THE SHORT-GRASS PLAINS AND POST OAK-BLACKJACK WOODLAND OF OKLAHOMA IN HISTORICAL PERSPECTIVE

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INTRODUCTION

An invaluable adjunct to modern community ecology is the historical investigation. The historical perspective obtained from knowledge of "original" community structure and composition contributes inestimably to our intelligent analysis of the natural community in its modern setting of man-wrought disturbance. It contributes to our knowledge of community succession; in so doing it is of economic value, for it furnishes perspective to land management programs. To cite the specific example of wildlife management, information bearing upon community history and community succession leads us toward a realization of the potential capacity of certain areas for the production of game species and furthers a more complete understanding of the natural processes operating to make habitats favorable or unfavorable. The more thoroughly we comprehend these processes, the better able we will be to formulate land management programs affecting the welfare of presently available game species.

A valuable source of historical description is the literature of early exploration. In the daily journals so often maintained by explorers and early travelers are to be found many notations concerning the biota encountered on their journeys. Records of this nature make it possible to partly reconstruct a picture of natural communities as they

once existed under conditions relatively free of the widely corruptive introduction of white man as a permanent resident into the environment.

This investigation has entailed an examination of the literature of exploration touching upon the present state of Oklahoma. The direction taken by the study has been determined largely by the nature of the chroniclers' observations; narratives of travel through this region are especially productive of information pertaining to the short-grass plains and to the post oak-blackjack woodland, for these communities were striking in physiognomy and new in the experience of most recorders. In the following pages information obtained from the literature of exploration is applied to specific problems concerning the early character of these communities and the changes which they have undergone since settlement. This information is then discussed in regard to the classification of these communities according to the climax concept of community succession.

In considering the historical record it must be remembered that at no time during the exploratory period did the area exist under conditions free of human disturbance. Man had been an inhabitant of the region long before it was penetrated by white exploration. Although the native Indian, like the bison he hunted, may perhaps be considered a part of the fauna and his effect upon the biota, a natural influence, two alien sources of progressively more pronounced human disturbance were coincident with exploration: the approach of the frontier

and the immigration of a number of Indian tribes, native to the eastern United States, into eastern portions of the area.

A clarification of two terms used in this report seems desirable: "association" as used here includes no climax connotation but is used interchangeably with "community" in the abstract sense. Thus, the "post oak-blackjack woodland association" or "community" refers to the whole of the woodland together with all associated animals and plants.

THE SHORT-GRASS PLAINS

As our ecological knowledge and thinking progress, it becomes increasingly apparent that the interpretation of the ecological status of the short-grass plains association which has been widely accepted by ecologists is not altogether satisfactory. Primarily responsible for formulating this interpretation was Clements, who regarded the dominance of short grasses over a large portion of the Great Plains as the result of overgrazing by domestic animals and termed this association a disclimax, representing a modification of the climax mixed-grass prairie (Clements 1936, Weaver and Clements 1938, Clements and Shelford 1939). As proof of this modification Clements presented three sources of evidence: (1) mid grasses return within a few years to areas from which livestock have been exclosed; (2) mid grasses persist in areas where sandy soil or broken topography increases the water available; (3) photographs taken by the Hayden Expedition in 1870 unquestionably prove "that the undisturbed cover of the Great Plains was dominated by mid grasses" (Weaver and Clements 1938). "The narratives of early explorers and forty-niners furnish further proof that the original plains vegetation was mixed [prairie]" (Clements 1949). He thus denied the existence of the short-grass plains association prior to occupance of the area by white man (although other statements, seemingly

belying this conclusion, are found in his writings; see Clements 1949, p. 29).

Challenging the interpretation of Clements was Larson (1940), who maintained that (1) the short-grass plains could not have been caused by the overgrazing of domestic animals, for this association has been shown by the statements of early explorers to have existed before the introduction of cattle to the area, and (2) if caused by the overgrazing of animal life natural to the biome, the association must be called climax. In tacit agreement with Larson was Carpenter (1940), who regarded the short-grass plains as a climax association of the grassland biome. The historial-ecologist Malin (1956), in comparing the contrasting views of Clements and Larson, demonstrated that the historical record of exploration at mid-latitude tends to confirm the latter view and affirm the early existence of the short-grass plains.

Following is presented the information obtained from the diaries of early travelers which bears upon the existence of the short-grass plains association in and adjacent to Oklahoma before white settlement.

"Buffalo Grass"

Throughout the chronicles of the exploratory period are found allusions to "buffalo," "grama," and "mesquite" grasses, common names often used today to designate certain short-grass species. As might be expected, these terms were used differently by different recorders, and not necessarily to describe

species signified in the generally accepted modern meaning of the terms. As Malin (1956) pointed out, the chroniclers had only a vague idea of genus groups and were not species conscious. Botanists of the time had little data on these grasses of the plains; the correct naming, classification, and description of buffalo grass, for example, did not occur until 1859 (ibid.). Roe (1951) cited a number of differing descriptions by early chroniclers of "buffalo grass"; these he claimed preclude its being identified as any one species. Historical records covered in this investigation clearly demonstrate this confusion in terminology but also show that the descriptions of these grasses were not wholly at variance but, on the contrary, demonstrate a high degree of consistency. First of all, it is quite evident that all three terms were used to describe grasses encountered in quantity only on the higher, drier plains of the westernmost portions of the state, and found only to a limited extent from thence eastward. For example, on their westward journeys "grama-grass" was first noticed by both Beale (1860) and Bigelow (1855) in the general vicinity of Edwards Trading Post in present Hughes County, Oklahoma; "mesquite grass," by Marcy farther west, probably in present McClain County (Foreman 1939); "buffalo grass," by Abert (Emory 1848) on Turkey Creek along the Santa Fe Trail in present McPherson County, central Kansas, and by Wislizenus (1848) farther west, in present Barton County, Kansas. No exceptions to this usage of the three terms to describe predominantly western grasses were found in any of the journals

covered.

Another similarity of usage is apparent: the majority of travelers seem to have used "grama grass" and "mesquite grass," not to refer to any one species, but rather as a general, inclusive classification of different species, while "buffalo grass" was used in a more restricted, specific sense. Thus Whipple (1855) spoke of "the rich grama which bears the name of 'buffalo-grass,'" and Marcy (Foreman 1937), of several varieties of both grama and mesquite and of "a short variety of mesquite, called buffalo grass, from one to two inches in length." Beale (1860) found that "of grama grass there are many varieties." (His further comments indicate that, unlike many chroniclers, he did not include "buffalo grass" as one of these.) Similarly, John Torrey and Asa Gray spoke of the "numerous Grama-grasses of Texas and New Mexico" of which "Festuca macrostachya (n. sp.)" was listed as one (Pope 1855). Torrey (Emory 1848) identified buffalo grass specifically as "Sesleria dactyloides," as also did Wislizenus (1848) and Abert (Emory 1848). Abert described it as "a short and curly grass, so unique in its general character that it at once catches the eye of the traveler" (ibid.). Gregg (1905) specified that the "celebrated buffalo grass" was of two kinds, "both equally nutritious at all seasons."

Deviating from the general use of "grama grass" in the inclusive sense were Bigelow (1855) and Dodge (1877), both of whom gave to the expression a limited connotation. Dodge limited the grama to Texas, "a fine grass growing to the

height of two, and under very good conditions of three, feet...," perhaps a mid grass. In any event, although they may have been used in the modern sense by some recorders, more frequent use of the terms "grama" and "mesquite" to include "many varieties"--probably often both mid and short grasses--makes these expressions useless in collecting evidence for the early existence of the short-grass plains, except where described in detail as referring to short grasses.

To the use of "buffalo grass" in the restricted sense, only one exception was encountered in the literature covered: the later description by Hutchinson (1871) of use of the term to include all grasses with a curled leaf. Hutchinson continued however to mention the "true buffalo grass" which "... spreads on the ground somewhat in the manner of a strawberry vine, and its leaf curls close to the ground, so that it looks more like a bed of bleached moss than it does like common grass" (ibid.). (This description certainly suggests that Hutchinson's "true buffalo grass" is Buchloë dactyloides.) In more recent literature Garretson (1938) described a modern use of the term in the more comprehensive sense:

> Many stockmen whose herds graze the old buffalo ranges make little or no distinction among the various kinds of grasses. Buffalo, grama and mesquite are spoken of in a general way as buffalo grass. The true buffalo grass (Buchloë dactyloides) is often mistaken for curly mesquite (Hilaria belangeri)....

