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Plant Studies in Lyon County, Iowa

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PLANT STUDIES IN LYON COUNTY, IOWA.

D. H. BOOT.

The subject of this paper is one of a series of ecological studies carried on by the author during the last few years, and is a study of a part of the region, consisting chiefly of high prairie, in the northwestern part of the state, the tract considered covering a part of the southwest corner of Lyon county, which is the northwesternmost county in Iowa.

The region for many miles in every direction is dominantly prairie, although there are isolated groves, and fringes of timber are found along the streams and in sheltered parts of the rougher portions of the territory. The relation of such scattered groves and timbered tracts to one another, and to their prairie surroundings is always of interest, and presents ecological problems as yet only in part solved.

It is very desirable that detailed local study of the prairie flora be carried on in order to determine the many problems regarding its distribution and development, and the relations existing between the prairie plants and those of forested areas. The numerous environmental factors entering into these problems are a source of great interest, and a very inviting field of research. This work should be done while undisturbed tracts of prairie and forest are still to be found. Such an area was selected for consideration in this paper because it is one that shows very sharply the transition from forest to prairie; because it is located in the heart of the prairie region; because it is far removed from larger forest areas, and is on the very edge of the great plains, there being no forest of any size west of it until one comes to the foot hills of the mountains; and because it has been but little disturbed by man.

The locality chosen is in Lyon township, Lyon county, Iowa, along the state line. Here the Big Sioux river flows nearly due west for several miles, and the hills on the south side of the stream rise to a height of 180 feet above the water. In the part studied there is a level flood plain about 100 yards in width next the river, and then the bluff rises in a timbered slope extending south about one-fifth of a mile, to the exposed summit,

which is bare of trees, and carries only prairie plants. The variety of plant habitats to be found in close proximity to each other here varies from high, dry, exposed prairie, through scrubby bur oak woods, to heavy forest, as one descends the north face of the bluff. The bluffs along the river have deep ravines running back several hundred yards to the south in various places, and at certain points in these, small bogs appear about springs, while high, bare-topped ridges separate them. Photographs of the bluff from various points of view are given in Plates XI and XII. The profile of the hill is shown in figure 80.

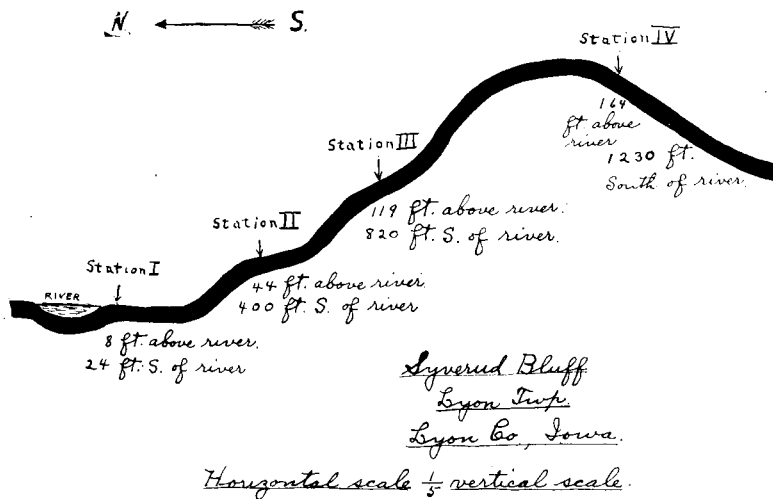


FIGURE 80

This region has been worked over by the glaciers several times. Bed rock outcrops a few miles to the north, where ledges of the well-known Sioux quartzite appear along the river, and about a mile northeast of the area studied, on the north side of the river, are ledges of Cretaceous rock. Over the wooded bluffs we have a thin humus which becomes thicker in the wooded areas, and on the river bottom. Beneath the humus on the bluffs is a moderate amount of wind-blown loess, in no case observed to be more than four feet thick. Below this is a very extensive bed of yellow Kansan drift, at Syverud Bluff not less than sixty feet in thickness. Next below this come several feet of water bearing Aftonian gravels of an interglacial period, and then come great deposits of the earliest glacial drift that covered

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PLATE XI.



this region, the so-called Nebraskan drift, here composed of a dark bluish jointelay, with small angular rock fragments, very impervious to water, and very tough and glutinous when it is wet. Many springs come out of the Aftonian gravel at the upper edge of the Nebraskan drift. They are fed by the rains soaking through the permeable Kansan drift sheet. Some of these springs are large, one such, a little farther along the river, flowing a constant stream easily large enough to fill a six inch pipe. In the area selected slumping of soils had occurred great enough to cause some general mingling of the various elements mentioned above as composing the geological formation. The river bottom is quite sandy.

On these bluffs we have the high upper hill tops exposed to all the winds that blow, and not sheltered in any way. Going down the bluff face we pass through zones of greater and greater protection from the southerly winds, and in the forest the trees shelter the herbaceous plants, and to a considerable degree one another, from the northerly winds, and from the sunlight. On the river bottom the shelter from prevailing winds is also assisted by heavy woods on the north of the river, and by the woodland up and down stream.

The particular tract selected for this study is in section 20, township 98 north, range 48 west, in Lyon township, at a point that I call Syverud Bluff, from the gentlemanly farmer who owned it.

Man has exerted a minor influence on the flora of this tract. Some of the largest of the trees have been cut down, and the bottom land and the forested bluff face have been very lightly pastured.

