

Campbell, J.J.N. 1985. The Land of Cane and Clover: presettlement vegetation in the so-called Bluegrass region of Kentucky. Report from the Herbarium, University of Kentucky, Lexington. 93 pages.

I printed and distributed this document in 1985, based partly on research for my Ph.D. during 1977-1980. Although much additional relevant information has now been accumulated, which will allow a more intensive treatment of this subject, these original notes are reproduced here, 30 years later, in order to help set the scene. Most of the conclusions in this report—and even some of the suggestions—remain valid today. However, a more refined functional concept for the dynamics of this vegetation is now emerging from deeper review of the literature and more detailed study of better remnants such as Griffith Woods in Harrison County. This concept is being gradually developed and presented at my website: bluegrasswoodland.com, especially the “Bluegrass” page. Relevant material includes a long file with collected quotations from many more sources, plus interpretative comments: “Historical Notes on Native Vegetation in the Bluegrass and Some Adjacent Regions.”

The following corrections or clarifications to the original 1985 report are noted.

p. 4: in last paragraph, reverse “greatly” and “me”.

p. 18: insert “in” below “Lewis County”.

p. 55: “buffalo-grass” of several authors may have been deer-tongue grass (*Dichanthelium clandestinum*); see discussion in “Historical Notes...”

p. 57: “beargrass” of several authors may have been gama-grass (*Tripsacum dactyloides*); see discussion in “Historical Notes...”

p. 57: “wild oats” of Cresswell (1775) may have been river-oats (*Chasmanthium latifolium*; not “*Uniola laxa*”).

p. 57: the “reed” of Walker (1824) may have been reed-grass (*Phalaris arundinacea*).

p. 58: the “pea vine of Nourse (1775) may have been river indigo (*Baptisia australis*).

p. 59: “richweed” of several authors was either *Ageratina altissima* [= *Eupatorium rugosum*] or *Pilea pumila*.

p. 59: the first species in list of last paragraph should probably be *Planodes virginica* [= *Arabis virginica*].

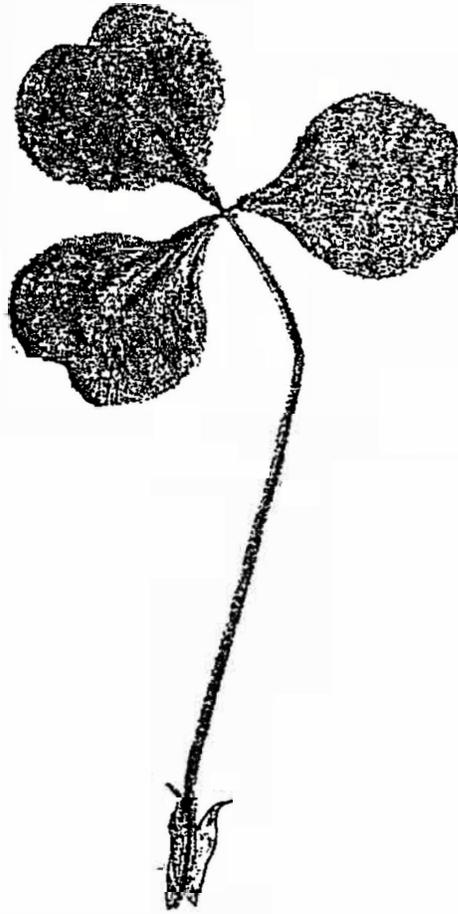
p. 91: a reference was omitted:

ROE, F.G. 1951. The North American Buffalo: a critical study of the species in its wild state. University of Toronto Press, Ontario. 957 pages.

Jullian Campbell
September 2015

THE LAND OF CANE AND CLOVER

PRESETTLEMENT VEGETATION IN THE
SO-CALLED BLUEGRASS REGION OF KENTUCKY



Julian J.N. Campbell

A Report from the Herbarium

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Lexington, Kentucky, 40506

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"Brothers: the fertile region of Kentucky is the land of cane and clover - spontaneously growing to feed the buffaloes, the elk and the deer; there the bear and beaver are always fat - the Indians from all the tribes have had a right from time immemorial, to hunt and kill unmolested these wild animals, and bring off their skins, to purchase themselves clothing - to buy blankets for their backs and rum to send down their throats, to drive away the cold and rejoice their hearts, after the fatigue of hunting and the toil of war (great applause from the crowd). But

"Brothers: the long knives have overrun your country, and usurped your hunting grounds, - - They have destroyed the cane - trodden down the clover - killed the deer and the buffaloes, the bear and the racoon - They are building cabins and making roads on the ground of the Indian camp and warpath: The beaver has been chased from his dam and forced to leave the country (palpable emotion among the hearers).

"Brothers, the intruders on your lands exult in the success that has crowned their flagitious acts:- They are planting fruit trees and ploughing the land where not long since were the canebreak and clover field. Were there a voice in the trees of the forest, or articulate sound in the gurgling waters, every part of this country would call on you to chase away these ruthless invaders who are laying it waste:- Unless you rise in the majesty of your might and exterminate the whole race, you may bid adieu to the hunting ground of your fathers - to the delicious flesh of the animals with which it once abounded, and to the skins with which you were once enabled to purchase your clothing and your rum."

(Spoken by Simon Girty - a "renegade white man" - to assembled tribes at the Grand Council at Chillecothe, Ohio, before marching on Bryan's Station, Kentucky, about 10 km NE of Lexington, in 1782. He is describing the first white settlements in Kentucky, i.e., in the Inner Bluegrass. From "John Bradford's Historical and Co. Notes on Kentucky", ed. J.W. Townsend, Grabhorn Press, San Francisco, 1932.)

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THE LAND OF CANE AND CLOVER: PRESETTLEMENT VEGETATION
IN THE SO-CALLED BLUEGRASS REGION OF KENTUCKY

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SUMMARY

This paper reexamines early descriptions of vegetation in north-central Kentucky, seeking to understand the primeval landscape ecology of the Bluegrass Region. This region is defined by the exposure of Ordovician strata, which are generally calcareous, with some exceptionally fertile soils on phosphatic limestones. It is clear that the region was generally "well timbered", but minor areas on richer soils were more thinly wooded. There was much cane on richer soils, frequently with woodland cover, but in some areas with little or no cover. There was a widespread network of buffalo trails linking salt licks. Patches of open grassy vegetation occurred along these trails, but such purely herbaceous vegetation formed a negligible proportion of the whole area. In the main contact period, the few Indian settlements were concentrated at the periphery of the region, and there is no record of burnt vegetation. However, the population had been much larger, with several agricultural settlements within the region during the Fort Ancient Period, ca. 1000-1700 A.D. It is likely that disturbance of the vegetation had been greater in that period, and that much of the widespread successional woodland evident when Virginians arrived in 1750-1800 had grown up after the dissipation of the Fort Ancient Culture. That dissipation may be attributed to indirect effects of European contacts, through warfare related to the fur-trade and the spread of diseases.

Forest of richer soil was composed of walnuts, sugar maple, ashes, cherry, buckeyes, honey and black locust, coffee tree, elms, mulberry, hackberries, oaks, hickories, yellow (tulip) poplar, etc. (in approximate order of decreasing abundance). Forest of poorer soils was composed of oaks (mainly white), beech, poplar, sugar maple, walnuts, hickories, black locust, sassafras, etc. In comparison with general landscape descriptions, early deed surveys on richer sites appear to have over-emphasized hickories, buckeyes, elms and boxelder, while under-emphasizing walnuts, locusts, coffee and cherry. This bias may have reflected preferences for particular disturbance zones or timber qualities. The most curious puzzles in interpreting old colloquial names are the cases of "overcup oak" (perhaps *Quercus lyrata*, now known at only one site in the Bluegrass) and "black" or "hoop ash" (perhaps *Fraxinus nigra*, now unknown in Kentucky). Also, white walnut has declined drastically, with a disease complex. There appears to have been some shift from walnuts and sugar maple to oaks and ashes, especially blue ash, as dominants of surviving forests during the late 19th Century. This shift may simply reflect the artificial preservation of the drier ash lands for "wood pastures", with the moister walnut-maple forests largely cleared for crops, or it may be due to real change in hydrology.

Shrubs on rich sites were primarily pawpaw (most abundant), spicebush, plum, hornbeam (with sugar maple), hawthorn (with walnut, etc.), ironwood and redbud (the latter two in oak forests as well as moister types). On poorer oak sites, dogwood was the major shrub, perhaps with a little crabapple,

hazel, etc. Cane was most closely associated with the walnut-locust-buckeye woodland, and with the minor areas of blue ash-burr oak "savannah-woodland". In open woodland between canebrakes, dominant grasses were "wild rye" (Elymus spp.) and "buffalo grass" (probably broad leaved Panicum spp.), perhaps with bluegrass (Poa pratensis) and nimble will (Muehlenbergia schreberi) near buffalo trails. Other herbage described before destruction by settlement was composed of running buffalo clover (Trifolium stoloniferum; now unknown in Kentucky), pea-vine (Amphicarpa bracteata; often climbing on cane), nettles (Urtica dioica, etc.) and richweed (probably Pilea pumila), together with a large assemblage of showy spring woodland flowers, etc. Most of this rich herbage must have occurred in moist woodland. There are few historical or modern records of typical prairie, barrens or cedar glade species in the region, in marked contrast with the surrounding Knobs Region and other areas with poorer soils.

The Bluegrass forests were distinct from the rest of Kentucky in the dominance of walnuts (open sites), sugar maple (shady sites) and ashes (drier sites), which are all typical of richer soils. Also, the white oak group was more abundant relative to the black oak group. The central and southeastern sections of the region were largely covered with forest types of richer soil, the northwestern with those of poorer soil. Among trees typical of secondary succession on moist sites, walnuts were frequently dominant in the southeast, but poplar was rarely dominant, even in the northwest. Shade-tolerant beech prevailed in the west, on the shaly hills and plains partially covered with loess. Compared to Eastern Kentucky, there was little brushy vegetation in the Bluegrass, and this showed no clear geographic match with areas of secondary forest. There was a general concentration of disturbed vegetation types towards the southeastern sections, along with the buffalo trails and Indian campsites. Further complexities in these patterns must await more detailed reconstruction, especially with more research of deed surveys.

The most unusual feature of presettlement forests was the abundance of a few species on richer soils, which are now much less common in general, even within well preserved remnants. Such woody species include buckeye (Aesculus glabra), honey locust (Gleditsia triacanthos), coffee tree (Gymnocladus dioicus), pawpaw (Asimina triloba) and cane itself (Arundinaria gigantea). Together with Trifolium stoloniferum, and probably other herbaceous species now rare or locally extinct, these plants may have been particularly suited to relatively stable "ecotones" with continual, moderately intense disturbance, between more undisturbed forest dominated by sugar maple on one side, and the most open (grazed or formerly burnt?) areas with black walnut and other "weedy" species on the other side. Today, extremes of disturbance or abandonment tend to prevail within native vegetation. For Nature Conservation, there is now an urgent need study the small remnants of this former "ecotonal" vegetation, and to promote its preservation or reconstruction, with appeals for public support based initially on historical interest.

PREFACE AND ACKNOWLEDGEMENTS

In my dissertation, "Present and Presettlement Forest Conditions in the Inner Bluegrass of Kentucky" (1980), I barely scratched the surface of presettlement vegetation study. I have taken things much further in this report, but there is much more to do, especially with deed survey data. That work will be laborious, requiring a true bookworm instinct, which I myself would delay until retirement from field work. However, with continuing feedback and cooperation from my colleagues in the region, I would like to contribute a second edition in a few years, with added chapters on settlement impacts, modern problems and the remaining flora. In the meantime, I have gone far enough, I hope, to promote renewed conservation action with the help of this study.

There is a crying need for academics to join forces with concerned citizens in persuading our landowners, governments and the general public of the great treasure, aesthetic at least, in the small remaining fragments of natural vegetation, which are still being slowly destroyed in many areas due to careless ignorance or greed. A carefully selected sample of the original vegetation could be used to preserve the great majority of species, and would involve small sacrifice in commercial development. I believe that most people would like to see this done, especially because such vegetation is the only living link we still have with the primeval ecosystem where buffalo and Indians roamed. However, there is a general ignorance and apathy about the problems involved, compounded by inane arguments about economic growth and jobs in quantity (often with immigrants benefitting more than local people), overlooking costs to the quality and diversity of life in this region.

Several people have helped greatly me while writing this report: Willem Meijer and Phil Crowley arranged space for typing and word processing, etc., and provided general intellectual support; the staff of the Special Collections Library at U.K. retrieved many obscure volumes from their stacks; Burle Clay, Chris Turnbow and other archaeologists at U.K. gave me much unexpected information about Indians; Carol & Jerry Baskin, Bill Bryant, Pat Dalton, Marc Evans, Max Medley, Peg & Tim Taylor, Mary Wharton and others provided local botanical information and companionship; my wife, Sandra, and her dog, Houdini, kept me diverted and well exercised in place of field work.

INTRODUCTION

In this paper, I attempt to answer the question: what vegetation grew in the Bluegrass Region 200-250 years ago, when settlers first arrived from the east? This endeavour, together with interpretation of the general ecological pattern which existed then over the landscape, is vital to any current discussion of potential biological production in the region, its academic or aesthetic interest, and conservation or reconstruction of model natural areas.

The pioneers found that variation in natural vegetation provided a reliable indication of soil fertility, which was particularly high in some sections, producing extraordinarily high crop yields according to some observers. However, after a tortuous socio-economic history, most of the richest land has now come to be used for relatively inefficient human food production through livestock, for the luxury of race-horse rearing, for the dependence on tobacco, then, finally destroying most vestiges of natural systems, for the increase of humanity in urban sprawl. This region was the first in Kentucky to be intensively settled, and it has remained the most densely populated. Some type of woody vegetation covered virtually all the land before settlement, yet today it only covers about 20% overall, less than any other major region of Kentucky (Kingsley & Powell 1978, Karan & Mather 1977). In richer areas, woody cover is only 1-10%. The fundamental application of this paper must be to persuade more people of the full biological potential here, to realize how often this has been ignored and wasted, and how much action is needed now to improve this situation.

GEOLOGICAL BASIS

The Bluegrass Region is defined here as the area in north-central Kentucky with Ordovician bedrock exposed (McFarlan 1943, McDowell et al. 1981). Peripheral Silurian areas are sometimes included in physiographic definitions, but these areas lack the distinctive natural vegetation of the Ordovician (e.g. Table 5 below). Elsewhere in Kentucky, there is a minor exposure of Ordovician bedrock along the Cumberland River to the south, and in adjacent Tennessee, there is a large region (the Nashville Basin) similar in many respects to the Bluegrass.

The oldest rocks exposed in Kentucky are in the Bluegrass Region: the Middle Ordovician High Bridge Group deposited about 475 million years ago. Uplift has caused these strata to be exposed only in the south-central sections of the region, where the Kentucky River is trenched. They largely consist of limestone or dolomite, and there is a little chert (bentonite). The overlying Lexington Limestone, including some interbedded shales (mudstones), is the typical bedrock of the "Inner Bluegrass". Some strata here contain relatively high phosphate concentrations, and the soils are especially fertile (Peter 1857-84, Gentry 1960, Jillson 1968a, Soil Conservation Service 1968, etc.). However, some minor nutrients (Mg, Zn, B, Mn) may be in short supply at certain sites (R. Blevins, L. Duffield & J. Harrison, pers. comm.). Above this rock is the transition to Upper Ordovician strata, beginning with the Clays Ferry Formation, which consists of interbedded limestones, clay shales (mudstones) and siltstones. Together with the overlying Garrard Siltstone or Kope Formation (largely mudstones), the Clays Ferry forms the "Eden Shale Belt" or "Hills of the Bluegrass". Above

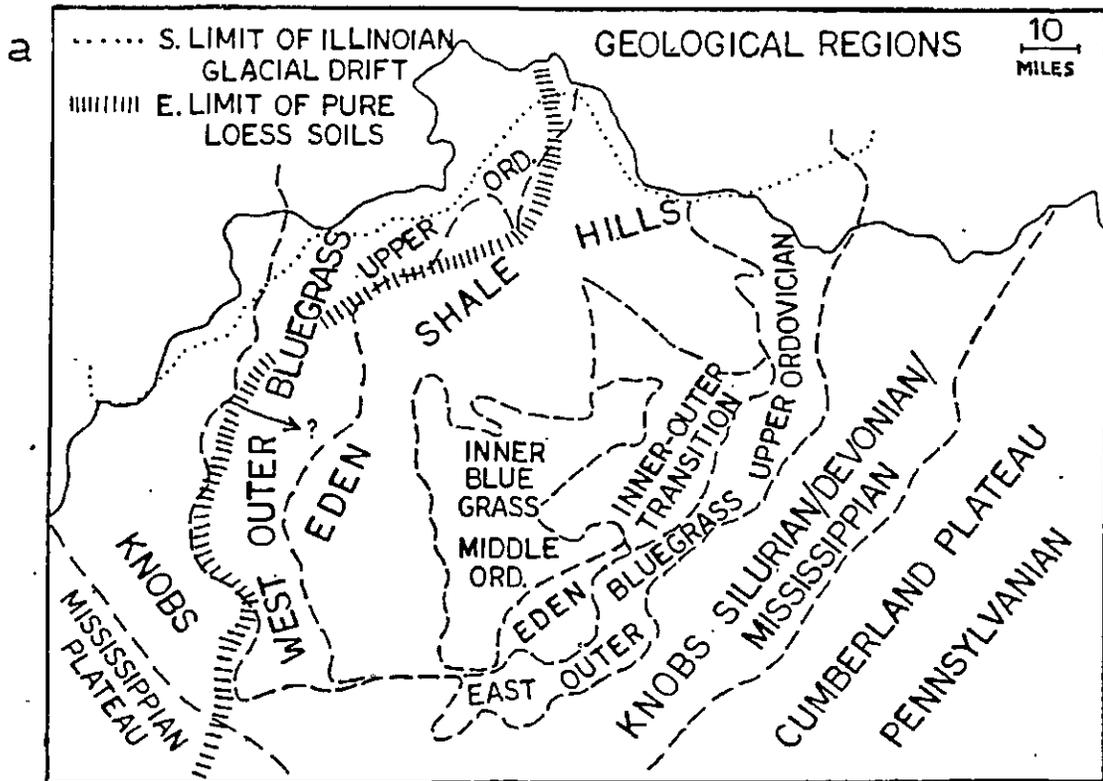
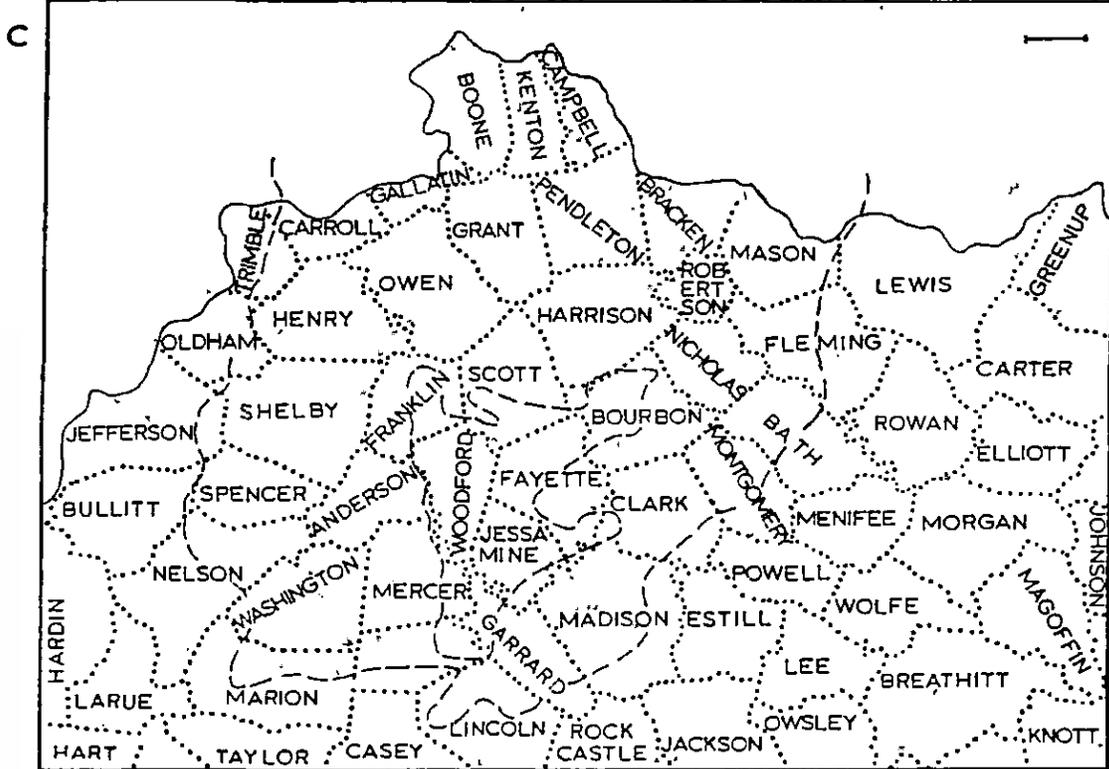
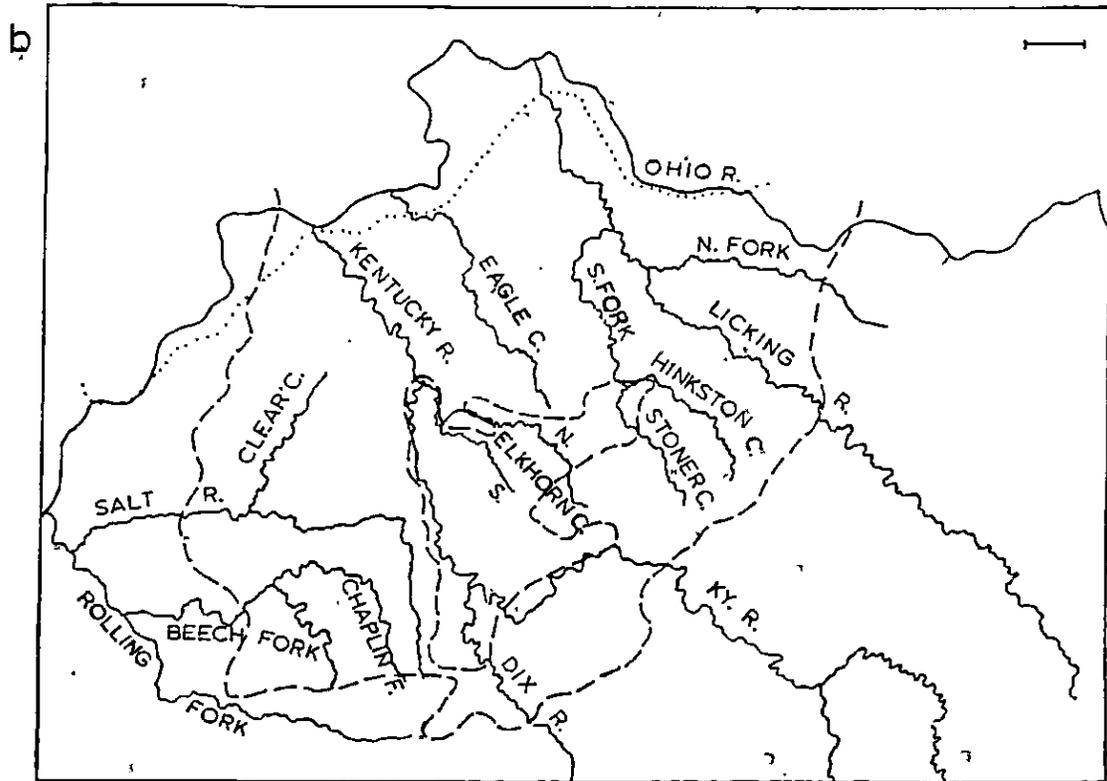


FIGURE 1a. Geological Regions of North-Central Kentucky. See text for sources and description.

1b (opposite). Major rivers and creeks of North-Central Kentucky.

1c (" "). Counties of North-Central Kentucky.



these strata, there is a return to more nutrient-rich limestones and shales: the Calloway Creek Limestone and the Ashlock or Grant Lake Formations. These strata typify the "Outer Bluegrass" zone. The uppermost Ordovician strata are the Drakes or Bull Fork Formations. The Drakes contains dolomite in addition to the usual limestone and shale. The lowest Silurian rock is also largely dolomitic. Some limestones occur in the Silurian, Devonian and Mississippian strata that form the "Knobs" Region around the Bluegrass, but these have low phosphate concentrations and the predominant rocks instead are non-calcareous shales.

Within the Bluegrass, there are also some minor parent materials other than bedrock, which have local importance.

(a) To the north, in a transitional vegetation region along the Ohio River, various glacial deposits cover flatter uplands, primarily of Illinoian age.

(b) To the west and north, wind-blown loess, apparently of glacial age, is the predominant mineral matter in upper soil horizons on flatter uplands, and, even within the Inner Bluegrass, loess may form 30-50% of minerals in the top 50 cm (Barnhisel et al. 1971).

(c) To the east and south, alluvium has been washed in from non-calcareous regions, leaving recognizable terrace deposits near major rivers, as old as Pliocene (Jillson 1943-48, U.S.G.S. maps).

Figure 1a summarizes the geological zonation, and shows one further complication. In the east, the Eden Shale Belt is much less clearly expressed, both in terms of the hilly topography so prevalent in the northwest, and in terms of lower soil fertility. Soil series typical of the Outer Bluegrass predominate in the transition here from the Inner Bluegrass to the true Outer Bluegrass (S.C.S. 1975). This gap in the Eden Shale Belt has not yet been adequately explained, though it may be attributed to a reduction in the amount of shale and siltstone, perhaps in combination with ancient meanderings of the Kentucky River (e.g. Jillson 1963).

ACADEMIC PROBLEMS

There was no systematic land survey by early authorities in Kentucky, except for the far-western "Jackson Purchase". Landscape descriptions, from the time of settlement in the late 18th Century to the end of the 19th Century, form the basic sources for this paper. In this period, there was a transition from description in personal journals and rudimentary geographic accounts to a more rounded natural scientific context. Except for the early botanical sketches of A. Michaux (1795), F. Michaux (1805) and C.S. Rafinesque (1819), the first people to begin detailed botanical description of the region were C.W. Short (1828-4), R. Peter (who collected with Short), D. Owen (1857) and W.M. Linney (1882-87), though the latter two did little or no collecting. There was, unfortunately, little building on the work of Short and Peter, and except for some further collection and limited notes on selected plant groups (e.g., Garman 1900, 1902, 1913), full botanical description did not resume until the 1940's, especially with E. Lucy Braun (1942). There is still no complete floristic list of the region.

In this modern period, so far, there has been rather little success in reconstructing some picture of the original scene, by piecing data together from historical sources and old forest remnants. Reasonably extensive forest is limited to some of the shaly hills and to gorges along the major rivers, where the shallower soils emphasize drier forest types dominated by oaks,

hickories, ashes and red cedars. Extrapolation from these areas to the richer lands would provide a biased view, though some selected moist forests with exceptional protection here may be useful in discussions of potential climax vegetation (Campbell 1980). Instead, based on a few historical sources, and from examining scattered old trees in farmland, etc., E. Lucy Braun (1942, 1950) found the Inner Bluegrass to be "the most anomalous vegetation area of eastern United States", though she pointed to some similarity with the Nashville Basin. McHargue (1941), Davidson (1950), McInteer (1952), Wharton & Barbour (1973), Bryant et al. (1979; Bryant 1983, etc.) and Campbell (1980) have also dealt with some historical problems, especially in relation to Inner Bluegrass forests, but these studies still do not provide a regional view of the whole vegetation.

The provisional conclusion from these studies is that forest did cover most of the region, but some of the more fertile areas had curiously open woodland or "savannah", with unusually extensive canebrakes (*Arundinaria gigantea*) on uplands, and perhaps even some open grassland. Based largely on remaining old trees, it has been suggested that this open woodland was dominated by ashes and oaks, especially blue ash and chinquapin (yellow) oak, species which are generally rare in other regions. However, we still have little idea of how extensive the open areas were, how the ashes and oaks were distributed relative to other trees (some of which had equally unusual abundance), and what herbaceous vegetation grew on the ground. Moreover, although various hypotheses have been suggested to explain the unusual vegetation, there has been no firm discussion of their relative merits.