In spite of these apparent exceptions, the more common use of the term in the restricted sense and its description as "short" (Abert in Emory 1848, Boone in Fessler 1929, Dodge 1877, Marcy

in Foreman 1937, Wislizenus 1848), "thick" (Dodge 1877), "curly" (Abert in Emory 1848, Dodge 1877), "nutritious" (Bigelow 1855, Dodge 1877, Gregg 1905), and curing "like hay uncut" (Dodge 1877) suggest that, by the majority of chroniclers at least, the term "buffalo grass" was employed, if not actually to refer to Buchloë dactyloides, then to indicate the short grasses as a group. Consequently, in discussing the early presence of short-grass plains in the area, the only records used will be those which employ the term "buffalo grass," unless detailed description by the recorder definitely indicates that the other term he used signified a short-grass species.

Evidence of the Early Existence of the Short-Grass Plains

The short-grass plains association currently occupies only the extreme northwestern portion of Oklahoma (Fig. 1). Only two chroniclers were found who gave evidence which might be construed as demonstrating the pre-settlement existence of the short-grass plains within or immediately to the west of the state. Simpson (1850), for one, found in 1849 that immediately to the west of the Antelope Hills (Fig. 2) one entered "the region of buffalo grass" (possibly implying the area of its predominance). Along the Washita River near the 100th meridian (the present western boundary of the state, exclusive of the panhandle), Whipple (1855) in 1853 noted that buffalo grass was "pre-dominant." As for the meaning of "buffalo grass" as used by these chroniclers, that Whipple

Fig. 1. The vegetation of Oklahoma, exclusive of the Panhandle: an approximation adapted from Duck and Fletcher (1943).

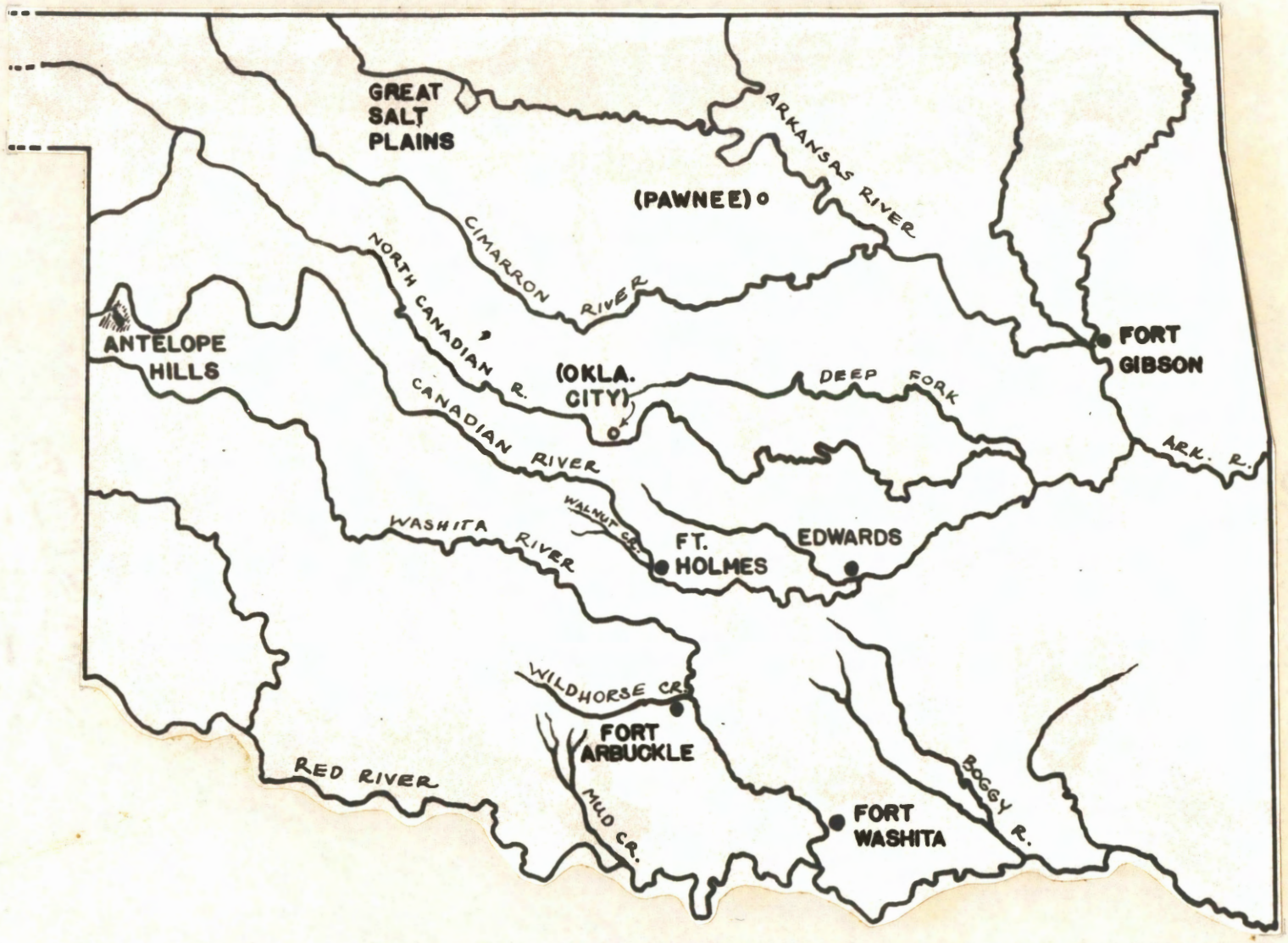

Fig. 2. Map of Oklahoma, exclusive of the Panhandle, locating rivers and modern and historical place names mentioned in the text.

used the term in the restricted sense is clear from his description of this grass as one of the grama grasses (page 7); unfortunately, however, no specific description of "buffalo grass" which would define Simpson's use of the term was found in his journal. If both were referring to short grasses, as would seem probable, these observations would suggest an early eastern limit of the short-grass plains in the Canadian-Washita-100th meridian region which would closely approximate the boundary shown by recent maps. However, no conclusion can be based on such limited evidence.

In the perusal of journals of exploration through present Oklahoma there were encountered a number of descriptions of "short" grasses from outside the state. The earliest of such descriptions found was that of Castenada, chronicler of Coronado's expedition of 1542. Speaking of lakes, "some fresh, some salt," at an undetermined spot on the plains, he reported, "The grass grows tall near these lakes; away from them it is very short, a span or less" (Winship 1904). Much later, in 1854, in areas of Texas below the Red River, Pope (1855) found that "grama and mezquite grasses ... cover the entire surface." His description of these grasses fits the short grasses; he found that they were

> ... short and curly, growing very thickly and almost matted, and form a spongy sod. They do not dry up and lose their strength and nutriment during the winter, as is the case with the grasses further east, but actually "cure" where they grow, like hay which has been prepared by the farmer.

Again, in describing the Staked Plain or Llano Estacado of Texas and New Mexico on his route along the 32d parallel,

Pope found these same grama grasses "in abundance." Also traversing the Llano Estacado, Marcy in 1849 found buffalo grass "the only herbage" upon these plains (Foreman 1939). In 1852 he again described buffalo grass as predominant in the same area (Foreman 1937):

> The grass upon the Staked Plain is generally a very short variety of mezquite, called buffalo-grass, from one to two inches in length, and gives the plains the appearance of an interminable meadow that has been recently mown very close to the earth.

This generalization is given authority by Marcy's many years of experience on these plains and by his reputation for accurate description, vouched for by the historian Foreman (1939). The short length which this reliable observer ascribes to this "buffalo grass" and his description of its wide coverage and appearance of having been "mown very close to the earth," weigh heavily as evidence for the early existence of the short-grass plains to the west of present Oklahoma in the Llano Estacado region.