The prairie hill top was not pastured, nor had it been cultivated in the part belonging to this study. A few stray clover plants only have come in from a near-by field. We have here, therefore, an almost pure native flora. Such a pure native flora is a rarity in any part of Iowa, or of the states near to Lyon county, because the great value of the agricultural lands has led to the cultivation of almost all the prairie tracts, and the scarcity of timber has led to the destruction in large part of the native forest.

On this bluff a tract 145 feet wide from east to west, and running from the river south to the hill top, and extending

over the hill top and down the south side, was selected for detailed observation as to soil, atmosphere, and other conditions affecting plant growth.

Typical stations were selected as follows:

Station I on the river flat, 8 feet above the river, in ordinary season, and 24 feet south of it.

Station II near the foot of the bluff, 44 feet above the river, and 400 feet south of it.

Station III in the timber, half way up the bluff side, 820 feet south of, and 119 feet above, the river.

Station IV, 1,230 feet south of the river, 164 feet above it, located on the open prairie.

The total area in forest on this tract studied was about 160,000 square feet. The area in prairie was about 100,000 square feet.

It will be seen by the plant lists of the several stations that the flora of this locality does not comprise a large number of species of flowering plants. The number of flowering plants native to the upper Mississippi valley is considerably more than a thousand, and our list here is limited to 162 species. The locality is so far west and north that, for Iowa, it has severe conditions. The plants of the prairie are largely plants of the western plains, while the flora of the forests has more the appearance of the forests farther east. In accordance with the prairie conditions we find that 62 per cent of the dry prairie plants of station IV are of a type unsuited for the more protected tracts of stations I, II, or III, and do not occur at these stations at all. Typical of these plants are *Andropogon scoparius* and *Andropogon furcatus*, *Anemone patens* var. *Wolfgangiana*, *Aster sericeus* and *Aster oblongifolius*, *Bouteloua curtipendula* and *Bouteloua hirsuta*, *Grindellia squarrosa*, *Helianthus scaberrimus*, *Kuhnia eupatorioides* var. *corymbulosa*, *Petalostemum candidum* and *Petalostemum purpureum*, *Solidago missouriensis* and *Solidago nemoralis*, and *Viola pedatifida*. These plants are characterized by devices for protection from the drying effects of the hot southwest summer winds, and the scorching effects of the blazing summer sun. In some the leaves are markedly firm and rigid (*Solidago missouriensis* and *Helianthus scaberrimus*), or are clothed with hairy coverings (*Solidago nemoralis*, *Kuhnia eupatorioides* var. *corymbulosa*, *Aster sericeus* and *Anemone patens* var. *Wolfgangiana*). In others the leaves are

much dissected, in strong contrast to related species growing in sheltered localities (*Viola pedatifida*, *Petalostemum candidum*, *Petalostemum purpureum* and *Anemone patens* var. *Wolfgangiana*), or they have very well developed root systems (*Petalostemum candidum*, *Petalostemum purpureum*, *Aster sericeus*, *Kuhnia eupatorioides* var. *corymbulosa*, and *Andropogon scoparius*). Gummy secretions protect some, as in *Grindellia squarrosa* and *Helianthus scaberrimus*, while others protect themselves by very narrow and convolute leaves (*Bouteloua curtipendula*, *Bouteloua hirsuta*, *Andropogon scoparius* and *Andropogon furcatus*).

Of the plants found at Station IV, the high prairie, 19 per cent are found at Station I, the river flat. Thirty-two per cent of the plants of the dry prairie, Station IV, extend down the upper north face of the bluff to Station III, and, 12 per cent get to Station II, the lower forest level on the north bluff face. Some of these are strays, as in the case of *Cirsium iowense*, and *Oxalis stricta*, whose home is on the high prairie, but a few specimens of which occur, perhaps accidentally introduced; others, as *Melilotus alba*, are naturalized plants found at all stations, though growing much more vigorously in the damp river-bottom soil than in the dry soil of the high prairie, while there are hardy natives, as *Euphorbia marginata*, which can endure the dry upland, but also flourish more luxuriantly on the river flat. *Rudbeckia laciniata*, found at all stations, we would expect at the protected stations, and look upon it as a stray on the high dry prairies. This plant is unusual in Northwest Iowa.

Fifty per cent of the flora of Station I is not found at any other station, and 83 per cent of it does not appear at Station IV, which is its greatest extreme as respects conditions in this locality. Seventy-six per cent of the plants found at Station I (river flat) do not appear at Station II (lower timbered bluff face), and seventy per cent of them at Station III (upper timbered bluff face). The difference between II and III in favor of III is to be accounted for by carriage of seeds by birds in the case of such plants as *Vitis vulpina*, *Symphoricarpos occidentalis*, *Sambucus canadensis*, and *Ribes Cynosbati*, and to other accidents of local distribution in the case of *Agastache nepetoides*, *Chenopodium hybridum*, *Euphorbia marginata*, *Laportea canadensis*, *Polanisia trachysperma*, *Ulmus americana*, and *Veronica fasciculata*. In the

case of such plants as *Vernonia fasciculata* in particular, whose home here is on the prairie, and which produces a large crop of easily distributed seed, the only reason for it not being found at Station II just as at Stations I, III and IV, is chance seed dispersal, as it is well able to endure the conditions. Because of the accidents of chance seed dispersal in so narrow a strip as the tract under consideration many plants that are native to the scattered groves of this region are missed.