In this paper, I review all available historical material, much of which has received little previous examination in this context. I use quantitative assessment of vegetation features wherever possible. While not drastically altering previous conclusions, this new synthesis does provide a much more detailed view, and some relatively specific hypotheses that may be tested with further historical and paleoecological research. A general model of forest type distributions in relation to each other, and to major environmental factors, has already been generated, based on a large set of modern data from Kentucky and surrounding states (Figure 2; Campbell 1981). This scheme provides an initial framework for interpreting historical patterns, to be reassessed at the conclusion of the paper. The best final test of these ideas will have to involve analysis of pollen fossilized in wetlands, but few suitable sites are known in the Bluegrass Region itself, and there has been little interest in developing such research programs within the state.

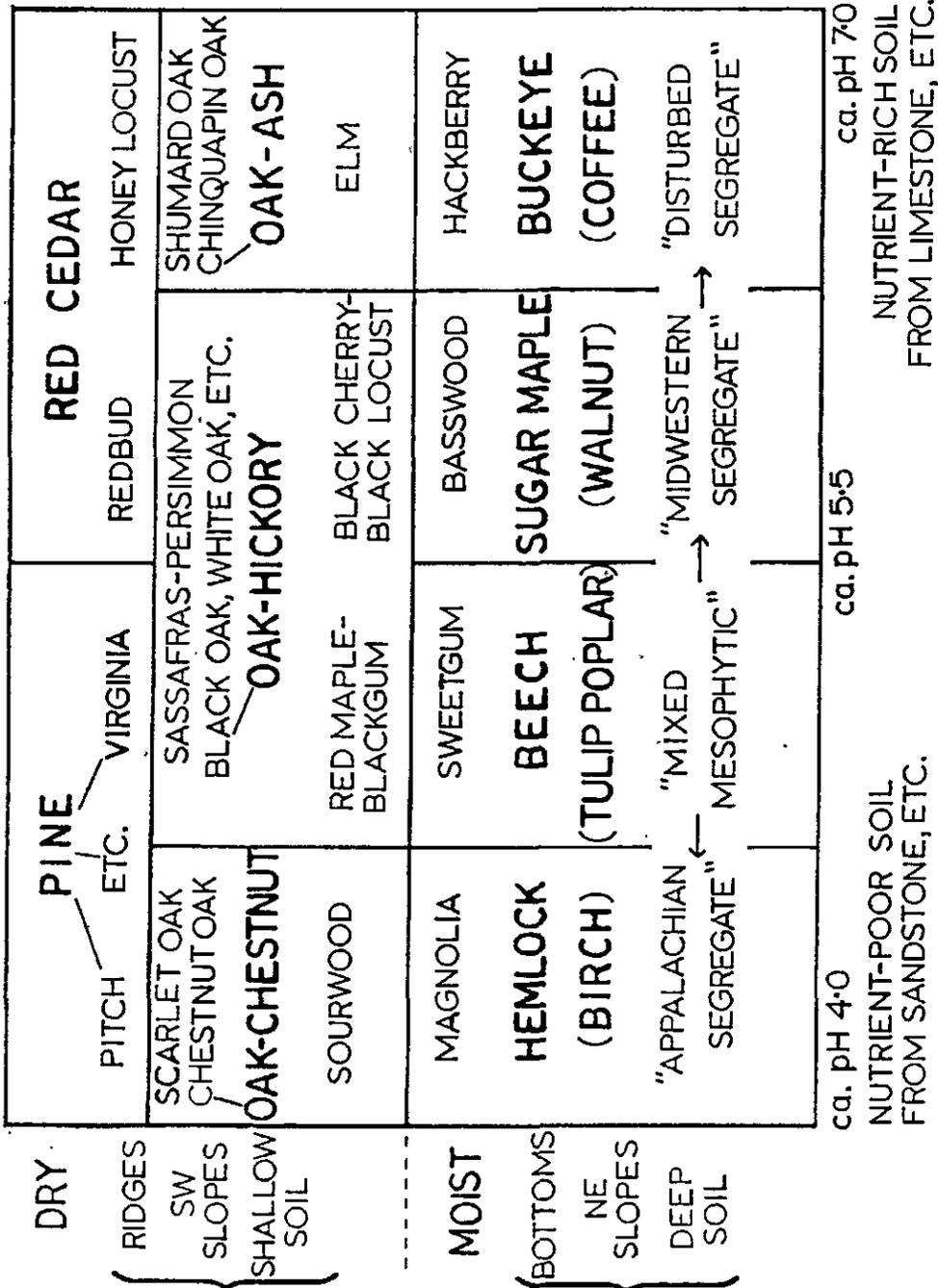


FIGURE 2. Summary diagram of central E. North American forests and their environmental distribution, based on a DECORANA ordination of modern data from Kentucky and surrounding states. This emphasizes upland climax dominants before settlement (large type), with major mesic successional associates in parentheses. Other trees shown are mostly successional with broad moist-dry ranges.

VEGETATION STRUCTURE

WELL-TIMBERED LAND

The evidence from early accounts is that most of the Bluegrass Region at the time of settlement was covered by forest with no obvious opening between tree crowns. All general descriptions of north-central Kentucky indicated this. Filson (1784) wrote: "The country in general may be considered as well timbered, producing large trees of many kinds, and to be exceeded by no country in variety". Morse (1789) described the Inner Bluegrass, with "the natural growth, large walnuts, honey and black locust, poplar, elm, oak, hickory, sugar tree, etc.". Imlay (1792) contrasted the "pararies" and "beech swamps" of southwestern Ohio as "fertile situations which are only inferior to the woody plains of Kentucky in extent and climate". After traversing the Bluegrass Region, Barrow (1795) wrote: "The growth in these parts is black walnut in great abundance, vastly large and tall sugar-tree...[etc.] The growth of trees in these countries is so luxurious that they form a shade so universal and add thereto the darkness of the soil that it may well be called as it is rendered from some of the Indians tongue; "The dark and bloody ground"". Marshall (1812 re 1779) described the primeval landscape as "the country being thickly wooded, and deeply shaded...". Later geographic and historical treatments of the 19th Century all confirm that the original forest was essentially unbroken (Owen 1857, Stickney 1872, Shaler 1885, Renick 1880, Linney 1882-87, Peter 1882, Allen 1892).

Some of the more pertinent quotations from central localities, in the Lexington area itself (C. Fayette Co.), are as follows. Matthew (1840's re 1783) stated that around Bryan's Station: "Land that had not cane on it, was grown up with white blossoms, and the trees were tall ash, sugar-trees, elms, hackberry, tall and very thick. What locust there was, was very high and wind broken. Locust, walnut, low scrubby hackberry, and some elm, and sometimes sugar trees, vast quantities of buckeye, where cane grew abundant. Soil much better where cane was. Buckeye outlasts [?] sugar tree". About 10 miles to the southwest, where the city of Lexington began, Farrar (1840's re 1788) described how "Forest of burr oak and black walnut" had to be cleared for roads (see also Collins 1840's re 1778). Levasseur (1825), when travelling across the region, learnt that the site of Lexington "not more than forty years ago, was covered by immense forests". In his History of Fayette County, Perrin (1882) stated: "The finest black walnut, blue ash and burr oak were destroyed indiscriminately. There was no prairie land here; every acre had to be cleared of its timber" (see also Staples 1939).

In accounts of surrounding areas, Drake (1840's re 1794) described land near Mayslick (Mason Co.) "covered with an unbroken forest", consisting "chiefly of blue ash - tall, straight". Parry (1794) noted land in central Bourbon County "of the first quality, being timbered like the rest, with walnut, cherry, blue-ash, buckeye, locust and hackberry". A. Michaux (1793) travelled through "portions of forest lands with very scattered plantations" between Lexington and Kentucky River to the south. Collot (1826 re 1796) travelled "eighteen miles over a woody and uninhabited country" between Wolf's Run (SE. Lexington) and Frankfort, though in Lexington itself there was "not a tree to be seen four [sic] miles around". A decade later, Cuming (1807) travelled only "ten miles mostly through woods" between Lexington and Frankfort on the old road across N. Woodford County, and he contrasted this with the more settled Leestown Road across S. Scott County. "Well timbered"

land was also noted in Mercer County by Brown (1790) and in Henry County by J. McAfee (1773).

The above details refer mostly to richer areas. A rare description of the poorer Eden Shale Belt was provided by Hoffman (1835), travelling between Cincinnati and Georgetown (see also Palmer 1818). Away from the few cultivated areas, his only notes on vegetation indicate unbroken forest: "a tall wood...country, which appeared to be generally heavily wooded...little alteration in the scenery...a deep wood...red bud and wild plum...a romantic forest...a wood of ancient beeches...a majestic tulip tree...".

Unfortunately, we have virtually no record of exactly how large the trees were. Some observers simply mentioned large or tall trees (for species see Tables 1 & 4). In addition, an Anonymous (1791) traveller through the region wrote: "Among the many accounts that have been given of Kentucky, none of them have done justice to the timber. Oaks and locusts on the flat lands are common at five and six feet diameter. Poplars growing on the beach [sic] lands are so common at five and six through, as hardly to be noticed - The beech grows to the thickness of four and five feet, and both the last mentioned to the height of 120-130 feet. These and the advantage of pasture in the woods, constitute the great excellence of Kentucky...". Owen (1857) also noted poplar to nine feet, and beech to four.

We also have little idea of the undergrowth in these woods, in terms of individual species. However, many accounts simply referred to a great abundance of herbage, grasses and cane in the woods, and in some cases this vegetation was described as occurring under trees, as opposed to in openings (Hanson 1774, Smith 1795, Finley 1796, Harris 1797, Marshall 1812, etc.).

The terms savannah, glade, barrens, prairie, natural meadow or grassland, were never used in accounts of the Bluegrass Region at the time of settlement, though various types of open woodland mixed with canebrakes and a few pure grassy patches were indicated in certain areas, as described in the following sections. These limited accounts of partially open forest stand in marked contrast with the accounts of open areas in adjacent regions. For example, Filson (1784) mapped two areas as "natural meadows" in the Brown-Adams-Scioto County region of southern Ohio, and he showed the famous Big Barrens Region on Mississippian limestone in west-central Kentucky. Several other authors dealt with southern Ohio and northern Kentucky, but only in Ohio mentioned natural meadows, savannahs or prairies (e.g., Gist 1751, Hutchins 1778, Imlay 1792, Smith 1795).

OPEN WOODLAND

The term "savannah-woodland" has been used by Bryant et al. (1979) to describe the partially open character of forests that appear to have existed before settlement in modern pastures that still have scattered large open-grown trees, mostly blue ash. In Eastern North America, the term savannah is generally used for wooded land with wide spaces between tree crowns allowing "grasses and other herbaceous vegetation to become the actual dominants of the community" (Curtis 1956). In analyzing early survey data from the Mid-Western Prairie Peninsula, savannah has been defined more strictly as having tree basal area of 1-10 square m/ha, with "open forest" as 10-20 square m/ha (e.g., Rodgers & Anderson 1979). We have no way to estimate original basal areas in the Bluegrass, but there are a few accounts that

suggest some tendency towards savannah, perhaps approaching 10 square m/ha. Such woodland appears to have been of limited extent, in contrast with the more droughty oak savannahs that dominated large areas in Ohio and further west in the Prairie Peninsula (see refs. of previous section).

An early account suggesting open woodland in the Bluegrass Region comes from Cresswell (1775). He noted an area near the Ohio River, probably in Boone County, with "Wild clover, what they here call wild oats and wild rye in such plenty it might be mown and would turn out a good crop. The great quantity of grass makes it disagreeable walking. The land is thin of timber and little underwood". His companion, Nourse (1775), described another area, southeast from Frankfort (C. Franklin Co., probably to NE. Woodford Co.): "...light with timber - little oak - mostly sugar tree, walnut, ash, and buckeye (horse chestnut) but the tops of the trees mostly scraggy, the surface of the ground covered with grass along the path, which was as well trod as a market-town path. About twelve mile the further we went the richer the land, better though of the same sort of timber, the ash very large and high, and large locusts of both sorts - some cherry - the growth of grass under amazing - blue grass, white clover, buffalo grass and seed knee and waist high; what would be called a fine swarth of grass in cultivated meadows, and such was its appearance without end...We had in our walk seen about 5 herd of buffaloes". Nourse also described the 15 miles between the mouth of Dix River and Harrodsburg (Mercer Co.): "...weeds as high as your head, the path but badly trod and continual logs and sticks across that I fell twice". Brown (1790) described the same land as "but middling and not very well timbered".

A more general account of land around Harrodsburg was made by Fleming (1779), with unusually detailed notes on the soil: "The soil every where in this country is surprizingly shallow as appears from the trees every where blown up by the roots. The roots of each tree is matted like hazel with scarce earth enough to cover it and as they cannot penetrate in depth they [are] always bringing up flags of the rock with it. The richest soil is reckoned the best black, the timber black walnut, cherry, honey locust, etc. I have observed the richest soil to bear the shortest timber and to be the shallowest in the mold. I would therefore prefer a good timbered tract tho' not quite so rich; to a richer tho' worse timbered tract, as there is a great probability of the ground being...not so subject to drought, and.. springs...being constant...".

Filson (1784) made a similar observation with reference to north-central Kentucky in general: "In some [places] the wood as the consequence of too rich a soil, is of little value, appearing like dead timber and large stumps in a field lately cleared. These parts are not considerable". In another generalization, Imlay (1792) wrote: "The best soil produces little timber but the locust, cherry, walnut, buckeye, sugar-tree, elm, beech, ash, satin wood [coffee] and pawpaw". Melish (1807) also stated that, between Lexington and Versailles, "Land in the natural state is easily cleared away, for notwithstanding the richness of the soil, the timber is mostly small and thin; and there are few situations in which the price of wood will not pay for the clearing". In a later geographic account, Flint (1832) stated that, although the region around Lexington had originally been forested, "The trees generally are not large but tall, straight and taper". Another relevant quotation is from Parry (1795), having traversed the Bluegrass from northeast to southwest, then arriving in the poorer lands on Silurian bedrock between

Bardstown (Nelson Co.) and Springfield (Washington Co.): "I came to the heaviest timbered land I had seen in Kentucky...poplar, oak, and hickory, and very large chestnut...".

Among other miscellaneous comments, there are brief references to "several miles when in open woods" near Cane Run (N. Fayette Co.- Bradford 1827 re 1786), and "open woods" on Foxes Creek (S. Fleming Co.- Sudduth 1840's re 1786). In addition, several authors noted poor, small or stunted timber of cedar and oaks within a few miles of the Lower Blue Licks (Robertson/Nicholas Co.) and along the Kentucky River cliffs (Brown 1790, Anonymus 1791, Collot 1796, F. Michaux 1805, Cuming 1807, Marshall 1812, Bradford 1827).

From the middle 1790's on, there are more general references to open woods, wood pastures or park-like land, as the typical relics of natural vegetation on richer soil. As will be documented in a future paper, these descriptions reflect the influence of disturbance from livestock and clearance.

BRUSHY VEGETATION

There are few indications of areas dominated before settlement by shrubby growth (implying multiple basal sprouts from individual plants), apart from the canebrakes. J. McAfee (1773) noted "a brushy fork on the east side of Crooked Creek full of swamps, black oak timber and hazel bush...", apparently along the Salt River in northern Mercer or southern Anderson County. This is the only reference to "swamps" in the pioneer literature. But, as expected, there were also brushy thickets on banks of major rivers: "a willow bar...where the bushes grew thick to the water's edge", at the mouth of Dix River (Butler 1840's re 1790); and "brushwood" with some trees as well, in the ravine of Licking River near the Lower Blue Licks (Marshall 1812, Bradford 1827; both re 1782).

On higher ground, Clinkenbeard (1840's re 1780) described Cane Ridge in Bourbon County as "the greatest place for plum bushes. We always called it the plum orchard", and, in adjacent Clark County, he also noted that pawpaw and spicebush occurred in the cane, while "prickly ash...grew very thick on Green Creek". Around Lexington, Short (1828) stated: "This portion of Kentucky was once the paradise of pawpaws, where immense orchards of large trees were everywhere met with"; but this species is generally small compared to major forest trees. There is a poetic reference to "pawpaw groves" in the original vegetation around Bryan's Station (quoted in Perrin 1882; see also Drake 1840's, in Mason Co.). There are also odd notes of "a brushy copse of wood" (Collins 1847 re 1778) and "The Spice Woods" (presumably Lindera; Fayette County Court Records 1779), both in or near northern Scott County. These limited indications of brushy vegetation are greatly outnumbered by references to forests or woods.

In contrast, there is at least one upland area in the adjacent Knobs Region that seems to have had more extensive brush. Walker (1824 re 1775) described travelling "through a country about twenty miles, entirely covered with dead brush...", between Rockcastle River and the cane lands of Madison County. On the Silurian dolomitic limestone, fringing the Bluegrass Region in southeast Madison County, "on slopes immediately below", Owen (1857) noted extensive "red bud lands" (Cercis), and further into the Knobs the white oak

dominated forest was "much disposed to briars". In addition, Sudduth (1840's re 1786) noted "a thick spicewood thicket" and "an open ridge" in the Knobs of central Lewis County. Place names also suggest that some areas east of the Bluegrass Region had more extensive brushy vegetation (Figure 10a below).

CANEBRAKES

There are many early descriptions of extensive canebrakes, i.e., areas dominated by the uniform stands of Arundinaria gigantea (sensu lato), the only bamboo species native to North America. These areas were a special feature of the Bluegrass Region. Elsewhere in its range, this species is largely restricted to bottomland, and the only canebrakes comparable in size with those here appear to have occurred on the Coastal Plain and in the Mississippi Embayment (West 1934, Hughes 1966). In Kentucky, Imlay (1792) stated that the typical cane height was 10-12 feet, with a maximum of 15-16 and minimum of 4-7. Also, Rogers (1910 re 1790) suggested that the cane on Cane Ridge (Bourbon Co.) was generally 8-12 feet high, while Graddy (1840's re 1788) described cane 10-12 feet high in central Woodford County. Cuming (1807) claimed a record of 40 feet. As indicated by the following accounts, trees appear to have been essentially absent in some of the canebrakes, but in others there was an intimate mixture with trees.

The most famous area for cane, with sparse tree cover, was Cane Ridge in eastern Bourbon County. This area was the only place which Filson (1784) marked with "Abundance of Cane" on his map of Kentucky, as opposed to just "Fine Cane" in other sections. Finley (1840's re 1790) wrote: "The land purchased by my father [on Cane Ridge] was part of an unbroken canebrake extending for twenty miles towards what was called the Little Mountain [Mt. Sterling, Montgomery Co.]: We had to cut out roads before we could haul the logs to build our cabins. The cane was so thick and tall that it was almost impossible for a horse or a cow to pass through it". Parry (1795) described the road from Cane Ridge to Mount Sterling as "hemmed in with cane, the most of the way". However, he also noted that "the timber in some places was chiefly honey-locust but in others varified with walnut, buckeye, hackberry and sugar-tree". Rogers (1910 re 1790) considered that this canebrake had been 15 miles long and "perhaps half as wide". In a later description, after the cane had been largely removed, Owen (1857) stated that it had only been one mile wide, and that "huge burr oak timber" was a "marked feature" here in Bourbon County, along with sugar-tree, honey locust, buckeye and boxelder.

In northern Clark County, to the south of Cane Ridge, Clinkenbeard (1840's re 1780) related: "Trees grew in the cane the same as elsewhere. Most all cane in this country with some shaune [shōfn ?] ridges...". However, apart from some abundant shrubs (see above), the only real tree he noted was "a good deal of locust". Further south, in central Clark County, Skinner (1840's re 1792) stated that "Winchester was a canebrake" (see also Stevenson 1840's re 1793). Shane (1840's) noted a "Cane Brake Road from Winchester to Dry Fork of Howards Upper Creek and so on. So called for the canebrake...including thousands of acres and some very good too"; apparently still existing when he wrote. Between central Clark County and Mount Sterling, Marshall (1840's re 1783) said there was "a wilderness overgrown with timber and cane".

Around Lexington (C. Fayette Co.), Todd (1791 re 1776) described the land: "nearly one half of it covered with cane, but between the brakes,

spaces of open ground as if intended by nature for fields. The ground appeared fertile, and producing amazing quantities of various kinds, some wild grass, wild rye and clover". He did not mention trees, but this may have been an oversight in so brief an account. Matthew (1840's re 1783) described how land covered with cane or "white blossoms" [= clover?] also had much tree cover, as already cited with other accounts indicating widespread dense forest around Lexington. However, to the north of Lexington, as far as the Great Crossing (formerly of buffalo routes) on North Elkhorn Creek (S. Scott Co.), there is a valley known as Cane Run, where trees appear to have been rare. Records (1840's re 1783) related that, after leaving North Elkhorn for the south, "We...soon found ourselves in a large canebrake, where we could get no wood to make a fire", except for "an old hickory stump about fifteen feet high", which was "all the fire we had that night". Their camp here was four miles from their destination at Bryan's Station, so they had travelled about the full six miles of Cane Run. At Great Crossing itself, Graves (1840's re 1787) stated: "Blackberries was a very rare thing, owing to the cane's being so thick. On my place, here, was an open space thick set with raspberries": Two to three miles east of Great Crossing, Guthrie (1840's re 1786) said that "Where Georgetown is, was all a canebrake", though Todd (1791 re 1776) mentioned "woods" around the first fort built here.

Around Versailles in Woodford County, Graddy (1840's re 1788) stated that one "couldn't find 10 acres of uncleared land that was not cane. Cane was all through here very thick". Owen (1857) also wrote that "luxuriant cane and peavine" had originally been widespread in central Woodford County and Fayette County, though as forest undergrowth. Gwynne (1840's re 1784), probably referring to southern Woodford County, stated: "Wherever big ash or big walnut now grows, there was cane lands...the big rank quality". In Mercer County, J. McAfee (1773) noted "canebrakes" north of Harrodsburg, then, travelling across northern Garrard County, "about 16 miles amongst broken ridges covered with cane and clover...". This route probably crossed the place now known as Cane Run in eastern Mercer County. No trees were mentioned here, but, when they arrived in central Madison County, J. and R. McAfee noted "about 20 miles through rich woods and mostly cane" and "rich cane woods", respectively. Walker (1824 re 1775) also "traveled about thirty miles through thick cane and reed" across Madison County from south to north.

In contrast to the indications of treeless areas in some of these canebrakes, several accounts state that cane grew in the forest as a major part of the undergrowth (e.g., Hanson 1774, F. Michaux 1805, Marshall 1812, Drake 1840's, Owen 1857, Stickney 1872). However, Hanson's is the only direct eye-witness description of such vegetation, referring to land along Elkhorn Creek in southwest Scott County: "Its undergrowth is clover, pea-vine, cane, nettle - intermixed with richweed. Its timber is honey locust, black walnut, sugar tree, hickory, iron-wood, hoop-wood, mulberry, ash and elm and some oak". Also, Drake recalled that in 1794, where he lived near Mayslick (Mason Co.): "The woods immediately beyond our fields were unutilated and not thinned out as you see them at present...The cane as high as my head..." (presumably with blue ash and buckeye, etc., as he related elsewhere). The kinds of tree associated with cane in these and other accounts are the same as those noted in more definite descriptions of open woodland (see above). Moreover, considering the distribution of cane today, it seems unlikely that it formed a major undergrowth component in the more shady climax forests of moist rich sites, dominated by sugar tree (*Acer saccharum* and its subspecies *nigrum*; Campbell 1980, unpublished).

GRASSLAND

There are only a few fragmentary records suggesting places where treeless grassland occurred.

(a) At the site of modern Frankfort, probably on bottomland near the major buffalo crossing, J. McAfee (1773) "...surveyed one track of land...containing 600 acres, about 100 of that meadow ground". His brother, R. McAfee, described this meadow as "with about 50 acres ready made, and there can be made 50 acres more with a little trouble...". Nourse's (1775) account of the grassy path through woods southeast of Frankfort is also relevant here (see above). Near the end of Nourse's 12 mile journey is Spring Station (Woodford Co.), where January (1840's re 1780) recalled: "The place where you went down to the springs, was all grassy".

(b) Todd's (1791 re 1776) description of "open ground" near Lexington has been quoted already. With reference to nearby Bryan's Station, when first settled, there is also a poetic (?) description of "Green meadows with antlered deer yet dotted, And lawns with flowers the loveliest still spotted" (Anonymous, quoted in Perrin 1882a).

(c) Fayette County Circuit Court Records (11th Feb. 1805) are concerned with the exact location of a "Grassy", "Pasture", or "Buck Lick" in Montgomery County, near the place still known as Grassy Lick. Various depositions stated that in 1776-83, there had been a piece of bottomland about half a mile below the lick which was "remarkable for its English or blue grass"; that this area was much more frequented by buffalo than other licks on the same creek; that the whole bottomland track was 844 acres, including some adjacent slopes where trees were blazed. Collins (1847) described an Indian mound and entrenchment here, and "thence down to a spring, some thirty yards off, for the width of the gate, there were no trees of any kind, when the country was first settled by the whites".

(d) The first Fayette County Court Records (1779-80) refer to an area about 7-8 miles northeast of the Lower Blue Licks on a large buffalo road, in Mason County, consisting of "about 3 or 4 acres of clear and open land". At or near this site, Linney (1885) claimed: "There is testimony which goes to show that in 1780 blue-grass was native, and growing at the three forks of Johnson's Creek, in Mason County". The significance of "blue-grass" in suggesting open country is discussed further below.

"Clover", the exact identity of which is discussed below, also appears to have been a local dominant, perhaps with little or no tree cover in some cases. Gwynne (1840's re 1784) described how the "Shawnee Run Indian trace" in Woodford County "passed through Clover Bottom...called so because the buffalo clover grew up there in a space about twice as big as this house (...3 room)". The Court records cited above (d) also refer to a "Clover Bottom" at a lick in Otter Creek (left fork), Madison County. However, there are many other accounts indicating that "clover" grew with trees, even in undergrowth at some sites, as with cane (see same sources above).

Other indications of "meadows" and "grassy" places, etc., could be cited from the pioneer literature, and from surviving place names. But even in some of the better examples detailed above, uncertainty remains about whether or not trees were scattered in the grass. Some place names even suggest a mix,

such as Walnut Meadow on the waters of Paint Lick Creek (Madison Co.), which was also mentioned in the Court records (d). It is notable that all of the more convincing accounts of purely herbaceous vegetation were on the richer lands, and close to buffalo trails or licks.

The narrow strip of Silurian exposure surrounding the Ordovician Bluegrass was distinctly more open in places. One of Filson's (1784) "natural meadow" areas in Ohio was located where prairie patches still survive on Silurian clay shales and dolomitic limestones, especially in Adams County (Braun 1950). Just south of here, Lewis County (Kentucky), Owen (1857) found that where the Silurian "marl" is denuded into conical mound-like eminences, it forms a kind of glade or "bald hill" in which few trees grow: but the soil is congenial to the prairie dock, wild sunflower, scabish, and rudbeckias". Further south, where the Silurian exposure narrows, the Indian village of Eskippakithiki was located "on a small prairie", according to Draper (1851). Several patches of prairie or cedar-glade vegetation have been discovered on the Silurian exposure during the past decade, with many rare species (e.g., Baskin & Baskin 1975; R. Cranfill & M. Medley, pers. comm.). No such communities have been found within the Bluegrass Region, apart from a 0.07 ha patch on Kansan glacial deposits in Boone County (W. Bryant, pers. comm.).

BUFFALO TRAILS AND LICKS

Numerous observers at the time of settlement described herds of buffalo, generally with about 20-100 animals, though occasionally up to 1000-1500 (e.g., Filson 1784). Wymore (1840's re 1779) stated that "buffalo would pass the station of Lexington every day, and sometimes all day long". There was a network of trails 10-100 feet wide or more, tending to connect with salt licks (Fig. 15; see also Jakle 1968, 1969). While buffalo were the most striking quadrupeds using these trails and licks, elk and deer were also common. Trails were eroded to about 3 feet deep in some places (e.g., Gwynne, Purdom and Workman 1840's re 1775-85).

