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THE PRAIRIE OF THE MISSISSIPPI RIVER BLUFFS

BY B. SHIMEK

The rugged bluffs along the upper Mississippi river, particularly those which border that part of the river flowing between Iowa and Wisconsin, display irregular treeless tracts on their slopes which are sure to attract the attention of observers who travel along the river either by water or by land.

Very few of these treeless areas on the more rugged bluffs are artificial clearings. The great majority are natural openings, and there is no evidence to show that they were ever covered with forest. On the contrary, their location indicates that the absence of trees is due to natural causes, and that they are of long standing.

The student of plants is soon impressed with the fact that not only are trees absent from these areas, but that the smaller plants, mostly herbs, which cover them belong very distinctly to the prairie flora. In other words, it is clear that these treeless areas are simply prairie tracts distributed irregularly on the more exposed portions of the bluffs, or dominating on larger exposed surfaces.

This point cannot be emphasized too strongly. The writer has made extensive collections and observations on these areas both in Wisconsin and Iowa,¹ and without exception they have yielded a prairie flora, with only such variations as occur upon the broad interior prairie plains of Iowa and adjacent territory.

These prairie areas are sometimes more numerous and extensive on the bluffs of the Iowa side, and again on those of the Wisconsin side. Their distribution is directly related to the direction of the line of the bluffs as is noted in the subsequent discussion, but there is no appreciable difference in their flora. Such differences as have been noted are exactly comparable to those which may be observed in different parts of the general prairie area. In the following notes it will be observed that the number of species appears to be larger on the Iowa side, but this is due to the more extensive field-work done on that side of the river. The lists here given include only the species actually collected on the bluffs along that part of the Mississippi which lies between Iowa and Wisconsin, and those from the Wisconsin side are from the vicinity

¹ The collections are preserved in the Herbarium of the State University of Iowa.

of Prairie du Chien only. The few species recorded from the Wisconsin side which do not appear in the Iowa list have all been found along the lower course of the river in Iowa, and the larger number reported only from the Iowa side includes species all of which have been found by the writer on the eastern side of the river in Illinois.

The flora of the broader prairies in Iowa exhibits certain variations which are definitely related to differences in topographic and moisture conditions. Certain species, such as the gramma grasses, *Bouteloua hirsuta*² and *B. oligostachya*, *Castilleja sessiliflora*, the evening primrose, *Enothera serrulata*, the asters, *Aster ptarmicoides*, *A. sericeus*, and *A. oblongifolius*, the blazing star, *Liatris punctata*, and others, are found upon the drier ridges and knobs, always mingled with plants of the general prairie; other species, such as the blazing star, *Liatris pycnostachya*, the golden rods, *Solidago canadensis* and *S. serotina*, and others like them, prefer the more sheltered moist surfaces, while most of the species are distributed irregularly over the general prairie with its intermediate conditions.

The same variation is displayed in the flora of the bluff prairies, though neither extreme is conspicuous. Comparatively few of the very xerophytic plants characteristic of the dry knobs and ridges of the western prairies are found in this area, the gramma-grass, *Bouteloua hirsuta*, and the asters, *Aster oblongifolius*, *A. sericeus*, and *A. ptarmicoides*, constituting the principal representatives observed.

The plants of the average (rather dry) prairie are much more abundant. The following species were observed on both sides of the river: the grasses, *Andropogon furcatus*, *A. scoparius*, *Sorghastrum nutans*, *Panicum virgatum*, *P. huachucae*, *Stipa spartea*, *Agrostis hyemalis*, *Bouteloua curtipendula* and *Elymus canadensis*; the prairie willow, *Salix humilis*; *Comandra umbellata*; the anemones, *Anemone cylindrica* and *A. patens* var. *Wolfgangiana*; the alum-root, *Heuchera hispida*; the cinquefoil, *Potentilla arguta*; the prairie rose, *Rosa pratincola*; the leguminose plants *Amorpha canescens*, *Petalostemum candidum* and *P. purpureum*, *Desmodium canadense* and *D. illinoense*, *Lespedeza capitata* and *Amphicarpa Pitcheri*; the yellow flax, *Linum sulcatum*; the New Jersey tea, *Ceanothus americanus* and *C. ovatus*; the dogbane, *Apocynum cannabinum*; the milkweeds, *Asclepias verticillata* and *A. tuberosa*; the prairie phlox, *Phlox pilosa*; the puccoons, *Lith-*

² The nomenclature of Gray's Manual, 7th ed., is followed in this paper.