Of the plants found at Station II, the lower part of the bluff face, 14 per cent are not found elsewhere. The total flora of this station is the smallest of all, being only forty-three species, or twenty-six per cent of the total number as compared with sixty-five species or forty per cent for Station I, seventy-five species, or forty-six per cent, for Station III, and fifty-six species, or thirty-four per cent, for Station IV. Of the plants not found elsewhere *Rubus idaeus* var. *aculeatissimus* would be expected at least in Stations I and III, but for the chance work of birds in distributing seed, *Verbena angustifolia* is certainly a stray and should appear higher upon the hill, or on the sandy bottom, *Phleum pratense*, which is probably introduced, must be classed as a stray that could flourish at any station, though poorly at Station IV. *Gymnocladus dioica* appears to belong properly in the rich woods of Station II, near the foot of the bluff, where protection is good, both from drouth and from flood. *Aster multifloris* var. *exiguus*, found only at this station, is perhaps a stray, for it frequents the sandbanks on the flat and the hills elsewhere. Of the plants found at Station II, thirty-seven per cent occur at Station I, sixty-five per cent of them at Station II, and sixteen per cent of them at Station IV.

Station III has thirty-seven per cent of species not found elsewhere. It has the greatest total number of species of all the stations, namely, seventy-five per cent, due to its being located between the high prairie and the lower bluff woodland. It has eighteen species found also at Station IV, and twenty-eight species found also at Station II. Singularly, it has twenty species found on the river flat at Station I. Typical of the hardy plants that extend down to it from Station IV we have *Solidago rigida*, *Rosa pratincola*, *Monarda mollis*, *Aster ptarmicoides*, and *Ambrosia psilostachya*. These, while at home on the dry prairie, are able to extend their range down the wooded bluff face as far as

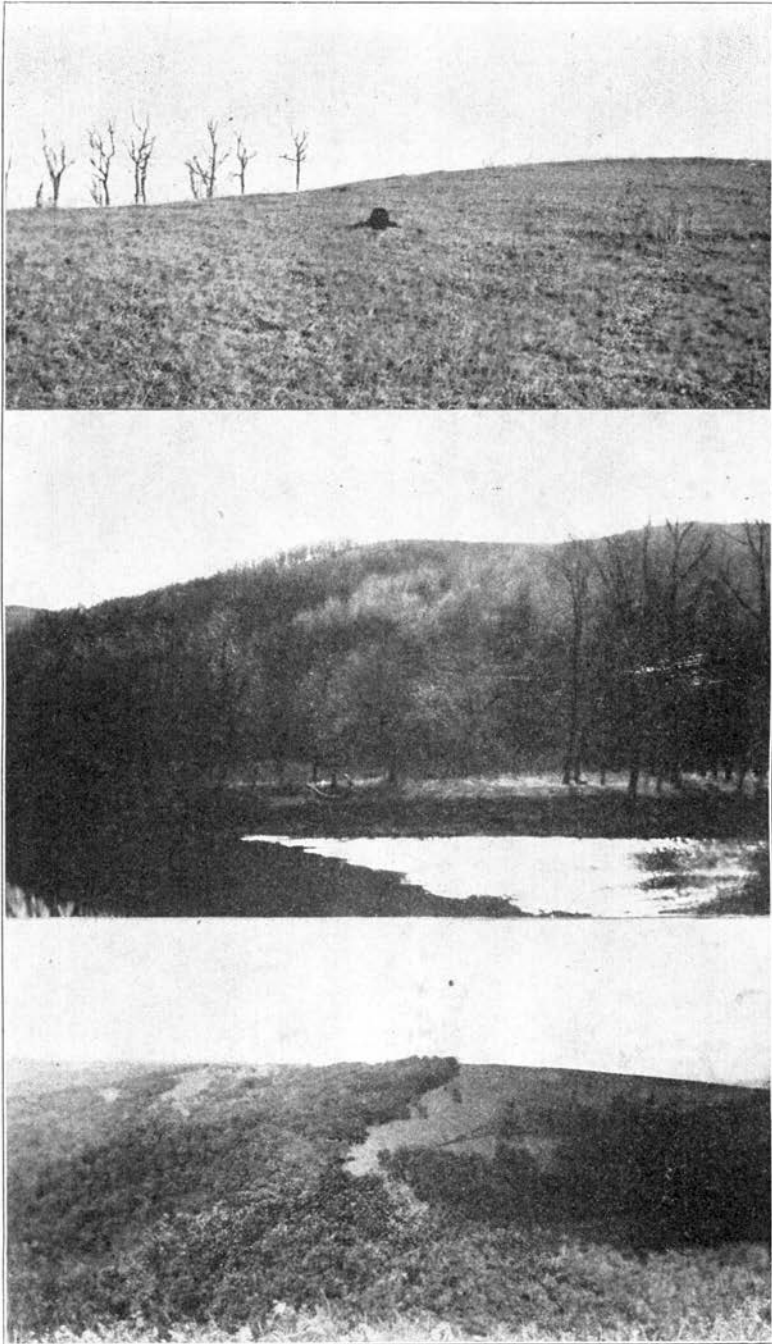
Station III. *Elymus strictus* is an example of a plant more at home in the woods of Station III, as shown by the number of specimens, but able to extend its range upward to the dry prairies, where a few appear. *Anemone cylindrica* is an illustration of a plant at home on the dry prairie, but able to accommodate itself to the drier parts of the woods, so that a few specimens appear at Station III. Of the plants at Station III, which appear abundantly at Station II, *Quercus macrocarpa*, *Ulmus fulva*, *Silene stellata*, *Ostrya virginiana*, *Fragaria vesca* var. *americana*, and *Aquilegia canadensis* illustrate those which must have some protection, and flourish best where the shelter is good. *Quercus macrocarpa* illustrates well the effect on the hardiest trees of the difference in the conditions for growth due to variation in shelter. The 190 specimens found on the tract studied are all grouped in Stations II and III, with the taller, thicker trees almost invariably lower down, and those near the upper tree limit low, small in diameter, and gnarled and stunted in every way (see Plate XI, I and II). Station III marks the upper tree limit for a number of the hardier trees as well as the limit for a number of the hardier herbaceous plants which extend up through all the stations until they come to the extreme conditions of the dry prairie. Examples of these are *Acer Negundo*, which shows regular diminution in size from Station I to Station II, *Ribes gracile*, also much more vigorous and numerous at Station I than at Station II and Station III, *Praxinus pennsylvanica* var. *lanceolata*, *Tilia americana*, and *Arctium minus*, all showing the same traits as to size and vigor. Of plants found only in the upper woods typical examples are *Monarda fistulosa*, *Prunus virginiana*, *Rosa blanda*, *Liatris scariosa*, *Lepachys pinnata*, *Heliopsis scabra*, and *Carya glabra*. Strays able to hold their own are illustrated at this station by *Celastrus scandens*, *Juniperus virginiana*, *Lactuca scariola*, and *Trifolium pratense*.

