is a result of wet soil, shallow root systems, and exposed location. Before destruction the canopy consisted of black, red, white, and swamp white oak (*Quercus bicolor*), white ash, red maple, and black gum (*Nyssa sylvatica*).

The shrub stratum in the spicebush-arrowwood type is 7 to 8 feet high and is continuous and dense. The number of species encountered is greater in this type than in any of the others. Several species of *Rubus*, greenbrier (*Smilax rotundifolia*), and numerous saplings of the various tree species common to the site are locally important.

Herbs are abundant along the stream and the adjoining areas in the few places where the shrubs are sparse. Skunk-cabbage (*Symplocarpus foetidus*), spotted touch-me-not (*Impatiens capensis*), and clearweed (*Pilea pumila*) are the characteristic herbs encountered. The moss layer is better developed in this type than other areas of the forest as a result of the higher percentage of wind-throws which create a more favorable substratum for mosses.

2. Arrowwood-Greenbrier (*Viburnum dentatum-Smilax rotundifolia*) Type.

The arrowwood-greenbrier area occupies 7 per cent of the forest. This type is encountered in two distinct sections of the forest. One is located in a portion that has never been cleared (Fig. 1, at the western edge of the main forest tract). This will be referred to as type no. 1. The second such area is located at the western end of the western part of the forest and will be referred to as type no. 2. The western part of type no. 2 was cleared in 1872 and cultivated until 1890. The part that was farmed has better drainage than the other areas occupied by this type.

The canopy over the arrowwood-greenbrier area is comprised largely of pin oak (*Quercus palustris*), white ash, and red maple. American elm (*Ulmus americana*) occurs in site no. 1, swamp white oak in no. 2, and black gum is present in small amounts in both. The drier portion of the area supports white, red, and black oaks as the principal canopy trees. The canopy there is more open and is about 10 feet lower than in the area which was not cleared.

The shrub stratum is well developed in type no. 1 and in the portion of type no. 2 which was not farmed. In these areas greenbrier has grown onto the other shrubs and saplings present to the extent that it forms an almost continuous layer. There are, however, areas where arrowwood is the principal shrub and other places where it and greenbrier are equally important. The shrub layer in the segment which was farmed is not as well developed but rather is more discontinuous. Locally either greenbrier or arrowwood or both are important, but more often there is no shrub layer at all.

Except in spots, the herb layer is relatively sparse and open. Spring beauty, rue-anemone, spotted touch-me-not, and wood rush (*Luzula campestris*) are the principal herbs in the older woods, whereas *Carex pensylvanica* is more important in the area that had been cultivated. Mosses are of infrequent occurrence.

3. Swamp Fetterbush (*Leucothoe racemosa*) Type.

The swamp fetterbush type occupies 0.5 per cent of the woods. It is situated on the area that was cleared in 1872 and farmed until 1890.

Pin oak is the dominant canopy tree with red maple, swamp white oak, and black gum as associates. These form a more or less continuous canopy that is about 85 feet high.

The shrub stratum is 4 to 5 feet high and is moderately dense and continuous.

Swamp fetterbush is the characteristic shrub, but highbush blueberry (*Vaccinium corymbosum*), greenbrier, and arrowwood are important. Herbs and mosses are sparse.

4. Poison Ivy (*Rhus radicans*) Type

The poison ivy type is the smallest recognized shrub type present in the forest, but it is extremely distinctive. The drainage is very poor. Several inches of standing water are generally present during the winter and early spring.

Stratification consists of only three definable layers—canopy, shrub, and herb. The canopy and herb strata are essentially the same as in the surrounding arrowwood-greenbrier area. The shrub stratum consists primarily of single unbranched stems of poison ivy that originate from an underground system.

Poison ivy is important along the entire fringe of the woods.

C. TREE REPRODUCTION

A description of the vegetation of Hutcheson Forest would be incomplete without a note concerning the distribution of seedlings and saplings of the canopy species. Even though oak and hickory comprise over 85 per cent of the canopy, saplings of these species are seldom encountered. Seedlings are frequent but only a very small percentage remains alive long enough, except in wind-throw openings, to become trees. Of the few saplings of oak and hickory encountered, at least 95 per cent are associated with wind-throw areas.

Of the other canopy species such as white ash, beech, sugar maple, red maple, and Norway maple, all except beech are prolific seeders in the woods. They are all far better represented in the reproductive classes than the oaks and hickories, a situation which is the reverse of the proportional contribution of mature trees in the canopy.

White ash and red maple, while common as seedlings and saplings in the shaded areas, rarely are encountered as trees whose crowns have reached above the understory. But like the oaks and hickories they grow very well in openings created by wind-throws, where they are abundant.

