# Notes Upon the Distribution of Forest Trees in Indiana.

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It is recognized at the outset, that even in a restricted area, such as that under consideration, much of uncertainty is given to any conclusions drawn because of lack of exact data covering every part. The richness of the tree flora in a given county as contrasted with that of adjoining counties, is usually to be explained by the presence of a skilled and persistent worker. It is very certain that no county in the State is entirely destitute of trees, in spite of the fact that not a single species may be reported as occurring within its bounds in any published report.

It frequently happens, also, that reports covering certain counties have been based upon the work of untrained observers who have failed to discriminate closely related species or who have made incorrect determinations, in either case confusing the situation and necessitating a careful revision of the data. While effort has been made to eliminate errors arising from such causes it is more than probable that some have escaped detection, but in the main as regards the species discussed the data seem accurate and complete.

Of the one hundred twenty-six indigenous species mapped in connection with this study, the larger part by far are probably of general distribution throughout the State. Variation in the density of the stand and in the size and form of individual trees are of course found, but the non-occurrence of any one of the species of this group in any county, under favorable conditions, would be more notable than its presence.

A relatively small group is confined to the extreme northeastern counties of Lake, Porter and Laporte.

Quite a large group is restricted to the southern counties or those lying in the first three tiers north of the Ohio River. A peculiar tree flora within this group is that of Posey, Gibson and Knox counties, lying along the lower stretches of the Wabash River. Some of the trees reported from this subdivision no doubt are of wider range than indicated, since few

counties in the State have been worked with such persistence and with such painstaking accuracy. Others of the species are doubtless restricted to the rich alluvial soils of the lower Wabash Valley.

To these might be added a small group showing a distribution so unconnected as to be extremely difficult of explanation. An instance is found in *Pinus Strobus* L., which is found in Lake, Porter and Laporte, extreme northwestern counties; Warren and Montgomery, western-central counties; and in Clark in the southeastern part of the State. Its occurrence in the northwestern counties affords no difficulty; the western-central location might be explained as a continuation of the former area; but the recurrence of the species in Clark County on the Ohio River in the eastern part of the State furnishes a difficult problem. In the case, also, of *Cratægus coccinea* L., we find equally unrelated areas, this species being reported only from Noble and Steuben, extreme northeastern counties, and Floyd, a southern county on the Ohio River. The genus Cratægus, however, presents such difficulties in the discrimination of species that the case just cited may possibly be due to lack of accuracy in determination.

The species limited to Knox, Gibson and Posey counties or to some part of the area are as follows:

*Taxodium distichum* (L.) L. C. Richards.
*Hicoria Pecan* (Marshall) Britton.
*Quercus lyrata* Walter.
*Quercus Michauxii* Nuttall.
*Quercus falcata* Michaux.
*Celtis mississippiensis* Bosc.
*Cratægus viridis* Linnæus.
*Cratægus nitida* (Engelmann) Sargent.
*Gleditsia aquatica* Marshall.
*Ilex decidua* Walter.
*Forestiera acuminata* (Michaux) Poinet.

In addition to these species, which seem strictly limited to the region named, two others have been reported from a single additional county:

*Catalpa speciosa* Warder. Gibson, Knox, Posey and Vigo.
*Fraxinus Michauxii* Britton. Gibson, Posey and Marion.

The Bald cypress (Taxodium) is a southern swamp form, which finds in the Indiana locations its extreme northeastern limits. In Indiana it is

found only along the wet (often submerged) banks of streams or in river swamps or sloughs. The local distribution has been carefully worked out by Deam.[1] While not as large a tree as in the South Atlantic and Gulf States the species as found in Indiana often reaches a height of 145 feet and a diameter of six feet. The species may be regarded as having entered the State in the period of flooded streams, maintaining its foothold in situations unfavorable for the ordinary species of this latitude. The areas in which the species occurs in the State are being rapidly reduced by agricultural operations and its disappearance from the tree flora of the State seems inevitable.