The extent of variation in conditions at the several stations is indicated by the variation in flora, 20 per cent of the entire number of species being found at Station I, and nowhere else, 3 per cent of the entire flora appearing only at Station II, 17 per cent of it growing only at Station III, and 21 per cent of it only at Station IV. Only 1.8 per cent of the entire flora is able to adapt itself to the conditions found at all of the stations, 8

per cent appears at three stations, 26 per cent appear at two stations, and 63 per cent at a single station.

The very distinct division of the flora into prairie and forest, with the great differences between their floras, naturally lead to attempts to explain their close proximity. Lists of plants have been made by various botanists within the territory surrounding Lyon county on the north, the east and the south. In McMillan's "Metaspermae of the Minnesota Valley", we have listed, among other things, the trees of that nearby tract. None of the trees in the Lyon county area are absent from these lists, nor from the lists in Shimek's report on territory east of this, as given in "The Plant Geography of the Okoboji Region". This Lake Okoboji region is in the valley of the Little Sioux river, and between that valley and the valley of the Big Sioux river intervene long stretches of open prairie without trees. If the forest trees of the Big Sioux valley had come from the east across the country it would be reasonable to expect trees to be found on the intervening prairie. The same may be said concerning the introduction of forest trees from the Minnesota forest to the northeast. A glance, however, at the map of Iowa makes clear a highway the trees could follow, viz.: up the valley of the Missouri river, and along the Big Sioux river to the region. All along this course the protection of bluffs and broken ground, the presence of water nearby, and the transporting agencies of animal life that would follow the stream, would be present to aid in the gradual advance of the trees into a region dominantly xerophytic prairie. Local conditions make it possible for the trees of protected places to survive the generally harsh conditions that prevent the presence of a general forest.

The prairie plants, in turn, are almost all found outside of Lyon county, and most of their names are reported from Harrison and Monona counties. All of them occur in Woodbury county, about Sioux City. They extend north into Minnesota, as shown by the reports of Upham, and sixteen of them reach the Red river valley, as shown by the same author. Lyon county is near the eastern edge of the great plains and the plants are those of the dry prairies. They could be brought to this area in many cases by wind transportation of seeds, by seeds being carried by birds and animals, and by gradual advance by growth. Not needing the protection of a river bank, the greater amount



of soil moisture, nor the high relative humidity demanded by the mesophytic or by the hydrophytic plants, they could travel directly over the prairie, and because of these qualities continue there. Birds flying over the prairie will drop such seeds of trees as they carry, any where, but the greater part, falling in unsuitable places perish. The less hardy vegetation survives only when it has a favored location. After obtaining a footing in a stream valley the forest also may spread down stream by the waters transporting the seed.

STATISTICS OF FLOWERING PLANTS OF SYVERUD BLUFF.

	Sta. I		Sta. II		Sta. III		Sta. V	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Number of species and per cent of grand total at each station.....	65	40	43	26	75	46	56	34
Number of species and per cent of Station I's total found in other stations -----			16	24	20	30	11	17
The same in per cent of grand total of species.....			16	10	20	12	11	7
Number of species and per cent of Station II's total found in other stations -----	16	37			28	65	7	16
The same in per cent of grand total of species.....	16	10			28	17	7	4
Number of species and per cent of Station III's total found in other stations -----	20	26	28	37			18	24
The same in per cent of grand total of species.....	20	12	28	17			18	11
Number of species and per cent of Station IV's total found in other stations -----	11	19	7	12	18	32		
The same in per cent of grand total of species.....	11	7	7	4	18	11		
Total number of species not found in other stations.....	33		6		28		35	
Per cent of entire flora not found in other stations.....		20		3		17		21
Per cent of flora of separate station not found elsewhere.....		50		14		37		62
Total number of species collected.....	162							
Per cent of entire flora growing at all stations.....	1.8							
Per cent of entire flora growing at three stations.....	.8.							
Per cent of entire flora growing at two stations.....	26.							
Per cent of entire flora growing at only one station.....	63.							

