H. S. Pepoon then presented the following paper:

THE FOREST ASSOCIATIONS OF NORTHWESTERN ILLINOIS.

A large area in northwestern Illinois, which, roughly speaking, occupies practically all of Jo Daviess county, except a narrow strip along the northeastern border, and a small portion of the adjacent counties of Carroll on the south and Stephenson on the east, is or rather was occupied by almost continuous forest growth. In Illinois. as a rule, the wooded lands lie adjacent to streams, but here there is no such distribution. Ridge and valley alike have this forest covering. The accompanying map will show the distribution of woods, which sustain a remarkably close relation to that peculiar physiographic feature called the "driftless area."

A very large percent of the original woodland has disappeared before the ax and "grub-hoe," and it is no exaggeration to state that in many parts not more than ten percent of the first growth remains standing, so that the aspect of large areas is that of a rolling prairie; but even now the remaining portion is amply sufficient to form a basis for the study of the forest associations, and all the more so because each passing year further decreases the number of remnants.

This paper, therefore, will partake of the historical as well as the actual in dealing with the subject, and it is largely with the idea in mind of preserving many interesting facts of distribution that it is undertaken.

The Forest Associations are so intimately and vitally connected with the character of the soil, the amount of water supply, and the greater or less perfectness of drainage, that it

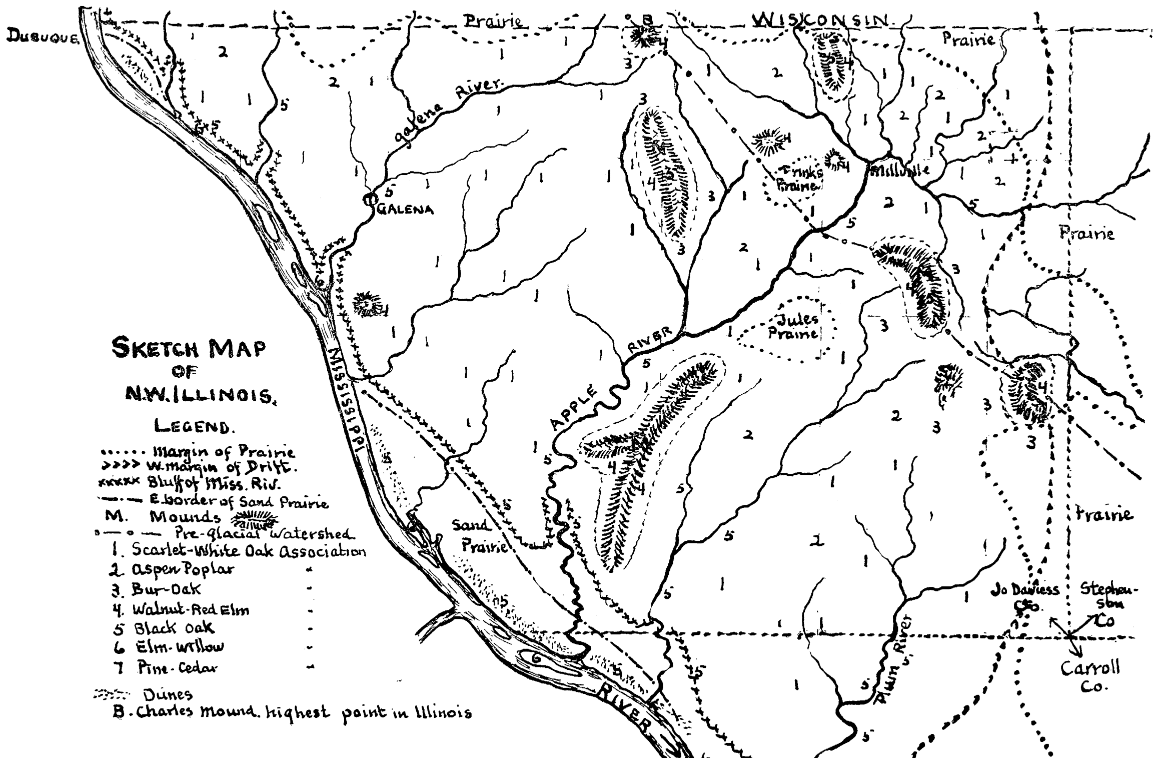
Dubuque
Prairie
B
Wisconsin
Prairie
Galena River
Galena
Millville
Frinks Prairie
Jules Prairie
Apple River
Mississippi
River
Sand Prairie
Prairie
Prairie
Plum River
Jo Daviess Co.
Stephenson Co
Carroll Co.
Sketch Map of N.W. Illinois.
Legend.
...... Margin of Prairie
>>>> W. margin of Drift.
xxxxx Bluff of Miss. Riv.
—·— E. border of Sand Prairie
M. Mounds
o — o — Pre-glacial Watershed
1. Scarlet-White Oak Association
2. Aspen-Poplar
3. Bur-Oak
4. Walnut-Red Elm
5. Black Oak
6. Elm-Willow
7. Pine-Cedar
Dunes
B. Charles Mound, highest point in Illinois