Dodge (1877), another experienced plainsman, also found "buffalo grass" predominant on the Staked Plains. His description certainly seems to be of a short grass:

> The higher portions of the second plain are covered with the famed buffalo-grass. It covers the ground very thickly, to the exclusion of other grasses, or even of flowers. The blades are short, but two or three inches long, and curl upon themselves, forming a thick close mat of beautiful sward, green as emerald in early spring, but of yellowish grey later in the season. This grass is extremely nutritious.... Its best quality is that it does not, like other grasses, dry up and become withered and lifeless from the dry heat of summer, but seems to cure itself as hay uncut, and preserve through the fall and winter all its nutritive qualities.

The impact of the foregoing generalization is reduced, however,

and doubt is cast on the reliability of Dodge as an observer as he continues to say,

> The "buffalo-grass" of the high plains and ... "grama-grass" [described as two or three feet in height; see page 7, though entirely different in growth and appearance, are really identical. This I discovered accidentally. At Fort Dodge I had a small piece of ground covered with sods of buffalo-grass taken from the high prairie. It was watered daily, and otherwise well cared for. To my astonishment it appeared to change its whole nature, grew tall and rank, and in due time developed the seed-heads of the true "gramma-grass."

The "sods of buffalo-grass" which Dodge describes may have contained an appreciable percentage of mid grasses, closely cropped by grazing, which grew to full stature only when protected by him from grazing. Fort Dodge lay approximately on what is today the boundary between short-grass plains and mixed-grass prairie in Kansas. It is quite probable that Dodge took his sods from this vicinity, especially since he specified "prairie," a term commonly used then, as today, to designate the taller eastern grasslands, and therefore not at all strange if they included mid grasses to a large degree. Moreover, that the plot was "watered daily" would have made conditions favorable for the establishment of mid grasses in the sod or for the growth of mid grasses already present.

We have no real assurance, however, that the "short" grasses which these observers found covering the Staked Plain were not really sods of mixed-grass prairie in which the mid grasses were made inconspicuous by the close grazing of plains animals, particularly bison. Nevertheless, this doubt is to a great degree dispelled when we consider the known deterioration of mixed-grass prairie and increase of short grasses

which result from overgrazing.

There remains the possibility that the exploratory period coincided with a period of extended drought such as that of the 1930s, and that the dominance of short grasses over extended areas might therefore have represented the temporary response of mixed-grass prairie vegetation to a succession of very dry years. This possibility is highly unlikely in face of the testimony of Malin (1956) that available records of military outposts show the years 1844, 1845, 1848, and 1849 to have been wet years. Marcy's narrative of 1849 (Foreman 1939) amply demonstrates the wetness of that year in particular.

By way of summary, it may be said that the foregoing descriptions of buffalo grass occurrence outside of the present state, especially in the Llano Estacado region, leave little doubt of the pre-settlement existence of the short-grass plains association to the west and southwest of Oklahoma, and that records of two chroniclers suggest that, for one area near the western border of the state, early and recent eastern boundaries of the association may prove closely correspondent.

Grazing by Buffalo

Those ecologists who hold the short-grass plains to be "disclimax" attribute its current existence to overgrazing by domestic cattle. This theory, in view of the almost certain existence of the short-grass plains, at least in some areas,

prior to settlement, presents the possible corollary that the past existence of this association may also have been a result of overgrazing--by buffalo and other plains animals.

Among the travelers who described the effects of grazing by bison was Pattie (Flint 1905), who in 1824 found buffalo and wild horses at one point on the plains "in such prodigious numbers, as literally to have eaten down the grass of the prairie." Another was Ellsworth (Williams and Simison 1937) who, to the east of the post oak-blackjack woodland in 1832, observed that "... close eaten praries [sic] spread with Buffaloe dung, showed, we were near the great herd...." Hildreth (1836) generalized that "... where the immense herds of cattle are found, the pasturage is cropped close to the earth," and Dr. J. S. Candee (Foreman 1939) reported,

> The vegetation in some places and at some seasons is luxuriant. ... In some places, and at the proper season, the forage for miles in extent, hundreds of thousands of acres, is literally eaten to the turf by immense herds of buffalo....

Boone was told by William Bent, an experienced plainsman, that, during his journey from the Rocky Mountains to the Great Bend of the Arkansas River (in Kansas) in the summer of 1843, the grass was found to have been so closely grazed by buffalo that his cattle had almost starved (Fessler 1929). These and similar observations attest to the markedly visible effect of buffalo grazing upon the grassland vegetation in general.

If we could assume that Clements was correct in stating that the climate of the short-grass plains area is currently suited to the establishment of mixed-grass prairie (Weaver and

Clements 1938) and if it could be shown that such was also the case during pre-settlement times, we could then be reasonably certain, in view of the numbers of buffalo once inhabiting these plains and of evidence like the above concerning their grazing, that overgrazing and, to a lesser extent, trampling by bison were important causative factors in this association's early existence. This is the possibility suggested by Larson (1940). But we cannot make these assumptions. As for Clements' assertion that the short-grass plains area is climatically adapted to a mixed-grass prairie vegetation, his processes of reasoning in reaching this conclusion (as described by Weaver and Albertson 1956) have recently been cogently challenged by Malin (1957), who questioned whether a wet year, such as that during which Clements discovered the alleged true nature of the plains climax, can be considered the true measure of the area's climate. Even if further investigation should vindicate Clements' contention, there still remains the uncertainty that climatic conditions in the area prior to settlement were the same and suited, in the absence of disturbing factors, to the establishment of mixed-grass prairie. Therefore, until the current climatic-vegetational status of the short-grass plains over its entire extent can be finally determined and compared with climatic records for the area in order to deduce its one-time climatic potential, there can be inferred no general, all-inclusive causal relationship between buffalo grazing and short-grass plains existence, although the extensive presence of the grazing factor

must be granted, and it would not be unreasonable to postulate that in marginal areas buffalo were instrumental in tipping the scale of factors in favor of short-grass dominance. Also, the role of other factors--among them, prairie fires and primitive man--in influencing this association must be investigated and evaluated.

In considering the buffalo question it is interesting to note the following possibility: if grazing by bison had been causative in maintaining short-grass dominance in an area suited to mixed-grass prairie, then, other factors being equal, in the years intervening between reduction of buffalo numbers and extensive grazing by domestic animals, we could expect that succession took place throughout the area with a resultant increase of mid grasses. Although hardly conclusive, it is of interest to note that Clements, citing a belief of pioneers that blue stems followed in the wake of settlers and drove out the buffalo grass, believed that this renewed growth of taller grasses did occur (Weaver and Clements 1938), and from Carretson (1938) we have the following positive statement:

> The buffalo grass lasted a few years after the buffalo were gone and then it was replaced by what is known as blue-joint grass.
>
> The grass first appeared on the eastern edge of plains in small patches which soon grew into each other, hiding the buffalo grass wherever it grew. As the buffalo disappeared the blue-joint steadily advanced westward until it had completely covered the buffalo grass plains.
>
> Buffalo grass has not become entirely extinct, however, although it has everywhere retired before the encroaching blue-joint, and it is now to be found only in comparatively small patches....

Possibly to be construed as evidence supporting such an interim growth of mid grasses are the photographs taken in 1870 by the Hayden Expedition, which Clements used in support of his conclusion that the undisturbed cover of the Great Plains was dominated by mid grasses, for by 1870 the buffalo were well on their way to extirpation (cf. Larson 1940). Again, even if such a growth of mid grasses did occur, it could also have been caused wholly or partly by climatic fluctuation in the direction of more rainfall.

Climax Status

If the terminology of Clements' school of climax theory is to be applied to this association--and Malin (1956) has demonstrated the departure from realism of this concept of climax which presumes a state of nature before the intrusion of white man and which presumes climate, in an environment where disturbance is the norm, the major vegetation-determining factor--then it certainly cannot be applied until more is known of both the historical and current status of the association.