Saplings of sugar maple and Norway maple are common but are not of as frequent occurrence as white ash and red maple, but the number of these is high in proportion to the number of seed trees. Also, their successful seedlings and saplings are not restricted to wind-throw areas but also grow well in places having a continuous canopy and understory.

D. COMMUNITIES ADJOINING THE FOREST

1. Young Woodlot.

The young woodlot community occupies a poorly-drained area (7 acres) that was utilized as a pasture until 1921, at which time it was abandoned. Approximately half of this area is dominated by American elm, red maple, pin oak, swamp white oak, and white ash which average about 25 feet in height. The other half is dominated by river birch (*Betula nigra*) of equal height. The shrub layer is ill-defined except locally where greenbrier or poison ivy are important. *Poa trivialis* is the principal herb, and it occurs with lesser amounts of species common in old fields.

2. and 3. Lowland Thicket and Marsh.

These communities are located on a site formerly occupied by a small pond that was drained in 1935. The portion which corresponds to the shallower part of the pond is covered with a thicket of silky dogwood (*Cornus amomum*), and small trees of red maple and pin oak. *Carex* spp., *Juncus* spp., *Polygonum* spp., sensitive fern (*Onoclea sensibilis*), and skunk-cabbage dominate the herb layer. The marsh occupies a section which corresponds to the deeper portion of the pond. It is dominated by the same herbs present in the thicket. Common elder (*Sambucus canadensis*) occurs in isolated clumps as the only major woody species.

4. Old Field.

The section mapped as old field occupies 8 acres. It was abandoned agriculturally in 1921. Pin oak trees scattered liberally throughout dominate the aspect, but among them there is a mosaic of open grassy spaces and individuals and clumps of shrubs and

trees. Clumps of bayberry (*Myrica pensylvanica*), river birch, Japanese honey-suckle (*Lonicera japonica*), red cedar (*Juniperus virginiana*), and hawthorn (*Crataegus* sp.) are important locally. Between the clumps *Andropogon scoparius*, *Potentilla simplex*, and numerous other characteristic old field species exist in abundance. *Polytrichum ohioense* (Ren. & Card.) is frequently encountered between the clumps of herbs.

5. Fields 1-7.

Fields 1 and 2 were planted in 1954 in corn with Italian rye-grass (*Lolium multiflorum*) as a cover crop. In 1955 they were planted in oats with a mixture of white and yellow sweet clover (*Melilotus alba* and *M. officinalis*). In 1956 these fields are dominated by Italian rye-grass, white and yellow sweet clover, and alsike clover (*Trifolium hybridum*).

Field 3 was abandoned agriculturally in 1950. *Potentilla simplex*, *Aster* sp., *Solidago* sp., *Juncus effusus*, *Linaria vulgaris*, *Plantago lanceolata*, and *Agrostis alba* dominate the aspect.

Fields 4, 5, and 6, in 1956, are planted in soybeans, corn, and wheat respectively. Field 7 is being used as a playground by East Millstone School.

IV. Discussion

Several investigators have employed certain dominant species of the lower layers of the community in conjunction with dominant canopy species as a criterion for classifying associations or as a basis for quantitative sampling. Daubenmire (1952), in a study of the coniferous forest of northern Idaho and adjacent Washington north and east of Columbia Plateau, recognized four vegetation zones (*Picea engelmanni-Abies lasiocarpa*, *Thuja plicata-Tsuga heterophylla*, *Pseudotsuga taxifolia* var. *glauca*, and *Pinus ponderosa*). With the aid of dominants of the lower strata he classified these four vegetation zones into 13 climax plant associations. Oosting and Billings (1939) and Oosting and Bourdeau (1955) in phytosociological studies of two different virgin hemlock forests in western North Carolina were able to distinguish two distinct hemlock communities on the basis of associated species of the lower strata. McCormick (1955) found it profitable to use shrub distribution as a criterion to recognize certain communities in the New Jersey Pine Barren region.

The shrub layer of the Hutcheson Forest is so distinctive from place to place that it has been used as an indicator of communities in the area. The term shrub type is used to designate these various forest communities. The shrub layer is not considered as a community in the sense of Lippmaa (1939) but as an integral part of the forest unit of which it is the indicator.

In some of the shrub types there are no detectable changes taking place in relative dominance within the lower layers of the forest. This is not true of the canopy species, and in the course of time the influence of canopy changes may have their effect on the inferior strata.

The eight shrub types in the Hutcheson Forest vary considerably in their characteristics. They fall into three groups: (1) In some of them, a few dominants with the ability to carry through their complete life cycle have become established and little or no change is taking place in the composition. (2) In others the dominants are able to reproduce and maintain themselves vegetatively, rarely if ever carrying through all stages of their life cycle. (3) In still others no species have as yet gained dominance, the shrub layer being an unorganized mixture of species.