Fig. 10.

is necessary to obtain a reasonable conception of these elementary factors in distribution. No region of Illinois probably compares to Jo Daviess county in the extent and perfection of the drainage elements, for it must be remembered that we are dealing with an ancient land surface that for milleniums has been subjected to the erosive action of frost and rain, so far as we know, without a break since the days of the Niagara limestone. Countless ravines and small and large valleys cut up the surface in every directon, so that a plot of level land is a rarity, every where slopes, more or less pronounced, being the topographical feature paramount in the landscape. Only on the expanded summits of the watersheds are there any areas of poor drainage found and these are of limited extent, and yet, as shown hereafter, they are sufficiently potent to produce a forest association. The water table is in many parts very deep in the earth, this being practically true of large portions of the Galena limestone, and yet only on very limited and very local land surfaces is a genuine scarcity of water to be found. As the rainfall is about forty inches per annum, plant life rarely suffers any serious drawback from this source. The soil is everywhere the result of disintegrated rock remaining in situ except on the "bottoms" of the streams, small and large, where considerable areas of alluvium are found, and again some more or less pronounced loess soils, particularly in evidence in some of the area bordering the Mississippi river (see Soil Survey of the Dubuque Area). A clay subsoil, grayish, yellow, or even ocher red, with a few flints here and there, of many feet thickness, merges into a surface soil of clay, clay-loam, or even a black humus in limited districts, the latter particularly in evidence as border deposits where the forest and prairie join, or at the junction of Niagara and Cincinnati shales. A very limited amount of sand is found in these soils, but near the Mississippi river are several square miles of sandy soils of varying purity, evidently of river and wind formation.

Owing to the general uniformity and topography, we find one general forest association and a number of minor ones that may be designated as follows:

a. The scarlet and white oak, a general forest growth.
b. The aspen-poplar.
c. The red elm-walnut.
d. The white elm-willow.
e. The black oak.
f. The bur oak.
g. Pine red cedar.

The scarlet and white oak association is the all pervading one and everywhere gives the general tone to the woodlands. The association consists almost entirely of the oaks named, but varies in every possible degree between a pure white oak and a pure scarlet oak growth. In general, however, there will be a small preponderance of one or the other species according as the soil has more or less humus and less or more clay. The richer the soil, the more the scarlet oak abounds, and the poorer and more clayey, the more abundant will be the white oaks; most of the trees of this association are second growth; a typical example, extending over one-half mile square, having a tree for every five or ten feet square of land surface, or 400 to 1600 to the acre. These trees will average 12 to 16 inches in diameter, 50 to 70 feet in height, and represent a time growth for the scarlet oaks of 50 years, and for the white oaks 75. Here and there large white oaks are to be seen, two to four feet in diameter and up to 300 years of age. Many such are suitable for sawmill material, but their number is very rapidly diminishing. Occasional scarlet oaks 2 feet to 30 inches in diameter are found, of a probable age of a century or more. Often there are absolutely no other tree species included, and this will certainly be the case where the soil is of moderate fertility. As the soil thins, the white oaks with an occasional shag bark hickory presents a solid front. Running to the other extreme of soil richness, there will be found a few specimens of black cherry, pig-nut hickory, red oak and very rarely a red elm and bass wood.

As this exclusive association constitutes most of the forest growth of Jo Daviess county, it follows that the two oak species are the source of practically all the wood and timber supply of the region. The height noted above nowhere approaches the till growth so commonly seen in Michigan, Indiana, and Ohio. For post timber the young white oaks are very valuable; but the scarlet oaks are almost worthless for such a purpose, having but little durability in contact with the soil.