ospermum canescens and *L. angustifolium*; the mints, *Scutellaria parvula*, *Monarda mollis* and *Hedeoma hispida*; the ground cherries, *Physalis virginiana* and *P. pruinosa*; *Scrophularia leporella*; the northern bedstraw, *Galium boreale*; and the Composites, *Lactuca canadensis*, *Hieracium canadense*, *Kuhnia eupatoroides* var. *corymbulosa*, *Solidago speciosa* var. *angustata*, *S. rigida*, *S. nemoralis*, *Aster multiflorus*, *Antennaria plantaginifolia*, *A. neglecta* (?), *Heliopsis scabra*, *Rudbeckia hirta*, *Lepachys pinnata*, *Helianthus scaberrimus*, *Coreopsis palmata*, *Artemisia ludoviciana*, and the thistles, *Cirsium discolor* and *C. iowensis*. To these might be added the harebell, *Campanula rotundifolia*, which did not occur on the general prairie in Iowa but is very common on the prairies of Manitoba and North Dakota. In Iowa it occurs more commonly on rocky ledges, though it is quite frequently found on the prairie openings of the bluffs.

In addition to the foregoing species, which occur on both sides of the river, the following were found on the Iowa side only: the grasses, *Panicum Scribnerianum*, *Agrostis hyemalis*, *A. alba* var. *vulgaris* and *Koeleria cristata*; the sedges, *Carex pennsylvanica* and *C. festucaeae*; the blue-eyed grass, *Sisyrinchium campestre*; *Smilacina stellata*; *Potentilla canadensis*; the legumes *Baptisia leucantha* and *Astragalus canadensis*; *Oxalis violacca*; *Polygala Senega* and *P. verticillata*; *Viola cucullata*; *Zizia aurea*; the green milkweed, *Acerates viridiflora*; *Onosmodium occidentale*; *Scrophularia leporella*, *Gerardia aspera* and the lousewort, *Pedicularis canadensis*; and the Composites, *Lactuca ludoviciana*, *Liatris scariosa*, *Solidago missouriensis*, *Aster laevis*, the rosin-weeds, *Silphium laciniatum* and *S. integrifolium*, *Artemisia dracunculoides* and *Cirsium Hillii*.

The following were found only on the Wisconsin side: the prairie vetchling, *Lathyrus venosus*, and the foxglove, *Gerardia grandiflora*.

All of the preceding species were (and are) characteristic of the unbroken drier prairie and belong to the largest group of prairie plants, — those characteristic of the average prairie. With them were associated several species which show wide variation in habitat and which also occur on the prairie, especially along the borders. They are: the hazel, *Corylus americana*, the strawberry, *Fragaria virginiana*, the sumach, *Rhus glabra*, the poison ivy, *R. Toxicodendron*, the wild grape, *Vitis vulpina*, the heal-all, *Prunella vulgaris*, and Culver's-root, *Veronica virginica*. All are found on both sides of the river.

In addition to the foregoing there is a group of plants which are usually found in rather moist places on the prairies, but occasionally appear in drier places. In the bluff territory they are found on the more sheltered parts of the prairie tracts. They are: the grass *Muhlenbergia racemosa*, the meadow rue, *Thalictrum dasycarpum*, *Potentilla monspeliensis*, *Pycnanthemum flexuosum*, *Gerardia auriculata*, *Lobelia spicata*, the golden-rods *Solidago canadensis* and *S. serotina*, the sunflower *Helianthus grosseserratus*, and the white gentian, *Gentiana flavida*. The last was found on the Iowa side only.

There is also a group of native plants which are commonly found on the prairies, but which readily invade disturbed or cultivated areas. Most of them have become noxious weeds, and they were evidently weeds on the original prairie, for while on undisturbed prairie they were more or less mingled with the plants of the preceding lists, they were the first to take possession of the areas disturbed by gophers and other burrowing animals, or eroded by water. They take possession of areas disturbed by man equally readily. They are the following: the grasses *Poa compressa* and ³*Agropyron Smithii*; *Chenopodium leptophyllum*; *Silene antirrhina*; the peppergrass, *Lepidium apetalum*, and the prairie mustard, **Sisymbrium canescens*; the spurges *Euphorbia Preslii*, **E. maculata* and **E. serpyllifolia*; the evening primrose, *Oenothera biennis*; the milkweed, *Asclepias syriaca*; the plantain *Plantago Rugelii*; the wild morning-glory, *Convolvulus sepium*; *Verbena stricta*; the rag-weed, *Ambrosia artemisiifolia*, and other Composites, as *Solidago rigida*, *Erigeron ramosus*, *Achillea millefolium* and *Gnaphalium polycephalum*.