One of the most substantial trails on record was between Drennon's Lick (Henry Co.) and the Kentucky River crossing at Leestown (now in Frankfort, Franklin Co.). Yet R. McAfee described this as "a small buffalo path which was about 150 yards wide in common about 30 miles across low flat ridges, middling good land and timber, but no water" (16th July 1773). At the crossing, the McAfees and other surveyors described this trail as being 100 feet wide, and the dust several inches deep; in some places the hooves of the buffalo had worn the ground down several feet (Johnson 1912; originals not located).

Drennon's Lick itself was "about one mile in length and 100 yards in breadth", i.e., about 40 acres (15 ha), according to R. McAfee (1773). This estimate is close to the 50 acres (20 ha) with "not a blade of grass upon it" noted by Cresswell (14th June 1775). Big Bone Lick (Boone Co.) was another of the largest licks, "about 200 yards long and as wide" (R. McAfee), i.e., about 80 acres (30 ha). Gordon (1766) here noted: "The extent of the muddy part of the lick is 3/4 of an acre"; and Douglass (1773 cited in Collins 1847, original not located) described how the ground was depressed three or four feet within an area of about 10 acres.

At Knob Lick (Boyle Co.), just south of the Bluegrass Region, there was "100 acres without a stick or grass", according to Nourse (19th June 1775).

Rafinesque (1836) visited this area in 1820: "a large barren volcanic hill of clay, of which I took maps and drawings. Here I found a new *Pachysandra* and many rare plants"; sadly, his details have not been found. At White Lick (Garrard Co.), also in the southern Knobs Region, Collins (1847) described an area of about 10 acres: "The ground is deeply indented with ravines, and marks resembling the tracks of wagon wheels, newly made, are now plainly visible, and have been visible since the settlement of the country some sixty years since".

The most famous lick area close to the Inner Bluegrass, on the edge of the Eden Shale, was the Lower Blue Licks (Robertson/Nicholas Co. boundary). No direct estimates of bare area here exist. But in about 1794, some 5-10 years after buffalo had been eliminated, Drake (1840's) approached this area from the northeast along the old trail: "and when three miles from the springs, we came to an open country, the surface of which presented nothing but moss-covered rocks interspersed with red cedars", which he attributed to the trampling of buffalo. Smith (1795) stated that "at the distance of 4 or 5 miles from it, you first begin to perceive that change. The earth seems to be worn away...". Cumming (1807) related how the buffalo had "pressed down and destroyed the soil to a depth of three or four feet, as was conspicuous yet in the neighbourhood of the Blue Licks, where all the old trees have their roots bare of soil to that depth" (see also Collot 1796, Marshall 1812, Bradford 1827, etc.). Later, Perkins (1857) wrote that "The hills about the Blue Licks are even now almost wholly without wood, and the scattered cedars, which at present lend them some green, did not exist in 1782". The typical forest surrounding the trampled area was dominated by white oak (*Quercus alba*), according to F. Michaux (1805) and Drake (1840's).

Although these bare roads and licks were dramatic local features, they must have covered a very small proportion of the whole region. Unfortunately, there is little direct description of buffalo influences in the transition from these completely bare areas to the surrounding forest. However, Joseph Scholl (re 1782, cited in Wilson 1927, original not located) said: "At Blue Licks, in early times, the Buffalo would drink the brackish water freely, and then their appetites would be sharpened and all the herbage - every green thing for a long way around - would be browsed off". At Drennon's Lick, R. McAfee (8th July 1773) stated: "the woods round that place are trod for many miles that there is not as much food as would feed one sheep...". Near Big Bone Lick, Croghan (1765) noted that "we passed through a fine timbered clear wood", when approaching from the Ohio River. Collins (1847), alluding to Douglass's survey of Big Bone Lick (original not located), wrote: "At a very early day the surrounding forest had no undergrowth, the ground being covered with a smooth grassy turf". Collins also related how Stamping Ground (Scott Co.) "derived its name from the fact that herds of buffalo which resorted here for salt water, tramped down the undergrowth as well as the soil for a great distance around...". At the lick near Boonesborough (Madison Co.), Ranck (1901) stated that, in 1775 (sources not given), "the rich soil, thanks to generations of animals that had haunted the lick, was open, firm, and almost free from undergrowth, and, except about the trampled lick and in the broad buffalo path, was adorned, early as it was, with great patches of fine white clover and thickly carpeted with a natural grass...Kentucky bluegrass".

In a more general context, several accounts indicate that cane was a preferred food of buffalo, and that they were particularly numerous in land with canebrakes. For example, Daniel Boone related to Filson (1784) that when

he first arrived in the region during 1769, the buffalo "were more frequent than I have seen cattle in the settlements, browsing on the leaves of the cane, or cropping the herbage of these extensive plains...". It seems likely that much of the rich herbage of grasses and legumes between the canebrake (e.g. Todd 1791, cited above) was maintained by buffalo. As a more pertinent example, Hedge (1840's re 1789) stated that around Strode's Station (Winchester, Clark Co.), where a buffalo trail led to the Blue Licks, "There was very little cane through here, mostly covered with wild-rye and peavines".

Some crude estimate of overall buffalo densities and movements might be attempted using the pioneer literature, but that is beyond the scope of this paper. In the meantime, one can suggest that that densities approached 50 per square mile (20 per square km), a figure estimated for the Mid-Western Tall-Grass Prairie Region, in contrast to the general density in adjacent forest regions on the order of 1-5 per square mile (Roe 1951). Elk and deer were also relatively abundant here, according to some early accounts (e.g., Smyth 1784, Bradford 1827, Draper 1851). The paucity of buffalo bones at archaeological sites in the Ohio Valley has sometimes been said to indicate their absence here, until about 1500 A.D. (e.g., Jakle 1968). However, it is known that Indians "jerked" buffalo meat by drying it cut off the bone, and there may have been little use in carrying the heavy bones back to camps or settlements.

That the productive vegetation of the Bluegrass Region has a fundamental attraction for large herbivores is also indicated by fossil records of ungulates from the Ice Age (Pleistocene): mastodons (mammoth, etc.), elephants, horses, tapirs, peccaries, sloths, bison (extinct forms), musk ox, reindeer, moose, elk and deer. At least 9-10 times as many collections per unit area have been made in this region, compared to the rest of Kentucky (data from Hay 1923, Jilison 1968b, and B. Clay, pers. comm.). It seems unlikely that biases due to superior preservation at high pH, or to more intensive searching, can fully explain this concentration. Big Bone Lick in Boone County is the major site for these fossils in Kentucky (with more than 20 collections), and small clusters of collections have been made at the Lower Blue Licks in Robertson County (5 or more) and at Drennon's Lick in Henry County (3). Collections have been reported from other widely scattered localities in the Bluegrass Region: in Boone (1), Kenton (2), Campbell (1), Carroll (1?), Henry (1), Owen (1), Franklin (5), Scott (1), Harrison (1), Bourbon (1), Fayette (4), Clark (1), Woodford (2?) and Mercer (4) Counties. The only localities in the rest of Kentucky (about 80% of the area), are as follows: in Jefferson (5), Henderson (1), Livingston (1) and Union (1) Counties, all on lowlands near the Ohio River; also, single mastodon finds further east in Barren, Jackson, Magoffin and Johnson Counties; and peccary finds in Rockcastle and Wayne Counties.

INDIAN SETTLEMENTS AND FIRES

It is generally believed that there were no permanent settlements of native Indians within the Bluegrass Region when Virginians first arrived from the east about 1750. However, there were some areas of habitation and forest clearance at the periphery, mostly along the Ohio River, and also in the eastern transition (Fig. 15). In this transition, the most well-known site was Eskippakithiki or Little Pick Town (now called Indian Old Fields), on Lulbelgrud Creek in eastern Clark County, which is about one mile onto the exposure of Silurian bedrock.

Based on uncertain sources, Beckner (1932) suggested that, in about 1740-60, 3500 acres at Eskippakithiki was cleared land on "level prairie country" (see also Draper 1851). Risk (1840's) said: "I heard one of the partners...say the Old Fields were all covered with bluegrass when he first saw it", in 1775. When Risk, himself, first saw it in 1780-90, his description indicates some tall-grass prairie component: "very high with grass, as high, some as a horse's back, and with a head to it" (suggesting Andropogon gerardi), along with "sprouts of white hiccory, and cherry tree, and black locust, and black walnut". He believed the area had been "a white oak valley" before being cultivated. Simon Kenton is reported as saying (in E. Kenton 1930 re 1770?): "The Indians...never made but two settlements in Kentucky - one on Slate Creek, and one at a place called Lul-bel-grud; and at both places they raised corn...[At Lulbelgrud] I don't know how long ago it was, but the locust is a thrifty growth in Kentucky, and the trees were big enough to make ten rails, and the corn hills were plain to be seen there. They put might big hills to their corn".

The settlement on Slate Creek was presumably the same noted as an "Old Indian Town" about 6 miles from Mud Lick (Bath Co.) in the first Fayette County Court Records (1779-80). This site was probably also on Silurian exposure. These court records also refer to an "Old Indian Town" on the waters of Silver Creek about two miles from a "Stone Lick", and "an Old Indian Town House" on the head of an eastern branch of Paint Lick Creek near "a sink hole spring", both in southern Madison County and again at the edge of the Bluegrass Region. The exact locations of these historical sites have not yet been rediscovered, even Eskippakithiki, but recent archaeological work has turned up another 18th Century settlement (ca. 1750's), in Nicholas County within the Bluegrass Region (Chris Turnbow, pers. comm.).

Despite the limited extent of Indian settlements in the 18th Century, there are many accounts of Indians in the region, generally hunting or raiding Virginian settlements, which persisted into the 1790's. Some locations of camp sites are indicated in these accounts (e.g., same sources as above). An exceptionally detailed eye-witness account was provided by Sudduth (1840's re 1794?): "in search of Indians...above the narrows of Red River...They had peeled a number of trees, cut out cane breaks and made a large camp and enjoyed themselves I suppose verry well". Although some 20 miles east of the Bluegrass Region, this camp was located in the cane that extended along rich bottoms. Even further east, probably in Johnson County, McQueen (1840's re 1780) stated: "Some little reed cane grew up in the Mingo bottom and some few buffalo strayed up that way...Indians had formerly lived in the Mingo bottom. All a prairie, to the back part of it". One of the few 18th Century village sites known in Eastern Kentucky is located in this area (Figure 15 below).

There is much archaeological evidence to extend this fragmentary view from the contact period backwards in time. However, this information is currently being synthesized at the Department of Anthropology and the Office of the State Archaeologist (University of Kentucky), and thorough treatment is beyond the scope of this paper. In the meantime, based on general accounts (Griffin 1966, Trigger 1978, Hockensmith 1980, Pollack et al. 1984, etc.) and some unpublished data (Chris Turnbow, Burle Clay and others, pers. comm.), the following outline is possible.

In marked contrast to the contact period, it appears that the preceding Fort Ancient Culture, dated about 1000-1700 A.D., did have a major concentration of activity within the Bluegrass Region, as well as along the Ohio River bottomland itself and in other regions further north. In the Bluegrass Region, the economy was based on summer agriculture and winter hunting, probably with a population of several thousand. Most agricultural settlements seem to have lost their permanence during the 17th Century, though some along the Ohio River persisted into the 18th Century.

It is likely that this dissipation of the culture, some 100 years before Virginian settlers arrived, was caused by military disruptions, and by diseases introduced from Europe that spread within the Indian populations. Tribes of the Iroquois Nation, originally based in the eastern Great Lakes Region, acquired guns from European traders after 1640, and during 1650-80 they attacked residents of the Ohio Valley to expand their hunting areas, especially for beaver and other traded furs. In the central Ohio Valley, the Shawnee, tentatively linked with the Fort Ancient culture, were the principal victims, though other tribes were involved on both sides of the aggression. To quote Hunter (in Trigger 1978, p. 590): "The Iroquois had craved the Ohio country not for habitation but for hunting, and having devastated it they had little interest in resettling it". Many of the Shawnee moved to other regions, though there was some attempt at resettlement in the 18th Century, including the village of Eskippakithiki noted above.

Further reconstruction of the Indian way of life, game populations, vegetation patterns, landscape ecology and climatic changes in prehistoric times, is a challenging interdisciplinary field that will have great relevance to the aims of this paper. But for the moment, one can only suggest that the Indian population in this region may have had a substantial impact on vegetation, not so much from the restricted agricultural settlement, but from the potential use of fire to hunt and maintain the range. Records of fires set by Indians are quite frequent in the Big Barrens of west-central Kentucky before settlement (e.g. Baskin and Baskin 1981), and in other tall-grass prairie regions of the Mid-West (e.g. Jakle 1968). Such fires, and the direct effects of buffalo, might have been the major factors maintaining open woodland and canebrakes in the Bluegrass Region. The frequent records of walnut and locust woodland at the time of settlement may be attributed to a relaxation of disturbance some 50-100 years before pioneers arrived, because those trees today are typical canopy dominants in successional forest that old on richer soils (Campbell 1980). There are also some early notes suggesting older second growth forest, about 150 years, on abandoned Indian lands near Lexington (Imlay 1792) and Cincinnati (Smith 1795).

Although disturbance from buffalo was still evident along trails in the Bluegrass Region when pioneers arrived, there was not a single account of

burnt vegetation. Clinkenbeard (1840's re 1780) even stated that, in the Clark-Bourbon County area, "Could not burn this country, always too damp. Wet soil under the grass, kept it wet. Burning out in the poor barrens, it did. But never could here, or would [have] been all burnt up, so many hunting fires". With reference to Kentucky, Roosevelt (1889) claimed that "Fires sometimes utterly destroyed immense tracts of this pasture, causing heavy loss to the settlers; and one of the first cares of pioneer legislative bodies was to guard against such accidents". However, the Journal of Proceedings from the Boonesborough meeting, which Roosevelt cited (reproduced in Ranck 1901), mentions only "An act to preserve the range" in the list of items. It appears that he was generalizing too far, based on more western reports of fire.

In further contrast, there were also early reports of fire in regions east of the Bluegrass. During his travels across Eastern Kentucky, T. Walker (1749) described an area in Jackson County where "The woods have been burnt some years past, and are now very thick, the only timber being almost all kill'd", and an area in Morgan County with "the only fresh burnt, woods we have seen". Also, the "twenty miles, entirely covered with dead brush" noted by F. Walker (1824 re 1775) southeast of the Bluegrass Region, can only be attributed to fire (McHargue 1941).

The Bluegrass is a relatively moist region in Kentucky, and it appears to have generally lacked flammable vegetation of pine, cedar and prairie grasses, in contrast to adjacent regions. Cane, however, is flammable in certain seasons, dry years, and stages of its life-cycle (after stems flower and die), and its extensive rhizome system allows exceptionally fast recovery (e.g., McHargue 1941, Hughes 1966, Kozlowski and Ahlgren 1974). By burning at the right time, Indians could have maintained and expanded this valuable forage.

SPECIES COMPOSITION

LARGE TREES

LANDSCAPE DESCRIPTIONS (1750-1850). To many people experienced in observing the primeval forests of that time, there was a clear distinction between trees typical of rich soil and those of poor, implying some direct role of chemical factors. Based on a summation of these descriptions (Table 1), rich forest in the Bluegrass Region was typically composed of walnuts (mostly black), sugar maple (probably with the black subspecies most typical; see below), ashes (mostly white and blue), cherry (black), buckeyes (mostly Ohio), honey and black locusts, coffee bean tree, elms (mostly red and white), mulberry, hackberry, oaks and hickories (species rarely stated), poplar (yellow) and sycamore (in approximate order of decreasing generic frequency). Species within genera were often not discriminated.

Walnut and sugar maple were both listed in almost all accounts of richer forests, sometimes with notes about the special large size of trees (Table 1). Walnut was noted as a major component of the forest, or at least listed first, about twice as often as sugar maple. Ashes, cherry and buckeyes, in turn, were listed in most accounts, but indicated as major components only about half as often as sugar maple. Honey and black locust were listed in only half the accounts, yet honey locust was noted as a major species as often as sugar maple, while black locust trees were noted as especially large as often as sugar maple. Other trees were listed in only no more than half the accounts. However, coffee tree, in particular, was consistently regarded as one of the most reliable indicators of the richest soils (Table 1: columns 35-40).

Forest of poorer soil in this region and its transitions, though generally not as poor as some montane and sandy regions further east, was composed of the following trees: oaks (mostly white, some red and black), beech, poplar, sugar maple, ashes, walnuts, hickories, black locust, sassafras, etc. (Table 1). While the oaks were generally dominant, beech and poplar were apparently more abundant in areas close to the Ohio River. Trees virtually absent from the richer forest were sassafras, persimmon, blackgum, sweetgum, chestnut oak and pines, and even in the poorer forest these were minor components.

DEED SURVEYS (1785-1805). In my dissertation (1980), I compiled some records of trees used for marking edges of properties surveyed in the central and eastern Bluegrass sections when the land was first settled. Details of sources and the nature of these data will not be reproduced here, except to note that the major sources - early County Court Record Books - still remain largely unexplored, and there is much more work to do in precisely locating the areas referred to by each deed survey. These surveys may be subject to various biases, being unsystematic and following no regular transects. However, summation of data from many sites in the same county does at least provide some further general insight, to be weighted provisionally in comparison with other sources.

Deed surveys from Woodford County (then including S. Franklin Co.) and Fayette County (then including Jessamine and S. Scott Cos.) are most representative of the Inner Bluegrass, with only about 20% of this land located in the Eden Shale Belt. The most frequent trees recorded were sugar maple, hickories, buckeyes, ashes, elms, oaks, walnuts, hackberry, honey and

Table 1. Tree species listed by early observers (1750-1850) in different regions of the Bluegrass and adjacent land.

Taxon	Beech, oak, etc., of poorer soil										Sugar tree, ash, walnut, etc., of richest soil										Total																									
	Near Ohio River					South					General					S. Ohio Rv. E Bluegrass						Inner Bluegrass					General																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40						
Pine																																														
Chestnut oak																																														
Chestnut																																														
Beech (2)	*	*?	*	*	*?	+	*	*?																																						
Cucumber t.																																														
Poplar (3)																																														
Sweetgum																																														
Sycamore (1)																																														
Blackgum																																														
Persimmon																																														
Sassafras																																														
Oak (1)	+ ^a / ₂	+	+ ^a	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Hickory	+																																													
Lynn																																														
Sugar tree (4)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Maple																																														
Boxelder																																														
Walnut (4)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
Hackberry																																														

Table 1. Continued.

11. D. Barrow	1795	General, Bluegrass, low class land	large/fine/excellent oak, etc.
12. F. Michaux	1802	General, Kentucky, 2nd/3rd class land	(typical trees)
13. C. Gist	1751	Little Miami Rv. to Scioto Rv.	well timbered/full of beautiful natural meadows
14. J. Smith	1795	Hamilton to Cincinnati, Ohio	amazing large walnut/scarcely any undergrowth but pawpaw/ earth green as a carpet with wild rye
15. J. Finley	1796	Scioto River bottoms	lofty sugar tree, etc./beneath all, the wild rye green as a wheat field, mixed with clovers
16. A. Ellicott	1803	General, Ohio River bottoms	(excluding black willow)
17. J. Melish	1807	General, Ohio River banks	heavily timbered
18. J. Flint	1818	General, Ohio Rv. near Madison IN	(red cedar abundant near Kentucky River)
20. D. Drake	1840's re	Mason Co. KY near Mayslick	unbroken forest with cane (oak, pea-vine and buffalo grass 3 miles to southeast)
21. N. Parry	1794	Bourbon/Montgomery Cos. KY	cane most of the way and timber...
22. E. Harris	1797	Mason Co. KY near Washington	large buckeye, etc./underbrush/pasture all over the woods
23. W. Chenault	1880's re	Madison Co. KY	sugar maple forest/money locust groves/undergrowth timber/undergrowth
24. T. Hanson	1774	Scott Co KY along N. Elkhorn Creek	forest overspread the luxuriant undergrowth
25. H. Marshall	1812 re	General, plains of Elkhorn Creeks	richest soil bears shortest timber
26. W. Fleming	1780	Mercer Co. richest soil	land without cane had tall very thick ash, etc./vast quantities of buckeye with cane
27. S. Matthew	1840's re	Fayette Co. around Bryan's Station	large walnuts, etc./surface covered with clover. etc.
28. J. Morse	1789	General, east-central Bluegrass	timbered like the rest with walnut, etc.
29. N. Parry	1794	Bourbon Co., first class land (trees)	trees grew in the cane, the same as elsewhere (but he only listed shrubs and locust)
29. W. Clinkenbeard	re	Clark/Bourbon Co. (undergrowth only)	shady forests (yellowwood on river banks)
30. A. Michaux	1793	Mercer Co., mouth of Dix River	forest surrounding plantation
31. F. Michaux	1802	Mercer Co., flat land nr. Harrodsbury	(excluding species typical along Kentucky River, etc., see also (9))
32. C. Short	1828	Fayette Co., a few miles around Iex,	luxuriant timber of the finest quality
33. L. Collins	1847	Woodford Co., general	

Table 1 , Continued.

34. L. Collins	1847 Inner Bluegrass, general	(typical trees)	
35. J. Filson	1784 General, rich land in Bluegrass	well timbered in general/some of richest places with little timber/covered	with cane, etc.
36. G. Imlay	1792 General, rich land in Ohio Valley	The best soil produces little timber but the locust, etc.	
37. D. Barrow	1795 General, 1st class land in Bluegrass	trees luxurious/shade universal/undergrowth of shrubs/herbage very plentiful in	uninhabited parts
38. F. Michaux	1805 General, 1st class land in Kentucky	ground in forests (now bare) was covered with cane	
39. F. Michaux	1819 General, richest soil in N. America	(from notes under Celtis, Fraxinus, Ulmus, Gleditsia, Gymnocladus, Cladrastis,	Juglans)
40. T. Flint	1832 General, richest soil in Kentucky	trees not large but tall/cane now replaced by grass in the forest	

Abbreviations and symbols:

* More abundant species (? indicates unclear); where species identifications are given, the upper abbreviations indicate more common. In addition under each species name (left column), the number of records as an especially large tree is in parentheses. Only species mentioned more than once in early accounts are listed here; see Filson, Barrow, Drake, Michaux, and especially Short (with collections by him and Peter), etc., for further details.

Species: Oak	a - alba	r - rubra, etc.	v - velutina, etc.	# - macrocarpa shumardii muhlenbergii imbricaria
Hickory	t - tomentosa	o - ovata/laciniosa		# - cordiformis laciniosa ovata tomentosa
Maple	s - saccharinum	r - rubrum	p - pennsylvanicum	
Walnut	n - nigra	c - cinerea		
Elm	a - americana	r - rubra		
Locust	under black locust	"/" indicates just "locust" in original source; could be honey locust		
Buckeye	o - octandra	g - glabra		
Ironwood	C - Carpinus (hornbeam);	O - Ostrya (hophornbeam)		
Ash	q - quadrangulata	a - americana	p - pennsylvanicum?	(also nigra is indicated by F. Michaux, Short, Collins, etc.)
Grasses	N - nimble will (Muehlenbergia schreberi);	M - meadow grass (?)		
Nettle	d - Urtica dioica	c - U. chamaedryoides		

black locust, mulberry and boxelder, in decreasing order, excluding those no more than 1% (Table 2).

I have not yet compiled data from sufficiently large and uniform areas of poorer soil, for direct comparison with this sample. However, in the rather widespread and heterogeneous group of surveys made by Daniel Boone and his associates in the eastern Bluegrass and adjacent Knobs, between Boone Creek and the Forks of Kentucky River (in the Draper Collection), there are some clear shifts in composition. Trees with decrease in percentage of at least half, compared to the Inner Bluegrass sample, are coffee tree, buckeyes, hackberries, elms and boxelder (Table 2). Those with increases of at least double are beech, poplar, oaks (in general), chestnut, pine, sassafras and blackgum. So-called "white oak" was codominant with sugar maple in this eastern region, which appears to have had rich and poor forest types in approximately equal representation.

In search of more detailed patterns within these survey data, I examined the associates of each species or genus (as identified) at each surveyed point, where more than one individual tree was often recorded. I summed these associates at all points within the region (i.e., weighting composition by the presence of each subject taxon). For simplification, I then considered only those associated species forming more than 10% of the total (for details, see Campbell 1980). The resultant network suggests how the trees were segregated into forest types (Figure 3). Moreover, the type at each survey point can be estimated from the taxonomic composition of its trees, with trees at adjacent points assisting. Thus, by pooling all data, the compositions of these types can be reconstructed (Table 3), with major features are as follows.

(a) "White oak" dominated (41-55%) with "red" oak (9-12%), black oak (5-7%), hickories (15-21%) and minor modal (under 5% but with peak percentage here) red cedar, blackgum, maple (silver or red; see below), chestnut and pine.

(b) Sugar maple dominated (41-55%) with hickories (4-20%) and minor modal beech, poplar and lynn (basswood).

(c) Ash dominated (24-65%) with sugar maple (7-17%), hickories (4-20%) and minor modal elm and sycamore.

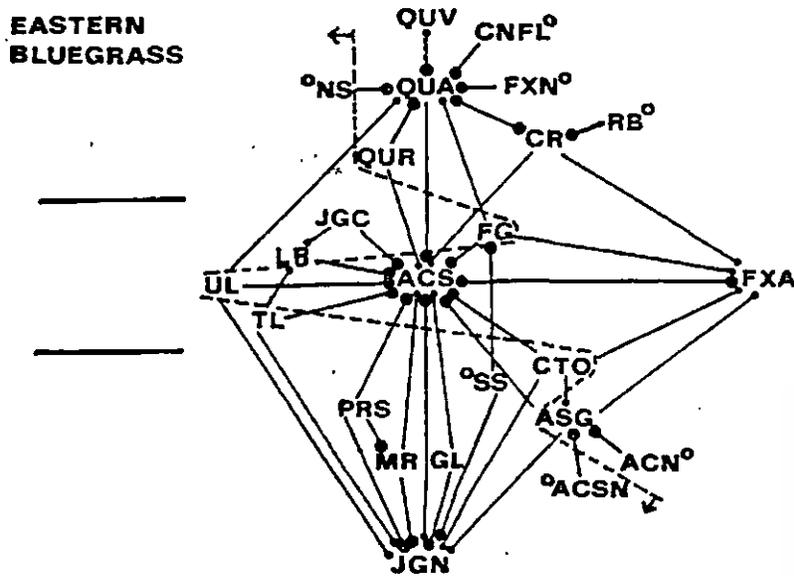
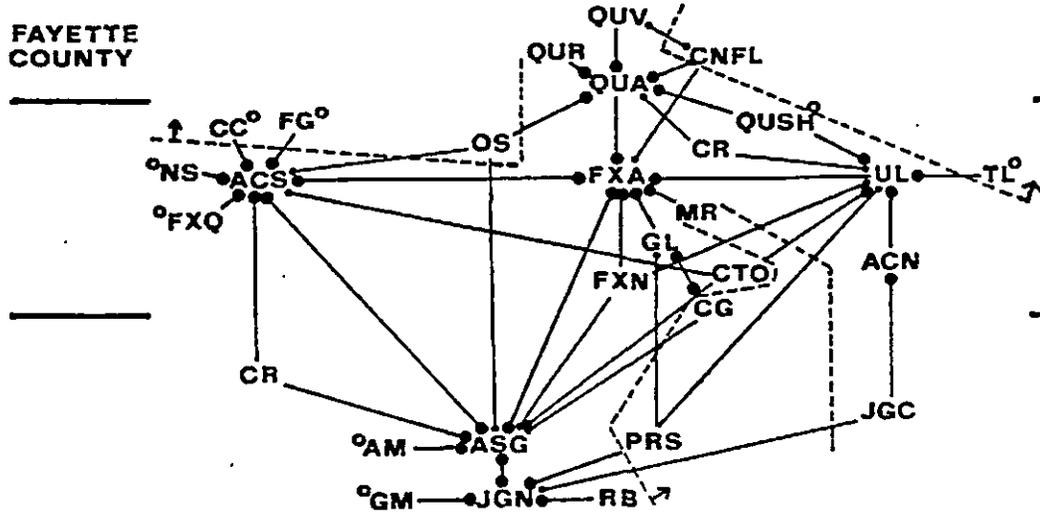
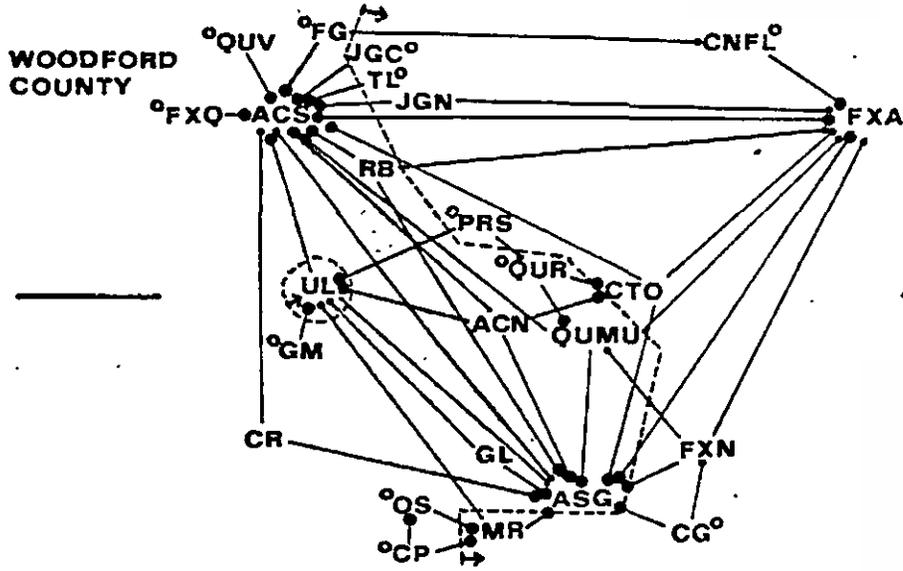
(d) Buckeye dominated (13-28%) with hickories (12-22%), walnuts (3-23%), honey locust (1-10%) and minor modal boxelder, hackberry, coffee tree, mulberry, cherry, black locust, sassafras.