The undergrowth in the association is as a rule more marked by its absence than presence, great portions of the woods being absolutely devoid of it. The most common shrub is the hazel (*Corylus americana*), that in some of the moister places attains a height of 16 feet and a diameter of 2½ inches. Blackberries (*Rubus nigrobaccus*) are abundant in isolated patches that bear a constant relation to abundant water, being a certain feature of ravine heads. An occasional grapevine (*Vitis vulpina*) is seen and in rich soil the Virginia creeper (*Psedera*). Of substratum trees, certain hawthorns (*Crataegus tomentosus* and *C. mollis*), the wild plum (*Prunus americana*), black haw (*Viburnum prunifolium*), and choke-cherry (*Prunus virginiana*) complete the list. The plums are remarkable for fruit variation of every size, from bullets to great oval fruits 1½ inches in diameter, green, red, yellow and variegated, acerb, sour, and sweet in flavor.

The herbaceous plants in the white oak type are very few in number, either in individuals or species, and the botanist has hard work to obtain anything of note. Only a very few plants are in any sense characteristic. *Carex pennsylvanica is* everywhere, so also are innumberable spots of *Antennaria;* in the open places *Potentilla canadensis* is common; this is certainly a scant list. As the scarlet oaks predominate, and particularly where the humus is in large amount, there is found a great increase in these forms of plant life, and individuals and species become exuberant in numbers and growth. As an example, it may not be amiss to record again what I stated in Plant World, volume VII, that on the old home farm in Warren township of this county, 230 acres in extent, and having

130 acres of the scarlet oak woodland, there were found 355 species of plants.

In the scope of this paper it will be necessary to mention but a limited number of the more characteristic forms. Nowhere is the fact more plainly emphasized than here, that the *exposure* is a dominating factor in determining distribution of plant life. In this association type it is only on northeasterly slopes that the yellow lady slipper (*Cypripedium hirsutum*) is found, and then only in dense shade. This species is very local, not more than one or two "patches" being found in a township, and it is always in close proximity to the two ferns *Osmunda Claytoniana,* and *Asplenium Filix-foemina,* both in great abundance. These patches are invariably in the moist rich shade of ravines having an eastward trend. The twayblade (*Liparis liliafolia*) is a rare associate, and *Habenaria bracteata* and *Orchis spectabilis* are yet rarer. It is worth recording here that the last species was found by me in 1891 in identically the same situation and exposure, three miles southwest of Lewiston, Fulton County, growing so abundantly as to tint the woodland with its beautiful colors. Other species not so "finicky" as to exposure are *Trillium, declinatum, Uvularia grandiflora, Allium tricoccum, Podophyllum, Geranium maculatum, Desmodium grandiflorum, Viola sororia, Sanicula canadensis, Osmorhiza, Aralia racemosa, Steiromma ciliatum, Triostium aurantiacum.*

On the flattened crests of nearly all the watershed ridges, or rather, in many cases, the broad elevations between adjacent streams are poorly drained areas, thin-soiled as a rule, and occasinally with a small circular pond, the remains of an ancient "buffalo wallow." These tracts are the ideal home of the *aspen-poplar association.* They are generally of small extent, but now and them assume the proportions of a respectable woodland. The individual trees are commonly scattered, though not infrequently forming dense growths. Here and there are small open spaces surrounded by luxuriant clumps of hazel, which send out arms and straggling bands among the aspens. Practically the only other woody plant of size is the pussy willow

(*Salix discolor*). The roots of the poplar barely penetrate the soil, which is water-saturated in spring and early summer, and often they lie on the surface for a rod or more. The aspens attain at times a height of 60 feet and a diameter of 28 inches, but more commonly they are dense growths, 30 to 40 feet tall, and 4 to 6 inches in diameter. The ultimate fate of these latter trees is the grove of scattered adults, all that remains of the former hosts in the struggle for existence.

In these aspen associations there is practically nothing herbaceous that is characteristic, except that it is here that the rare orchid *Habenaria bracteata* is most surely to be found. In the small prairies that have been referred to as certain to be found with every such association, and doubtless of Indian fire origin (see later) a few species are ever present. *Baptisia leucantha, Polygala viridescens* carpeting large areas, *Koellia virginiana, Gerardia tenuifolia,* the rare *G. auriculata,* and a few plants of *Rumex Britannica,* make up the list. As hinted, these aspen flats were prairies of considerable extent in the days of Indian control, and were continued as such by the habit of firing the grass in spring that new and fresh growth might be afforded to the game of the region. When the first white men came to the country about 1800, a horseman could ride through the open woodland or through the openings in every direction. With the coming of the whites there was a cessation of the fires, and the lodgment and growth of the wind-snow aspen seed on the moist open lands caused their gradual reduction to the small open spots which are now so characteristic.