Further Research

The overriding conclusion to be drawn from this examination of the history of the short-grass plains is that our knowledge and understanding of this association are surprisingly deficient, that not only is additional research--historical, experimental, and observational--necessary, but, also, our

present knowledge needs critical reappraisal. In addition to the climatic aspects discussed here, the edaphic relationships of the association also require investigation. Specific questions to be answered are the following: (1) How do past and present extents of the association compare? (2) What is the climatic history of the area? (3) Is the climate now potentially suited to mixed-grass prairie over all, only part, or none of the area, and was the situation the same prior to white settlement? (4) What factors other than grazing by bison were important in the pre-settlement ecology of the association? (5) Did extensive growth of mid grasses occur in the latter years of buffalo reduction, and, if so, in what specific areas? (6) How did the period of such growth, if it did occur, compare with the pattern of climatic fluctuation?

THE POST OAK-BLACKJACK WOODLAND

A large area in Oklahoma today is occupied by the post oak-blackjack woodland association (Fig. 1), composed primarily of the two xeric species of oak, Quercus stellata and Quercus marilandica, after which it is named. This community, known at least in part to the early traveler as the "Cross Timbers," extends from Kansas south across Oklahoma into Texas, where it is bifurcated into two projections separated by a broad Grand Prairie (Fort Worth Prairie). Bruner (1931) and Weaver and Clements (1938) referred to the association as savannah. According to Bruner, in Oklahoma it is characterized by varying degrees of dominance of woodland and grassland, depending upon soil: "... in general throughout the savannah, rocky outcrops and sandy areas are characterized by woodland while the finer textured soils are occupied by grasses." This restriction of the woodland to soils of coarse texture is a widely recognized relationship (Carter 1931, Weaver and Clements 1938, Tharp 1939, Dyksterhuis 1948, Weaver and Albertson 1956) and was also noted by Marcy (Foreman 1937, 1939) and Michler (1850), among other early chroniclers.

Although edaphically controlled, this woodland community was regarded by Bruner (1931) as essentially a transition between forest and grassland. In forest-prairie transition

areas elsewhere, a great deal of evidence has been accumulated to indicate that timber has increased either in extent or in density since white settlement. In both popular and scientific opinion, the pre-settlement treelessness of areas which seemed suited to forest growths has been widely attributed to prairie fires, and the growth of timber since settlement in many such areas, to the subsequent elimination or reduction in the incidence of these fires. Among the proponents of this theory were Shaler (1915), who thought fires to have been responsible for the existence of extensive prairies in western Kentucky, and Gleason (1913), who concluded that the location of isolated groves on the eastern side of prairie sloughs in central Illinois was due to the protection from fires afforded by the water barrier. Similarly, Dickens (1928) believed the elimination of prairie fires since the settlement of Kansas explained the increase of timber along the streams and ravines of that state, and James (1905) attributed post-settlement growth of timber in Missouri to the same cause. Bessey (1897) remarked upon an eastward advancement of pines in western Nebraska in areas "... where the fires have been kept out, and where cattle are not allowed to destroy, and man is himself not too actively engaged in the work of forest destruction." For Oklahoma, Bruner (1931) claimed of the tongue of eastern grassland entering the state from Kansas, "Because of the recurrence of prairie fires, forest has not developed, but there is abundant evidence that forests are replacing the prairies since the settlement of the country and the cessation

of fires."

Others believed a change of climate since settlement to have been responsible for the increasing timber. This explanation was discounted by Malin (1956) whose historical studies led him to recognize a widespread post-settlement growth of new timber in many transitional areas and to grant the role of the elimination of prairie fires in allowing this new growth.

Did a similar increase in density or in extent of post oak-blackjack timber occur after settlement in Oklahoma? If so, was reduction of prairie fires an important causative factor?

At least one author, the historian Foreman, answered both questions in the affirmative. In commenting upon a passage from Simpson's narrative of his journey with the Marcy expedition of 1849 in which Simpson described "a very high prairie, of an extent only limited by the horizon beyond you. ... seldom dotted with a tree, except upon the water courses and ravines," Foreman (1939) remarked that,

> This section of Pontotoc and McLean [sic] counties [between Edwards and Fort Holmes near the south bank of the Canadian River; see Fig. 2] is now well covered with timber. It is a fact not generally realized, but demonstrable from historical records supplemented by scientific research and the testimony of old people still living, that the timbered area of Indian Territory has greatly increased in extent with the passing of the years. Great expanses of Oklahoma known as the "Plains" when they were barren of timber many years ago, later took on forest growths indigenous to the country, that expanded until beautiful wooded aspects today characterize most of the country. ... Without attempting a scientific explanation of this phenomenon, it is illuminating to note that of old-timers who say that since the white man began settling the country, prairie fires, often set by Indian hunters to start the game from covert, have become less frequent and destructive,

and tree life has been permitted to grow and extend its area.

The Cross Timbers alone seemed successfully to resist the prairie fire; and it was the contrast between this area of stunted woodland, and the broad expanse of treeless prairies, that made the Cross Timbers a phenomenon of note to early travelers, a distinction that has well nigh disappeared with the growth of timber on the adjoining prairies. This feature of our early travelers and map makers is now unknown to cartographers and students.

To the foregoing may be added the following general statement of Gregg (1905):

> Indeed, there are parts of the southwest now thickly set with trees of good size, that, within the remembrance of the oldest inhabitants, were naked as the prairie plains; and the appearance of the timber in many other sections indicates that it has grown up within less than a century.

In a modern study of the Western Cross Timbers of Texas, Dyksterhuis (1948) concluded an increase in the density of oaks since settlement. The resulting widespread change from an original savannah to the present predominantly woodland physiognomy he attributed to intensive overgrazing which he believed operated in two ways to favor the increase in coverage by woody species, (1) by reducing the competition for moisture experienced by the oaks and (2) by preventing the accumulation of sufficient fuel for hot ground fires which once killed young oaks and the lower branches of the larger trees. Weaver and Albertson (1956) believed there occurred, as the result of overgrazing, an increase of woody growth throughout the association.

In the following discussion, accounts of the woodland written by early travelers are examined in an attempt to determine the "original" nature of the association and therefore to detect what, if any, changes have occurred in extent or in

density of timber since settlement. Since prairie fires may have played an important part in determining the character of the pre-settlement woodland, observations of fire or of evidence of fire are also noted.

The Association Between the Canadian and Red Rivers

The most frequently traveled routes through the area of pre-settlement Oklahoma lay between the Canadian and Red rivers. The chronicles of early expeditions through this area make one fact readily apparent: the "Cross Timbers" encountered there by the early chroniclers occupied only a portion of the area which recent maps show as post oak-blackjack woodland. Supporting this conclusion is Marcy's general description of the nature of the "Cross Timbers" (Foreman 1937) in which is found his estimate of its extent:

> This extensive belt of woodland, which forms one of the most prominent and anomalous features upon the face of the country, is from five to thirty miles wide, and extends from the Arkansas river in a south-westerly direction to the Brazos [River of Texas], some four hundred miles.
>
> At six different points where I have passed through it, I have found it characterized by the same peculiarities; the trees, consisting principally of post-oak and black-jack, standing at such intervals that wagons can without difficulty pass between them in any direction. The soil is thin, sandy, and poorly watered.

Marcy's estimate of the width of the "Cross Timbers" is corroborated by the accounts given by other travelers in the same region. Gregg (1905), for instance, formed the same estimate of its breadth--varying from five to thirty miles. Beale (1860) judged the belt to be from five to fifty miles wide; Carleton (Foreman 1930), ten to fifteen.

Michler (1850), Marcy (Foreman 1939), and others found this "Cross Timbers" between the Canadian and Red rivers composed of two separate belts of timber, the "Lower" (easternmost) and the "Upper" (westernmost) Cross Timbers. According to Michler (1850), at the point near Fort Washita at which he crossed them the eastern band was ten miles broad, and the western band, fifteen. The intervening prairie he found to be fifteen miles wide and "entirely destitute of timber."