Based on further discussion of these data and experience of modern forest fragments (Campbell 1980), Figure 4 presents my ecological artist's impression of primaeval forest distributions in the east-central Bluegrass sections.

When comparing these survey data with the general descriptions summarized above (Table 1), made during the same period (mostly 1770-1820), it is clear that the relative frequencies of trees differ considerably, though essentially the same group of 30-40 species are present. Within the richer forest types, trees with much more frequency in the deed surveys are hickories, buckeyes, elms and boxelder, while those with much less frequency are walnuts, both locusts, coffee tree and cherry (differences of at least x 2 in percentage). There is little overall difference in the geographic or edaphic distribution of these two groups, based on historical or modern patterns (Campbell 1980). It does not seem that distinct physical (abiotic) environments were being selected by the surveyors to any degree that would explain such shifts in composition. However, these trees over-emphasized in

FIGURE 3. Major associations between tree taxa noted at deed survey corners. (from Campbell 1980). For further details of each region, see Campbell (1980), this text and Tables 2 and 3. For abbreviations, see Table 3. Lines join trees with their most frequent associates (large dots) or other associates (forming over 10% of the total; small dots), without the widespread hickories (CR). All taxa have hickory (species combined) as a major associate, except for those pointed to from the dashed lines. Each regional diagram is oriented with respect to the general, interpreted gradient from rich moist soils (low on page) to poor dry soils (high). Bars at sides show divisions into groups of trees considered typical of major forest zones, which are used to reconstruct the types in Table 3.

FIGURE 4 (opposite). Ecological artist's impression of forest compositional patterns over the presettlement landscape, based on early land surveys and modern remnants. See text, and especially Campbell (1980), for justification. Only major tree species are shown (for abbreviations, see Table 3). For details of soil series (with abbreviations), see Campbell (1980; and S.C.S. 1968, etc.).



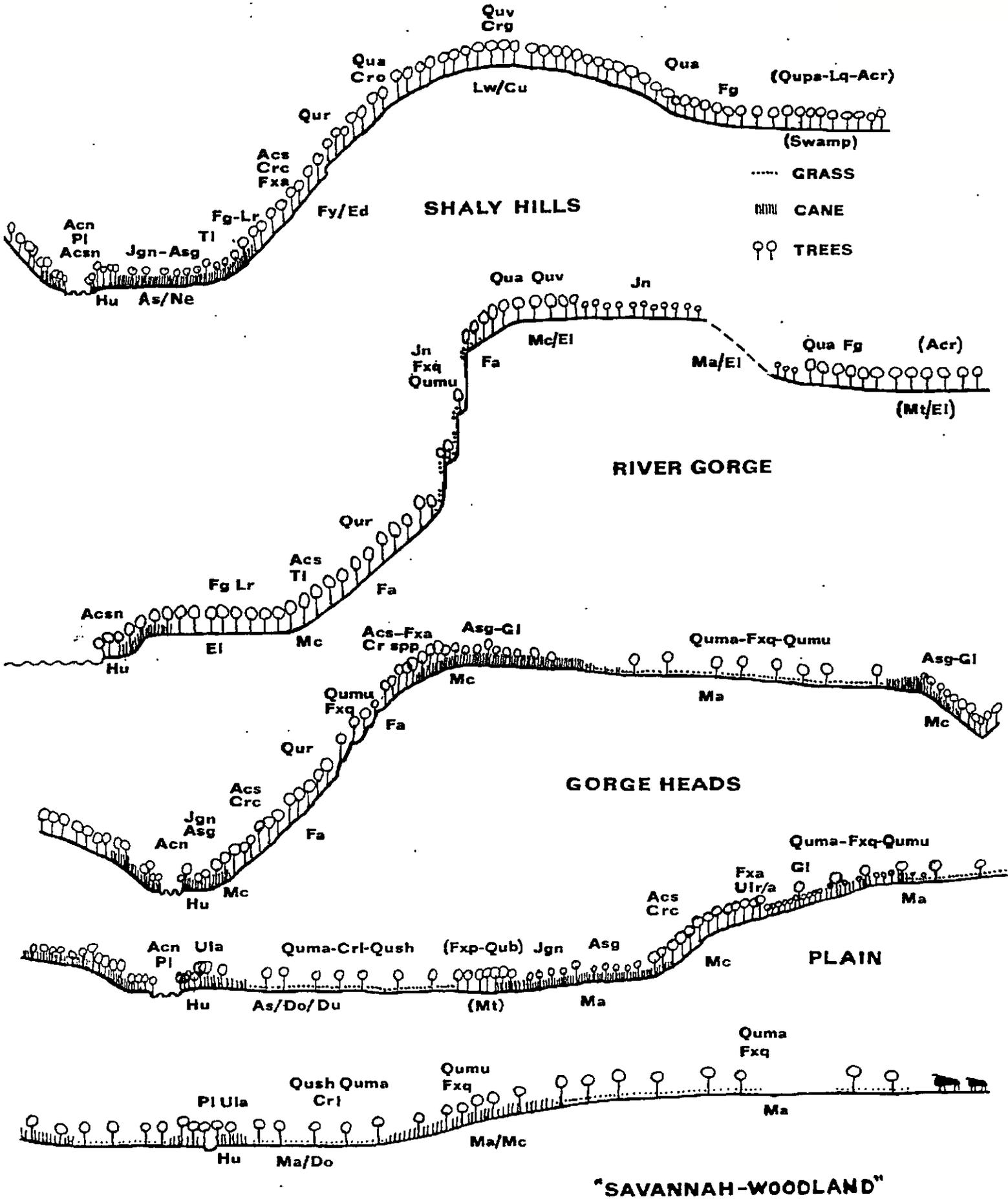


Table 2. Total percent composition of trees listed at deed survey corners (1785-1805).

Region	Woodf. Fayette Bourb. Eastern	Woodf. Fayette Bourb. Eastern						
Liriodendron	0.05	0.11	2.89	Aesculus	12.35	9.51	13.32	3.68
Fagus	0.21	0.69	0.48	Morus	1.91	1.00	2.03	1.44
Nyssa	0.05	0.12	-	Vitis	0.11	-	0.12	-
Quercus ?rubra	0.70	2.00	0.42	Carya ?cord.	0.48	0.19	0.43	-
Q. ?alba etc.	4.47	8.56	3.09	Carya ?sp.	14.28	20.30	12.70	11.07
Q. velutina	0.75	1.34	0.24	Juglans	4.79	6.67	4.61	7.81
Acer ?saccharin.	0.16	0.04	-	[J.cin./nig.	0.35	1.32	?	2.22]*
Cornus florida	0.48	0.39	0.18	hoopwood	1.33	2.27	2.25	0.25
Juniperus	0.27	0.23	-	hoopash	0.16	0.42	0.61	-
Tilia	1.06	0.62	0.36	Crataegus	0.70	1.58	3.65	-
Fraxinus amer.	2.77	0.85	0.85	Ostrya?	0.91	1.04	1.04	0.21
Acer saccharum	20.57	12.70	16.62	Carpinus?	0.16	0.27	-	-
Prunus serotina	0.26	0.89	1.03	Robinia	1.17	1.92	1.46	0.75
Gymnocladus	0.58	0.46	0.24	Ulmus	6.92	8.33	7.04	1.90
Fraxinus ?sp.	8.31	7.48	6.72	Cercis	0.05	0.29	0.06	-
black ash	0.80	0.42	1.94	Asimina	-	0.16	0.12	-
Acer negundo	2.93	1.39	3.65	Fraxinus quad.	0.21	0.62	0.42	-
Celtis	5.70	3.09	4.31	Quercus macro.	0.05	0.12	-	-
Gleditsia	3.19	2.50	5.22	Q. ?shumardii	-	0.54	0.12	0.21
Platanus	0.58	0.46	0.79	Q. ?bicolor	-	0.12	-	0.04

See Table 3 for details of nomenclature, totals and single occurrences. Bourbon County data, with a total of 1642 trees, are from F. Cassidy (pers. comm.); these include traces of bettewood, peach and plum. * Ratio of "white" to "black". General order of trees is from "Eastern" concentrated to central (Woodford/Fayette Cos.).

Table 3. Percent composition of forest types re-constructed from deed survey associations (Fig. 5)*.

Forest type/region ¹	WHITE OAK			SUGAR TREE			(WHITE) ASH			BUCKEYE/WALNUT			
	F	E		W	F	E	W	F	E	W	F	E	
Acn boxelder (<i>Acer negundo</i>)				2.60	1.54	0.24				1.85	4.38	1.56	2.06
Acsn maple (<i>A. saccharinum</i> , <i>A. rubrum</i>) i.e. silver/soft/water, red maple	0.22	0.95		0.12		0.60	0.34				0.13		
Acs sugar tree (<i>A. saccharum</i>) later: sugar maple	2.86	1.31		41.04	55.52	47.26	11.30	7.49	16.77		2.70	4.29	8.42
Asg. buckeye (<i>Aesculus ?glabra</i>)	1.54	0.12		1.48	3.34	1.55	2.05	2.87	0.62		27.54	25.71	12.71
Am pawpaw (<i>Asimina triloba</i>)					0.26						0.52		
Cp hornbeam (? <i>Carpinus caroliniana</i>)				0.37	0.26			0.62					
hickory (<i>Carya</i> spp.)	20.70	14.80		13.11	16.71	8.10	7.19	20.33	3.73		17.89	22.34	12.03
Cro scalybark/shellbark hickory (<i>C. ovata</i> , <i>C. laciniosa</i>)				0.12	0.77								
Crl black hickory (<i>C. ?laciniosa</i>) (or <i>C. glabra</i>)											0.13	0.13	
Crc white hickory (<i>C. ?cordiformis</i>) (or <i>C. tomentosa</i>)			0.84	0.49			0.68	0.10			0.39	0.52	35
Cs chestnut (<i>Castanea dentata</i>)													
Cto hackberry (<i>Celtis occidentalis</i>) (rarely <i>C. tenuifolia</i>)	0.22	0.24		6.43	0.77	0.48	3.77	6.37	0.62		5.66	1.82	5.15
Cc redbud (<i>Cercis canadensis</i>)	0.22			0.12	0.26			0.21				0.26	
Cnf dogwood (<i>Cornus florida</i>)	2.20	2.86		0.62			1.03		1.24		0.13		
thorn, haw (<i>Crateagus</i> spp.)					0.26			2.05			1.42	0.91	
Cgc white thorn (<i>C. ?crus-gallii</i>)								0.62			0.26	0.52	
Cgm redthorn, redhaw (<i>C. ?mollis</i>)								0.30					
Ds persimmon (<i>Diospyros virginiana</i>)			0.36										
Fg beech (<i>Fagus grandifolia</i>)	0.22	0.84		0.49	4.37	6.90			0.62				0.34

ash (<i>Fraxinus</i> ?sp.)	3.52	0.37	2.83	5.83	42.46	15.40	34.78	3.73	2.60	4.47
Fxa white ash (<i>F. americana</i>)	0.66	0.25	0.26	0.24	13.70	1.64	29.19	1.29	0.26	2.23
Fxn ² black ash, hoop-ash, hoopwood (?F. nigra)	0.66 0/1/2 3/0/1	0.62 2/1/2 0/0/1	0.26 0/0/1	0.36 2/0/1	2.05 0/0/6	7.08 9/7/53	1.24 2/0/2	4.38 13/2/17	1.43 2/3/6	0.52 1/0/2
Fxq blue ash (<i>F. quadrangulata</i>)		0.37	1.29		0.34	0.41			0.91	
G1 honey locust (<i>Gleditsia triacanthos</i>)		0.37	0.77	0.60	0.68	5.24		7.08	1.43	9.97
Gm ³ coffee ash/nut/bean, bean/pea tree witch hazel (<i>Hamamelis virginiana</i>)		0.37			0.68	0.10		0.77	1.43	
			0.26							
walnut (<i>Juglans</i> ?sp.)	0.22	3.21	0.77	3.21	2.40	1.33	1.24	2.83	14.55	22.68
Jgc white walnut (<i>J. cinerea</i>) later: butternut	0.12	1.11	1.03	1.55		1.23			1.17	1.03
Jgn black walnut (<i>J. nigra</i>)		2.35		0.36	1.03	0.10		0.51	2.34	1.03
Jn cedar (<i>Juniperus virginiana</i>)	1.32	0.62								
Lr poplar (<i>Liriodendron tulipifera</i>) later: yellow p./tulip tree	0.22	0.12	0.51	6.90			1.24			0.69
MI crabtree (<i>Malus coronaria</i>) i.e. crabapple									0.26	
Mr mulberry (<i>Morus rubra</i>)	0.22	0.37		0.83			2.16	4.24	0.52	4.64
Ns' blackgum, gum (<i>Nyssa sylvatica</i>)	0.22	0.12	0.26	0.12					0.13	
Os ironwood (? <i>Ostrya virginiana</i>) also: hophornbeam	2.42	0.74	1.29	0.24			0.51	1.42	0.78	0.34
Pn pine (<i>Pinus</i> ?sp.)										
Pl sycamore (<i>Platanus occidentalis</i>)		0.12	0.26	0.48	2.05	1.13		0.51		1.20
Prs cherry (<i>Prunus serotina</i>)		0.12	0.26	0.48			0.31	0.51	2.47	3.95
oak (<i>Quercus</i> ?sp.)			0.26	0.36			0.21			0.52

Qua ⁴ white oak (Q. alba, Q. muehlenbergii, Q. macrocarpa etc.)	4.57	1.80	3.33	3.08	2.16	3.11	4.89	0.91	0.34		
Qub swamp white oak (Q. bicolor)								0.13			
Qupa wateroak (Q. ?bicolor/palustris)								0.26	0.17		
Qui willow oak (Q. ?imbricaria)	0.22				0.31		0.13				
Quma burr oak (Q. macrocarpa)											
Qupr chestnut oak (Q. prinus)	0.24										
Qur red oak (Q. rubra, Q. shumardii)	9.03	12.05	0.60	1.24	0.72	1.24	0.39	0.26	0.17		
Qush Spanish oak (Q. ?shumardii, falcata)	1.32	0.60			0.72						
Quv black oak (Q. velutina)	7.49	5.37	0.24				0.26		0.17		
Rb black locust, locust (Robinia pseudoacacia)	0.22	0.72	0.24	0.68	0.21	1.24	1.29	5.97	1.37		
blackberry (Rubus spp.)	0.22										
elder (Sambucus canadensis)							0.13				
Ss sassafras (Sassafras albidum)		0.48	0.24						0.69		
Tl lynn (Tilia spp.)		2.22	0.77	5.71	1.23	0.62	0.26	0.13	0.52		
elm (Ulmus ?sp.)	2.86	1.31	2.38	4.12	14.99	0.62	4.38	3.38	2.41		
Ula white elm (U. americana) later: american elm		0.12			0.10						
Ulr red elm (U. rubra) later: slippery elm		0.25	0.24						0.17		
grapevine (Vitis ?sp.)		0.12					0.13				
Total number of trees	454	838	809	389	839	292	974	161	777	770	582

1 W - Woodford County, F - Fayette County, E - Eastern Bluegrass (see text).
 2 See text for possible synonymy; absolute numbers under percentages.

3 Other names for Gymnocladus were pea locust, mahogany (Draper MSS 15CC25) and satinwood (Imlay 1792).

4 Later names for Qu. muehl. are yellow/yellow chestnut/chinquapin oak; Qu. macr., overcup oak (?); Qu. stel., post oak; Qu. falc., southern red oak; Qu. imbr., laurel/shingle oak; Qu. mar., blackjack.
 * The trees at each survey point were assigned to a forest type based on the dominant species, or estimated from associates if the dominant was lacking. Names used in the surveys are listed first, but the alphabetical order follows Latin names in parentheses. See text for further notes on common names used in later accounts (e.g. in hickories and ashes).

deed surveys are all considered to be relatively tolerant of shade (at least intermediate in Fowells 1965, etc.), and they are generally concentrated in lower strata of modern forests (Campbell, unpublished). In the under-emphasized group, only cherry is somewhat tolerant and understory-concentrated, and this only to a marginal extent. I suggest that the latter group formed a relatively early successional phase, concentrated in the rich grassy partial openings between the canebrakes. These sites may have been ideal places to center properties on, while the more shady surrounding forest tended to be where boundaries were located. Also, it is possible that intolerant trees, which tend to be concentrated in the dominant canopy class, with better form for building purposes, were more often set aside for immediate logging instead of marking boundaries.

NATURAL RESOURCE SURVEYS (1857-1919). Owen (1857) included many notes on forest composition in his generally geological surveys of individual counties. He referred to areas of "primitive", "virgin" or "original" growth wherever possible, though he often noted that the understory had been removed. With soil analyses by Robert Peter (1857-61), he was able to specify more precisely the forest types associated with high or low fertility, especially phosphate. If his various lists of tree species are assigned to forest types defined by dominant species and characteristic associates, the following compositions are obtained (Table 4).

(a) Beech dominated forest (26 sites), with occasional dominance of poplar, also including sugar maple, oaks (mostly white), hickories (mostly shellbark), walnuts, ashes, etc.

(b) Oak dominated forest (mostly white, some red; 23 sites), including hickories, beech, sugar maple, etc.

(c) Sugar maple forest (no pronounced dominance; 15 sites), including black walnut, ashes (mostly black), oaks, buckeye, etc.

(d) Black walnut forest (no pronounced dominance; 13 sites), including sugar maples, ashes (mostly blue), oaks, locusts (mostly black?), cherry, etc.

(e) Burr oak forest (no pronounced dominance; 4 sites), including ashes, hickories, honey locust, buckeye, sugar maple, etc.

(f) Blue ash dominated forest (with other ashes; 6 sites), including sugar maple, walnut (black?), hackberry, oaks, etc.

Because Owen's notes were fairly systematic, with a few typical sites in most counties, the proportion of sites with each forest type is probably a good approximation for the whole Bluegrass Region. The beech and white oak types were restricted to less fertile soils of the Eden Shale or Outer Bluegrass, while the others occurred on richer soils in the Inner and Outer Bluegrass.

On the adjacent Silurian dolomitic rocks, Owen indicated that poplar and beech were the most frequent dominants, but with white oak, hickories, sugar maple, black walnut and ashes widespread as well. However, the "Beargrass Lands" of Jefferson County, near the old buffalo route between Louisville and Frankfort, were quite distinct, dominated by black walnut and with other typical trees of the Bluegrass woodlands: black locust, cherry, elm, ash, hackberry, boxelder, buckeye, hickories (pignut and shellbark), coffee, oaks (red and overcup), sugar and beech.

A few notes by Shaler and other workers in the Geological Survey, in Peter (1876-84), have been incorporated into Table 4 with Owen's data. In addition, Shaler (188?; see also Peter 1882) wrote that blue ash, black walnut, black locust and coffee tree indicated the best soils, while beech, white oak, red oak, black oak and blackjack oak indicated progressively worse

soils.

Linney (1882-87) also made notes on forests with his geological surveys (Tables 5 and 6). He made more precise species identifications and geological correlations, but his work covered only western, southern and eastern sections of the region, excluding most of the Inner Bluegrass. Also, he had difficulty finding representative undisturbed forests, often deploring the general wasteful destruction that had taken place. Nevertheless, he found the following patterns.

(a) Beech forest was largely restricted to the Upper Ordovician Garrard Siltstone ("Middle Hudson siliceous mudstone"), with poplar again a consistent locally dominant associate, and sugar maple, walnuts, white oak, etc.

(b) White oak forest was concentrated on shaly strata at lower and upper extremes of the Upper Ordovician, i.e., the Clays Ferry ("Lower Hudson") and Drakes Formation, etc. ("Upper Hudson"). Associates of white oak on the lower strata were sugar maple, red oak, hickories, etc., with local groves of post oak and laurel (shingle) oak. Associates on the upper strata were black oak, hickories, post oak, sugar maple, walnuts, etc.

(c) Mixed forest with sugar maple and/or walnuts (mostly black) as most abundant species was typical of the some soils on Garrard Siltstone and the overlying Ashlock or Calloway Limestones, with associated yellow (chinquapin) oak, blue ash, white oak, poplar, red oak, hickories, cherry, mulberry, etc.

(d) Mixed forest dominated by blue ash and/or yellow oak was typical of the Ashlock/Calloway and Lexington ("Trenton") Limestones, consistently associated with cherry and hackberry, and less frequently with shellbark hickory, coffee tree, sugar maple, mulberry, etc.

(e) On the Silurian dolomites and shales, he reported some distinct forest types indicative of poorer soils, though rich types were also intermixed. The poorer types included Spanish oak (specified as *Q. falcata*) and sweetgum (*Liquidambar*), which are virtually absent from the Bluegrass Region.

One later source that may still provide some limited insight to presettlement conditions is the report of J.E. Barton (Commissioner of Geology & Forestry at Frankfort) in 1919. This was the first attempt to estimate timber volume throughout the state, together with details of composition by county. However, it is not clear what methods were used. Barton stated: "The only figures available date back some years and a large share of the removal of the timber in Kentucky, due to large operations, has taken place within a recent period.. [but].. the figures here given were compiled under conditions which did not permit an extremely close and careful estimate.. [and].. experience heretofore has shown that estimates of standing timber usually fall considerably below the actual cut".

Caution is clearly needed in using these data, but more recent attempts at general forest survey in the state have provided less details relevant to old-growth. The forest cover estimated for the Bluegrass Region in Barton's report was only 5-6%. However, this forest area probably included a greater proportion of old-growth than the so-called "commercial forest land" that now covers about 20%, much on farmland abandoned since 1900 (Kingsley & Powell 1978). Some reasonably favorable check on the compositions reported by Barton is possible using notes from contemporary county histories. In Franklin County, Johnson (1912) listed 12 major tree genera, as did Barton, and 10 were shared. Moreover, the five most abundant genera, according to Barton, were the same, except for hickory, as those major timber sources

Table 4. Composition of forest types based on Owen's (1857) notes in geological surveys.

Frequency in forest types, named after dominant species (with some associated dominants combined)*.

Taxon	Beech	White-oak	Sugar-tree	Black walnut	Burr oak	Blue ash	Total-A
beech (2)	25 (11 major)	7	2			1	35 (32/3)
poplar (6)	11 (2 major)	4	4	2		1	22 (15/7)
blackgum	1	1					2 (2/0)
sassafras			1				1 (0/1)
sugartree (3)	9	7	15	7	2	4	44 (16/28)
hickory	8 (3/1/0)	9 (2/0/1)	9 (2/1/2)	4 (3/0/0)	3 (2/1/0)	1	34 (17/17)
walnut	6	6 (3/0)	13 (5/0)	12 (6/2)	1 (1/0)	4 (1/0)	42 (12/30)
hackberry		1	1	3		3	8 (1/7)
elm	1		1	3		1	4 (1/5)
mulberry			2	2	1	1	6 (0/6)
black locust cherry	2 (1?)		2	6 (3?)	1	1	12 (2/10)
coffee tree	1		3	5		2	11 (4/7)
honey locust				1			1 (0/1)
buckeye (1)			2	2			10 (2/8)
boxelder			4	2		2	12 (2/10)
ash (1)	7 (3/4/2)	2 (2/0/0)	10 (5/3/2)	7 (3/2/5)	3 (1/0/1)	6 (3/1/6)	35 (9/26)
oak (6)	11 (4/1/0) (0/0/1)	23 (11/0/0) (6/1/0/m) (14 major)	5 (3/0/0) (1/1/1)	8 (5/1/1) (2/0/0)	4 (3/3/0) (1/0/1)	3 (0/1/2) (1/0/0/1,s)	54 (34/20)
Total-B	26-83	23-63	15-75	13-66	4-20	6-33	87 (49/38)

Table 4. Continued.

Undergrowth	Beech	White-oak	Sugar-tree	Black walnut	Burr oak	Blue ash	Total
dogwood	1		1		1 (mixed oak)	-	3
pawpaw	1 (poplar)		2				3
redbud		1 (x?)	1		1 (mixed oak)		3
spicebush		1 (x?)				1 (x)	2
ironwood			1				1
elder			1				1
hawthorn						1	1
cane			1 (x)	2 (1x)	2 (2x)	1 (x)	6
pea-vine			1 (x)		1 (x)		2

* Where Owen noted that one species in particular formed the major part of the forest, this is noted in parentheses.

Species identifications, though not always given, are noted in parentheses with the following system:

hickory (shellbark or scalybark/pignut or black/mockernut) oak (upper: white/burr/chinquapin or yellow
walnut (black/white) oak (lower: red/black/pin/other
ash (black/white/blue) (m - blackjack, l - laurel, s - spanish).

Note: these identifications must be treated with caution. Also, I have assumed that "locust" is black (shown as ?).

Total-A is the total frequency of the tree at all localities (with separation of beech + white oak/others).

Total-B is the total number of localities for each forest type - followed by total number of tree occurrences.

x Undergrowth species stated to have been largely eliminated since settlement.

Table 5. Continued.

	Mixed types	Post. oak	White oak	Blue ash	Sugar-tree	Beech	White oak	Blue ash	Total-A
hickories	3 (1/1/0)		3 (0/1/1)	3 (3/0/0)	3 (1/1/0)		2 (0/1/0)	3 (2/0/0)	14 (5/9)
linn				1	2	2		1	6 (4/2)
sugar-tree	3		2	4	6 (1 major)	6	3	1	22 (9/13)
boxelder	1								
white walnut	1	1	1	1	2				4 (1/3)
black walnut	4 (1?)	1	2 (1?)	1	6 (3?)	8 (4?)	1	2	20 (11/9)
hackberry				7	1			3	11 (0/11)
winged elm		1							
white elm	2	1	1 (?)	1	2			1	5 (1/4)
mulberry	1		1	2	3			2	8 (1/7)
black locust	2					1		1	2 (1/1)
cherry	1			8	3			3	14 (0/14)
honey locust	2								
coffee-tree				3	1			2	6 (0/6)
buckeye					2			1	3 (0/3)
laurel oak							2		2 (2/0)
swamp white oak				1		1			2 (1/1)
yellow oak	1			7	5			3 (1 major)	16 (1/15)
burr oak	1		1					1	2 (1/1)

Table 5. Composition of forest types based on Linney's (1882-87) notes in geological surveys.