As a result of the decomposition of the Saint Peter sandstone ledges on both sides of the river the slopes are sometimes quite sandy, and on such areas several characteristic sand-plants appear with the prairie flora, as often occurs on sandy portions of any prairie. The following were collected: the grass *Eragrostis pectinacea* var. *spectabile* and the sandbur, *Cenchrus carolinianus*; the sedges *Cyperus Schweinitzii*, *C. filiculmis* and *Carex cephalophora*; the sand-bean, *Strophostyles angulosa*; the sand puccoon, *Lithospermum Gmelini* (on the Iowa side); and the Composites, *Ambrosia psilostachya*, *Helianthus occidentalis* and *Artemisia caudata*.

On the pastured or otherwise disturbed areas the following introduced weeds also occur: the finger grass, *Digitaria sanguin-*

³ Those marked with an asterisk were found only on the Iowa side.

alis and bluegrass, *Poa pratensis*; *Asparagus officinalis*; the hemp, *Cannabis sativa*; the black bindweed, *Polygonum convolvulus*; the clovers, *Trifolium pratense* and *T. hybridum*; the white sweet clover, *Melilotus alba*; mullein, *Verbascum thapsus*; and the Canada thistle, *Cirsium arvense*. These plants seem, here as elsewhere, to make no headway where the prairie surfaces remain undisturbed.

As is illustrated and suggested by these several lists, every feature of the treeless bluff areas simply duplicates the conditions which exist upon the broader prairies, and we must consider these areas simply as outliers or detached fragments of the general prairie. As shown by the preceding lists the flora of the open bluff areas is identical with that of the general prairie. As usually, the Composites lead in the number of species, the grasses and legumes following in the order named. On the general prairie in Iowa the species belonging to these three families constitute about 47% of the total number, and on the bluff prairie they slightly exceed 50%.

These areas are clearly prairie, and as such they offer valuable testimony on the question of the treelessness of the prairies, both by their character and their distribution on the bluffs.

It is important to note that the greater portion of the valley between Iowa and Wisconsin has a general southeasterly trend, and that only a comparatively short stretch above Waukon Junction, Iowa, takes a distinct northeasterly course. Along all that part of the valley with a southeasterly trend the bluffs on the Wisconsin side face the southwest and west, while those on the Iowa side face the southeast and east. In all this portion the prairie areas are much more conspicuous on the Wisconsin bluffs (see Fig. 1), and are located on those faces which have a southwesterly or westerly exposure. The forested portions are chiefly in the ravines and gullies which cut the bluffs, and on those faces which look to the northeast or north because of abrupt turns in the line of the bluffs. A conspicuous example of the latter may be seen in the Wisconsin State Park just below the mouth of the Wisconsin river. Here the bluffs turn abruptly to the east along the latter stream, and all that portion which faces the northwest and north is heavily wooded.

On the Iowa side the bluffs (exclusive of the rocky ledges and cliffs) in this stretch are mostly heavily wooded (see Fig. 2), the limited prairie areas appearing only where a turn in the bluffs gives a more southerly exposure, or where a point juts out into the valley.

Above Waukon Junction, however, where the course of the valley is southwesterly, the exact reverse is true. The Wisconsin side is here sheltered, facing more to the north, and the Iowa side is exposed, facing more or less to the south, with the result that the forest and prairie conditions are just reversed, the Iowa side now displaying much more prairie.

The writer has previously shown ⁴ that the treelessness of our prairies is due to the factors which make for xerophytic (or dry) conditions, chief among which are the afternoon (or "two o'clock") sun and the westerly and southwesterly dry winds which are frequent during the summer. These factors cause an increased loss of water by transpiration from plants both directly and indirectly (the latter through influence on the relative humidity of the air), and as a rule their combined influence is greatest at about two or three o'clock in the afternoon when the sun's heat is most intense. The slopes or surfaces exposed to the southwest will thus suffer most from these factors and will retain only those plants which are strongly fortified against the loss of water, namely, the prairie plants. These plants are variously protected by impervious cutin, by a covering of scales or hairs, and by various other devices well known to students of plants. As a result they are enabled to live through the hottest part of the summer's day, or through a longer period of drouth, where the unprotected (or less protected) plants of the forest would perish.