Most of the soils on which these aspens grow are what locally are termed "hard pan," having a dense impervious clay subsoil that renders the areas very marshy in spring. Usually in clearing the woodland these places are the first to be grubbed out, on account of the ease with which the laborer can remove the tree, root and trunk. The surface roots aid greatly in this undertaking. Properly fertilized and particularly so if holes are dug through the hard pan for drainage, the land produces good crops. This hard pan explains the formation of the wallows before mentioned, which were very common on all such flat lands as late as 1890, but which have now almost entirely disappeared. These circular ponds were rarely more than 18 inches deep and generally contained water during the entire year.

The remaining associations are very local, or are very much circumscribed by the encroachments of agricultural operations, but even now in the aggregate covering many square miles of Jo Daviess county. So scattered are they that they show but little influence on the general tone of the forest features, and without reference to the order given above each may be briefly considered.

While it is true that occasional bur oaks may be found widely scattered, as isolated specimens here and there, and in all probobility squirrel or pigeon sown, it is equally true that genuine associations of this species occur as fringes or limited patches, always denoting good strong soil, well drained, and in many places designated by the term "bur oak openings." The origin of such a term is obscure and I make no attempt to solve it. In general, while the bur oak is the dominant species, this association is not a pure growth, but a number of different trees is almost certain to be found. The oaks are often very large, with wide-spreading branches, and have a trunk diameter of 2 to 4 feet, and height of 80 feet, and in a typical woodland will stand 50 or 60 feet apart.

Just what the cause may be for these limited areas devoted to a particular species is not positively determined, but the conjecture is made that where the underlying lime rocks have become disintegrated sufficiently and are near enough the surface for good drainage, and where finally much humus has accumulated, such places seem to be the ideals for bur oak development. In nearly all of the best examples that are known to the writer, this association occupies the highest horizon of the Galena limestone at the point where it is overlaid with crumbling shales of the Cincinnati formation. Such a region has an abundant moisture from the innumerable springs that have their origin in the sloping steeps of the latter strata, rising in disintegrated masses to meet the weather worn escarpments of the Niagara.

An external factor, strangely enough, almost entirely precludes the determination of a peculiar herbaceous flora for this association, viz: that owing to the enormous production of very nutritious acorn food, such groves are almost invariably "hog pastures," and all wild growth has either become exterminated, or so mixed with pasture weeds as to become useless for purposes of study.

Above this growth on all the lands lying adjacent to the great Niagara mounds, so common and conspicuous a feature of the landscape of northwestern Illinois, is to be found an irregular belt or zone, occupied largely by black walnut and red elm, which here and there, by reason of the erosion caused by some drainage line, assumes the form of a great amphitheater, surrounded on all sides, but the outflowing, by the steep slopes of the mound, partly Cincinnati and partly Niagara, both talus-like in appearance. In such places the species named reach magnificent proportions, are very numerous in individuals, and are commonly associated with basswood and red oak in much less numbers. The soil is very rich, full of humus, plentifully supplied with moisture, and is by all odds the most prolific in species of any area in the entire region. Here are to be found in great profusion those species that are the rarest of plants elsewhere.

Nowhere except in the immediate valley of the Mississippi river are the trees so luxuriant. The undergrowth resembles in most particulars the rich scarlet oak type of the first association and many of the herbaceous plants are the same. From this it would seem that shallow-rooted plants find the areas quite similar, but the deep-rooted trees evidently discover something in the one region not found in the other, and this something is potent enough to produce a great difference in tree growth.

In these favored ampitheaters are to be found, among others, the following herbaceous plants various rare Carices as *C. albursina, pedunculata, plantaginea, Frankii, Erythronium albidum* by thousands, *Uvularia grandiflora, Orchis spectabilis, Asarum canadense Actaea rubra, Sanguinaria, Dicentra cucul-*

laria, Caulophyllum, Podophyllum, Dentaria laciniata, Viola scabriuscula, Geranium, maculatum, Impatiens aurea, Oxalis racemosa, Phlox divaricata, Hydrophyllum virginianum, Scutellaria versicolor, Agastache, Campanula americana.