Frequency in forest types, named after dominant species (with some associated dominants combined)*

Tree Taxon	S I L U R I A N			U P P E R				O R D O V I C I A N			Blue ash of Lexington limestone	Total-A
	Mixed types of Crab Orchard shale/dol.	Post oak of Brassfield dolomite	White oak of Drakes dol./limes./muds. etc.	Blue ash of Ashlock /Calloway limes. etc.	Sugar-tree of preceding + following strata	Beech of Garrard siltstone etc.	White oak of Clays Ferry muds./limestone	MIDDLE ORD.				
scarlet oak	1	3										
chestnut	1											
beech	3				2	9 (9 major)	1					12 (10/2)
poplar	3 (2 major)			1	5	9 (1 major)	1					16 (10/6)
sweetgum	3 (1 major)											
sycamore	1											
blackgum	2	1				1				1		1 (0/L) 42
red maple	2											
persimmon		1										
sassafras	1	3				1		1				2 (2/0)
spanish oak		3 (3 major)										
post oak		4 (1 major)	2					2				4 (4/0)
black oak		1	3							1?		4 (3/1)
white oak	3 (1 major)	4	4 (2 major)	1	4	5	4 (4 major)					18 (13/5)
red oaks	3	4		1	3	2		2		1		9 (4/5)

Table 5. Continued.

	Mixed types	Post oak	White oak	Blue ash	Sugar-tree	Beech	White oak	Blue ash	Total-A
black ash					1				1 (0/1)
white ash	2 (1?)		1 (?)	2	1	2 (1?)	1	1	8 (4/4)
blue ash				8 (1 major)	4			3 (2 major)	15 (0/15)
red cedar	2	2	1				1		2 (2/0)
soft maple	1								
Total-B	5-50	4-30	4-22	8-52	6-56	9-48	4-21	3-31	34 (17/17)
Undergrowth									
dogwood	1		1			1	1		3 (3/0)
black haw			1						1 (1/0)
ironwood			1						1 (1/0)
hornbeam					1				1 (0/1)
redbud					1	1			2 (1/1)
cane					1 (x)		1	1	3 (1/2)
spicebush								1	1 (0/1)
grapevine								1	1 (0/1)

* See Table 4 for explanation of symbols, totals, etc. The main difference is that Linney provides more species identifications, and these are shown. However, hickories are still a problem. Total-A refers only to Ordovician. The red cedar dominated communities noted by Linney along Kentucky River cliffs and elsewhere are excluded. (see Table 6).

Table 6. Dominant trees noted by Linney (1882-87) in different counties on different geological strata

Bedrock	Western Counties			Southern Counties			Eastern Counties		
	Old She	Spe Nel		Was Mar	Gar Lin	Mad	Cla Mon	Bat Fle	Mas
Silurian	B* G			G* G* G*	G* G* G*	G* G*		B* G	
Outer Bluegrass ("Upper Hudson")	B* W* S* A	B* W* ^u S ^l A ^l	P* O C	W* S ^l A ^l	W* A ^l	W* A ^l	W* A ^l	W* ^u A ^l	W* A ^l
Garrard Siltstone ("Middle Hudson")		B* B*		B* W S	B* W S	B* W S		B W S	B* O S
Clay's Ferry Shale ("Lower Hudson")		W*		W* S	W* S	W* S		W* A	W*
Inner Bluegrass ("Trenton")				C ^u A ^l W ^l B ^l	C ^u A ^l W ^l B ^l	C ^u A ^l W ^l B ^l		A* Y	
High Bridge Strata				C C C C C	C C C C C	C C C C C			

Species abbreviations: A - ash (mostly blue) G - sweetgum O - post oak
 B - beech P - yellow poplar W - white oak
 C - cedar Y - yellow (chinquapin) oak

* Most widespread dominant; u - restricted to upper strata; l - restricted to lower strata; s - restricted to south.

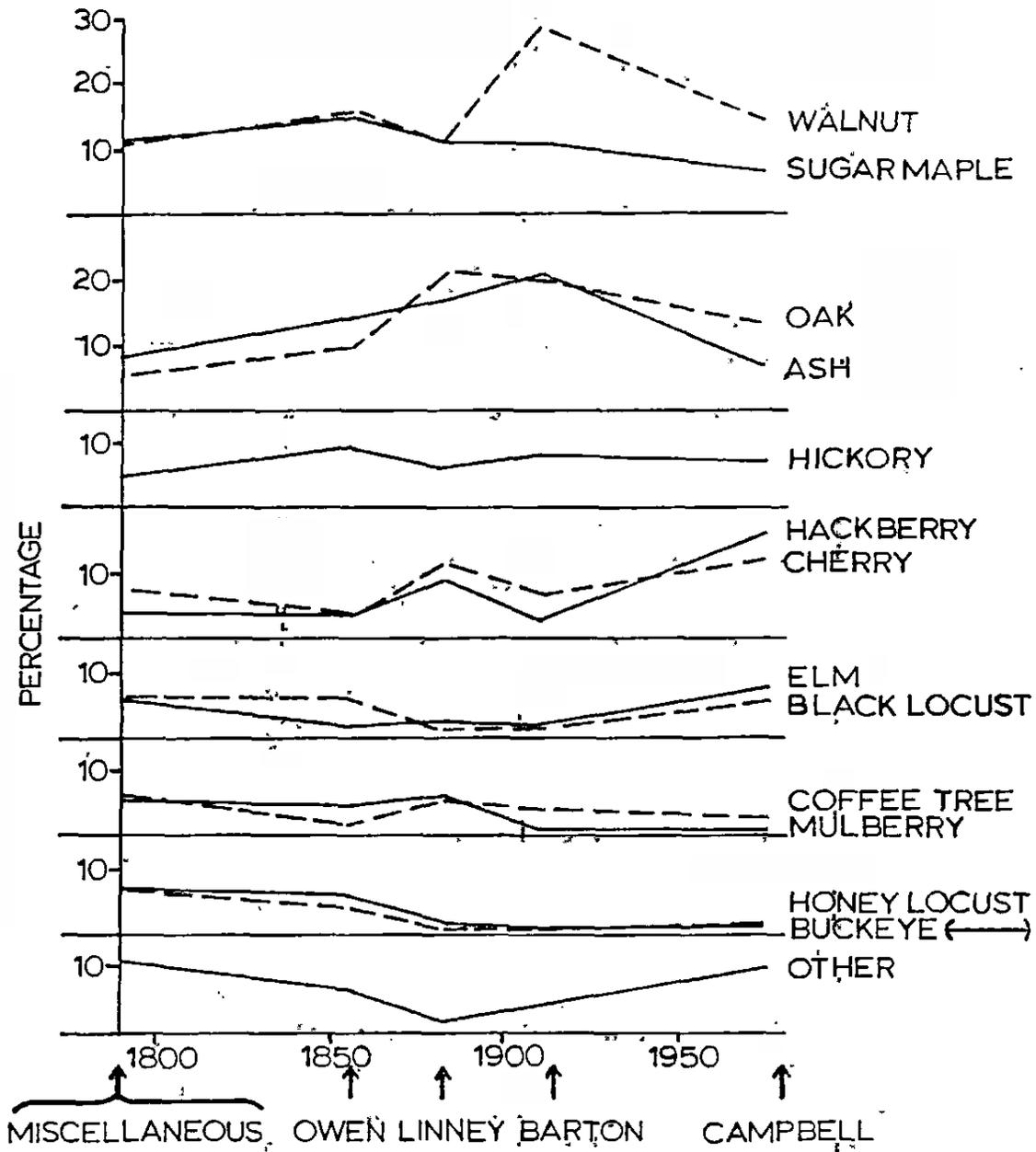


FIGURE 5. Temporal change in forest composition on richer soils, as suggested by miscellaneous early notes (1750-1850; from Table 1), Owen (1857; from Table 4), Linney (1882-87; from Table 5), Barton (1919; from Table 7) and Campbell (1980, p. 63; mean basal area of successional phases D-G). Because the various sources assess composition in different ways, these changes may reflect certain biases, but the large shifts in dominants do deserve comment (see text). Data from poorer soils, originally with white oak and beech forest dominant, are not yet sufficient for comparison.

indicated by Johnson: walnut, ash, beech, oak. In Fayette County, only 7 genera were listed in common with Perrin (1882a), out of 10-11 within each source. However, the five most abundant genera, according to Barton - walnut, ash, oak, hickory, maple - were the same as those noted at least twice by Perrin, except for the addition of honey locust and buckeye.

Barton's report listed seven Bluegrass Counties with forests dominated equally by beech and oaks (all species combined), and with lesser amounts of maple, poplar, gum, etc. These counties were mostly in the western section. Fourteen counties, generally to the north and east, were dominated by "white" oaks (but including chinquapin, burr, etc.), with almost equal amounts of "red" oak species, and less of hickories, beech, maple, etc. Eight counties were transitional from this oak dominated composition to the Inner Bluegrass, with more ash and walnut. Only the two purest Inner Bluegrass Counties (Woodford and Fayette) were dominated by walnut, with ashes almost as abundant, followed by oaks, hickories, maple, etc. Hackberry was listed only in this central region and the transition, though just as a minor component. Other minor trees showed little geographic pattern.

In comparing these various sources above, there would appear to have been some temporal changes in the composition of surviving forests on richer soils (Fig. 5). Even as early as Owen's (1857) survey, minor shifts are indicated, though sugar maple and walnut remained dominant, still with almost equal frequency to each other. In the later surveys of Linney and Barton, there seems to have been a major shift to dominance by oaks and ashes. Then in modern forests (from Campbell 1980), which are dominated by young successional stands, there has been some return to walnut, but with a lot more hackberry, etc., instead of sugar maple. The potential significance of these trends is discussed further below.

PROTO-TAXONOMIC PUZZLES. Many early accounts do not distinguish between the different species within genera, and even where they do, there is uncertainty about the usage of common names in some cases. Table 3 lists most tree species known today in the Bluegrass Region, together with the common names that seem to have been applied to them. Several patterns and problems deserve further comment.

(a) In the white oak group (subgenus *Lepidobalanus*), *Quercus muehlenbergii* (chinquapin oak) and *Q. macrocarpa* (burr oak) are the most common species today on richer sites. These must have been combined with *Q. alba* (true white oak) and others as "white oak" in many accounts. Short (1828) was the first author to clearly distinguish these species in the region, noting that *macrocarpa* was the most abundant around Lexington, followed by *muehlenbergii*, then *alba* itself, which was largely restricted to poorer sites near the Kentucky River, as today. Owen and Linney indicated similar differences, and Linney also listed post oak (*stellata*) as a local associate of white oak, as today. Chestnut oak was never noted for certain within the Bluegrass Region, and it is today extremely rare (one site vouched?).

Owen also referred to "overcup oak" as common in Fayette and Jessamine Counties (associated with hickories, white oak, ashes, etc.), and at one site in Garrard County. "Overcup oak" is used for *Q. lyrata* today, but that species is now known at only one site in the Bluegrass Region, a few acres of green ash swamp in northern Jessamine County (Meijer 1976; there are, however, no historical records of *Taxodium*). Short did not list *Q. lyrata*,

Table 7. Composition of forest regions based on Barton's (1919) summary of standing timber in Kentucky.

Tree	Percentage of board feet estimated in each region*						Walnut region of Inner Bluegrass	
	Black oak region of Knobs, etc.		Beech region of west Bluegrass		White oak region of north and east walnut trans.			
	W	S	E		NW	SE	NE	
Pine ("yellow")	3	+	4			3		
Chestnut oak		5	7			1		
Chestnut	2	13	10			4		
Beech	30	5	7	33	18	4	3	2
Poplar	2	1	5	5	1	5	1	+
Gum (black/sweet)	3	1	3	5	+	7		+
Sycamore	10	2	1	3	2	4	1	2
Post oak	4	2		1				
Black oak (group)	34	34	30	14	23	18	21	15
White oak (group)	1	15	16	19	24	23	42	28
Hickories	2	11	8	3	13	8	11	8
Basswood	+		2	1	1	2		1
Maples (mostly sugar?)	3	2	4	12	6	10	8	9
Walnuts (mostly black?)		1	+	1	2		2	10
Hackberry								2
Elms	+	+	+	2	1	+	2	2

but did include "overcup oak" as a colloquial synonym of *Q. macrocarpa*. Since these two species are closely related, with hybrids found, this puzzle remains intractable.

(b) In the red oak group (subgenus *Erythrobalanus*), Short noted that what he called "Quercus palustris" (or "pin oak") was most common around Lexington. However, his description ("beautifully scalloped" leaves, etc.) and the current absence of *palustris* within the Inner Bluegrass strongly suggest that he was referring to shumardii, which is now the most common species of the group. Owen and Linney also failed to specify shumardii, though Owen referred to "pin oak" at several sites. Short noted that imbricaria (shingle oak) was less common, though typical of richer sites with muehlenbergii, while velutina (black oak) was restricted to poorer sites. F. Michaux (1805) did not see any velutina between Maysville and Lexington. Short did not list rubra (true red oak), which is also less common today, though typical of rather dry old growth in gorges and occasionally elsewhere. Most of the colloquial "red oak" in deed surveys, etc., probably referred to shumardii and rubra, while "black oak" referred to velutina, but some general uncertainty remains. Other species (marilandica, falcata, coccinea) were very rarely noted, if at all, within the region, and they are extremely rare today (no more than one site vouched?).

(c) In the hickories, many common names are unreliable (black, white, pignut, bitternut). Carya laciniosa and C. ovata were generally confused under the names shellbark or scalybark, though scalybark may have been largely restricted to ovata, based on modern usage. Only Short, or occasionally Linney and Owen, noted that laciniosa (as "sulcata") was more characteristic of the richer Inner Bluegrass soils. Short also noted that what he called "porcina" (synonymous with glabra) was the most common hickory around Lexington, especially as young trees, but his description ("about 7 leaflets") and the current rarity of glabra suggest confusion with cordiformis, which is today the most common hickory (both may be called pignut or bitternut). F. Michaux (1819) stated that the largest Carya tomentosa (mockernut) he saw in North America was near Lexington (over 20 inches in diameter), but, from other accounts and modern remnants, it seems this species was rare here on richer soils.

(d) In the ashes, Fraxinus pennsylvanica (green) was never distinguished from F. americana (white), and it must have been included under "white ash", though one assumes it was virtually confined to wet sites, as today. F. quadrangulata (blue ash), in a different section of the genus, was distinguished by several early observers, and it was characteristic of the richest lands. However, even on these lands it appears to have been originally second to "white ash" (Tables 1 and 3). Later, Short (1828) stated that these trees were about equally abundant, then, in the notes of Owen (1857) and Linney (1882-87), blue ash was listed more frequently. Today, blue ash is more common among remaining older trees on richer sites, but white ash is much more common in young stands.

The identity of the "black ash" referred to in early accounts remains a most curious puzzle. Today, this name is used for Fraxinus nigra, but that species is found only north of the Ohio River; typically at swamp edges. No collections of F. nigra from Kentucky have been located. The name "black ash" was used about as frequently as white ash in early deed surveys, especially in association with the general ash and buckeye dominated forest types.

Short, Owen and Linney also used this name, and Short (1828) even specified it as F. sambucifolia, an old synonym of nigra, noting characteristic sessile leaflets and black steaks in the wood. Short stated that it was "a large tree, but much less frequent than either of the preceding, in this neighbourhood; in the western part of the State, on the contrary, it becomes more abundant than either...". Owen (1857) listed black ash in several counties, about as frequently as blue ash, though concentrated in the beech/white oak/sugar maple types, as opposed to the black walnut/burr oak/blue ash types then most characteristic of the richest soils. In contrast, Linney (1882-87) only reported it (as sambucifolia) from two areas in the southern Bluegrass counties. A statement of F. Michaux (1819), when discussing F. nigra, adds to the intrigue: "Observation. Another lofty species of ash exists in Kentucky, which is also called black ash; but I am too imperfectly acquainted with it to attempt a description". Early surveys of 1775-1805 also used the names "hoopwood" and "hoopash", the latter being another traditional name for F. nigra (e.g., Little 1953). In northeastern U.S.A., "hoopash" was locally used for Celtis (hackberry), but some of the surveys in Kentucky used "hoopash" together with "hackberry" in the same deed, and it was never used with "black ash". "Hoopwood" is more uncertain, since it was used together with these other names in some deeds, and it has no modern usage. It was listed much more frequently with the general ash forest type of Fayette County than in other regions examined (Table 3). Full consideration of these old references to black ash must also take account of other Mid-Western regions where it has been reported outside of its current range (some cited in Campbell 1980). In the meantime, it does appear that there was a disappearance of wet-site nigra during the 19th Century, perhaps related to the apparent increase of dry-site quadrangulata. The last unconfirmed record of nigra in the region was of a tree in Trimble County near the Ohio River, which died in the 1970's (Kingsley & Powell 1978, pers. comm.).

(e) In the elms, early deed surveys mentioned red elm (Ulmus rubra) about twice as often as white elm (U. americana), and this greater abundance was also suggested by F. Michaux (1805). However, Short (1828) later noted that U. rubra "has almost disappeared from the forest around Lexington in consequence of its destruction by cattle", though "In the more accessible situations among the cliffs of the Elkhorn and the Kentucky River, it is occasionally met with...". Today as well, rubra is much less common than americana. Other elms were only specified by Linney (1882-87), i.e., rock elm (thomasi; in southern gorges) and winged elm (alata; in one adjacent area of the Knobs), and these are similarly limited today.

(f) In the walnuts, white (Juglans cinerea) was noted about as frequently as black (J. nigra) by early deed surveyors. However, the proportion shifted from about 25% in Woodford County, to 55% in Fayette County, to 70% in the eastern sections. Even if one adds all unspecified walnut as black, the proportion of white would be a minimum of 5-25% (with the greater proportion in sugar maple forest; Table 3). From identification frequencies in early landscape descriptions, as well, the proportion of white appears to have been about 30-50% overall (Table 1), and Short (1828) noted that it was "even more abundant" than black around Lexington (Fayette Co.). Today, it does not even approach 0.1%, a decline attributed to disease (Campbell 1980).

(g) The buckeyes, Aesculus glabra and A. octandra, were rarely distinguished in early accounts, never in deed surveys. However, Rafinesque (1819)

indicated that glabra ("Pavia muricata") was very common in the Bluegrass Region, but rare elsewhere in Kentucky. Also, Short (1828) stated that glabra ("pallida") was abundant in rich lands, while octandra ("flava") was less abundant, "being in this locality confined to the alluvion bottoms of the Kentucky River". This difference is similar today. However, hybrids have occasionally been collected on the uplands, including by R. Peter from southeast Lexington in 1835 (Philadelphia Academy of Natural Sciences).

(h) The name "maple" was apparently not used for Acer saccharum/nigrum until Short and others emphasized the taxonomic link with Acer saccharinum (silver maple), A. rubrum (red), etc. "Sugar tree", always meaning saccharum/nigrum, was listed much more often than "maple". A. nigrum, black maple, was never separated from its close hybridizing relative, saccharum (sensu stricto), except by Palmer (1818), who indicated that nigrum was common around Kentucky settlements (see also F. Michaux 1819). A. saccharinum was rarely distinguished from A. rubrum, but the only references to rubrum were from outside the Bluegrass Region, and today rubrum is much rarer within the region.

(i) The various varieties or so-called species of Tilia (lynn/basswood), which are generally not well separated in modern botanical work, were never separated at all in the period treated here (though Barrow 1795 noted "black linn"). Neither were the various intergradient taxa of Celtis (hackberry) separated, though one assumes that C. occidentalis was then, as now, much more common than C. tenuifolia, which is restricted to edaphic extremes.

(j) Among remaining, monospecific, genera in the Bluegrass, there was little confusion, except perhaps in the case of black locust (Robinia pseudoacacia) and honey locust (Gleditsia triacanthos). It is likely that "locust" alone generally referred to Robinia, judging from later usages in conjunction with Latin names (e.g. Linney 1882-87). The species are easy to distinguish, and both were abundant according to discriminating accounts (Table 1). Blackgum (Nyssa sylvatica) and sweetgum (Liquidambar styraciflua) were sometimes just listed as gum, but Liquidambar was never listed for certain within the Bluegrass, and it is very rare today (2 sites vouched?).

SMALL TREES, SHRUBS AND CANEBRAKES

Information on woody plants other than trees is much more meagre, but some generalizations are possible. On richer sites, the shrubby undergrowth and occasional open thickets were largely composed of the following species, based on landscape descriptions and deed surveys (Tables 1 and 3): pawpaw (Asimina triloba), spicebush (Lindera benzoin), hawthorn (Crataegus mollis, C. crus-galli, etc.), plum (Prunus americana, P. munsoniana, etc.), redbud (Cercis canadensis), ironwood (Ostrya virginiana) and hornbeam (Carpinus caroliniana; with the latter two not reliably separated). Less frequently listed species were Indian arrow-wood (Euonymus atropurpurea), prickly ash (Zanthoxylum americanum), crabapple (Malus coronaria), hazel (Corylus americana), elder (Sambucus canadensis), dogwood (Cornus florida, C. drummondii, etc.), blackhaw (Viburnum prunifolium, V. rufidulum), and blackberry or raspberry (Rubus spp.). Pawpaw was listed about twice as frequently as any other species in landscape descriptions, but in deed surveys ironwood was the most frequent. Ironwood, judging from its ecology today, may have occurred in more shady forest concentrated at edges of properties, as argued above for trees over-emphasized in deed surveys.

Possibly, its hard wood was also useful for marking boundaries.

From the trees associated with these shrubs in deed surveys (Table 3, Figure 5), the following segregations are indicated. It is clear that hornbeam was most frequent in the forests dominated by sugar maple and ashes, while hawthorns were more frequent in the mixed woodland of buckeye, walnut and honey locust, etc. Pawpaw may have been most abundant with buckeye, in particular, though frequent in other types of rich soil as well (Table 1). Ironwood and redbud were more widely distributed, being found in the "white oak" forests of poorer or drier soils as much as in the richer types. Dogwood was the only common shrub clearly more typical of the oak forests. Also, crabapple and hazel were never definitely reported from richer Bluegrass soils, though Short stated that both had been much more common, in general, before settlement.

Much of this shrubby growth, and especially the cane and other herbage on richer soils, was removed after settlement, as described by many authors from the 1790's on. In particular, Short (1828) noted that "cultivation and the ravages of cattle have greatly lessened the number" of pawpaws (the original "immense orchards"; see above). He also stated that spicebush had been much reduced, as had slippery (red) elm and mulberry, which are both relatively shrubby and palatable tree species.

Because of such rapid decline, information on the nature of canebrake vegetation is particularly fragmentary, though it is clear that this occupied relatively rich soil (see above section under Vegetation Structure). Several of the shrubs listed above may have been scattered in the cane. This is suggested by Clinkenbeard's account (see above). However, briars (*Rubus*) apparently were rare, based on Grave's account (see above) and general descriptions (Table 1). That cane was intimately associated with the buckeye-walnut-locust woodland of richer soils, is suggested by accounts of Matthews, Clinkenbeard, Gwynne, Parry, Owen, etc. (see above). Buckeye was a common building material in some of the early settlements on cane lands (Stewart, Graddy; 1840's re 1787-88). Also, some association of cane with the blue ash-burr oak types is suggested by accounts of Gwynne, Drake and Owen, etc. (see also Davidson 1950, Campbell 1980). However, cane was absent from the ash-sugartree-elm-hackberry forest described by Matthew (see above), in which white ash may well have been the dominant, based on modern associates (Campbell 1980). Finally, Gwynne (1840's re 1784) contrasted the cane on richer lands with that on land dominated by white, red and black oaks (in Woodford or Jessamine Co., near the river), which "was only in very little patches, and that not the big rank quality but a kind of maiden cane, as high as a man's head".

GRASSES AND OTHER HERBAGE

On richer soils the following plants were listed as major components of the ground cover in, at least three accounts during 1750-1850, before being removed by agricultural and pastoral activities: wild rye and other grasses, clover, pea-vine, nettle and richweed (Table 1). Some kind of grass, and clover, were listed in most accounts, about twice as often as the next most frequent plant, pea-vine. The exact identities of these plants are discussed below. After the 1790's, most of this natural ground cover was gone, largely replaced by 1850 with pasture plants introduced from the east, notably bluegrass (*Poa pratensis*) and white clover (*Trifolium repens*).

On poorer land typically dominated by oak forests, there is much less information, presumably because the herbage was less extraordinary. However, in the northern transitional region of southern Ohio, opposite Augusta (Bracken Co. Kentucky), Smith (1795) noted "wild pea-vine in abundance" within tall forest of "mostly red and white oak". Moreover, at the northeast edge of the Eden Shale Belt (Mason or Robertson Co.), Drake (1840's re 1794) related that on "oak land" there was still "luxuriant herbage consisting largely of what was named pea-vine, with a full growth of buffalo grass". Imlay (1792) also indicated that so-called buffalo grass was typical of "middling soil".

More indirect evidence supports the view that pea-vine, in particular, may have been typical of slightly poorer or drier soils, sometimes with cane. In Kentucky, place names with "pea" in them occur 12 times as Pea-Vine Ridge or Pea-Ridge, and only three times as Pea Branch (Field 1961). In contrast, place names with "clover" are mostly indicative of lowlands, with 11 cases of Clover Bottom, Branch, Fork, Lick, etc., only one neutral name, Clover Field, and one upland, Clover Gap. Cane also is largely used in a lowland context, in accord with its associated trees indicative of richer soils (see above). However, Cane Ridge on the weakly expressed Eden Shale (see Introduction) from Bourbon County to Montgomery County, which supported extraordinarily extensive cane (see above), had soil that was less phosphatic (Owen 1857) and more red (Collins 1847) than the richest black soil of the Inner Bluegrass. Yet Collins also noted that this soil was "more durable...and not so easily affected by a dry or wet season" (and see Fleming 1779, quoted under Open Woodland above). There was certainly an intimate mixture of cane and pea-vine in some localities. Imlay (1792) stated that pea-vine "runs up the cane, shrubs and rye grass...". Stickney (1872) wrote that Lexington was originally "covered with heavy timber, under which was a thick growth of cane so intertwined with pea-vine as to be almost impenetrable...". Palmer (1818) described how, after the cane had largely been grazed away in the Kentucky settlements, "several sorts of grass, pea-vine, etc., have sprung up and supplied its place". Owen (1857) also noted that pea-vine had been a major associate of cane in the undergrowth of several areas.

If cane, pea-vine and buffalo grass were still abundant on "middling soil" in the region, what grew on the large area of Eden Shale Hills with the poorest soils? Virtually no description of herbage was made here. There is only Cuming's (1807) note, referring to land northeast of the Lower Blue Licks: "barren hills, bearing little else besides wild pennyroyal, with which the air is strongly perfumed, and a few stunted shrubs and trees...". Rafinesque (1819) also stated that *Isanthus* (false pennyroyal) was very common in the Bluegrass Region, though he gave no exact localities.

Presumably, there was indeed relatively little herbage in the poor Eden Shale oak-hickory woods, as observed today in remaining fragments.

The exact identities of the major herbaceous plants listed above are of considerable interest, since some of the common names are no longer applied, and some species would appear to have declined drastically, or virtually disappeared. The following discussions attempt to consider all relevant evidence.

WILD RYE. This was the most frequent grass to be given some special name, and its identity is relatively certain, i.e., Elymus spp., which are still known as wild rye. Elymus virginicus remains relatively frequent and locally dominant on moist sites, with E. villosus replacing it on drier sites, but both prefer the partial shade of open forests and forest edges. E. riparius and E. canadensis are much rarer, neither collected in the Inner Bluegrass at all.

In marked contrast with Elymus, as the most abundant native grass on richer soils in early accounts, and in modern remnants of natural vegetation, it is important to note that typical grasses of prairies, barrens and cedar glades are rare in the Bluegrass Region (Fig. 11a below). Moreover, based on the early collections of Short and Peter, etc., there is no evidence that these species, such as Andropogon gerardi, A. scoparius, Sorghastrum nutans, Panicum virgatum, Sporobolus spp., etc., were formerly widespread. Their more open habitats are mostly associated with relatively dry or poor soils, rarely, if ever, with the types of woodland found on rich Bluegrass lands. Even Andropogon virginicus (broom sedge), a common weed of pastures on poorer, often "exhausted", soil today, was rare according to Barrow (1795): "These parts are totally exempt from the curse of broom sedge and wild sorrel".