PLANT LIST.

SPERMATOPHYTES.	Sta. I	Sta. II	Sta. III	Sta. IV
SUBDIVISION I. Gymnospermae				
Family Pinaceae				
Juniperus virginiana L.....			+	
SUBDIVISION II. Angiospermae				
Class I. MONOCOTYLEDONEAE				
Family Alismaceae				
Sagittaria latifolia Willd.....	+			
Family Gramineae				
Andropogon scoparius Michx.....				+
Andropogon furcatus Muhl.....				+
Bouteloua curtipendula (Michx.) Torr.....				+
Bouteloua hirsuta Lag.....				+
Setaria glauca (L.) Beauv.....				+
Elymus striatus Willd.....			+	+
Hystrix patula Moench.....			+	
Phleum pratense L.....		+		
Poa pratensis L.....		+	+	+
Eragrostis megastachya (Koebe) Link.....	+			
Eragrostis pectinacea var. spectabilis G.....	+	+		
Muhlenbergia tenuiflora (Wil.) BSP.....	+	+		
Panicum capillare L.....	+	+		
Family Araceae				
Arisaema triphyllum (L.) Schott.....		+	+	
Family Liliaceae				
Allium stellatum Ker.....				+
Class II. DICOTYLEDONEAE				
SUBCLASS I. Archichlamydeae				
Family Salicaceae				
Populus deltoides Marsh.....	+			
Salix nigra Marsh.....	+			
Family Juglandaceae				
Ca. ya glabra (Mill.) Spach.....			+	
Juglans nigra L.....	+	+	+	
Family Betulaceae				
Alnus sp.....	+			
Ostrya virginiana (Mill.) Koch.....		+	+	
Family Fagaceae				
Quercus macrocarpa Michx.....		+	+	
Family Urticaceae				
Laportea canadensis (L.) Gaud.....	+		+	
Ulmus americana L.....	+		+	
Ulmus fulva Michx.....		+	+	
Urtica gracilis Ait.....	+			
Family Tiliaceae				
Polygonum Hydrophyllum L.....	+			
Polygonum virginianum L.....		+		
Family Chenopodiaceae				
Chenopodium album L.....			+	
Salsola Kali var. tenuifolia Mey.....	+			+
Chenopodium hybridum L.....	+		+	
Family Amaranthaceae				
Achillea tuberculata Moq.....	+			
Amaranthus retroflexus L.....	+			

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
Family Caryophyllaceæ				
Silene stellata (L.) Ait. f.....		+	+	
Family Ranunculaceæ				
Clematis virginiana L.....			+	
Aquilegia canadensis L.....		+	+	
Anemone cylindrica L.....			+	+
Anemone patens var. Wolfgangiana (Bess.) Koch.	+			
Family Menispermaceæ				
Menispermum canadensis L.....			+	
Family Cruciferae				
Erysimum cheiranthoides L.....			+	
Radicula palustris var. hispida (Des.) Robin	+			
Family Capparidaceæ				
Polanisia graveolens Raf.....	+			
Polanisia trachysperma T. & G....	+		+	
Family Saxifragaceæ				
Ribes gracile Michx.....	+	+	+	
Ribes Cynosbati L.....	+		+	
Family Rosaceæ				
Geum virginianum L.....	+			
Crataegus mollis (T. & G.) Scheele			+	
Geum canadense Jacq.....			+	
Prunus virginiana L.....			+	
Rosa Blanda Ait.....			+	
Rosa pratincola Greene.....			+	+
Fragaria vesca var. americana Port.		+	+	
Rubus idaeus aculeatissimus (Mey) Reg. & Til.....			+	
Potentilla monspeliensis L.....	+			
Prunus americana Marsh.....	+	+		
Family Leguminosæ				
Gymnocladus dioica (L.) Koch.....		+		
Melilotus officinalis (L.) Lam.....		+	+	+
Trifolium repens L.....		+	+	
Melilotus alba Desr.....	+	+	+	+
Astragalus caryocarpus Ker.....				+
Oxytropis Lamberti Pursh.....				+
Petalostemum candidum Michx.....				+
Petalostemum purpureum (Vent.) Rydb.				+
Trifolium pratense L.....			+	
Amorpha canadense L.....				+
Strophostyles helvola (L.) Brit....	+			
Apios Tuberosa Moench.....			+	
Astragalus canadensis L.....			+	
Family Linaceæ				
Linum usitatissimum L.....				+
Family Oxalidaceæ				
Oxalis stricta L.....	+	+	+	+
Family Rutaceæ				
Zanthoxylum americanum Mill.....		+	+	
Family Euphorbiaceæ				
Euphorbia marginata Pursh.....	+		+	+
Euphorbia petaloidea Engelm.....	+			