Comparison with a recent vegetational map (Fig. 1) will show that these estimates are hardly representative of the current extent of the association and also that a distinction between two belts of timber is not readily apparent. What part of the present association was then once "Cross Timbers"? In the report of his exploration of 1851, Marcy (Foreman 1937) pin-pointed this landmark; speaking of a journey west from Fort Arbuckle, he described the route of a wagon trail which he established:

> ... the road for the first six miles follows up the valley of Wild Horse Creek in a direction south (50) degrees west, when it bears a few degrees south and passes through a gap in a chain of low mountains which run nearly parallel with the course of the creek; it then enters the Cross Timbers, there twenty miles wide and composed (as at other points) of post oak and another variety of oak called "black-jack," generally short, crooked and scrubby, but the trees standing at such distances, that but little labour is required in clearing out a road for wagons. ...
>
> At thirty-one miles from Fort Arbuckle the road emerges from the timber and enters the grand prairie, and from this point with the exception /of/ here and there a spot, there is but little good timber. Six miles from the outer edge of the Cross Timbers the road crosses a small stream about fifteen feet wide called "Mud Creek," which is very appropriately named.

The "Cross Timbers" described by Marcy then lay between Fort

Arbuckle and Mud Creek (cf. Fig. 2). His account of 1852 (Foreman 1937) again demonstrates the "Cross Timbers" to have been west of Fort Arbuckle; on this occasion he was traveling eastward from the plains toward Fort Arbuckle and entered the Cross Timbers at their western border:

... we were in motion ... in a course nearly due east, down the right bank of Wild Horse creek for eight miles, when we entered the Cross Timbers upon the ridge dividing this stream from Mud creek (an affluent of the Red river which puts in above the Washita).

They continued through the Cross Timbers on the next day, and on the third day,

As soon as it was sufficiently light to enable us to see the trail this morning, we started on, keeping the old wagon trace through the timber for eight miles, when it led up into the road I had made the last season [described above], between Fort Arbuckle and Fort Belknap [Texas], at a point fourteen miles from the former post.

* * *

Two miles after striking the road [i.e., 12 miles from Fort Arbuckle] we emerged from the Cross Timbers, and passing over a range of low mountains lying south of Wild Horse Creek valley, encamped nine miles from Fort Arbuckle.

Farther north, along his route of 1849 near the south bank of the Canadian River, Marcy (Foreman 1939), describing his position as nearly opposite Fort Holmes (Fig. 2), wrote,

The country we have passed over to-day has been entirely prairie, with the exception of a few scattering trees upon the borders of the branches heading near the crest of the "Divide" [between the Canadian and Washita rivers]. As we are now near the eastern borders of the "Lower [eastern] Cross Timbers," I shall start out in the morning and endeavor to find a good road to pass our wagons through.

In searching for this route, he discovered that the "Divide" followed a circuitous route "... and extended some fifteen miles before it came out upon the prairie west of the [Lower or eastern] 'Timbers.'" In returning to camp, he followed

Walnut Creek (Fig. 2) which ran "almost a due east course, between the 'Cross Timbers' and the Canadian." When the party finally got under way, they emerged upon "the large prairie between the two 'Cross Timbers'" at a point near the head of Walnut Creek.

Marcy's descriptions of the boundaries of the "Cross Timbers" were among the most specific encountered, but among others who agreed with him in locating the eastern limits of the Cross Timbers immediately to the west of Fort Holmes were Simpson (1850), who accompanied Marcy's 1849 expedition, Whipple (Foreman 1941), and Gregg (1905). Simpson (1850) specified coming upon the Cross Timbers "2 or 3 miles" west of Fort Holmes. "These timbers [two belts and intervening prairie] continue for a distance of about sixty-six miles...." (ibid.). Hitchcock (Foreman 1930) found that the Cross Timbers crossed the Red River forty miles west of the mouth of the Washita River, and Kichler (1850), traveling west from Fort Washita, encountered them nineteen miles west of the Washita.

These descriptions serve to locate the pre-settlement "Cross Timbers" of the area between Canadian and Red rivers on the western edge of the present post oak-blackjack woodland association. Examination of the vegetational map of Fig. 1 will show, on the western extreme of the present association, an almost continuous body of woodland which, from the Red River, extends to the west of north and splits into two well-defined lobes. These lobes continue north, the eastern

terminating at the Canadian River and the western extending in patches across and along the north side of that river. This western portion of the present association undoubtedly corresponds to the "Cross Timbers" of which the foregoing travelers spoke. Further evidence to this effect may be inferred from the statement of Gregg (1905) that,

> South of the Canadian, a branch of these Cross Timbers projects off westward, extending across this stream, and up its course for 100 miles or so, from whence, it inclines northwest beyond the North Fork [North Canadian], and ultimately ceases, no doubt, in the great sandy plains in that direction.

That travelers in this area between the Canadian and Red rivers apparently found the "Cross Timbers" at the western extreme of the present association does not mean that to the east of the "Cross Timbers" the woodland did not then exist. Whipple (1855) said of the eastern area, "The ravines were wooded, and patches of timber were scattered at irregular intervals along the route, forming detached portions of the Cross Timbers." Gregg (1905) specified that this eastern woodland was "mostly oak of various kinds, of which blackjack and post oak predominate," and added,

> From the Arkansas river to Chouteau's Fort [another name for Fort Holmes--near "the extreme edge of the far famed 'Cross Timbers'" (ibid.)] our route [in 1839] presented an unbroken succession of grassy plains and fertile glades, intersected here and there with woody belts and numerous rivellets....

Later, in 1840, he remarked, "The uplands from the Arkansas boundary to the Cross Timbers, are everywhere beautifully interspersed with isolated prairies and glades...." (ibid.). Similar to these descriptions was that by Kendall (1847) of

the woodland south of the Red River in present Texas: "On the eastern side of the Cross Timbers the country is varied by small prairies and clumps of woodland...."

The 1842 narrative of Hitchcock (Foreman 1930) presents another general picture of the vegetation found to the east of the "Cross Timbers." The following description was recorded by him when in the vicinity of Edwards (Fig. 2):

> ... we passed a few miles of as beautiful prairie as I almost ever saw.... We came upon its beauty suddenly by ascending a hill of easy aclivity, from the summit of which I looked off to the right and had every possible variety in view--hills with and without timber valleys, with and without timber and plains the same....

Southwest of Edwards, near Boggy River, he pictured the view similarly: "... part prairie strips of woods and spots of wood and streams marked by timber waving through the country; the sight bounded by hills south of Boggy, partly bare and in part timbered...."

The writings of Nuttall (1905) describing the association at its extreme southeastern limit in the state, along the Red River, indicate interspersed woodland and prairie also, the woodland of a dense and thicketed nature.

Thus, the historical record pictures the pre-settlement post oak-blackjack association in the area between the Canadian and Red rivers as composed of an eastern area of rather scattered clumps of oak timber, bordered on the west by a relatively narrow, more prominent belt of timber, the "Cross Timbers." The descriptions which have been quoted lead one to believe that it was the continuity of the "Cross Timbers," as opposed to the parkland aspect of timber to the east, which

provided, at least in part, the contrast causing travelers to distinguish it from the remainder of the association and to apply to it the special name. Origin of this difference was undoubtedly edaphic. Extensive prairies bordering the belt, especially along the much traveled route immediately south of the Canadian River, may have emphasized the contrast.

Suggesting that the "Cross Timbers" in this area was once largely savannah, in the sense of an open woodland of scattered trees with grass understory, is the summation of Marcy's contact with it, contained in his report to the Adjutant General of his exploration of 1852 (Foreman 1937): "At six different points where I have passed through it, I have found ... the trees ... standing at such intervals that wagons can without difficulty pass between them in any direction." Marcy similarly emphasized the open nature of the woodland at another point within his narrative: "... the trees standing at such distances, that but little labour is required in clearing out a road for wagons" (ibid.). To quote Möllhausen (1858) on the same subject, "Throughout their whole extent the Cross Timbers show the same character; the trees are chiefly dwarf oaks, standing with such wide spaces between them that waggons can drive through with great ease...." Möllhausen's limited acquaintance with the association hardly justified such a broad conclusion; these words, so similar to Marcy's, are very likely based on Marcy's report. In contrast to Marcy, Michler (1850), upon his contact with the "Lower Cross Timbers" west of Fort Washita, found the timber a

somewhat denser growth: "To pass through it we were compelled to follow old Indian trails, cutting our way wherever the wagons could not pass." Gregg (1905), too, found the growth dense upon occasion: "The underwood is so matted in many places with grapevines, greenbriers, etc. as to form almost impenetrable 'roughs' which serve as hiding places for wild beasts, as well as wild Indians...." These passages emphasize the variation in density of woody growth which one would expect to have existed, probably in response to soils, through the "Cross Timbers." Still, recalling the varied contacts of Marcy with this belt of timber and the nature of the report from which his words were taken, that of an officer to his superior, it seems reasonably safe to place our confidence in his reliability and tentatively to conclude that the "Cross Timbers" in this region was predominantly savannah.