BUFFALO GRASS. This was listed in at least five accounts between 1775 and 1796, with a few later references to it having been an abundant plant in pioneer years. This plant was certainly not Buchloe dactyloides, which is currently known as buffalo grass, but distributed in Western North America, with no records in Kentucky or adjacent states. In his general description of Kentucky, Imlay (1792) wrote: "The buffalo grass is rather coarse, grows from 9 to 18 inches high, and is generally most plentiful in a middling soil. It has a broad leaf, and seems unworthy of cultivation". Harris (1797) also referred to a common "broad leaved grass" in Mason County, near where Drake noted "buffalo grass" (see above). Filson (1784) stated that "Where no cane grows, there is an abundance of wild-rye, clover and buffalo-grass, covering vast tracts of country...". The most likely candidates for this buffalo grass are Panicum boscii and P. clandestinum, or minor related species, which have no special common names today. These species are widespread and locally abundant in woods and openings, respectively, where there is freedom from grazing and mowing. They show no pronounced concentration on rich or poor soils, but P. boscii is most typical of moderately dry and poor oak woods. They range in height from about 10 to 40 inches, and their leaves are broader than other grasses, averaging about one inch (2-3 cm). Triodia flava (grease grass, purple top) is the only other large native grass that is as widespread in the region as these early accounts suggest for buffalo grass. However, Triodia is confined to open fields, and its leaves are narrower (ca. 1 cm). None of the prairie grasses have leaf widths exceeding half an inch (1-1.5 cm).

BLUEGRASS. This was mentioned in some of the earliest accounts of the Ohio Valley (e.g., Gist 1751, Nourse 1775), and, by the middle of the 19th Century, the name came to be used for the extensive growth of Poa pratensis in the Bluegrass Region. However, there is still great uncertainty about whether this species is truly native. Early colloquial names may be doubted. P. pratensis is traditionally known in Britain as meadow grass, sward grass or spear grass, but these names were generally replaced in the North American colonies by English grass or bluegrass (McHargue 1926). The weedy Poa compressa, which has a stronger bluish tint and is more certainly exotic, was also called bluegrass, perhaps more often than P. pratensis in the 18th Century (see also Bradbury 1819). Of other grasses now found in the Bluegrass Region, exotic Dactylis glomerata (Peter 1882) and native Muehlenbergii schreberi, etc., might also have been called bluegrass simply from their color.

The whole status of Poa pratensis in North America remains unclear. Gray's Flora (revised by Fernald 1950) states that, within northeastern U.S.A. and adjacent Canada, it is indigenous northward, introduced and cultivated southward. Hitchcock's Grasses (revised by Chase 1950) states that it is all introduced from Europe. Only more detailed biosystematic studies can address this problem, with analysis of genes and gene expression in the many varieties. There are other Poa species with a circumboreal distribution in arctic-alpine zones, and one might expect that some P. pratensis of boreal-subalpine or northern hardwood zones is native in North America, now much confused with introduced races (Elizabeth Kellog, Harvard Herbaria, pers. comm.). A similar situation, but with some tentative separation of native and exotic races, is seen in the Agostis stolonifera complex.

Most early records of bluegrass in Kentucky refer to introductions of Poa pratensis by Virginians, one claimed as early as 1752 (Draper's account of John Finley; cited in Beckner 1932), others in 1769 (Martin 1854/67; but see Ranck 1901), 1780 (Clinkenbeard 1840's), 1794 (Renick 1880), 1800 (F.H. Gordon 1871; cited in Killebrew 1878), etc. Renick (1880) also stated that some was brought from Ohio. Nourse's (1775) account of the path southeast from Frankfort mentioned bluegrass some five years before that area was first settled (quoted above), but one cannot be sure this was P. pratensis. Most other early records and claims of native status (e.g., Morse 1789, Chenault 1884) remain unsubstantiated.

There is, however, one source that suggests Poa pratensis in a restricted primeval setting: references to the buffalo-frequented Grassy Lick (Montgomery Co.) in Fayette County Circuit Court of 1805 (see above under Grassland). The "English or blue grass" known here in 1779 "was the first we had seen in the country", according to Moses Thomas, and in 1785 this site "was then remarkable set with blue grass much more so than any bottom on the creek", according to William Yates. The earliest date referred to by these statements was 1776 (see also Schull 1840's re 1778). While it is possible that the grass rapidly spread along buffalo trails to this lick, after being introduced in 1752 to adjacent Clark County (see above), it is also possible that it had been dispersed previously along buffalo trails connected with northern native populations. Nearby to the north, at the three forks of Johnson's Creek in Mason County, near the large buffalo road than ran through Lower Blue Licks, Poa pratensis also grew in 1780 before settlement, according to an unnamed source of Linney (1885).

NIMBLE WILL. This is the common name for Muehlenbergia schreberi. In early accounts, it was only mentioned by Barrow (1795), but he noted that it was "very pernicious in these meadows". Later, historians stated that this was one of the few grasses specified by pioneers (Renick 1880, Perrin 1882). Today, it is a common weed under heavy grazing on moist rich sites, both in pastures and open woodlands.

OTHER GRASSES. Beargrass is a name not found in original accounts of pioneers, but Renick (1880) stated that this name was used by old settlers, along with buffalo grass. Also, Rothbert (1927) considered that Beargrass Creek in Jefferson County was named after the plant now known as such: Yucca filamentosa. However, this place name was used as early as 1775, and Yucca is apparently not native to Kentucky, escaping from cultivation only after the mid-19th Century. This name remains a mystery, but since the so-called Beargrass Lands of Jefferson County had forest similar to the rich Inner Bluegrass soils (Owen 1857, see above); it is likely that beargrass was in fact used for the same Panicum species as was buffalo grass (or perhaps mostly for P. boscii, as the smaller one?). Other uncertain names, used only once, are the wild oats (!) of Cresswell (1775), perhaps Uniola laxa, and the reed of Walker (1824 re 1775), perhaps Phragmites communis (see above quotations).

CLOVER. The only clover known to have been native in the Bluegrass Region, though now apparently extinct here, is Trifolium stoloniferum, or "running buffalo clover" (Brooks 1983). T. reflexum, "buffalo clover", has been found in the northern transition near Cincinnati, but reports from within the Bluegrass Region have turned out to be erroneous in cases where collections were made, though there remains an unvouched report from the southern periphery by Linney (1882). The prairie clovers, Petalostemon spp., have never been reported in the region, and only rarely in adjacent regions (the western Knobs; Fig. 11b). The introduced T. repens, (Dutch) white clover, spread rapidly when pioneers first arrived and pastures expanded, as with bluegrass (see above), and other exotic clovers followed. But many of the early references to clover, even as "white clover", indicate a strong association with natural vegetation, as in examples cited already, and there are other biological clues. T. repens is generally smaller than T. stoloniferum in several features, with a typical leafy height of 5-20 cm, as opposed to 10-40 cm. Also, T. repens generally does not flower until mid-May, then continues all summer, whereas T. stoloniferum just flowers from mid-April to June. T. hybridum is another introduced species, which is more similar superficially to T. stoloniferum, but there are no reports of this species in Kentucky before the late 19th Century (Garman 1902).

The following pieces of evidence deserve special mention in supporting the case for T. stoloniferum.

(a) There are a few collections of this species from Lexington (Fayette Co.), and from Kentucky without locality, though probably from the Lexington area as well (mostly listed in Brooks 1983). These collections are dated 1834 ("fields about Lexington"), 1835, 1882 and 1902 ("Mt. Tabor Pike", in Lexington; by H. Garman in the Agr. Sch. Herb. at Univ. of Ky.).

(b) Perrin (1882a) stated in his History of Fayette County: "we now sometimes see a specimen of "buffalo clover". This has a large white blossom, is intermediate between the common white and red clover, and is only to be found in very shaded places. It will not grow in open ground, and is of little

value for animals food...". The term buffalo clover was also used in several pioneer sources (Gwynne 1840's re 1784; Draper 1851, quoting N. Boone?; R. McAfee 1845 re 1783; E. Kenton 1930, quoting S. Kenton; David 1819).

(c) Simon Girty is reported to have said in 1782 (Bradford 1827): "the fertile region of Kentucky is the land of cane and clover.. canebreak.. clover field..."; but "the long knives... have destroyed the cane - trodden down the clover...". He was urging some Indians to protect their hunting grounds by attacking Bryan's Station (Fayette Co.). This statement suggests a large native clover typical of the region (and see above: Matthew 1840's re Bryan Station in 1783).

(d) The Anonymous (1791) description of the old buffalo road from Maysville to Lexington stated: "You frequently find beds of clover to the horse's knees...". Imlay (1792) referred to "native clover" on the same road, "in no respect different from the clover in Europe, but as it is more coarse and luxuriant".

(e) Walker (1824) wrote that the rich soil near Richmond (Madison Co.) was "covered with clover in full bloom", when he arrived in late March of 1775. Spring was apparently early in some pioneer years (see also Filson 1784, Imlay 1792, etc.). At Boonesborough (Madison Co.), Henderson (1775) stated that there was "a turf of white clover" on May 14th. Nourse (1775) noted "white clover, buffalo grass and seed knee and waist high" southeast of Frankfort on May 30th (see above). These flowering dates suggest T. stoloniferum rather than T. repens.

PEA-VINE. This was "a common name for Amphicarpa bracteata (Wood's Botany of 1869; cited in Braun 1950), now generally known as hog-peanut. Though this usage is not confirmed in Kentucky, there is little reason to doubt it. Imlay (1792) noted that pea-vine has "tendrils" like the garden pea, "blossoms of a reddish hue, and it produces a small and imperfect pea. In very rich soil, it grows from 3 to 5 feet high; but in general it does not exceed 18 inches or 2 feet". Another interesting comment is from Graham (1840's re 1782): "The children in the spring nearly lived on these peas, the vines of which were very luxuriant. Were very much like the black-eyed pea, only a little flat." This statement does not accord with the late-summer flowering of Amphicarpa. However, Draper (1851, based on N. Boone re 1770's) described the major forage legumes as follows: "the clover, a kind with large white blossom, lasting the entire growing season, but the pea vine only affording sustenance in the latter part of summer and early autumn". Today, Amphicarpa is widespread, but it is generally restricted to moist partially shaded sites, especially at less disturbed edges of streamside forest, where it sometimes has cane to climb on.

Other climbing plants in the pea family (Leguminosae) are much less frequent in the Bluegrass Region, though one should not completely rule out Apios spp. and Phaseolus polystachios, which are more common in some surrounding regions. Also, Nourse (1775) described "a kind of pea vine, blue blossoms, no smell", which he cut down to make a bed "on a small island that the lowness of the water had made a bed of stones", in the Kentucky River between the mouth of Elkhorn Creek and Frankfort on May 28th. From the flowering date and color, this plant must have been the woody vine Wisteria macrostachya, which has been collected in nearby Shelby County (Gray Herbarium; Braun 1943).

NETTLE. This name must refer to Urtica dioica, U. chamaedryoides or Laportea canadensis, all well-known as nettles today and typical of moist rich soils.

Solanum carolinense is known as "horse nettle", but it seems unlikely that this small weed of open pastures was a significant component of the regional vegetation. Some pioneer accounts describe how a nettle was used to make fibre for cloth (Fleming 1780 in Mercer Co.; N. Boone re 1770's in Bourbon Co., cited in Eckert 1967, p. 703; Jackson 1840's re 1786 in Clark Co.; Barrow 1795 re pioneer years in general). Fleming wrote that this nettle was "very tall and strong", while Boone related that it "in rich lands grows four feet...". Barrow also used the term "Kentucky nettle (a weed peculiar to these parts and a sign of great fertility)". The plants used for fibre, from the size alone, must have been U. dioica, but this species is today unknown in the Inner Bluegrass, including the counties referred to in these accounts. U. dioica only survives in the Outer Bluegrass to the north and west, mostly along the Ohio River. The other two species of nettle are more common today, though restricted to shady sites. U. dioica differs from U. chamaedryoides in preferring more open sites, while Laportea is restricted to less disturbed forest.

RICHWEED. This is a common name for Pilea pumila, another plant in the nettle family (Urticaceae) that is widespread and locally abundant on moist to wet rich shady sites, especially on disturbed floodplains. However, the name is also applied to Collinsia canadensis (Labiatae), which is typical of moist to dry soil in less disturbed forest, now restricted to gorges along the Kentucky River. Suitable conditions for Collinsia, like Laportea, were probably more widespread before settlement. However, richweed was only mentioned in three known pioneer accounts (Hanson 1774, Harris 1797, Kenton 1930).

SHORT'S LIST, ETC. We have no detailed record of the flora until Short (1828-9) began to publish his "Prodromus Florula Lexingtoniensis", concerning "those plants which are more commonly met with in excursions of a few miles around this place". Unfortunately, his work was not completed, dealing only with the spring flora of February to May. Nevertheless, the native species that he noted as "frequent" or "abundant" near Lexington are of considerable interest, since we have no better botanical description of the region until the modern era (from Braun 1943, on).

These common native spring flowers of Short are as follows, using modern names were possible, and with his habitat notes:

- Cardamine "virginica" (parviflora?) - cultivated fields
- Erigenia bulbosa - rich alluvions of larger streams
- Claytonia virginica - meadows and pastures
- Erythronium albidum - rich alluvial bottoms of streams
- Corydalis aurea - among grass, fence corners, cultivated situations
- Urtica chamaedryoides - rich moist woods
- Isopyrum biternatum - woods
- Sanguinaria canadensis - rich moist shaded woods
- Veronica peregrina (native?) - gardens and cultivated fields
- Viola cucullata - moist meadows and pastures
- Viola "obliqua" (papilionacea?) - in common with above
- Viola striata - among the grass in moist situations
- Phlox divaricata - half reclaimed lands and borders of fields
- Cerastium hirsutum - cultivated grounds
- Erigeron "bellidifolium" (pulchellus?) - pastures and meadows
- Erigeron philadelphicum - overrunning meadows
- Phacelia purshii - moist meadows

Camassia scilloides, - moist meadows, disappearing upon cultivation
Podophyllum peltatum - rich shaded woodlands
Aquilegia canadensis - rocky moist banks of creeks and rivers
Hydrophyllum canadense - half cultivated land, fence corners, etc.
Oxalis stricta - gardens and other cultivated ground.
 Of these plants, Claytonia, Sanguinaria, Viola cucullata, Erigeron philadelphicus and Podophyllum were apparently among the most abundant, noted as "profuse", etc.

Other plants of Short were not noted as frequent, or rare and restricted, and they may have been generally intermediate in abundance: Cardamine bulbosa, Erythronium americanum, Dentaria laciniata, Trillium sessile, Ranunculus abortivus, R. fasciculatus, Arisaema triphylla, Oxalis violacea. He also noted that Caulophyllum thalictroides, Jeffersonia diphylla and Orchis spectabilis had been more frequent before being disturbed by settlement. Other native species that he listed were mostly restricted to the rocky gorges along the Kentucky River and Elkhorn Creeks, as opposed to the general uplands. With special reference to the Eden Shale Belt, he only listed Collinsia verna, as "profusely abundant on many parts of the Dry Ridge Road to Cincinnati".

Other miscellaneous notes of common native herbs on richer soil, from various sources, are as follows, using modern Latin names where possible (* summer or fall flowering):

Filson (1784)	<u>Hydrophyllum canadense?</u> , <u>Lactuca?*</u> , <u>Lepidium virginicum</u> , <u>Lilium?</u> , <u>Lobelia cardinalis*</u>
A. Michaux (1793)	<u>Cacalia</u> spp.*, <u>Eupatorium aromaticum*</u> , <u>Crepis?*</u>
Barrow (1795)	<u>Phytolacca*</u> , <u>Xanthium*</u> (see also Clinkenbeard 1840's)
Rafinesque (1819)	<u>Eupatorium rugosum*</u> ; <u>Polymnia uvedalia*</u> , <u>Phlox glaberrima*</u> (also <u>Isanthus brachiatus*</u> of poorer soil; see above)
Flint (1832)	<u>Podophyllum peltatum</u>
Drake (1840's)	<u>Bidens*</u> , <u>Sicyos?*</u> (corn fields)
Allen (1892)	<u>Viola</u> , <u>Helianthus*</u> , <u>Cirsium*</u> , <u>Vernonia*</u> , <u>Podophyllum</u> <u>Senecio*</u> , <u>Phytolacca*</u> , <u>Ambrosia*</u> , <u>Eupatorium?*</u> (see also "dog-fennel" of Perrin 1882a)

As can be seen, the few spring flowers noted by these people were also noted by Short, except for Filson's "pepper-grass" (assumed to be Lepidium virginicum) and his mysterious "finest crown-imperials in the world", implying lilies, which are now rare even in less disturbed forest. It may be significant that lily bulbs are relished by hogs, which ran wild in the woods during pioneer years.

The above assemblage of plants, paying special attention to Short's spring flora, is generally most typical of rich moist woodland, though some species are more typical of cleared land. Persistence by some of these species in meadows and pastures (e.g., Claytonia and Camassia) seems to have been more notable in Short's time than today, presumably because there had been less history of intensive disturbance in the clearings then. Only Cardamine, Veronica, Cerastium, Viola papilionacea, Erigeron spp. and Oxalis stricta, of Short's 25-30 common species, are truly persistent in cleared areas today.

There is no evidence of a true prairie component in this flora. From Weaver's (1954) general lists of plants found in prairies, only Viola papilionacea, Erigeron philadelphicus and Oxalis stricta, which are widespread weedy species, were also included in Short's 22 more frequent species. Additional spring-flowering species listed by Weaver were either less common in Short's description (O. violacea, Fragraria virginiana), or absent (Hypoxis hirsuta, Phlox pilosa). None of Short's species, even his less common ones, are reported to occur in open prairie, barrens or cedar-glade communities remaining in Kentucky (e.g. Baskin & Baskin 1975, 1981), except for Sedum pulchellum, which Short noted as typical of rocks. Additional spring flowers listed by Baskin & Baskin are mostly infrequent and restricted to edaphic extremes (Cyripedium candidum, Viola pedata, V. egglestonii, Leavenworthia exigua, Arenaria patula, etc.), with only Arenaria patula occurring today within the Bluegrass, associated with Sedum pulchellum in rocky openings along the Kentucky River.

Full consideration of the flora, together with summer and fall flowering species, is beyond the scope of this paper, impossible based on historical sources. However, I am currently undertaking a complete floristic inventory of the central Bluegrass Region. As outlined already, it is clear that prairie grasses and legumes, for example, are rare or absent in the region, in marked contrast to adjacent regions (Figure 11). Among more frequent grasses and legumes in the region, only Elymus virginicus (wild rye) and Amphicarpa bracteata (pea-vine) are occasionally found in true prairies elsewhere (Weaver 1954, Baskin & Baskin 1981), and both these are more abundant in moist open woodlands. The few summer and fall flowering plants noted in early descriptions above are again mostly typical of field edges and open woodland on rich soil, with none indicative of true prairie.

A few more miscellaneous records of herbaceous species have special conservation interest. Ginseng (Panax quinquefolia) was apparently a scarce plant in richer Bluegrass lands, since it was almost never mentioned, despite its economic value. However, it may have been exterminated quite early in some areas. Nathan Boone (1840's) recalled, when his uncle Col. Daniel Boone had a warehouse at Limestone (= Maysville, on the Ohio Rv. in Mason Co.): "During the fall of 1787 and winter of 1787-88, Col. Boone was busily employed in digging a quantity of ginseng, even employing several hands...by the spring he had some 12 or 15 tons", much of which got wet and rotted when going up the river. The only other mention of this plant in the sources searched for this paper is in Jackson's (1840's) statement that, during 1788 at Clay's Ferry (on the Kentucky Rv. in SE. Fayette Co.), "I went to dig ginseng, and got full of seed tick".

Another special activity in pioneer years was "fire-hunting" by night on the Kentucky River, transfixing deer along the banks with a bright light on a canoe. Both Nathan Boone and Wm. Moseby (1840's re 1770-90) described how the deer would be feeding on a tender "moss" in the shoals. This "moss" must have included aquatic vascular plants such as Elodea, Zannichella, Potamogeton and perhaps Podostemon, which were all collected in the river by Short and Peter during 1825-45, but which are now exterminated by damming and pollution. Finally, there is a curious note by Clinkenbeard (1840's re 1779) that parakeets, now extinct, "lived on cuckleburrs", i.e., Xanthium, a weed of pastures.

DISTRIBUTION MAPS

FOREST TYPES

Although earlier geological surveys showed some contrasts between forests of the Bluegrass Region and other regions in Kentucky, Barton's (1919) report was the first to provide uniform data for the whole state. If these data are mapped, the Bluegrass is seen to be distinct in several ways (Figures 8, 9). In particular, the only counties with forests dominated by trees typical of the richest soils occurred in the Bluegrass, i.e., two counties with walnut and seven with oak-ash forest. Walnut exceeded its major successional equivalent on middling soil, yellow poplar, in 23 of the 33 Bluegrass counties, but in none of the 87 other Kentucky counties. Similarly, among trees typical of somewhat drier sites, ash exceeded hickory in 11 Bluegrass counties, but in only two marginal counties elsewhere. There were also more counties in which maple (mostly sugar maple of rich moist shady forest; see above) exceeded beech (the climax dominant on poorer soils), i.e., in 21 of the 33 Bluegrass counties compared to 20 of the other 87 (and 12 of the latter 20 must have largely referred to red maple on the western bottomlands). Also, among the oak species, the "white oak" group was more abundant than the "black" (or red), in contrast to most other regions. The white oak group may generally prefer soils of somewhat higher fertility, though overlapping much with the black (e.g., Fowells 1965; Campbell, unpublished review).

Despite the general predominance of sugar maple over beech in the region, beech was still dominant in seven counties, in contrast to only four elsewhere. Moreover, sugar maple was nowhere the county dominant, apparently due to the greater disturbance of richer soils, favoring walnut and other successional trees. In the whole state, beech and walnut were the only county dominants that are truly "mesic" trees, avoiding moisture stress from dry or wet conditions. Outside the Bluegrass, apart from the four scattered beech counties, "subxeric" trees were dominant in almost all 87 counties: oak-chestnut, mostly in the east, and oak-hickory, mostly in the west. The four remaining western bottomland counties had gum, either "subhydric" Liquidambar or wide-ranging Nyssa.

Within the Bluegrass Region, early notes on forest composition, from the pioneers to Owen (1857), show some clear geographic patterns. Trees typical of richer soil were concentrated in central and southeastern sections, while those of poorer soil were concentrated north and west of the Inner Bluegrass (Figure 6). There was only a minor secondary concentration of rich soil trees within the western Outer Bluegrass. Beech was predominant in the west, and oak in the north. Place names (Field 1961) add support for these patterns, especially in showing the shift from sugar maple to beech, among mesic climax dominants (Figure 7). The general explanation for these trends must be that the Eden Shale has a more pronounced expression in the northwest, and loess reduces pure limestone influence on flatter Outer Bluegrass soils there (see Figure 1 and Introduction).

Within the limited southern area studied by Linney (1882-87), he also noted an east-west shift on the Garrard Siltstone (Table 6). In the west, beech alone was the typical dominant; in the east, sugar maple was a local dominant as well as, or instead of (in Montgomery and Clark Cos.), beech and white oak. Barton's (1919) timber estimates by county show a similar trend in the case of maple versus beech, but walnut and ash were concentrated only in

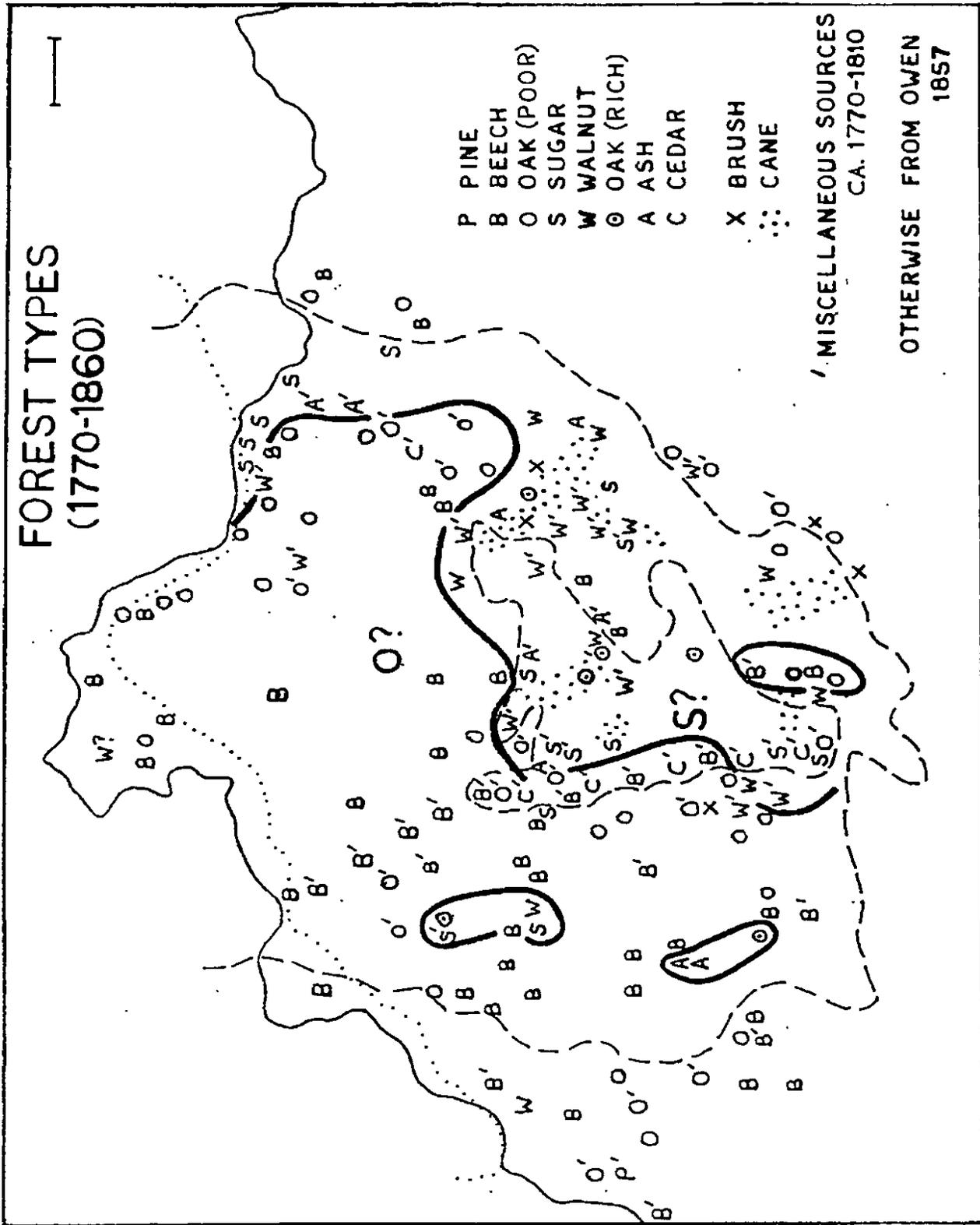
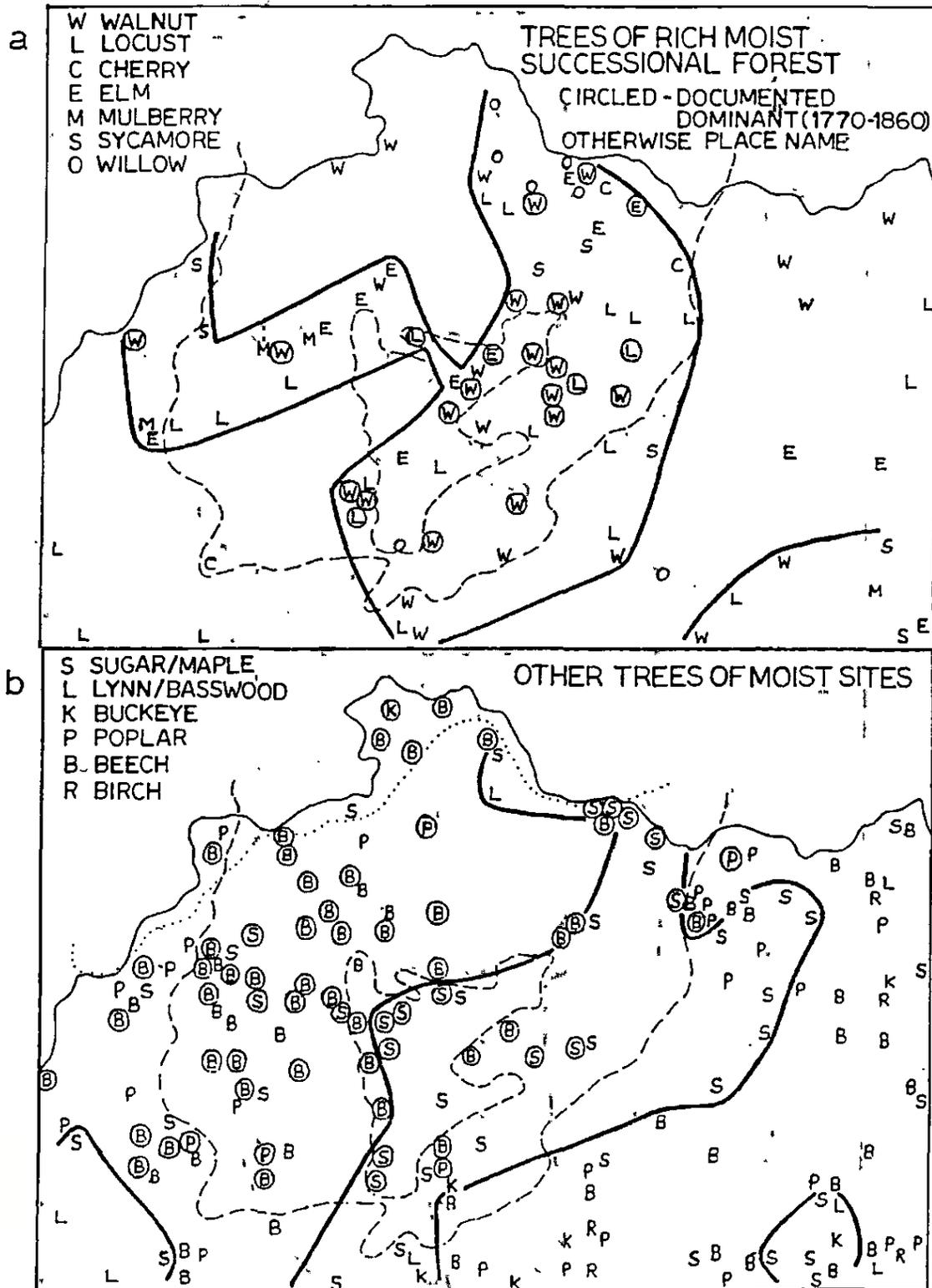