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
Euphorbia Preslii Guss.....	+			
Family Celastraceæ				
Celastrus scandens L.....			+	
Family Aceraceæ				
Acer Negundo L.....	+	+	+	
Acer saccharinum L.....	+			
Family Rhamnaceæ				
Ceanothus americanus L.....				+
Family Vitaceæ				
Vitis vulpina L.....	+		+	
Family Tiliaceæ				
Tilia americana L.....	+	+	+	
Family Violaceæ				
Viola pedatifida G. Don.....				+
Viola cucullata Ait.....			+	
Family Onagraceæ				
Circaea lutetiana L.....	+			
Oenothera muricata L.....			+	
Oenothera serrulata Nutt.....				+
Family Umbellifereæ				
Thaspium aureum Nutt.....			+	
Zizia aurea (L.) Koch.....		+	+	
SUBCLASS II. Metachlamydeæ				
Family Oleaceæ				
Fraxinus pennsylvanica var. lance- olata (Bor.) Sar.....	+	+	+	
Family Convolvulaceæ				
Cuscuta arvensis Bevr.....		+		
Family Boraginaceæ				
Lithospermum canescens (Michx.) Lehm.....				+
Lappula virginiana (L.) Greene....		+	+	+
Lithospermum Gmelini (Michx.) Hitche.....				+
Lithospermum Latifolium (Michx.) Lappula Redowskii var. occidentalis (Wats.) Rydb.....				+
Family Verbenaceæ				
Verbena bracteosa Michx.....	+			
Verbena hastata L.....	+			
Verbena stricta Vent.....	+			+
Verbena urticaefolia L.....	+	+		
Verbena angustifolia Michx.....		+		
Family Labiatæ				
Agastache nepetoides (L.) Ktz....	+		+	
Monarda fistulosa L.....			+	
Monarda Mollis L.....			+	+
Scutellaria lateriflora L.....	+			
Teucrium canadense L.....	+			
Lycopus virginicus L.....	+			
Mentha arvensis var. canadensis (L.) Briq.....	+			
Physostegia virginiana (L.) Benth.	+			
Family Solanaceæ				
Physalis pubescens L.....				+
Solanum Nigrum L.....	+	+		

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
Family Scrophulariaceæ				
Gerardia tenuifolia Vahl.....				+
Pentstemon gracilis Nutt.....				+
Verbascum Thapsus	+			
Family Phrymaceæ				
Phryma leptostachya L.			+	
Family Plantaginaceæ				
Plantago major L.....			+	
Family Rubiaceæ				
Galium Aparine L.....		+	+	
Family Caprifoliaceæ				
Sambucus canadensis L.....	+		+	+
Symphoricarpos occidentalis Hook..	+		+	+
Viburnum Lentago L.....			+	
Family Cucurbitaceæ				
Echinocystis lobata (Michx.) T. & G.	+			
Family Campanulaceæ				
Campanula americana L.....	+	+		
Family Compositæ				
Aster laevis L.....		+	+	
Aster multiflorus var. exiguus Fern.		+		
Eupatorium urticaefolium Reich...		+	+	
Lactuca floridana (L.) Gaertn.....		+	+	
Solidago latifolia L.....		+	+	
Taraxacum officinale Weber.....		+	+	
Ambrosia artemisiifolia L.....			+	
Ambrosia psilostachya DC.....			+	
Aster ptarmicoides T. & G.....			+	
Antennaria plantaginifolia (L.) Rich.				+
Artemisia ludoviciana Nutt.....				+
Aster oblongifolius Nutt.....				+
Aster sericeus Vent.....				+
Brauneria angustifolia (DC.) Heller				+
Grindellia squarrosa (Pursh.) Dunal				+
Helianthus scaberrimus Ell.....				+
Kuhnia eupatorioides var. corym- bulosa T. & G.....				+
Lactuca canadensis L.....				+
Liatris punctata Hook.....				+
Lygodesmia juncea (Pursh.) D. Don..				+
Solidago missouriensis Nutt.....				+
Rudbeckia laciniata L.....	+	+	+	+
Vernonia fasciculata Michx.....	+		+	+
Solidago nemoralis Ait.....				+
Arctium minus Bernh.....	+	+	+	
Helianthus decapetalus L.....			+	
Heliopsis scabra Dunal.....			+	
Lactuca scariola L.....			+	
Lepachys pinnata (Vent.) T. & G.			+	
Liatris scariosa Willd.....			+	
Solidago rigida L.....			+	+
Aster lateriflorus var. thyrsoides (GR.) Sheld.	+	+		

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
Aster paniculatus var. lanatus Fernald	+			
Bidens frondosa L.	+			
Bidens laevis (L.) BSP.	+			
Cirsium iowense (Pammel) Fernald	+			+
Eupatorium perfoliatum L.	+			
Erigeron canadensis L.	+	+	+	
Erigeron ramosus (Walt.) BSP.	+			
Cirsium canescens Nutt.	+			

THE FLORA.

(SECOND ARRANGEMENT OF LIST.)

The sharp transition in floras from one station to another is shown by the following list of the same plants as given in the preceding list, but arranged by stations instead of in the order of plant relationship. The + indicates the presence of the plant at any station, and the continuous line of +'s gives a regular curve of transition from Station I to Station IV.

Station I is river bottom, Station II is lower forest level of north face of bluff, Station III is upper forest level of north face of bluff, Station IV is bare prairie of hill top and southwest slope of hill.