As already noted the prairie areas on the Mississippi river bluffs are located on those portions of the bluffs which are most exposed to drying, hence chiefly on the slopes facing west or southwest, or on prominently exposed points or ridges, and their distribution strongly corroborates the conclusion that atmospheric factors which favor evaporation are chiefly responsible for the absence of the more sensitive forest plants from the prairies. Other causes, such as rapid run-off from steep slopes, very porous soils, etc., may contribute to the irregularity or insufficiency of the necessary water supply, but they are at best only secondary, or contributing factors.

The once prevalent and still current belief that the treelessness of the prairies is due to prairie fires obviously will not apply to the prairie of the bluffs. It is inconceivable that these often limited and widely separated areas should have been repeatedly visited by prairie fires, and moreover, they are known to persist

⁴ See *The Prairies* in the Bulletin from the Laboratories of Natural History of the State University of Iowa, vol. VI, No. 2, pp. 169-240, 1911, and other papers.

in many places which have not been swept by fires for many years. In fact the existence of these detached prairie tracts in many places is strong proof that the prairies were not caused by prairie fires.

Manifestly variation in rainfall cannot account for the differences between the closely contiguous prairie and forest areas of this region, nor can the prairie be due to the rapid run-off of water, for it is not always located on the steepest slopes.

The attempted accounting for the prairie on the basis of difference in the amount of water in the soil cannot find application in this region. It is at best an unsafe criterion since the greater amount of water in the soil of the forest is quite likely to be an effect rather than the cause of the forest covering, but in our area the prairie tracts are so manifestly related to topographic exposure, and so promiscuously mingled with the forest areas on soils of the same type, that the former rather than the latter must be looked upon as the determining cause. The geological formations on opposite sides of the river at McGregor and Prairie du Chien, for example, are essentially the same. The river has cut into the Saint Croix sandstone, which is exposed in places at the bases of the bluffs. Overlying this is the Lower Magnesian limestone, on which rests the friable Saint Peter sandstone, which underlies the Galena-Trenton limestone and shale. This in turn is capped with looser materials which have been referred to residual clays and loess.

On the slopes of the bluffs these materials are irregularly mingled producing a variety of soils, some of them quite sandy, the sand of the upper slopes being derived from the Saint Peter sandstone. This aggregation of formations results in variation particularly in the physical characters of the soils, especially at different levels, but the prairie and forest are not related to them, but seem to be determined, as noted, by exposure to atmospheric influences.

The vertical distribution of the prairie areas on these and similar bluffs on soils of various types, and their alternation on opposite sides of the river according to its direction, give strong proof that soils are not primarily responsible for the prairie,—neither can these peculiarities of distribution be explained under any of the older hypotheses. Exposure to excessive evaporation alone seems to account for these peculiarities.

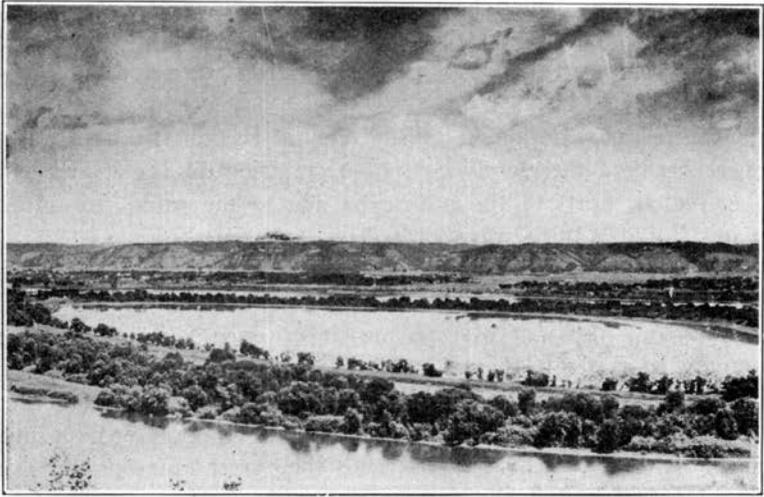


Fig. 1.—The bluffs on the Wisconsin side opposite and below Prairie du Chien. The lighter areas on the bluffs are prairie. Looking east. (Reduced from a photograph contributed by Mr. F. G. Bell, McGregor, Iowa.)



Fig. 2. — The bluffs on the Iowa side below McGregor. They are heavily forested excepting on the nearest projecting point where a bit of prairie appears. Looking a little east of south. (Photo by Mr. F. G. Bell, McGregor, Iowa.)