Concerning the larger eastern area of the association, the descriptions quoted clearly demonstrate its parkland nature; it was an area of alternating woodland and grassland. Some of the quoted passages give the impression of a preponderance of grassland in the region, others, of a preponderance of woodland. Only one author, Nuttall, was found to indicate density of timber within a wooded portion of this eastern parkland.

The Association North of the Canadian River

Explorations touching that portion of the association north of the Canadian River were much less numerous than those

to the south. One in particular, however, was very well documented, that of a party including Ellsworth (Williams and Simison 1937), Irving (McDermott 1944, 1956), and Latrobe (1835), who, in the fall of 1832, traveled a circuitous route from Fort Gibson up the Arkansas and Cimarron rivers, passing southward from the Cimarron to emerge from the woodland somewhere south of modern Oklahoma City near the Canadian River, and then re-entered the association, crossing the North Canadian and Deep Fork in returning to Fort Gibson. In this area, as demonstrated south of the Canadian River, a western "Cross Timbers" was evidently distinguished from the remainder of the association. The map of their route (McDermott 1944, 1956) clearly shows that, on the day on which they reached the "Cross Timbers" along the north bank of the Cimarron, they were well within the present area of woodland. The words of Irving (McDermott 1956) describe the eastern woodland as he encountered it and record his first sight of the "Cross Timbers":

> We now [Oct. 20] came once more in sight of the Red Fork [Cimarron], winding its turbid course between well-wooded hills, and through a vast and magnificent landscape. The prairies bordering on the rivers are always varied in this way with woodland, so beautifully interspersed as to appear to have been laid out by the hand of taste; and they only want here and there a village spire, the battlements of a castle, or the turrets of an old family mansion rising from among the trees, to rival the most ornamented scenery of Europe.
>
> About mid-day we reached the edge of that scattered belt of forest land, about forty miles in width, which stretches across the country from north to south, from the Arkansas to the Red River, separating the upper from the lower prairies, and commonly called the "Cross Timber."

What foreknowledge they possessed of the location, nature, and

extent of the "Cross Timbers" was evidently obtained, at least in part, from Colonel Arbuckle, commandant of Fort Gibson, as indicated by the following quotation of Ellsworth (Williams and Simison 1937):

Before we started, Col Arbuckle, told us many frightful stories, about the cross timbers, and we expected more difficulties /th/an we found--there is a range of country about 80 miles west of Fort Gibson extending from the Arkansaw on the north to Red river, covered with oaks and occasionally a few other trees--the width will average 30 miles But the soil is not the same, as has been represented--it is a mixture of wood & small prairies.

Irving's description of the woodland he saw east of the "Cross Timbers" is of a parkland. His comments regarding the previous days' journeys were similar (McDermott 1956):

/Oct. 11/ Beyond the river, the eye wandered over a beautiful champaign country, of flowery plains and sloping uplands, diversified by groves and clumps of trees, and long screens of woodland; the whole wearing the aspect of complete, and even ornamental cultivation, instead of native wilderness.

* * *

/Oct. 14/ ... wide views stretching on one side over distant prairies diversified by groves and forests,...

* * *

/Oct. 15, within sight of the confluence of Cimarron and Arkansas/ ... a country diversified by rocky ridges and waving lines of upland, and enriched by groves and clumps of trees of varied tuft and foliage.

* * *

/Oct. 16/ Having passed through the skirt of woodland bordering the river /Cimarron/, we ascended the hills, taking a westerly course through an undulating country of "oak openings," where the eye stretched over wide tracts of hill and dale, diversified by forests, groves, and clumps of trees.

Here we may take up Ellsworth's narrative (Williams and Simison 1937):

/Oct. 16/ The land during the first 10 miles was high & rolling--generally timbered with oak though here & there a prarie /sic/--too stony for tillage--better fitted for grazing--The last part of the days journey carried us through a more stony country and more barren soil--

* * *

[Oct. 19] The soil today was light--oak openings--

* * *

[Oct. 20, the day on which they first sighted the "Cross Timbers"] You well know that the barren prairies are the great objection to this country--The public are uninformed--The praries [sic] are not so extensive, as some suppose It is true the majority of the land is prairies, but they are divided by streaks of timber--rarely very rarely are you out of sight of timber--

Once in the "Cross Timbers" the party found traveling more difficult. In the words of Latrobe (1835):

None of our party I think will ever forget that hilly stony region, with its almost impenatrable forest of the closest and harshest growth, whose low rugged branches, black and hard as iron with the extremes of frost and fires, cost us many a fierce scramble and struggle on our passage both to and from the Canadian.

Similar complaints were registered by Irving on many occasions (McDermott 1944, 1956). Ellsworth (Williams and Simison 1937), however, had the following to say:

I fear you will have too bad an opinion of these cross timbers--they are the butt of our company and yet the travelling through them is not near as difficult as I imagined it would be. Capt Beans says "he had quite as lives travel in these woods as on the dry open prarie [sic]" I am not of this opinion but the obstacles we met with, were far inferior to travelling on any point of compass in Connecticut without roads--even here, if we had time, a fine road might be selected, avoiding the hills and roughest places, and lead us through rich valleys--such a selection would give very different impressions to the passing traveller--We ought therefore to receive the condemnation of men who have been irritated by scrtaches [sic] from briars and scrub oakes, with many grains of allowance--

Having re-entered the "Cross Timbers" from the western side on the return journey, Irving (McDermott 1944), approaching the North Canadian on November 1, recorded, "Fatiguing march over hills through deep ravines of parched dwarf oaks with flesh tearing twigs, through tangled thickets...." On the next day's march, which took them across the North

Canadian, they passed over "... a broken hilly country covered with Scrub oaks with interlacing limbs as hard as iron and intersected by deep ravines of red clay" (ibid.). During the journey of the days following, the growth evidently became less dense, for on November 3 they passed through "open oak forests" (ibid.), and on November 4, nearing the Deep Fork, "fine prairies like park scenery" (ibid.).

Another early traveler in this region was Nathan Boone (Fessler 1929). In May of 1843 near present Pawnee, Oklahoma, he observed that, "The country was much broken timber post oak and black jack openings, and prairie, the soil sandy and in some places the black jack on the hills appeared to be dying; no doubt attributable to the dry season."

The picture presented of the pre-settlement post oak-blackjack woodland north of the Canadian River is therefore quite similar to that of the woodland between Canadian and Red rivers--an eastern area of parkland and a western, more continuous "Cross Timbers." Concerning the density of the "Cross Timbers" in this area, the reflection of Ellsworth (Williams and Simison 1937) to the effect that "... the obstacles we met with, were far inferior to travelling on any point of compass in Connecticut without roads--" may perhaps be the most realistic presentation of the situation; these words suggest a rather open woodland. A comment by Latrobe (1835) concerning the "Cross Timbers" in general, "Properly speaking there was no undergrowth but a coarse grass," is similarly suggestive of savannah. In considering the words

of Latrobe and of Irving concerning the difficulty of passage through the timber, it should be noted that the Ellsworth party undoubtedly had their difficulties multiplied by the rough topography and the fact that they traveled in a general north-south direction through the "Cross Timbers," at right angles to the largely east-west orientation of streams and ravines in this section. Still, the existence of large areas of thicketed woodland is undeniable; a conclusion assigning relative predominance to savannah would be ill-advised. Evidence concerning density of timber in wooded portions of the eastern parkland is even less adequate.