In the first of these groups are four shrub types: the maple-leaved viburnum type, the arrowwood-greenbrier type, the spicebush-arrowwood type, and the black-haw type. The first three of these might be thought of as being stable in respect to all but the canopy layer, since the latter is the only layer that exhibits any detectable change taking place. Of these, maple-leaved viburnum is the type occurring on well-drained sites. Maple-leaved viburnum is the dominant shrub in mature forests of well-drained areas of the New Jersey Piedmont. In Bard's (1952) work on old field succession she first encountered this species in a 60-year-old field where it was secondary in importance, but she found it to be the dominant shrub in the mature forest. The spicebush-arrowwood

and the arrowwood-greenbrier types are both typical of sites having higher moisture levels. The spicebush is a particularly widespread indicator of moist soils, occurring even under flood plain conditions (Buell and Wistendahl, 1955; Wistendahl, 1955). With the exception of the canopy species, the members of these types seem to be living in complete harmony with the environment of the forest. The presence of the other types is attributable to historical factors or chance dissemination and establishment and they are to be considered as successional. The black-haw type owes its existence to more open conditions. As shading becomes more intense, black-haw is less vigorous and fails to flower. Maple-leaved viburnum is encroaching on the more shaded areas within this shrub type, thus indicating the indeterminate position of black-haw as a dominant in the shrub layer.

In the second group, those shrub types in which the dominant shrub is perpetuated by vegetative reproduction with flowering and fruiting uncommon, are choke-cherry and poison ivy types. The choke-cherry is not common in this part of New Jersey, and even on the margin of the woods where it gets full light intensity it rarely produces seed. Bard (1952) did not mention it as occurring in the old fields that she studied. The poison ivy in contrast is exceedingly common in this part of New Jersey. Bard encountered it in fields of all ages as well as in the mature forest, but it was most abundant in fields from 25 to 60 years of age. Its local dominance in the woods is related to a peculiar drainage situation.

The third group includes shrub types that occupy most of the area that was cultivated in the late 1800's. Black cherry characterizes one type and swamp fetherbush the other, but in each instance there are a number of associated species. The black cherry of the former type is not a shrub, of course, even though it is occupying a position with the shrubs. It appears to be existing in a suppressed state in which there is a constant replacement of older individuals by younger, more vigorous basal sprouts. There has not been sufficient time since abandonment for the canopy and understory to become continuous. Consequently, black cherry has been able to persist in a suppressed state without being eliminated. This community is bound to change through the deterioration of the cherry. There is no indication in the woods that this species has ever been successful as a forest tree. In this part of New Jersey it is primarily a small tree of open places. Bard found it ubiquitous in fields although never in large numbers.

In that designated the swamp fetherbush type, no species is predominant, there being a considerable mixture of species. Although arrowwood is most important, the swamp fetherbush is second and gives the type its distinction. Like the black cherry type, it appears to be undergoing successional development from the recent period of cultivation.

The values of using shrubs as indicators in a forest such as Hutcheson Forest are several. First, the shrubs are more sensitive than trees to variations within the habitat. Secondly, they are more useful than herbs, particularly since they are conspicuous and recognizable at all seasons.

The usefulness of shrubs in classifying associations as Daubenmire (1952) has done is restricted to climax or near climax communities. In vegetational studies, at least of late successional stages, they can be used as under circumstances similar to the Hutcheson Forest, in recognizing units for mapping or for related field work.

V. Summary

1. An oak stand on the New Jersey Piedmont was mapped with shrubs as indicators. Eight shrub types, four each on well-drained and poorly-drained sites, were recognized. These were divisible into relatively stable and successional units with maple-leaved viburnum the established shrub on well-drained sites and combinations of spicebush, arrowwood, and greenbrier on poorly-drained areas.

2. In this woods, shrubs are more useful in mapping than are trees or herbs. The trees apparently are not sensitive enough to express slight but significant changes in local environments. Herbs express these changes but are more discontinuous in distribution than the shrubs and are not evident during all seasons.

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**An Annotated Preliminary Catalogue of the Vascular Flora
of Rockland County, New York**

(Continued from *Bull. Torrey Club* 84: 126-134, 1957.)

J. HARRY LEHR

LEGUMINOSAE

CASSIA

*CASSIA NICTITANS L. Partridge Pea. Ramapo. (H)

BAPTISIA

*BAPTISIA TINCTORIA (L.) R. Br. Wild Indigo. Ramapo. (H)

CROTALARIA

CROTALARIA SAGITTALIS L. Rattlebox. Ramapo. (H)

CYTISUS

*CYTISUS SCOPARIUS (L.) Link. Scotch Broom. Ramapo. (H)