	Sta. I	Sta. II	Sta. III	Sta. IV
Acer Negundo L.	+	+	+	
Acer saccharinum L.	+			
Acnida tuberculata Moq.	+			
Agastache nepetoides (L.) Ktz.	+		+	
Alnus sp.	+			
Amaranthus retroflexus L.	+			
Arctium minus Bernh.	+	+	+	
Aster lateriflorus var. thyrsoides (Gr.) Sheld.	+	+		
Aster paniculatus var. lanatus Fernald.	+			
Bidens frondosa L.	+			
Bidens laevis (L.) BSP.	+			
Campanula americana L.	+	+		
Chenopodium hybridum L.	+		+	
Circaea lutetiana L.	+			
Cirsium canescens Nutt.	+			
Cirsium iowense (Pammel) Fernald.	+			
Echinocystis lobata (Michx.) T. & G.	+			+
Eupatorium perfoliatum L.	+			
Euphorbia marginata Pursh.	+		+	+
Euphorbia petaloidea Engelm.	+			
Euphorbia Preslii Guss.	+			

PLANT LIST--Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
<i>Eragrostis megastachya</i> (Koeler) Link.....	+			
<i>Eragrostis pectinacea</i> var. <i>spectabilis</i> Gray.	+			
<i>Erigeron canadensis</i> L.....	+	+	+	
<i>Erigeron ramosus</i> (Walt.) BSP.....	+			
<i>Fraxinus pennsylvanica</i> var. <i>lanceolata</i> (Bor.) Sar.	+	+	+	
<i>Geum virginianum</i> L.....	+			
<i>Juglans nigra</i> L.....	+	+	+	
<i>Laportea canadensis</i> (L.) Gaud.....	+		+	
<i>Lappula Redowskii</i> var. <i>occidentalis</i> (Wats.) Rydb.	+			
<i>Lycopus virginicus</i> L.....	+			
<i>Melilotus alba</i> Desr.....	+	+	+	+
<i>Mentha arvensis</i> var. <i>canadensis</i> (L.) Briq.	+			
<i>Muhlenbergia tenuiflora</i> (Wil.) BSP.....	+	+		
<i>Oxalis stricta</i> L.....	+	+	+	+
<i>Panicum capillare</i> L.....	+	+		
<i>Physostegia virginiana</i> (L.) Benth.....	+			
<i>Polanisia graveolens</i> Raf.....	+			
<i>Polanisia trachysperma</i> T. & G.....	+		+	
<i>Polygonum Hydropiper</i> L.....	+			
<i>Populus deltoides</i> Marsh.....	+			
<i>Potentilla monspeliensis</i> L.....	+			
<i>Prunus americana</i> Marsh.....	+	+		
<i>Radicula palustris</i> (Des.) Rob.....	+			
<i>Ribes Cynosbati</i> L.....	+		+	
<i>Rudbeckia laciniata</i> L.....	+	+	+	+
<i>Sagittaria latifolia</i> Willd.....	+			
<i>Salix nigra</i> Marsh.....	+			
<i>Salsola Kali</i> var. <i>tenuifolia</i> G. F. W. Mey...	+			+
<i>Sambucus canadensis</i> L.....	+		+	+
<i>Scutellaria lateriflora</i> L.....	+			
<i>Solanum nigrum</i> L.....	+	+		
<i>Strophostyles helvola</i> (L.) Brit.....	+			
<i>Symphoricarpos occidentalis</i> Hook.....	+		+	+
<i>Teucrium canadense</i> L.....	+			
<i>Tilia americana</i> L.....	+	+	+	
<i>Ulmus americana</i> L.....	+		+	
<i>Urtica gracilis</i> Ait.....	+			
<i>Verbascum Thapsus</i> L.....	+			
<i>Verbena bracteosa</i> Michx.....	+			
<i>Verbena hastata</i> L.....	+			
<i>Verbena stricta</i> Vent.....	+			
<i>Verbena urticaefolia</i> L.....	+	+		+
<i>Vernonia fasciculata</i> Michx.....	+		+	+
<i>Vitis vulpina</i> L.....	+		+	
<i>Apios tuberosa</i> Moench.....		+	+	
<i>Aquilegia canadensis</i> L.....		+	+	
<i>Arisaema triphyllum</i> (L.) Schott.....		+	+	
<i>Aster laevis</i> L.....		+	+	
<i>Aster multiflorus</i> var. <i>exiguus</i> Fern.....		+	+	
<i>Cuscuta arvensis</i> Beyr.....		+		
<i>Eupatorium urticaefolium</i> Reich.....		+	+	
<i>Fragaria vesca</i> var. <i>americana</i> Port.....		+	+	
<i>Galium Aparine</i> L.....		+	+	
<i>Gymnocladus dioica</i> (L.) Koch.....		+		