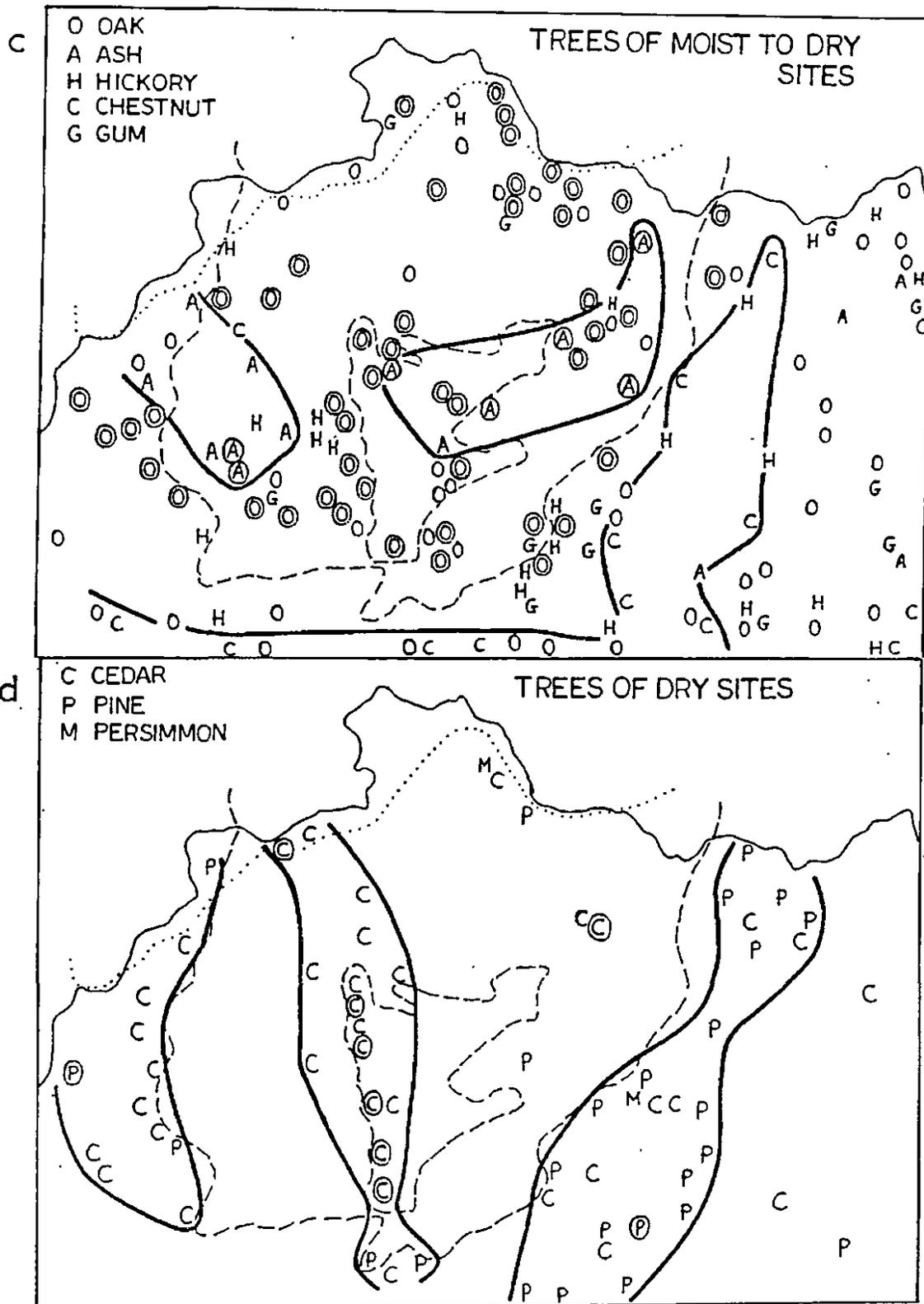
FIGURE 6. Map of forest types noted in the settlement period (ca. 1770-1860). Each symbol indicates the most common tree noted by an observer at that location. For simplification, some less abundant trees have been combined with associated dominants: locust and buckeye with walnut; elm with ash; yellow poplar with beech.

FIGURE 7. Distributions of different tree groups based on early notes (of Fig. 2) and place names (from Field 1961):



a. Trees typical of rich moist successional forest.

b. Other trees typical of moist forest (mostly "mixed mesophytic").



c. Trees typical of moist to dry sites (with broad tolerance).

d. Trees typical of dry sites (or successional on degraded sites).

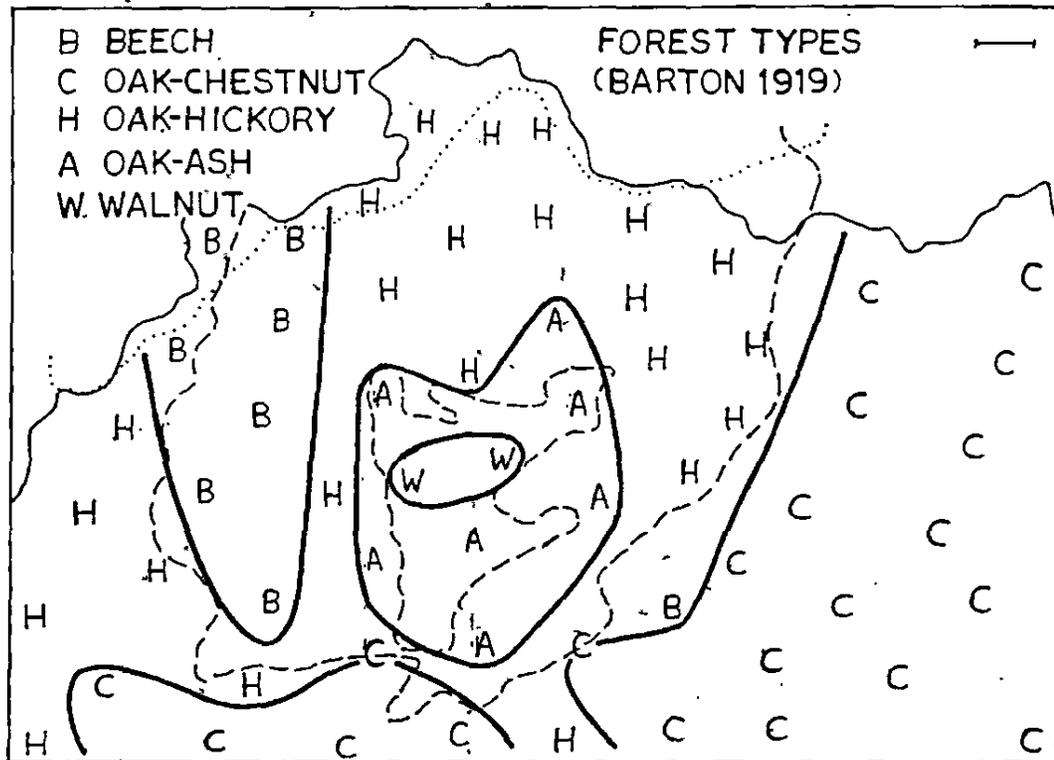
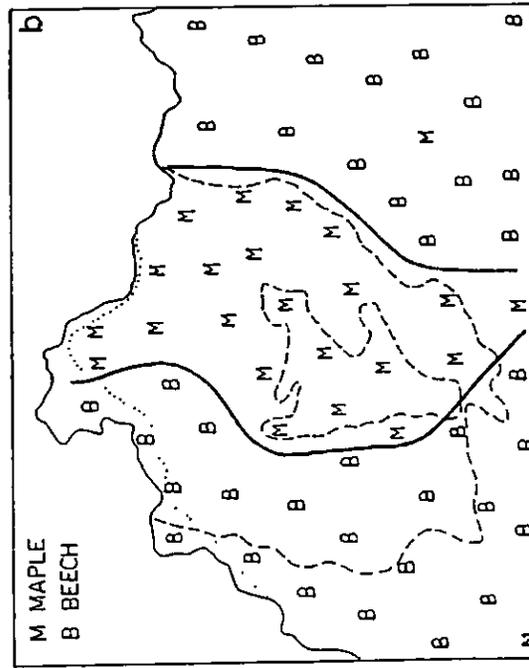
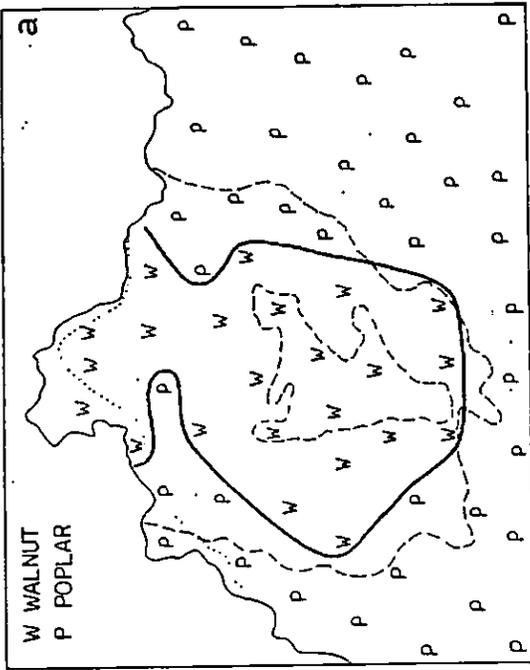
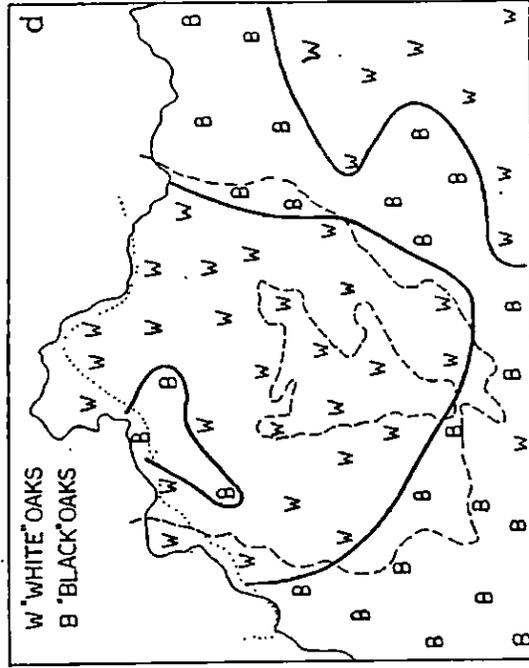
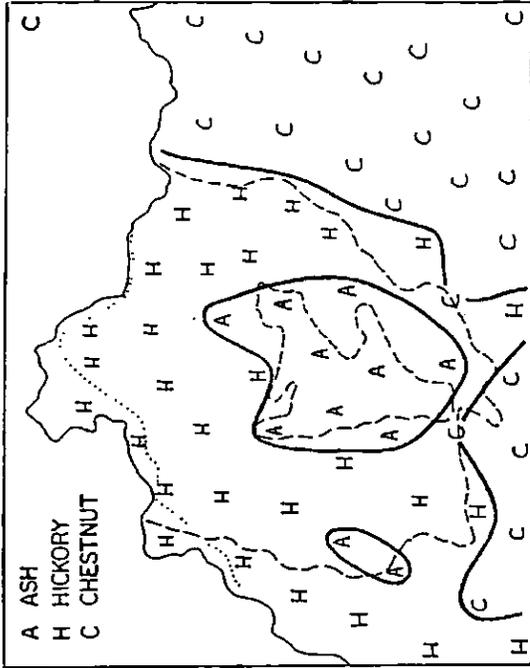


FIGURE 8. Dominant trees in each county, according to Barton's (1919) report. Congeneric species are generally combined in Barton's tables.

FIGURE 9 (opposite). The most abundant tree in each county within small ecological groups, based on Barton's (1919) report. Groups are selected to show contrasts in geological distributions.

- a. Walnut and poplar (successional dominants on moist sites).
- b. Maple (mostly sugar) and beech (climax dominants on moist sites).
- c. Ash, hickory and chestnut (oak codominants on drier sites).
- d. White oak and black oak groups (the two distinct subgenera).



the central sections, rather than southeast as well (Figure 9). The general destruction of forests on richer soils, by that time, may have influenced geographic patterns in surviving forests.

Trees typical of secondary succession exhibit patterns of special interest within the region. Those of moist rich soil, especially walnuts and locusts, were concentrated in central, eastern and southern areas, though also with a narrow extension through the western half (Figure 7a). Locusts appear to have been less strongly southeastern and somewhat transitional to walnuts, in accord with their generally wider soil tolerances (e.g., Fowells 1965, Campbell 1980). In contrast with walnuts, yellow poplar, which is the typical dominant after disturbance of beech forest today, was much less frequently indicated, even within the western sections (Figure 7b). On the driest and poorest sites in the region today, red cedar is the typical successional pioneer, with scattered sassafras and persimmon. Red cedar is now a major dominant on shaly hills where farmland has been abandoned. However, early notes indicate that this species was virtually restricted to the Kentucky River cliffs in the Inner Bluegrass, with a few "Cedar" place names downstream (Figure 7d). Also, sassafras and persimmon appear to have been quite infrequent. These trends show that secondary succession was largely occurring on richer soils, while typical climax trees were widespread dominants on poorer soils. Similar trends are evident in deed surveys, even with the limited study of central and eastern sections outlined above (Tables 2, 3; Campbell 1980).

There is some passing interest in place name patterns within regions adjacent to the Bluegrass, though direct observations of vegetation are not readily available for support. Immediately surrounding the Bluegrass, in the Knobs Region and on the escarpments beyond, there was clearly some shift to trees of poorer soils (Figure 7c, etc.). Moreover, there is a striking cluster of cedar place names in the west and, with pine, in the east. This clustering suggests drier soil conditions, perhaps also with more disturbance such as fire. Further to the southeast and southwest, onto the Cumberland and Mississippian Plateaus, respectively, there appears to have been some return to trees typical of better soils, though not as much as in the Bluegrass (Figure 7a,b).

These place names also show that, among mesic trees, there are striking shifts in the ratios of successional to climax species. Among trees typical of the richest soils, the walnut:sugar maple ratio in Bluegrass place names is about 7:3, but that in surrounding regions (mapped in Figure 7) is about 8:18. This trend suggests that the less extensive areas of rich soil outside the Bluegrass had been less disturbed in the early period when these names originated. In contrast, among mesic trees typical of intermediate soils, the poplar:beech ratios are 2:9 within the Bluegrass and 23:25 outside. This increase in poplar:beech ratio might be explained if wild fire was a more important disturbance factor in these surrounding regions, as compared to biotic factors within the Bluegrass (though perhaps with more controlled Indian fires). In these more hilly surrounding regions, beech forest generally occupies higher or more convex slopes than sugar maple, and would be more exposed to fires that began on the dry ridges with flammable pine, cedar and prairie grasses. As noted above, there is more historical evidence of fires in surrounding regions than in the Bluegrass itself.

LESSER VEGETATION

With little direct description of shrubs in the pioneer literature, place names provide an important complement in looking for geographic trends. As well as general "Brushy" or "Bushy" names, those indicating particular types of shrub can be considered. There is a widespread distribution of such names in Eastern Kentucky, but to the west they become less frequent and more patchily distributed (Figure 10a). Within the Bluegrass Region, there are only three clusters, largely in the shaly zones between Inner and Outer Bluegrass. There is no clear match between these concentrations and those of the successional trees described above (Figure 7). It may be that different types of disturbance history are involved, with shrubs indicating more recent or persistent disturbance (perhaps with more fire?). In the Bluegrass Region, the few shrubs named are mostly plum, rose and briar. In Eastern Kentucky, the major shrub is laurel (Rhododendron, Kalmia), with holly, rose and briar less frequent.

Canebrakes, with or without trees, were frequently noted at specific localities in the pioneer literature. Together with place names, these notes show a strong concentration in central and southeastern sections of the Bluegrass (Figure 10b). Further east in Kentucky, large areas of cane were never described on uplands, but place names, with a few early descriptions (see above), show an extension of "Caney Creeks" and "Runs", etc., southeast of the Bluegrass. Just beyond the southeast corner mapped here, Barker's map of Kentucky (Imlay 1792) shows "Cane on all these branches" of the Kentucky River headwaters.

Within the Bluegrass, the general absence of canebrakes on the Eden Shale is supported in local detail by Nathan Boone's (1840's re 1786) statement that "the nearest cane of consequence to the Lower Blue Licks (Eden Shale) was about 5 or 6 miles off, in the rich cane lands towards May's Lick (Outer Bluegrass)". Rich grassy vegetation was also located about that distance from the Licks, at the edge of the Outer Bluegrass (see quotations above from Drake 1840's, Linney 1885, etc.). Within the western Outer Bluegrass and adjacent regions, there are minor clusters of cane records near Drennon's Lick, along the Rolling Fork of Salt River, and along the Ohio River (Figure 10b). As with shrubby place names, there is no clear match between these outlying areas of cane and areas of successional trees. Cane appears to have been more strongly concentrated in southeastern sections than these trees, in general (Figure 7).

There are few "grassy" locations specified in the pioneer literature, but, again, place names provide some support. As with cane, grassy places seem to have been concentrated in central and southeastern sections of the Bluegrass Region, and, with indications of more open prairie-like conditions, extending into Eastern Kentucky (Figure 10c). The few records of prairie grasses in the region are concentrated in eastern and northern sections, with an odd cluster along the Kentucky River (between Raven Run and Boonesborough), and a smaller cluster near the Lower Blue Licks (Figure 11a). In the Knobs Region around the Bluegrass, there are virtually no records of wild rye, buffalo grass and blue grass in the pioneer literature (except on the Silurian transition), grass names that were linked with the Bluegrass woodlands (see above). But, instead, there is a concentration of "Gladie" and "Bald Knob" place names in eastern and southern sections, respectively. As already noted, early descriptions and existing collections of typical prairie

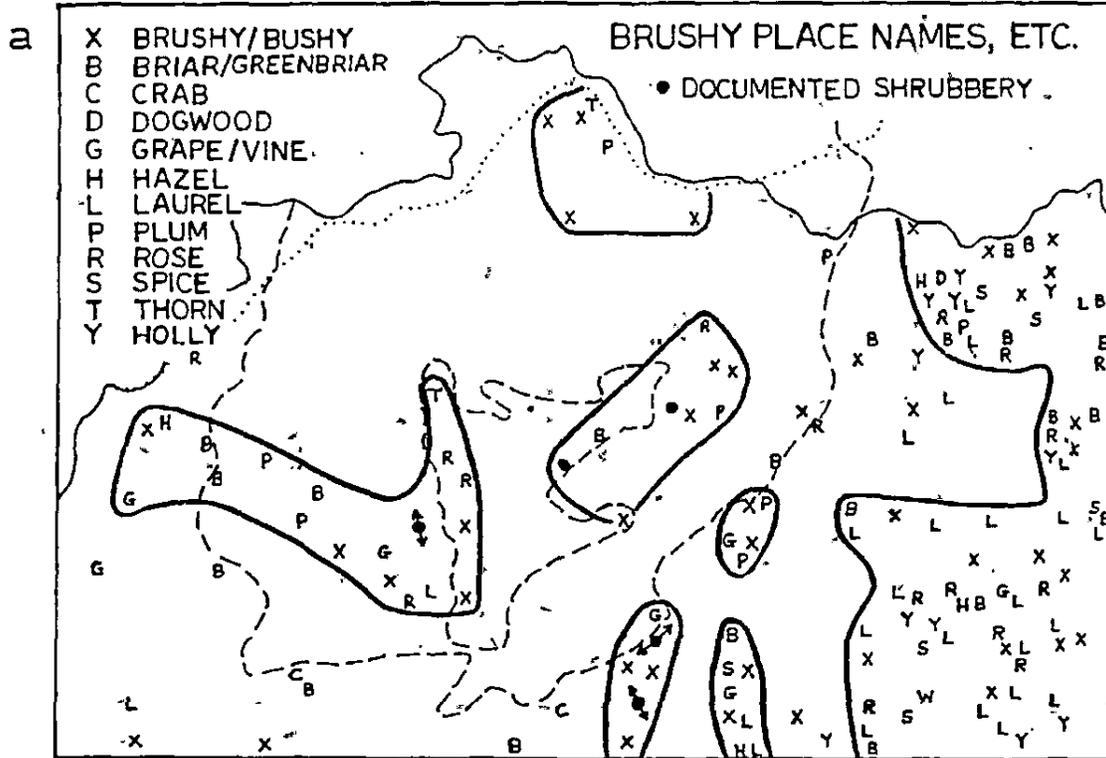
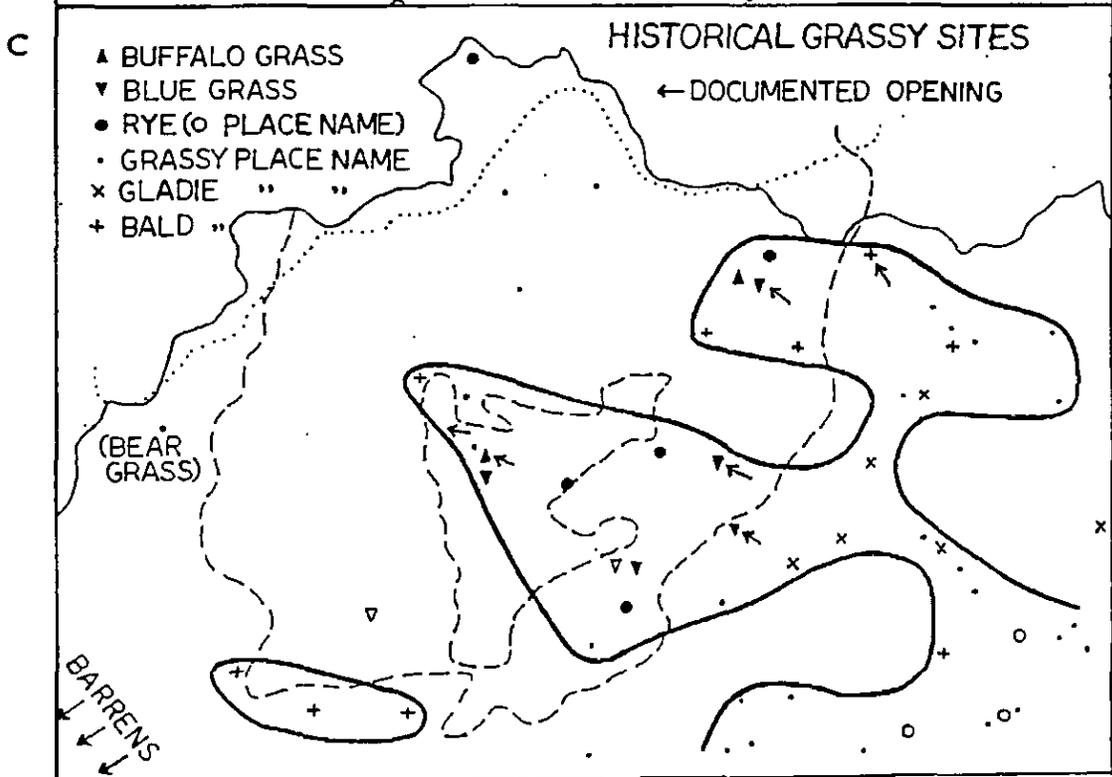
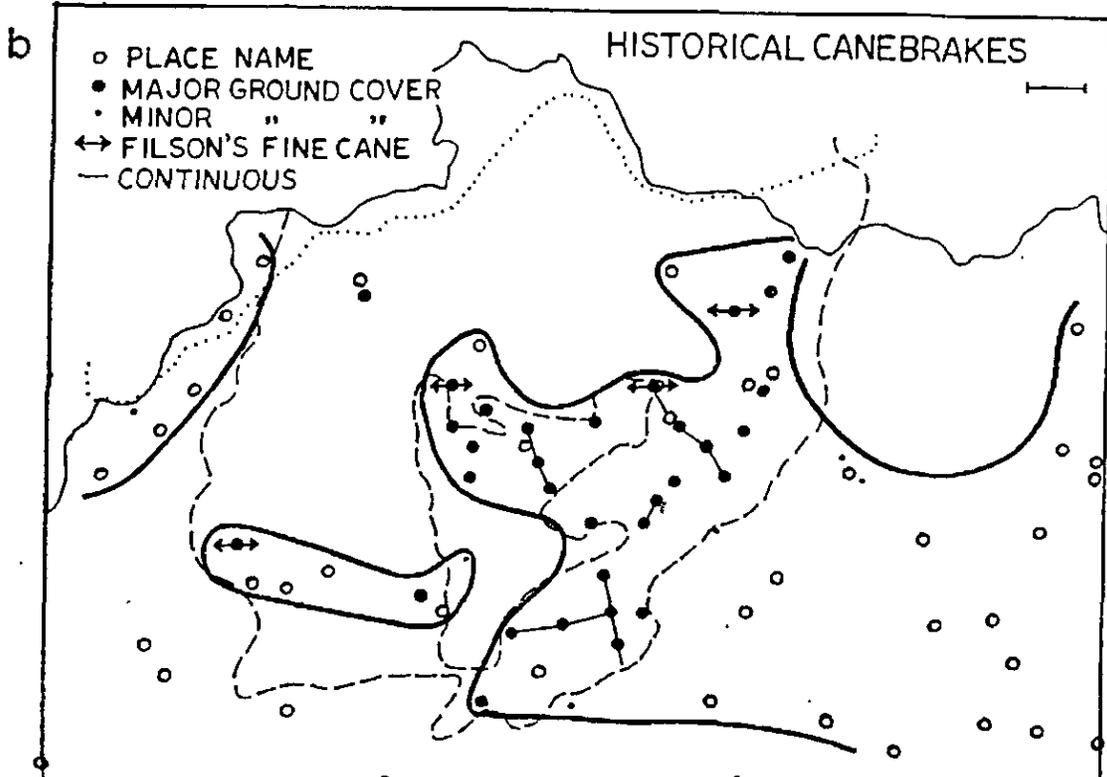


FIGURE 10a. Map of brushy place names (from Field 1961), and the few places with natural shrubbery noted in early descriptions without trees.

b (opposite). Map of canebrakes noted in early descriptions, and place names with cane (Caney Creek, etc.). No attempt is made to map the remaining fragments.

c (opposite). Map of grassy sites noted in early descriptions, and grassy place names. Sites shown with arrows were described as dominated by grasses or forbs, as opposed to woody cover.