The *black oak association* is remarkable for at least two things, viz: that commonly the oak is the only notable tree species, and further that wherever dry, barren, or eminently unfavorable land surfaces are found, there it will be certain to grow. These barren soils are to be found in three well-marked and seemingly quite different topographic areas: first, on the elevated summit ridges of the Niagara mounds; second, on the equally dry and rocky brows of the Apple river and Mississippi river bluffs; third, in the dune region adjacent to the Mississippi on sand prairie in the southwestern part of Jo Daviess county. A height of 60 feet and a diameter of 2 feet will mark the largest growths. They are generally scrawny, often hollow, and only in young trees thriftly in appearance. The most thrifty specimens are found on the tops of the mounds and in spots of some comparative richness of soil. May it not be true that the oak grows in pure sand of the dune or on the dry rocky knoll because it there finds little or no competition, and not because it would not do better on a richer soil if it were to be given possession. Seemingly an isolated species it consorts poorly with other plant growths of tree proportions.

With the black oak are to be found a very few tree species, most prominent among them an occasional great-toothed poplar (*Populus grandidentata*), June berry (*Amelanchier canadensis,*) and several species of *Crataegus.* The shrubby growth is mostly hazel, Jersey tea, and white dogwood (*Coruns paniculata*). Among herbaceous species a few only are conspicuous: various species of *Desmodium* and *Lespedeza, Viola pedata, Dodecatheon, Lithospermum canesens, Isanthus, Hedeoma, hispda, Gerardia laevigata, Liatris scariosa, Kuhnia, Aster linarifolius, A. ptarmicoides.* The sand dune flora of this oak association has some interesting additions to the above, notably *Opuntia, Rhus canadensis, Synthyris, Krigia virginiana, Tephrosia virginiana* and

Anychia. The oaks of this sandy district are never tall, generally very scraggy, and at best do not show any luxuriance of growth. This black oak forest, if it can be so called, varies from a few rods to three-eights of a mile in width, and extends along the Mississippi river for a number of miles, covering the river dune, and speading out over the gently rolling sandy prairie, but everywhere cut off from the forest growth of the uplands by a mile or more of sandy plain. On the bluffs, as before mentioned, the species is again found. The history of how it found a lodgment in the sand prairie nearest the river is an interesting bit of plant distribution. Probably carried by squirrels from woods adjoining the northern and southern ends of the prairie to the occasional trees of other species, as ash, honey locust and cottonwood, the acorns were covered by the drifting sand and so found soil and moisture enough to germinate and attain the tree estate. Plain grasses and other plants preclude much sand movement further from the immediate source of the sand, the river sand bars, and there is no possibility of the acorns becoming covered. It is interesting to note that the oak margin is not an even front, but is sinuous with advancing or retreating angles, indicative of the combat between forest and plain for the possession of the sands.

The *pine-cedar association* is one of vertical rather than horizontal aspect, occupying as it does all the cliffs of the Apple river and its tributaries, as they cut through the Galena limestone to reach the main stream or the Mississippi river into which it debouches. Certain sections of the Galena river also possess these cliffs and have the same trees. Undoubtedly we have here the evidences of either the *last stand* of a dying race, or the choice of such an inhospitable habitat to avoid competition, both pine and cedar having many xerophytic characteristics that fit them for life on the solid rock, into the crevices of which their roots are insinuated. The white pines attain a height of 110 feet, a diameter of 4 feet. The red cedar rarely assumes a growth of more than 30 feet. The herbaceoous plants of these cliffs have been fully discussed in the Cliff Flora of Jo Daviess county (Vol. II. Transactions Ill. State Academy of

Science). Perhaps no better illustration is needed to show that anchorage is a chief end of a tree root system, and not primarily to obtain a major amount of the plant food needed in up-building trunk and branches. Here again the writer must remark on the marvelous difference in the habitat of these two trees from the swamp home of the one in Michigan and the other in Massachusetts.

The alluvium of all the streams of any size, and reaching the greatest development along the Mississippi river, is the chosen home of the last association to be discussed, the *elm-willow*. As a matter of course, the soil is exceedingly rich but often very wet, although rarely marshy, and subject to every considerable overflow of the adjacent river. White elms are everywhere the common tree on the drier portions, assuming magnificent proportions (100 feet high and with a diameter of 6 feet). On the moister lands the soft maple grows to immense size, one specimen having a diameter of 7 feet. Near the water the black and peach willows are common, and commonly are the river bank trees. White and black ash are common, the latter in genuine swamps. Here and there are clumps of giant sycamores, that are the largest trees of the entire region. Where alluvial soil disappears and sand begins, the sand-bar willow, (*Salix longifolia*), is the dominant form, growing in dense thickets, and serving as a catch-all for all the debris of the great river, which debris is the beginning of the true bottoms.