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
<i>Lactuca floridana</i> (L.) Gaertn.....		+	+	
<i>Lappula virginiana</i> (L.) Greene.....		+	+	+
<i>Melilotus officinalis</i> (L.) Lam.....		+	+	+
<i>Ostrya virginiana</i> (Mill.) K. Koch.....		+	+	
<i>Phleum pratense</i> L.....		+		
<i>Poa pratensis</i> L.....		+	+	+
<i>Polygonum virginianum</i> L.....		+		
<i>Quercus macrocarpa</i> Michx.....		+	+	
<i>Rubus idaeus</i> var. <i>aculeatissimus</i> (Mey) Reg. & Til.....			+	
<i>Silene stellata</i> (L.) Ait. f.....		+	+	
<i>Solidago latifolia</i> L.....		+	+	
<i>Taraxacum officinale</i> Weber.....		+	+	
<i>Trifolium repens</i> L.....		+	+	
<i>Ulmus fulva</i> Michx.....		+	+	
<i>Verbena angustifolia</i> Michx.....		+	+	
<i>Zizia aurea</i> (L.) Koch.....		+	+	
<i>Zanthoxylum americanum</i> Mill.....		+	+	
<i>Ambrosia artemisiifolia</i> L.....		+	+	
<i>Ambrosia psilostachya</i> DC.....		+	+	+
<i>Anemone cylindrica</i> Gray.....		+	+	+
<i>Aster ptarmicoides</i> T. & G.....		+	+	+
<i>Astragalus canadensis</i> L.....		+	+	
<i>Carya glabra</i> (Mill) Spach.....			+	
<i>Celastrus scandens</i> L.....			+	
<i>Chenopodium album</i> L.....			+	
<i>Clematis virginiana</i> L.....			+	
<i>Crataegus mollis</i> (T. & G.) Scheele.....			+	
<i>Elymus striatus</i> Willd.....			+	+
<i>Erysimum cheiranthoides</i> L.....			+	
<i>Geum canadense</i> Jacq.....			+	
<i>Helianthus decapetalus</i> L.....			+	
<i>Heliopsis scabra</i> Dunal.....			+	
<i>Hystrix patula</i> Moench.....			+	
<i>Juniperus virginiana</i> L.....			+	
<i>Lactuca scariola</i> L.....			+	
<i>Lepachys pinnata</i> (Vent.) T. & G.....			+	
<i>Liatris scariosa</i> Willd.....			+	
<i>Menispermum canadensis</i> L.....			+	
<i>Monarda fistulosa</i> L.....			+	
<i>Monarda mollis</i> L.....			+	+
<i>Oenothera muricata</i> L.....			+	
<i>Phryma leptostachya</i> L.....			+	
<i>Plantago major</i> L.....			+	
<i>Prunus virginiana</i> L.....			+	
<i>Ribes gracile</i> Michx.....	+	+	+	
<i>Rosa blanda</i> Ait.....			+	
<i>Rosa pratincola</i> Greene.....			+	+
<i>Solidago rigida</i> L.....			+	+
<i>Thaspium aureum</i> Nutt.....			+	
<i>Trifolium pratense</i> L.....			+	
<i>Viburnum Lentago</i> L.....			+	
<i>Viola cucullata</i> Ait.....			+	
<i>Allium stellatum</i> Ker.....				+
<i>Amorpha canescens</i> L.....				+
<i>Andropogon scoparius</i> Michx.....				+

PLANT LIST—Continued

	Sta. I	Sta. II	Sta. III	Sta. IV
<i>Andropogon furcatus</i> Muhl.....				+
<i>Anemone patens</i> var. <i>Wolfgangiana</i> (Bess.) Koch				+
<i>Antennaria plantaginifolia</i> (L.) Rich.....				+
<i>Artemesia ludoviciana</i> Nutt.....				+
<i>Aster oblongifolius</i> Nutt.....				+
<i>Aster sericeus</i> Vent.....				+
<i>Astragalus carvocarpus</i> Ker.....				+
<i>Bouteloua curtipendula</i> (Michx.) Torr.....				+
<i>Brauneria angustifolia</i> (DC.) Heller.....				+
<i>Ceanothus americanus</i> L.....				+
<i>Gerardia tenuifolia</i> Vahl.....				+
<i>Grindellia squarrosa</i> (Pursh.) Dunal.....				+
<i>Helianthus scaberrimus</i> Ell.....				+
<i>Kuhnia eupatorioides</i> var. <i>corymbulosa</i> T. & G.				+
<i>Lactuca canadensis</i> L.....				+
<i>Liatris punctata</i> Hook.....				+
<i>Linum usitatissimum</i> L.....				+
<i>Lithospermum canescens</i> (Michx.) Lehm....				+
<i>Lithospermum Gmelini</i> (Michx.) Hitchc....				+
<i>Lithospermum latifolium</i> Michx.....				+
<i>Lygodesmia juncea</i> (Pursh.) P. D. Don.....				+
<i>Oenothera serrulata</i> Nutt.....				+
<i>Oxytropis Lamberti</i> Pursh.....				+
<i>Pentstemon gracilis</i> Nutt.....				+
<i>Petalostemum candidum</i> Michx.....				+
<i>Petalostemum purpureum</i> (Vent.) Rydb....				+
<i>Physalis pubescens</i> L.....				+
<i>Setaria glauca</i> (L.) Beauv.....				+
<i>Solidago missouriensis</i> Nutt.....				+
<i>Solidago nemoralis</i> Ait.....				+
<i>Viola pedatifida</i> G. Don.....				+

SUMMARY.

The northwest portion of Iowa, because of the nature of its topography and its dry climate, is almost destitute of woodland, and its flora is characterized by a large percentage of plants specially adapted to withstand severe drought. The forests of this region are very similar in make-up and appearance to the forests farther east, while the upland flora is made up of dry-prairie species.

In a particular representative locality in this region the plants group themselves in very definite fashion as is shown in the tabular summary of the flora for the several stations studied and summarized in percentages at the end of the list. The marked variations in lists correspond well with the marked changes in conditions found at the several stations.

The upper limit of tree growth is a transition area from the bare prairie to the wooded forest characterized by stunted trees and hardy shrubs able to endure almost as severe drought as the highly xerophytic plants of the open prairie.

A variation in conditions, due to exposure, sufficient to cause only a few degrees of difference in relative humidity, is enough to cause striking variation in forest covering, if the critical point for the plants struggling to find foothold is not passed.

The variation in soil is not of itself to be charged with the variation in flora because the same soil carries all the different floras within a few hundred yards of each other, the plants varying according to the exposure.

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