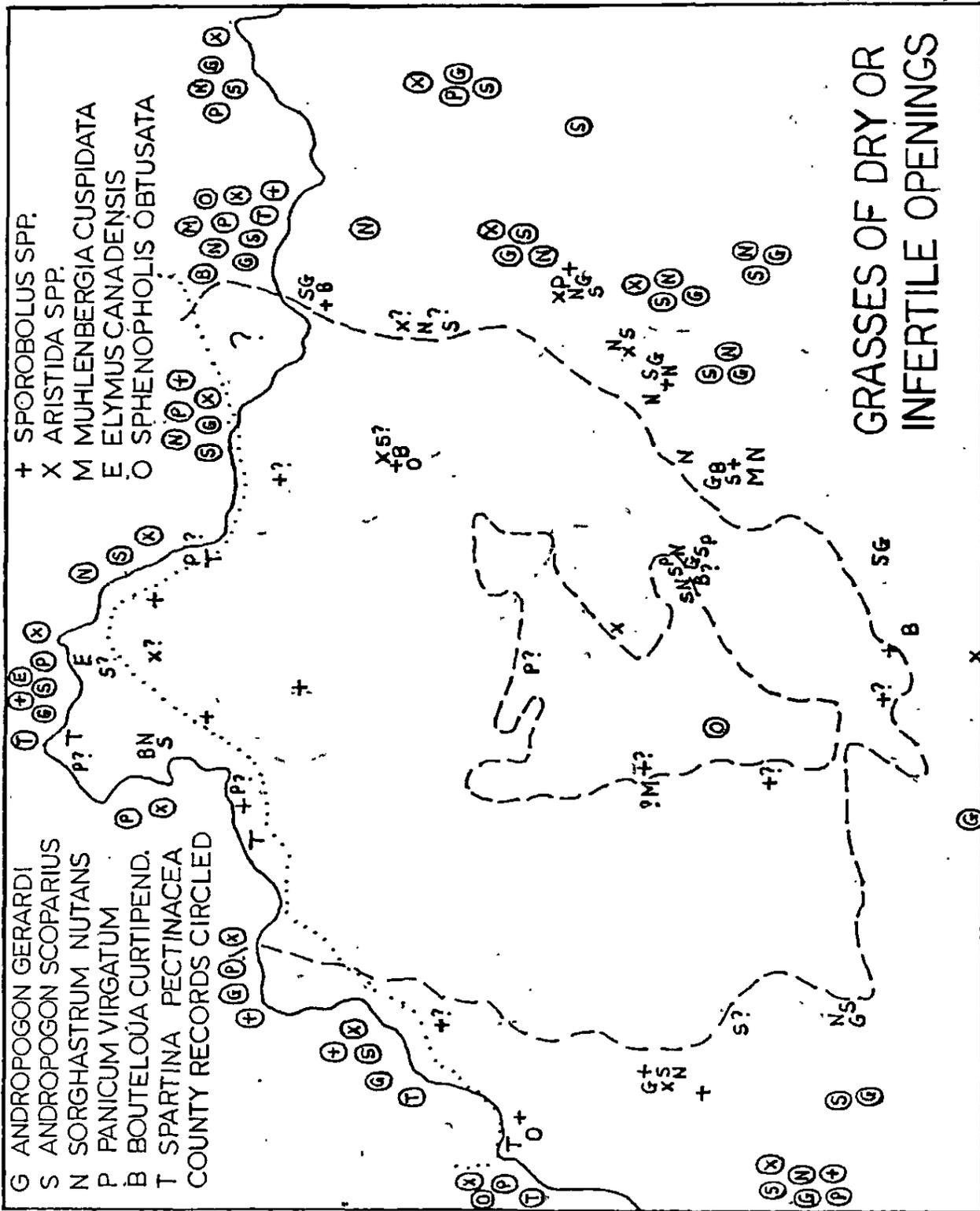
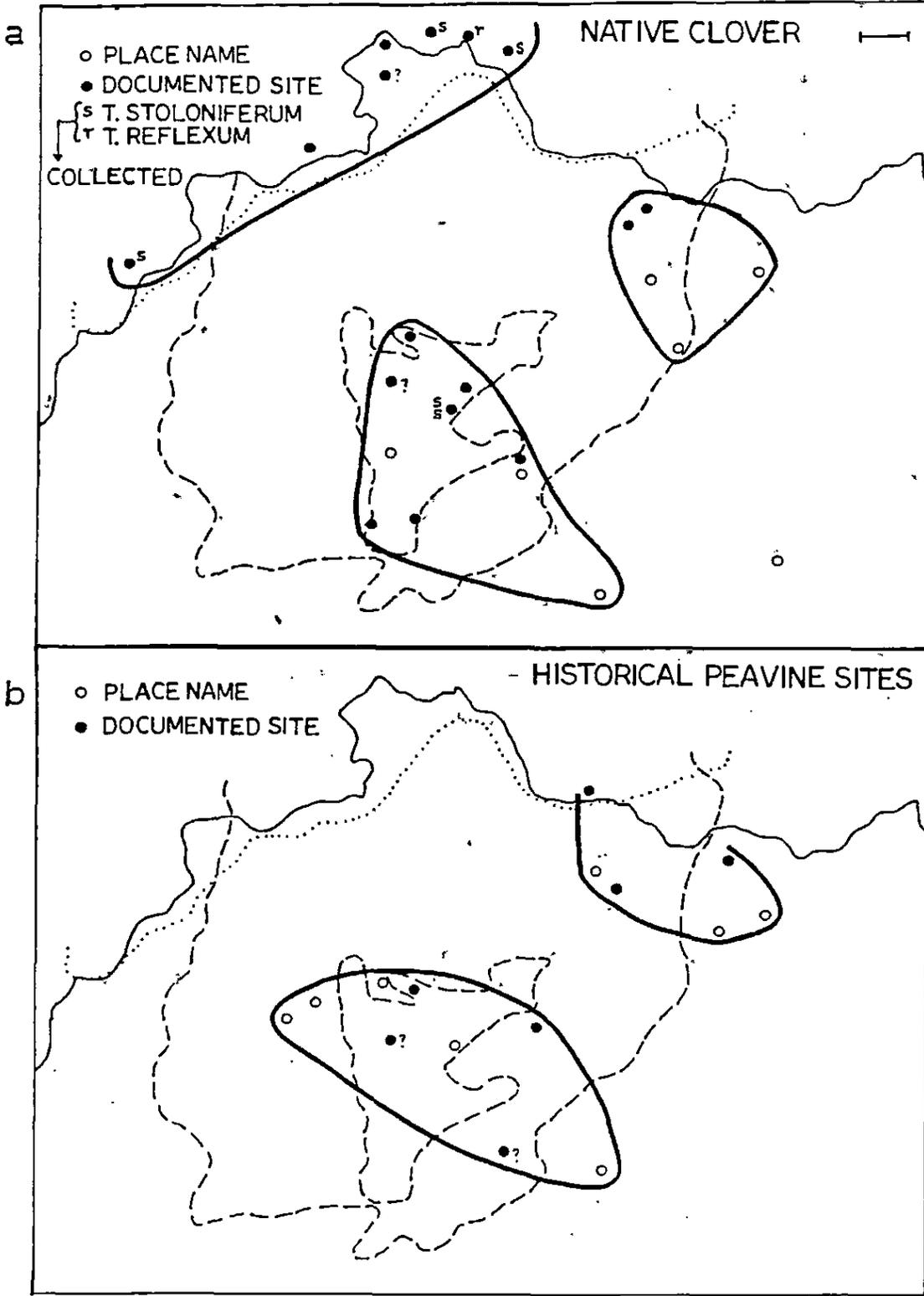


FIGURE 11a. Collection localities for grasses typical of dry or infertile openings (prairies, barrens, cedar glades, etc.), excluding widespread weedy species. This map is based on an ongoing floristic inventory of the region; a completed version with all sources will be available in 1986. Some collections are as old as the 1830's, and many sites are now lost within the Bluegrass.



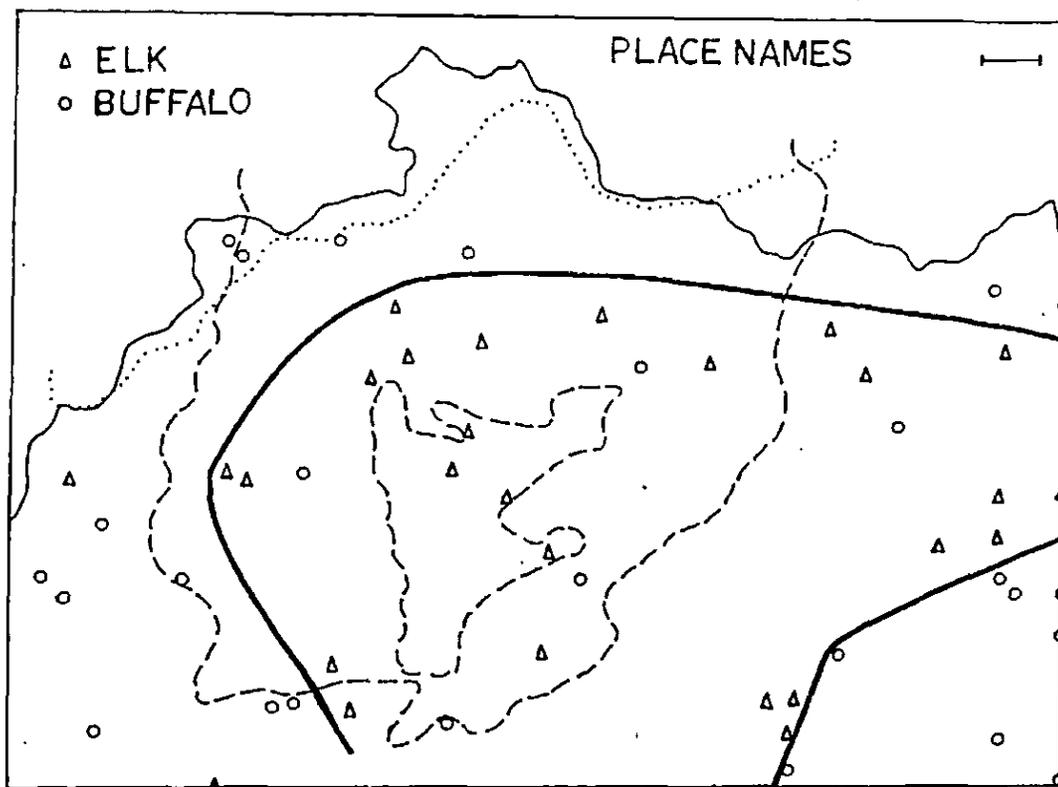


FIGURE 13. Place names with buffalo and elk (from Field 1961).

FIGURE 12a (opposite). Localities with native clovers noted by pioneers, suggested by place names, and proven by herbarium collections. See text for sources.

b (opposite). Localities with pea-vine noted by pioneers, and suggested by place names. No attempt is made to map the many modern records of Amphicarpa.

grasses indicate that open grasslands were more frequent in the Knobs (Figure 11). Further to the southeast on the Cumberland Plateau, there is some suggestion of a return towards grasses typical of the Bluegrass, with a cluster of "Rye" place names (continued beyond the limit of Figure 10c; from Field 1961), and with the rarity of prairie grass records (Figure 11a).

Clover and pea-vine, the two types of legume commonly specified in pioneer literature and place names, also show strong concentrations in central and southeastern sections of the Bluegrass Region (Figure 12). Moreover, these records are in two distinct clusters, centered on the richest limestone soils: one from the center to the southeast, and a smaller one in the northeast, both with a few records in the adjacent Knobs. The records of canebrakes, rye, buffalo, and blue grass are more widely dispersed, though also showing some concentration in these two areas. Clover records also occur along the Ohio River at the northwestern periphery of the region (Figure 12a), and, beyond the southeastern limit mapped here, there are a few more "Clover" and "Pea" place names on the Cumberland Plateau. Legume species typical of prairies, glades and barrens show a completely different pattern, based on available collection data. As with prairie grasses, they are clearly concentrated in the Knobs Region surrounding the Bluegrass, especially in western and eastern sections (Figure 11b). As already discussed, "Cedar" and "Pine" place names, indicative of dry open woodland, also have concentrations in these sections.

BIOTIC FACTORS

The map of buffalo trails presented here (Figure 14) is provisional, largely based on secondary sources (especially Myer 1925, Jillson 1930, Field 1966, Jakle 1968). There is much more work to do in checking primary sources (Jim Sames, pers. comm.). Nevertheless, the map does suggest a general concentration of routes in the Bluegrass Region, as compared to adjacent regions. In the southeastern sections of the Bluegrass, trails appear to have been more branched, and the salt licks more numerous. The largest trails and licks seem to have occurred in the northwest, acting as "interstates" and "rest-areas", respectively, for buffalo travelling between grasslands beyond the Ohio River or in western Kentucky on one side, and canelands centered in the southeastern Bluegrass on the other side. A quotation from Allen (1840's re 1784) is pertinent here: he described how pioneers had to cut roads through the cane to reach Bryan's Station, but, between here and Blue Licks "...they followed buffalo traces which were as plain as roads, after they got out of the cane". It is likely that these animals, together with elk and deer, were more spread out in the canelands. Place names suggest that buffalo roamed more widely than elk in Kentucky, though the clusters of elk names are difficult to interpret (Figure 13).

The map of known Fort Ancient sites (Figure 15) also suggests that, away from the Ohio River, human densities had been greater in central and southeastern sections of the region, presumably in response to soil fertility, vegetation productivity, and game animals density. This concentration of sites is stronger in the case of hunting camps, as compared to agricultural settlements. The lack of archaeological sites in the adjacent hilly regions of Eastern Kentucky is striking, though it may be partially attributed to lack of exploration.

In contrast with these Fort Ancient sites dated about 1000-1700 A.D., the

few sites known to have been occupied in the 18th century, largely through historical evidence, were concentrated only along the eastern edge of the Bluegrass and beyond (Figure 15). Conceivably, this shift in concentration to the east was a response to the disruptions noted above, with the eastern hills offering more security.

The greatest single cluster of known Fort Ancient sites is in southeast Franklin County and adjacent southwest Scott County, around the Stamping Ground area, where large buffalo roads entered the Inner Bluegrass and large herds congregated. Some other site clusters are located near large buffalo roads, licks or lick-clusters (e.g., Big Bone Lick, Drennon's Lick, the Lexington-Boonesborough route, the Falls of the Ohio, etc.). However, proper analysis of such correlation must await more detailed reconstruction.

Using more detailed Court House Records and other documents, together with further archaeological and botanical work in the field, it might be possible to show more precise correlations between areas of open or successional vegetation and biotic disturbance before settlement. Such association is already apparent at the general regional level in the central and southeastern Bluegrass sections. Also, at a finer scale, the few distinct indications of open grassy areas were all close to buffalo trails and licks, or Indian sites, as noted above. However, without more thorough mapping based on early deed surveys, it remains impossible to show fine patterns in the extensive matrix of woodland that covered most of the landscape.

One final pattern deserves mention in this context, though its interpretation is difficult. Within the western section of the Bluegrass Region, there is a progressive shift from north to south in concentrations of the following features: climax trees of moist sites (Figure 7b), successional trees (Figure 7a), brushy vegetation (Figure 10a), canebrakes (Figure 10b) and open ground (Figure 10c); though only indicated by three "Bald Knob" place names just south of the region). A hypothesis to explain this trend is that biotic disturbance concentrated along buffalo trails shifted south in late Prehistory, about 1500-1700 A.D., perhaps in response to the global cooling trend at that time (e.g., Bray 1971). Possible effects of this cooling on Indian cultures have been discussed elsewhere (e.g., Trigger 1978), and it has been suggested that southward movement of some tribes was a result (literature reviewed by Chris Turnbow, pers. comm.).

Did buffalo also move south? Within the western Bluegrass, documented buffalo trails exhibit pronounced east-west directionality (Figure 14). As already alluded to, this trend suggests rapid transit of the area, which was dominated by beech and oak-hickory forests on relatively poor soil, between the extensive western grasslands and the eastern canelands. The four or five trails mapped here correspond, approximately, with the zones of secondary forest, brush, cane and open ground, and one might imagine a successive abandonment of northern routes. There are no such trends within the eastern Bluegrass, where climatic factors might have been offset by soil fertility and by the cane, in which buffalo overwintered according to Nathan Boone (1840's re 1778; see also Draper 1851). This hypothesis is highly tentative, but it does illustrate the tantalizing potential for extension of these studies.

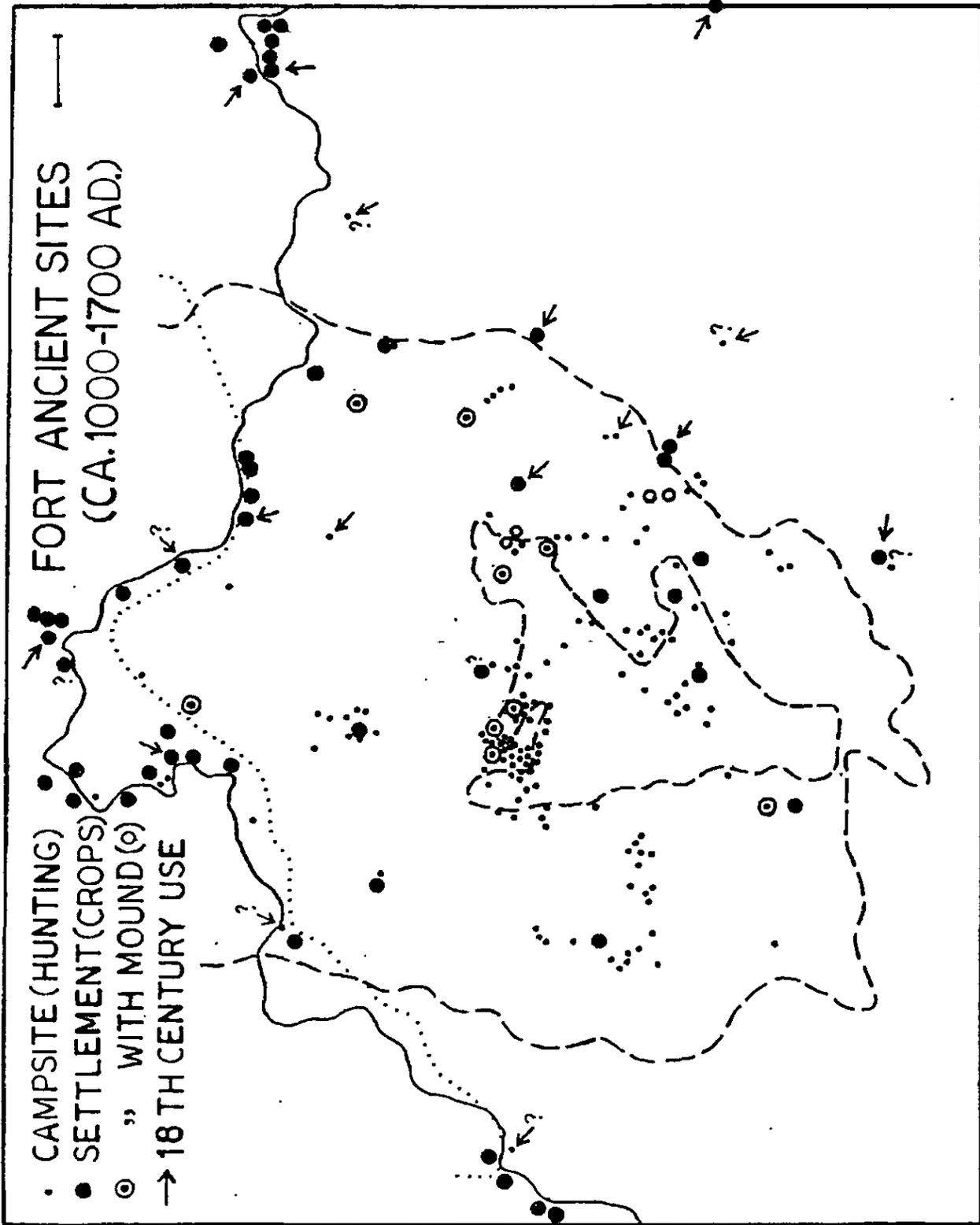


FIGURE 15. Settlements and campsites made by Indians during the Fort Ancient Cultural Period (ca. 1000-1700 A.D.) and in the contact period (1700-1800), based on Hockensmith (1980) and recent work by Chris Turnbow (pers. comm.). The four settlements at far left are Mississippian, added from Trigger (1978).

GENERAL DISCUSSION

INTERACTION OF EDAPHIC AND BIOTIC FACTORS

In summary, the Bluegrass Region was largely forested at the time of settlement. The species composition on the rich limestone soils was quite distinct from that on poorer shaly soils, with a widespread abundance of trees such as sugar maple and black walnut, which are generally restricted to lower colluvial slopes or alluvial ground elsewhere in Kentucky. Large areas on the richest soil were covered by relatively open woodland of walnuts, locusts, buckeye, etc., with an abundance of Poaceae (Arundinaria, Elymus, Panicum?, Poa?), Fabaceae (Trifolium stoloniferum, Amphicarpa bracteata) and Urticaceae (Urtica spp., Pilea) on the ground. This tendency towards park-like conditions may be largely attributed to the residual influence of biotic disturbance by Indians and large herbivores, especially buffalo.

However, to pursue hypothetical explanations of this open woodland more thoroughly, there is still a need to study the basic forest hydrology of the region, and the climatic history. Possible effects of moisture stresses, due to soil structure in combination with seasonal water-table changes, etc., have been discussed elsewhere (Campbell 1980). The oak-ash component, with ring-porous wood enabling more water-conductivity in the growing season, could have been particularly indicative of such moisture stress.

The apparent increase in importance of the oak-ash component within surviving forests during the 19th Century (Figure 5) may be attributed to two general factors:

- (1) selective clearance by settlers of the sugar maple-black walnut component, which is typical of soils with minimal stress and most suitable for crops, while leaving the famous blue ash lands, etc., as "wood pastures";
- (2) actual change in hydrology, due to forest clearance or climatic change, reducing growth and survival of the sugar maple-black walnut component relative to the oak-ash.

Today, old trees on the richest soils, typically left isolated in pastures, are mostly blue ash, with chinquapin oak, burr oak, shumard oak and shellbark hickory, etc. The size-class distributions of trees in these "savannah-woodlands" suggest that most of the stems originated in the 19th Century, though many are older, up to about 450 years (e.g., as indicated by Bryant et al. 1979, Bryant 1983). If most of these stems grew up after settlement in the late 18th Century, it may be possible to examine causes fairly closely, using available land-use history and climatic data. There is much potential for studies of tree rings in this context. Whether the old records of black ash have some significance here, in relation to the swampy site preference of Fraxinus nigra, remains uncertain. Further historical investigation of such records here and elsewhere in the lower Ohio watershed may be useful.

If there really was some resurgence of more drought-tolerant species within relatively undisturbed forest remnants, actual change in hydrology might be suggested. Moreover, the current failure of most species to regenerate in grazed or ungrazed remnants of the blue ash dominated community, with hackberry and black walnut, etc., taking their place (Campbell 1980), might also be attributed to some further ecological change in the reverse direction. Clearly, there are some important questions here, which are accessible to study.

The general scheme of forest type relationships generated from modern data throughout east-central U.S.A. (Figure 2) is a valuable aid to interpretation of presettlement patterns. Much of the "anomalous" character of Inner Bluegrass forest composition can be attributed to the exceptionally widespread rich moist soil conditions that prevailed here, as indicated in the lower right section of this scheme by the sugar maple-black walnut type. The prevalence of black walnut and other successional species, attributed to the concentrated biotic disturbance of these rich soils, added further unusual character, as already discussed.

However, there remains an important group of woody species in the presettlement vegetation that has little representation in modern remnants, neither in the small areas of climax forest dominated by sugar maple, nor in the blue ash "savannah-woodland", nor in the more widespread successional types dominated by black walnut, etc. These species, which seem to have been somewhat associated with each other (see above and Campbell 1980), are buckeye (*Aesculus glabra*), honey locust (*Gleditsia triacanthos*), coffee tree (*Gymnocladus dioica*), pawpaw (*Asimina triloba*) and cane itself (*Arundinaria gigantea*). They appear to have been particularly sensitive to settlement, though they are relatively vigorous competitors in the small fragments of forest they still dominate.

I have argued elsewhere (Campbell 1980) that these species were suited (perhaps even "adapted") to grow in ecotonal areas between the most intensively disturbed open areas along animal trails on one side, and the less disturbed forests of sugar maple, ashes and oaks on the other side. Some of these ecotones may have been relatively stable in their placement, with continual oscillation of forest boundaries rather than long-term directional succession. These species tend to have defensive (toxic, thorny) and reproductive characteristics (strong vegetative regeneration, poor seed dispersal) which might suit them to such stable regimes of moderate biotic disturbance. They do not appear suited to the extremes of clearance and abandonment that prevail over the landscape today.

CONSERVATION PRIORITIES

It is these suggested "ecotonal" woody plants that constituted the most unusual feature of presettlement Bluegrass forests, forming a community that was probably nowhere else as pronounced. Though none of these species is now endangered, except for cane at the county level, the small patches of forest in which they are still abundant today deserve high priority in nature conservation, at least because of their historical significance. These patches are living remnants of a land-use pattern that has vanished, but which was intimately involved with the economy of native Indians and Virginian pioneers.

The cane, in particular, once provided abundant forage of great nutritional value for buffalo and then cattle, as long as salt could be obtained (Jackle 1969). The productivity and biomass of temperate bamboo lands typically exceed grassland, and the nutritional quality rivals maize (McHargue 1941, McClure 1958, Hughes 1966, Veblen et al. 1980, Campbell and Qin 1983, and unpublished review). With proper management, cane could be re-established in model areas, perhaps even providing a little economic value other than from tourists! The settlers simply did not have the

knowledge or desire to maintain the cane, overwhelmed as they were with exploitation pressures.

Though conservation of native plant species has generally been neglected in and around the Bluegrass Region, since no attractive concentrations of endangered species remain in a reasonably natural setting, there is a small group of species that are critically endangered or extinct already. Solidago shortii is a goldenrod that has been only found near the Lower Blue Licks (Robertson Co.) and the Falls of the Ohio River (near Louisville). It has now disappeared at the latter site. It has never been found outside of Kentucky, and has recently received official endangered status from the Federal Government, with mandatory protection. Psoralea stipulata is a legume ("scurf-pea") that has only been found at the Falls of the Ohio, and is now feared extinct, globally. As discussed already, Trifolium stoloniferum, running buffalo clover, was once abundant in several areas of the Ohio Valley and adjacent regions. It is now known in the wild at only two sites in West Virginia, each a patch of about 1 square meter. It is currently receiving official endangered status (R. Bartgis, pers. comm.).

These three herbaceous species would all seem to have been adapted to conditions along buffalo trails, judging from the historical association of trails with their documented sites. Thus, they derive further historical importance, presumably having grown in the grassy zones between the bare trampled ground and the "ecotonal" forest with cane. Several other herbaceous species that are rare and endangered at the state or local level were probably associated with buffalo disturbance as well. For example, Bouteloua curtipendula is a short-grass prairie species, collected at the Lower Blue Licks in 1830-45, but now unknown here or elsewhere in the Bluegrass Region. Also, Helianthus mollis (downy sunflower) is another prairie species with only one site in the region, near an old buffalo route in Lexington (NE. of New Circle x Liberty Rd.), now threatened with development .

Native herbaceous species have suffered more than woody plants, because of their accessibility to overgrazing and mowing, together with the overwhelming introduction of exotic pasture plants and weeds from Europe and elsewhere. In order to preserve these species in their small fragmentary remnants of natural vegetation, we can delay no further in the proper study and legislative action needed.

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In the text, the actual date of an account is given first (in parentheses), followed in many cases by the date of events referred to in the account ("re 1782", etc.). Otherwise accounts generally refer to events within a few years of writing. Page references in the above list are selective, referring to the actual material quoted, as far as possible. In future editions, I hope to add an appendeix with complete quotations in chronological order.