Prairie Fires

Since the post-settlement increase of timber in other areas has frequently been attributed to the elimination or reduction of prairie fires consequent to settlement, it is illuminating to note the frequency of observation of prairie fires from the exploratory period and the opinions of the chroniclers concerning the effect of fires upon the vegetation. The journals leave no doubt that prairie fires were once characteristic of the state as a whole, especially in the autumn and winter months, when dry grasses were easily ignited and when stiff breezes made small streams and ravines ineffective barriers to the fires. Few early travelers failed to include in their diaries records of encounters with prairie fires or with scorched prairies.

Möllhausen (1858) in late August of 1835 gave a vivid

account of a prairie fire in the present post oak-blackjack woodland area, just to the west of Fort Arbuckle:

The wind, which was from the west, had been all day driving towards us clouds of smoke, which slowly floated before the breeze, or were more rapidly dispersed by a stronger gust. It was evident that as far as we could see from north to south, the prairie was in flames, and the fire was driven rapidly by the increasing wind over the high grass towards the east.

He went on to give his explanation for the origin of many such fires:

Although these fires in the prairies frequently arise from accident, or the carelessness of travelling or hunting Indians, it does sometimes happen that they are intentionally kindled by the inhabitants of the steppes, who burn great tracts of the plains to favour the growth of young vigorous grass. From among the singed stubble, fine blades shoot up in a few days, and the whole surface is soon clothed again in bright green and has the appearance of a well cultivated corn-field where the young corn is just springing up; and then the Indians proceed thither with their herds of cattle, after they have first kindled a fire in another district.

It is, nevertheless, a matter of no unfrequent occurrence that one of these intentionally kindled fires proves the destruction both of the cattle and of the Indians themselves; for though any one can light the fire, at almost any part of the waving grassy plains, it is often beyond any human power to control it after it is lit, when a storm wind arises to drive it over the boundless surface.

Other travelers also emphasized the role of the Indian in starting prairie fires:

There are many modes by which the fire is communicated to them [the prairies], both by white men and by Indians--par accident; and yet many more where it is voluntarily done for the purpose of getting a fresh crop of grass, for the grazing of their horses, and also for easier travelling during the next summer, when there will be no old grass to be upon the prairies, entangling the feet of man and horse, as they are passing over them. (Catlin 1926)

The Indians burn portions of the prairie every fall, setting the fires so as to burn as vast an extent of country as possible, and yet preserve unburned a good section in the vicinity where they purpose to make their fall hunt. The buffalo, finding nothing to eat on the burnt ground collect on that unburnt--reducing greatly the labour of the hunt. (Dodge 1877)

Although these fires are sometimes started by accident, yet they are more frequently kindled to afford easier traveling for the Indians, and to secure a fresh crop of grass for their horses. (Glisan 1874)

Irving (McDermott 1944) included in his journal notes on "Ringfires--made by Indians on prairies to drive game to a point--a few men will run from point to point and make a range of fires for miles." Another motive was advanced by a later writer (Inman 1899):

> Some of the most awful [prairie fires] in their results were purposely started by the Indians, who were jealous of the constant encroachment of the whites upon what the savage was pleased to call his own domain, and adopted this method, among their many devilish plans of driving off the intruders whose cattle and horses suffered fearfully by being deprived of their pasture in this manner.

Whatever the truth in the various motives adduced, the above quotations stress the importance placed by the chronicler upon fires in general and upon the Indian in setting them.

Whipple (1855) in 1853 recorded an apparently reliable instance of the setting of such fires by Indians:

> One of the party being ahead to-day, looking for water, discovered two Indians setting fire to the prairie. ... The fire which had been kindled threatened camp, and we were obliged to burn a wide space around us for protection. At night its appearance was sublime. Huge waves of flame, with a roaring sound like that of the ocean, were rolling over the rank grass, and rushing onward with fearful rapidity. In camping upon the dry prairie, it requires constant vigilance to avoid the catastrophe of a conflagration. Many a party has, by carelessness in this respect, been reduced to a destitute condition.

Whipple's journal includes descriptions of burning prairies on two later occasions. The narrative of Glisan (1874) also contains an account of fire charged to Indians:

> The band of Creeks, which passed our camp [near Fort Arbuckle] last October [1850] fired the prairie nearby.

* * *

After witnessing the feeble flickering of the prairie fire just mentioned, I began to suspect that travelers had drawn largely on their imagination to call such conflagrations sublime. I did not make sufficient allowance for the greenness of the grass, the absence of strong wind, and presence of daylight. A few weeks subsequently, when the grass had become withered and parched, the surrounding prairies caught fire in various places. The strong wind prevailing at the time was soon accelerated by the heat into a huricane--thus causing the fiery element to spread with amazing rapidity....

Sitgreaves and Woodruff (1859), in 1850 between the Cimarron and Canadian rivers in the western part of the state, mentioned "a large extent of the prairie [which] had been recently burnt by the Comanches in their system of manoeuvering the herds of buffalo."

First hand observation of the setting of signal fires and an instance of their spreading was related by Tixier (McDermott and Salvan 1940) while accompanying a band of Osage near the Great Salt Plains in July of 1840:

Toward nightfall, fire was set to the prairie to let the band of Ouachinka-Lagri [Osage chief] know of the return of our warriors. A cool wind pushed forth the flames with great rapidity and when it was quite dark we saw a long trail of fire burning through the prairie with a crackling similar to that of crumpled dry brambles stirred by the wind.

* * *

The prairie fire had driven the bison away ... the fires of Ouachinka-Lagri announced it was time to join him.

* * *

Going south [from the place at which the fire had been set]. we had to cross a desolate country. The earth was covered with black cinders and half-burned grass. A few trees, their leaves reddened by the fire, showed that this destructive element had raged here [the fire which they had set?].

* * *

We waited for several days for the fires which were to announce the arrival of the Patoka [Comanches] or Ouachinka-Lagri. Nothing came, so it was decided that we should go and get salt at the Great Saline (Niskureh-Tanga) and that the fire set to the prairie would let the Comanche know of our arrival, if they were around.

That the travelers themselves were responsible for the setting of an occasional fire is shown by the mention by Beale (1860) of a fire which broke out from the camp of the expedition's military escort.

Burnt prairies were encountered by the Ellsworth expedition of 1832, on November 1st, south of the North Canadian River in the post oak-blackjack woodland area (McDermott 1944). The account by Ellsworth (Williams and Simison 1937) on the next day is particularly noteworthy in describing the effect of fire in burning small woody growth to the ground-line:

> We saw that fires were burning all around us, and that the large prairies in front were all black, with the ravages of that element--Food is not only entirely cut off, where the conflagration rages, but the stubble left is very painful, for the horses feet--not only thatch, but small bushes, are burnt even with the ground; and as soon as the horse presses his weight upon them, they too frequently run into the fray and make him lame--I am thus particular in mentioning all these circumstances, as they are the constant anxiety of the traveller through these praries [sic] in the fall and early spring--

On November 7th they "... travelled later than any day before in consequence of the burning the prairies which destroyed the forage and we sought for [a] creek where the fire had been stayed--" (ibid.). Later in the month, Latrobe (1835) described a fire observed on the Arkansas River below Fort Gibson:

> As evening approached our attention was rivetted to the opposite banks of the river, from the prairie beyond which a dense smoke had been driving along the horizon the whole day. It was evident that the flames were approaching the river, and as it became dark, they gained the edge of the prairie. They first got into the cane-brake, crackling like a continued peal of musketry, and then burst into the wood of cotton trees over against us. Here urged by the wind, they continued raging for an hour with the greatest violence....