The Pecan (*Hicoria Pecan*) nowhere wanders far from the lowlands adjoining river courses. The species has been so largely cultivated in the State both for ornament and fruit that its original locations in the State are difficult to make out. Unquestionably its mass occurrence was in Knox, Gibson and Posey counties. Its occurrence in Vigo County, reported by W. S. Blatchley, is unquestionable, but may be regarded as exceptional. A record of its occurrence in Fountain County recorded in Indiana Geological Report, 1882, Vol. 11, p. 122, is of doubtful validity and may safely be disregarded. The remaining citation from Jefferson County (A. H. Young) is based upon a single tree located in the river bottoms near Hanover. It stood alone in a large bottom land, otherwise destitute of trees. It was near a dwelling and for this reason and because of its small size, it is a fair inference that it was a cultivated form. It is to my mind certain that the pecan as a member of the Indiana tree flora is mainly confined to the three southwestern counties, but extending in greatly reduced numbers northward as far as Vigo County. In any event, the northeastern limit of the species is reached in these locations. The trees are smaller than those of more southern and western localities and according to Deam, "only about one-fourth of the native trees ever bear fruit and only about one out of every ten trees is a profitable nut-bearing tree."[2] This southern and western form probably entered our area at about the same time and under the same physical conditions as the Bald cypress.

The Over Cup Oak (*Quercus lyrata* Walt.) according to Sargent occurs in "river swamps and small deep depressions on rich bottom lands, usually wet throughout the year."[3] This would explain the close restriction of the

[1]Eleventh Annual Report. Indiana State Board of Forestry, 1911. p. 108.

[2]Deam:—Op. cit. p. 138.

[3]Sargent. Manual of the Trees of North America. p. 269.

species to Gibson, Knox and Posey counties. The species is mainly coastal, occurring along the Atlantic and Gulf coasts, finding its way into the interior along the valley of the Mississippi and its tributaries. The occurrence of this coastal species, and of others which might be cited, in regions so markedly interior, suggests the thought that they entered our flora at the time when the great northward arm of the Gulf of Mexico practically divided the area of the United States into distinct eastern and western regions. A comparison of the boundaries of this arm of the Gulf of Mexico with the distribution of many species of plants gives striking support to such an explanation. In Indiana, the species is not ordinarily separated from the Burr oak (*Quercus macrocarpa* Michx., which it closely resembles.

The Cow or Basket Oak (*Quercus Michauxii*, Nuttall) so far as our records go occurs only in Knox and Gibson counties, where it is found in low, rich bottom lands. This restriction of area may be due in part to the close resemblance in size and habit of this species to the Swamp White Oak (*Quercus bicolor* Willdenow) and a consequent failure to distinguish it from that species. This oak, also, is more or less coastal in its mass distribution, finding its way into the interior along the valley of the Mississippi; while the Indiana localities represent its northeastern limit the species maintains its normal size and habit. Its ability to maintain a foothold in localities often covered with water serves to explain its persistence in the counties named.

The Spanish Oak (*Quercus falcata* Michaux) is reported definitely from Knox, Gibson and Posey counties, with an additional citation from Fountain County (Brown) which the writer has not had opportunity to verify. Some difficulty arises in this case because of the question of the validity of the species. According to Sargent *Quercus falcata* is separable into two species, *Quercus digitata* Sudworth, and *Quercus pagodæfolia* Ashe. According to Gray's Manual[4] *Q. falcata* is found on dry or sandy soil; upon the authority of Sargent *Q. digitata* grows in similar soils on dry hills; while *Q. pagodæfolia* occurs on rich bottom lands and alluvial banks of streams. In Indiana the form in question "is usually found in low ground, associated with *Quercus bicolor*, *Q. palustris*, *Q. Scheneckii*, *Q. stellata* and *Q. velutina*. The whole of the township is low."[5] The habitat as well as considerations of distribution would seem to indicate the species to be *Q. pagodæfolia* Ashe instead of *Q. falcata* Michaux. In the Proceedings of

[4]Gray's New Manual of Botany. Seventh Edition. p. 343.

[5]Deam. Op. cit. 207.

the Indiana Academy of Science, Vol. 11, page 142, and Vol. 12, page 299, I have previously expressed the opinion that the species in question is *pagodæfolia*. If this is true, this southern form came into our area along the valley of the Mississippi, and a species which is a large and valuable "timber tree in the river-swamps of the Yazoo basin, Mississippi, and of Eastern Arkansas"[6] might reasonably be expected in the low, wet bottom lands of the lower Wabash Valley. The Indiana station represents the northeastern limit of the species, a fact reflected in its sparing occurrence and reduced size. Deam's collection of 1915 show the occurrence of this species in Jefferson County.