Associated with these trees are a number of herbaceous plants that are characteristic. Among them we note *Leersia virginica* and *oryzoides, Cinna, Elymus, Polygonum* of many *species, Impatiens pallida* and *biflora, Convolvulus sepium, Cuscuta* of several species, *Stachys palustris* and *aspera, Scutellaria lateriflora, Chelone, Mimulus ringens, Lobelia cardinalis, Helianthus,* and *Solidago.*

In concluding these words about the forest trees, it will be advisable to mention a few species that may be called sporadic, to use a medical term, that is a few of one species found in a circumscribed locality, and perhaps no others known in the whole district or separated by miles of intervening territory.

The coffee bean is a marked example. A clump of six trees, 50 feet in height, occurs on the gravelly border of Apple river bottom, two miles below Millville, and no others are known until the bluffs of the Mississippi are reached, 25 miles northwest. *Morus rubra,* the mulberry, has exactly the same distribution. *Carya illinoiensis,* the pecan, occurs at one place on the elevated bottom of the Mississippi river, a single specimen 90 feet in height, and 3.5 feet in diameter, in the midst of a woodland of elm and maple. *Betula alba* is occasional along the bluffs of the Apple river, and again on the summits of Benton mound, at 300 feet greater altitude (1200 feet above the level of the sea,) and 10 miles distant. Honey locust exists as few specimens on sand prairie; *Ulmus racemosa* is seen only on the west branch of Apple river. It would be a difficult task to explain the origin of these species, some seemingly from the south, and one or two from the far northeast.

Enough has been said to give a glimpse of the tree distribution of the region, and the grouping that seems to be rational and most easily accounted for. Errors of judgment there may be, but the points of distribution are facts that I have sought the best explanation for, from the data at my command.

LIST OF TREES OF NORTHWESTERN ILLINOIS.

1 Pinus strobus,
2 Juniperus virginiana,
3 Salix nigra,
4 Salix amygdaloides,
5 Salix lucida,
6 Salix longifolia,
7 Salix discolor,
8 Salix rostrata,
9 Populus tremuloides,
10 Populus grandidentata,
11 Populus deltoides,
12 Juglans cinerea,
13 Juglans nigra,
14 Carya illinoensis,
15 Carya ovata,
16 Carya glabra,
17 Carya cordiformis,
18 Ostrya virginana,
19 Carpinus caroliniana,
20 Betula alba,
21 Quercus alba,
22 Qucreus macrocarpa,
23 Quercus bicolor,
24 Quercus muhlenbergii,
25 Quercus rubra,
26 Quercus palustris,
27 Quercus coccinea,
28 Quercus velutina,
29 Ulmus fulva,
30 Ulmus americana,
31 Ulmus racemosa,
32 Celtis occidentalis,
33 Morus rulra,
34 Hamamelis virginiana,
35 Platanus occidentalis,
36 Pyrus coronaria,
37 Pyrus ioensis,
38 Amelanchier canadensis,
39 Crataegus punctata,
40 Crataegus tomentosa,
41 Crataegus mollis,
42 Crataegus macracantha.

43 *Crataegus macrosperma,*
44 *Prunus serotina,*
45 *Prunus virginiana,*
46 *Prunus pennsylvanica,*
47 *Prunus nigra,*
48 *Prunus americana,*
49 *Gymnocladus canadensis,*
50 *Gleditsia triacanthos,*
51 *Zanthoxylum americanum,*
52 *Ptelea trifoliata,*
53 *Rhus typhina,*
54 *Euonymus atropurpureus,*
55 *Acer saccharum,*
56 *Acer saccharum nigrum,*
57 *Acer saccharinum,*
58 *Acer negundo,*
59 *Tilia americana,*
60 *Cornus alternifolia,*
61 *Fraxinus americana,*
62 *Fraxinus pennsylvanica,*
63 *Fraxinus pennsylvanica lanceolata,*
64 *Fraxinus nigra,*
65 *Viburnum opulus,*
66 *Viburnum lentago,*
67 *Viburnum prunifolium.*