Members of the Ellsworth party also made note of the effects of fire upon the timber in the post oak-blackjack woodland:

> The fires made on the prairies by the Indian hunters, had frequently penetrated these forests, sweeping in light transient flames along the dry grass, scorching and calcining the lower twigs and branches of the trees, and leaving them black and hard,... (Irving, McDermott 1956)

> The fires of the Prairies, extend through the cross timbers, and the shrubby [sic] oak, whose branches are proverbially tough, naturally, become doubly so, by being burnt--they appear dead to the eye of the traveller, but are so unyielding, as to tear alike his flesh and clothes, without mercy--(Ellsworth, Williams and Simison 1937)

Nuttall (1905) found the situation similar in the extreme southeastern extent of the association in the state; he described "woods covered with dwarfish post and black oaks, which having been burnt were extremely difficult to penetrate."

Before leaving the subject of prairie fires, it is interesting to note the comments of Dodge (1877) concerning the effect of fire upon growth of bottomland timber on the western plains:

> These prairie fires, which were formerly supposed to account for the treelessness of the plains, have really comparatively little to do with it. On the high prairie the grass is very short. When on fire, the blaze, from six to fifteen inches high, moves over the ground slower or faster, according to the wind, but not with vitality or heat enough to seriously injure a bush of a few inches in diameter. Yet the high prairie is bare. In the canons the grass is often five to ten feet high, and dried leaves, shrubs, bushes, vines, furnish a storehouse of fuel, sufficient to make a roaring vortex of twenty feet of flame. And yet the canons are full of vegetation. The only occasion where fire acts a prominent part as a cause of the treelessness is at the lower ends of the canons, where the bottoms widen out, and the hills, becoming lower are more remote, and afford less protection from the wind. Trees will grow in such positions, but not so stubbornly as in the canons. The fire in the long grass about their trunks, fanned by the winds to which they are exposed, will destroy

the smaller, and so burn the trunks and branches of the larger trees as frequently to kill them. In many such places the islands in the stream which fire cannot reach will be covered with fine trees and thick vegetation, while the contiguous banks are as bare as any portion of the high prairie. On many streams, particularly on the North Platte, some of the narrow bottoms of the canons are covered with splendid trees, large and old, without any small young trees, or a particle of underbrush. This is undoubtedly the effect of fire, and proves, I think, that prairie fires were not so frequent a hundred years ago as now.

As the settlements creep up the stream, and care is taken to prevent fires, the young trees spring up, and, as the growth of cotton-wood is extremely rapid, all the ground suited to their propagation is soon covered.

These comments, although concerning bottomland timber of the plains in general, are pertinent in that they describe the thinking of an experienced plainsman on the subject of the effect of fire upon timber. Also, it may be reasonably assumed that the effect of fire upon bottomland timber in grassland areas and its effect upon the association under consideration would have been similar.

The accounts pertaining to prairie fires which have been quoted need little further comment. They vividly demonstrate that fires were both frequent and destructive in the area.

Has the Timber Increased Since Settlement?

No evidence was found in the early literature which, without field comparison, would indicate a more restricted extent of timber in the association before settlement than at present. Early accounts did, however, suggest that in the "Cross Timbers" between the Canadian and Red rivers the association was predominantly savannah, rather than woodland or forest, although density of timber obviously varied. This

prior predominance of savannah would represent a difference from the present predominantly woodland physiognomy and would mean that woody growth within a part of the association has increased in density since settlement. The documented evidence of the wide pre-settlement incidence of prairie fires is, in itself, strong evidence for an increase in timber density if one accepts the theory that, in areas of close competition between timber and grasses, action of recurrent fires is to destroy seedlings and small trees and thus to favor grasses. However, final proof of the increase of timber in this area awaits concentrated field study such as that performed in the Western Cross Timbers of Texas by Dyksterhuis (1948). It is quite possible that the conclusions reached by Dyksterhuis, concerning an increase in density of timber through the action of overgrazing in reducing competition for moisture and in reducing fuel for fires, will also prove applicable here. However, as with the short-grass plains, it must be remembered that the grazing factor was present long before the introduction of domestic stock and may conceivably have been little increased since settlement, although the restriction of cattle to specific areas by fencing must be considered in viewing this question.

Descriptions, from the explorers' narratives, of prairie fires and of their known and assumed origin stress the importance of the Indian in setting those fires. Acceptance of the role of fire in restricting woodland growth must acknowledge the part played by the Indian in this retardation. An

increase in the density of timber since white settlement may be interpreted in the broad sense of an effect of the change in the human factor, the actions of the Indian in actively setting fires and in passively doing nothing to prevent those started in other ways, replaced by the different culture of the white settler, who not only acted to restrict the "destructive element," but whose cattle reduced the fuel for such fires.

Climax Status

Description of the successional status of the post oak-blackjack association presents a problem which is illustrative of the practical difficulty in the application of the necessarily simple cause-and-effect classification of Clementsian climax theory to the complex organism of a natural community. The problem is different than that with the short-grass plains, where reflection shows that our information is hardly sufficient for intelligent classification. Here the problem is essentially inadequacy of the terminology in describing the situation. In this case, we are relatively certain that the climate is now, and was prior to settlement, one best suited to grassland and that the oaks were then, and are now, enabled to survive in this climate by the greater availability of water in the sandy soils of the area. These relationships, claimed by Weaver and Clements (1938), were substantiated by Dyksterhuis (1948) in a long-term investigation of the Western Cross Timbers of Texas. On the basis of these relationships

the association was designated "postclimax" by Weaver and Clements (1938), who considered the oaks relicts from a former moist phase of the climatic cycle. While the term "postclimax" is descriptive of the relict status of an association in the clisere--that is, descriptive of its position in succession over geologic time, through climatic change--and in this sense is also descriptive of the relative position of adjacent communities, it leaves much to be desired in describing the absolute status of a community in developmental succession at the present time, under the present climate. When viewed in this respect it becomes a contradiction of the concept of climax in the sense that, by Clements' definition, a climax is a climatic ultimate. Even in the former sense, although the relationships which the term is intended to express may be valid, the contradiction of words applies. One wonders if "relict" is not sufficiently expressive here to need no further amplification.

How is the position of this association in succession under the currently prevailing climate to be expressed? If we think of the ecosystem of which this community is a part as in an arrested state of development toward a climatic ultimate of prairie soils and prairie community, then a better descriptive might be "subclimax." Use of "subclimax" in this sense, however, does damage to the definitiveness of this term, for the woodland can hardly be considered the "stage preceding the climax" in any concrete, demonstrable sere. Therefore, more desirable might be a retreat to the more general descriptive,

"proclimax," including by definition "all communities that simulate the climax to some extent in terms of stability or permanence but lack the proper sanction of the existing climate" (Clements 1936). If, instead of accepting climax as defined by Clements, one regards as climax any relatively stable community not in the process of further progressive succession (cf. Tansley 1920, Dice 1952, Whittaker 1953), the pre-settlement community would be termed an "edaphic climax." This designation, in that it recognizes the importance of edaphic factors in controlling this community, seems more clearly and accurately descriptive than does "proclimax."

The changes which have apparently occurred since settlement, some evidence for which is contained herein, further complicate the problem of classifying this community's position in succession. Dyksterhuis (1948) granted the post-climax nature of the oaks claimed by Clements but, because of the changes in both overstory and understory since settlement, regarded the present vegetation as "disclimax" oak woodland. The question here, as with "subclimax," is whether or not it is advisable to stretch the original definition of the term to fit this situation. The present community would certainly seem to be the result of disturbance, but hardly a "modification or replacement of the true [climatic] climax," as disclimax was defined by Clements (1936); it is rather a modification of the "proclimax" or "edaphic climax" of the pre-settlement community.

The value of classification of communities according to

any of the schools of climax theory is in its succinct descriptiveness of successional status. Within the framework of their definition by Clements, none of his classifications is quite satisfactory, except perhaps the general term, "proclimax," for the community as it existed prior to settlement. The "edaphic climax" of other climax theorists, although better representative of the pre-settlement community than "proclimax," when applied to the currently existing community fails to communicate the changes which it has undergone since settlement. It is therefore best perhaps entirely to avoid the implicit oversimplification of such description. More important is the recognition of the reality of this association as a woodland community enabled by edaphic factors to survive in a grassland climate and in which density of the oak overstory has probably increased widely since settlement in response to a complex of factors, among which reduction in prairie fires was probably important.

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