The Yellow Hackleberry (*Celtis Mississippiensis* Bosc.) is frequent or common along streams and in the lowlands of Gibson, Knox and Posey counties. It is a southern and western form, reaching a height of from 60 to 80 feet and a diameter of from 2 to 3 feet in the basin of the lower Ohio River. In Indiana which represents its northern limit the tree "is inclined to grow scrubby and crooked." (Deam.) It is medium sized, rarely exceeding a diameter of 18 inches. Its occurrence within our area is easily explained, since the counties named are not especially far removed from the center of its maximum development both as to size and numbers. It is a little difficult, however, to explain why it has not spread more widely in the State.

The Southern Thorn (*Cratægus viridis* Linnæus) is distinctly southern and somewhat western in its mass distribution, reaching its greatest abundance and largest size in western Louisiana and eastern Texas. It is found along stream borders and the margins of swamps in moist soils, doubtless finding it way into our area when such conditions were practically continuous.

The Shining Thorn (*Cratægus nitida* (Eng.) Sargent) is said in Sargent's "Trees of North America" to occur on the "bottoms of the Mississippi River in Illinois opposite the city of St. Louis." The species occurs in rich bottom lands in both Gibson and Posey counties in fair abundance as a small tree, from 20 to 30 feet high and with a broad and handsome crown. As a result of the recent work in the segregation of species in the genus Cratægus it is practically impossible to form any definite notion as to the range of any particular form. Much field work will be necessary before we can determine just what species of this puzzling genus are members of our flora. No opinion is expressed, therefore, regarding the source from

[6]Sargent. Op. Cit. 245.

which *C. nitida* came into the State. There is as much reason for regarding the Illinois station as the westward extension of the Indiana station as the reverse.

The Water Locust or Thorn Tree (*Gleditsia aquatica* Marshall) is found in a few localities in Gibson, Knox and Posey counties in sloughs and cypress swamps. This is a northern and eastern extension of a definitely southern species which must have entered our flora at a time when the swamp areas of the river bottoms were practically continuous and which has been able to maintain itself only in occasional deep river swamps within our boundaries. In Indiana the species is both rare and local and one which will, in all probability, soon disappear.

One of the Hollies (*Ilex decidua* Walter) occurs occasionally in the three southwestern counties, being invariably restricted to the borders of ponds and sloughs near water courses. Although at times it forms fairly dense thickets, it rarely, in our region, reaches tree size. The distribution as given in Sargent's "Trees of North America," p. 618, is significant in this connection: "Borders of streams and swamps in low moist soil; southern Virginia to western Florida in the region between the eastern base of the Appalachian Mountains and the neighborhood of the coast, and through the Gulf States to the valley of the Colorado River, Texas, and through Arkansas and Missouri to southern Illinois; usually shrubby east of the Mississippi River and only arborescent in Missouri, southern Arkansas and eastern Texas." It is merely another instance in which an essentially coastal form has found its way deep into the interior. When considered in connection with other cases, some of which have been cited, the conclusion is almost inevitable—that the only adequate explanation is to be found in relating it to the northward stretching arm of the Gulf of Mexico.

Pond-bush (*Forestiera acuminata* (Michaux) Poiret) is another species strictly limited to Gibson, Knox and Posey counties where "it is found in swamps, on the borders of ponds and on low river banks. It is very tolerant of shade and is frequently found growing in a thick stand of tall trees."[7] The Indiana stations represent the extreme northeastern limit of this species, which extends westward to Missouri and south to Texas. In Indiana it is ordinarily a shrub, at times forming almost impenetrable thickets. It is impossible to determine from the data at hand as to whether this is a western or southern form. In either case its habitat,

[7]Deam. Op. Cit. 342.

"low, wet river banks and swamps" suggest the same reasons for its occurrence in the Indiana flora as has been suggested for the preceding species.

Hardy Catalpa (*Catalpa speciosa* Warder) is a tree of the borders of streams and ponds and of fertile often flooded bottom lands. According to Sargent it is probably found in its greatest abundance and of the largest size in southern Illinois and Indiana, extending to western Kentucky and Tennessee, southeastern Missouri and northeastern Arkansas. In Indiana it is confined to Knox, Gibson, Posey and Vigo counties as a member of the original forests. Its occurrence in other counties is due to its widespread cultivation for post material or for ornamental purposes. Deam says,[8] "In Indiana it was found along the valley of the Ohio River as far east as Rockport and in the valley of the Wabash as far north as Vigo County. The mass of its distribution was west of a line connecting Terre Haute and Rockport." The citations given are, however, all that can be considered as verified. In the catalpa we evidently have another case in which the distribution is easily explained if it is related to a northward extension of the Gulf or to a condition of flooded rivers.

The Swell-butt Ash (*Fraxinus Michauxii* Britton) usually grows in low grounds which are inundated for several months during the year. As its common name indicates the swollen base is characteristic of this species. It has been collected in Gibson, Posey and Marion counties by C. C. Deam. The Gibson and Posey County stations represent normal conditions for the species; the Marion County collection is in different case. The tree, which was of medium size, was growing in moist soil by the roadside. The known care and accuracy of Mr. Deam preclude any doubt as to the determination, so that the occurrence of the species in this station must be referred to some accidental means of transportation or to what is perhaps more probable, the incorrect labelling of material furnished by some nursery for roadside planting. As a component member of our native forests the species is undoubtedly confined to Gibson and Posey counties. As this is a species but recently segregated its distribution is not yet thoroughly known. It, however, is known to range from New York to North Carolina and Louisiana and west to Missouri.

This is very evidently another case of a species of coastal distribution with a seeming extension well into the interior.

If we summarize these thirteen species, peculiar to our southwestern counties we find them all to be swamp forms or those growing in bottom

[8]Deam. Op. Cit. pg. 347.

lands frequently inundated during the year, or in low moist localities. We find that the larger part of them, in their mass distribution follow the swamps of the Atlantic or Gulf coast, or of both. It is very evident also that the extension of range northward must have occurred when similar physical conditions existed; that is, either at the time the Gulf of Mexico stretched an arm far into the north, or if a later date is preferred in the time of the flooded rivers and lakes of the Champlain period. Occasional means of transportation may serve to explain occasional cases, but where species become component parts of a forest in a region apparently remote from their mass distribution a different explanation must be sought.

Six species, so far as the records go, are confined to Lake, Porter and Laporte counties or to some one of them. In this region, also, extremely skillful and persistent work has been done by Rev. E. J. Hill, a fact which should be taken into account. The species peculiar to this region are the following:

*Pinus Banksiana* Lambert.
*Thuya occidentalis* Linnaeus.
*Betula populifolia* Marshall.
*Betula papyrifera* Marshall.
*Alnus incana* (Linnaeus) Muenchhausen.
*Celtis pumila* (Muhlenberg) Pursh.

The Jack or Scrub Pine (*Pinus Banksiana* Lambert) occurs in Lake and Porter counties, where it is fairly common on the sand dunes bordering Lake Michigan. The general range of this species is decidedly northern, the Indiana stations representing in all probability its extreme southern limit. In our area it is an undersized, rather shrubby form, maintaining itself with difficulty. The continuity of waterways is the evident explanation of the occurrence of this species in the Indiana tree flora.

The Arbor-Vitæ or White Cedar (*Thuya occidentalis* Linnæus) apparently occurs native only in Lake County. This characteristic species of northern swamp regions is found only in cold swamps of our area. There seems no good reason why it should not be found in similar situations in other counties bordering Lake Michigan. The form has been so extensively planted for windbreaks and for ornament that many incorrect citations are on record. Its presence as a member of our flora is evidently referrable to continuous waterways furnished by the Great Lakes.

The Gray or White Birch (*Betula populifolia* Marshall) is found in

scant numbers and of small size in Lake, Porter and Laporte counties. This typical northern species may also be regarded as one that has retained a foothold in isolated localities after the recession of the shores of Lake Michigan and the disappearance of the bordering swamps. The reported occurrence of the species in Tippecanoe County (Golden) "in sparing numbers along the Wabash River" demands further study. The well-known difficulty of discriminating the species of Betula, due to seasonal and age changes in appearance and habits, suggests that a closer study may prove the reference an error.

The Paper or Canoe Birch (*Betula papyrifera* Marshall) is found in Lake and Porter counties, always being reported as rare and of small size. This is another species definitely northern in its mass distribution, the Indiana stations standing as its extreme southern limit. It is probably another of the species which entered our area in the time of flooded rivers and lakes of the Champlain but one which has been able to maintain a precarious foothold up to the present time. Its early disappearance from the tree flora seems inevitable.

The Tag or Speckled Alder (*Alnus incana* (Linnæus) Muenchhausen) is found in Lake and Porter counties between dunes near to the lakes. This is the common alder found in swamps and on the borders of streams further north. It has been able to maintain itself in our area in greater numbers and with less reduction of size than any other one of these extreme northern species.

A dwarf shrubby form of Hackberry (*Celtis pumila* (Muhlenberg) Pursh) is included. In both Gray and Sargent the form is regarded as a variety of *C. occidentalis* Linnæus. Its general range is in the South Atlantic States ranging westward to Missouri, Colorado, Utah and Nevada. It has been reported only from Lake County near the Calumet River at Millers. Its occurrence in such a restricted locality is rather puzzling and as yet no satisfactory explanation has been reached. The form in the greater part of its range occurs on rocky banks of streams—a condition not even approximated at its Indiana station. The temptation to regard it as an ecologic variant of the very common *Celtis occidentalis* is almost irresistible.

Of the six species just discussed, five are definitely northern in their mass distribution. Their presence as members of our flora is very evidently referrable to the continuity of waterways existing during the

Champlain period. The more difficult problem is the explanation of their persistence.

A consideration of a few other species will serve to emphasize the point in mind.

The Larch or Tamarack (*Larix laricina* (DuRoi) Koch) is found in Porter, Marshall, Kosciusko, Noble, Steuben, DeKalb and Blackford. An examination of the older shore lines of Lake Michigan gives a sufficient explanation. Even the Blackford County citation, which seems well to the south, is made clear when the ancient bay of Lake Michigan extending southward through Allen County in the neighborhood of Fort Wayne is recalled.

Thus also the eastern Peach-leaved Willow (*Salix amygdaloides* Anderson) found in Lake and Kosciusko finds ready interpretation, as does also the case of the Wild Red Cherry (*Prunus Pennsylvanica* Linnæus fils) occurring in Lake, Porter and Kosciusko counties.

Any one who maps some of the more widely ranging species of the State will be immediately impressed by the close relations existing between the distribution of the species and the course of waterways. In some instances the distribution follows a single waterway, in others it seems to follow not merely the main stream but also all of the tributaries. Indeed, by far the most striking feature in the series of one hundred twenty-six maps is the definite way in which this relationship stands out. The most cursory inspection of the maps reveals it and serves to suggest at least a possible causal relation.

In the opinion of the writer the occurrence of given species in widely separated localities without intervening stations will be found to be due to the existence at some time in the past of practically continuous waterways connecting these now separated localities. Further, that such connections, in so far as the region under consideration is concerned, are mainly to be found in the Champlain period, although perhaps in some cases this connection was furnished by the northward stretching arm of the Gulf of Mexico. If the shore lines of streams and lakes of the Champlain period could be drawn upon our present maps many of our problems in Phytogeography would solve themselves. In confirmation of this view is the dominating influence of continuous waterways or of streams in the distribution of species clearly shown by any careful study of present range extensions.

In the main, widely ranging species, at least among trees, do not have

this wide range because of any perfection of seed dissemination, nor because of occasional means of transportation. It has more probably been brought about by a former connection of these separate regions, making them practically continuous. Such practical continuity may have been secured by means of the flooded rivers and swollen lakes of the Champlain period. This is not offered as a solution of all of the problems of plant distribution, but in the firm belief that in many of these problems the solution is to be sought in former physical conditions.

It was the original intention that the present paper should also include a discussion of the species restricted to the southern tiers of counties, but the time required to work our former shore lines and water-levels for that region was too great. The preliminary work, however, seemed to indicate confirmation of the conclusions indicated in this paper.