THE MORPHOLOGY AND NATURE OF A PRAIRIE IN COOK COUNTY, ILLINOIS.

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In the fall of 1926 the outstanding brilliancy of the flora and the frequency of unusual species found growing upon a piece of apparently unbroken farm land raised the question of the primitive or virgin character of the field.

This prairie is located in Cook County, Illinois, about eight miles west of Evanston, on Milwaukee Avenue road, in the vicinity of Ridgewood Cemetery. This tract of land is situated just west of the Glenwood Beach of Glacial Lake Chicago and approximately on the divide between the north fork of the Chicago River on the east and the Desplaines River on the west. It is probably of swamp origin resulting from Wisconsin glaciation.

It is a part of the Peacock estate which was Indian territory before the government land grant of 1842. From James Long, whose grandfather was the original owner, it was learned that this piece of sod had never been broken, or to his knowledge systematically grazed, although early in the spring of each year this land is burned over. Long described a number of prairie plants which are found here, using their common names, such as the prairie clovers, rosin weeds, blazing stars, and lillies. These he stated were characteristic of all adjoining land before it had been broken but that this particular plot had always had more plants and been more colorful than any other.

This study was made during the year 1927 with the intention of supplementing these observations with further work in succeeding seasons. However, in March of 1928, after a period of warm dry weather, the annual fire caused a very severe burning of the sod, leaving barren patches in many parts of the field. As a result the observations of this year would not be comparable with those of the preceding season. However, a new and very interesting problem is opened as to the effect of such a fire on the distribution and abundance of the prairie plants. Perhaps the season of 1927 should not be considered a typical but rather an unusual one as far as the great display of brilliant flowering

*Introduced by W. G. Waterman.

plants, especially those of early spring, are concerned. A long wet spring following an unusual winter with extremes of temperature may have accounted, at least in part, for such a showing.

Physical Features.

This tract of prairie is approximately ten acres in area, measuring 465x587x633x890 feet along the sides (Text Fig. 1). Beyond Milwaukee Road to the west is a grass meadow which has not recently been cultivated; on the south a truck garden; a cultivated field to the east; and on the north another uncultivated field which is separated from the prairie by a row of trees along the fence and a ditch.

Superficial inspection indicated that there are three physiographic areas; wet or hydro-xeric, meso-xeric, and xeric. The hydro-xeric or wet areas are limited to four localities of relatively small area, indicated on the chart by numbers 61, 63, 55 and 56. In the spring and late fall these areas, particularly at 61 and 63, are covered with water. Since there is no permanent ground water level near the surface, but merely a clay sub-soil, the water disappears during the summer and the ground is dry on the surface. At 55 and 56 this occurs earlier than at the other two stations and the soil has a slightly lower moisture content throughout the season. The meso-xeric belts which border the wetter localities have a still lower percentage of soil moisture and dry out sooner. They are indicated on the chart by the numbers 39, 40, 51, 52, 53, 54, 57, 58, 59, 62 and 64.

The xeric division comprises the larger part of the field and extends from southwest to northeast, continuing around the eastern arm of the large meso-xeric zone and forming a smaller ridge along the south. Between the north and south arms of this large wet spot in the eastern section, represented by numbers 32-36, is the knoll of greatest elevation on this prairie, having an extreme difference in level of not more than three or four feet.

In general, characteristic associations distinguish these three divisions. In addition individual species serve as indicators as for instance *Eleocharis palustris,* which is universally distributed in the wet areas and characterizes the border between meso-xeric and xeric associations. No true marsh plants are present in the hydro-xeric habitats with the exception of a very few specimens of *Typha latifolia* which were small and did not blossom, but

such semi-marsh plants as can stand drying out in the summer were frequent.

In order to verify this tentative division, soil moisture studies were made. Soil samples, using two hundred to four hundred grams, were taken at intervals of one or two weeks from June 9, to October 19, at nine stations. From August to October collections were made at the two hydro-xeric stations, 61 and 63, which were under water until midsummer. The surface soil was removed to a depth of two inches and the samples were taken not deeper than ten inches. The soil samples were oven dried at low temperature over a gas flame. The average soil moisture content for each station is indicated on the accompanying chart, while the complete record is found in Table I.

The results obtained show that this three-fold division can be substantiated since the average soil moisture contents are as follows: xeric 21.6%; meso-xeric 24.9%; hydro-xeric 28.4%; while the wilting coefficient of the stations thus grouped was 18.4, 22.3, and 21.5 respectively. The average soil moisture contents did not drop below the wilting coefficient. However, during the period from the middle of July to the middle of September every station except number 63, fell below the wilting co-

TABLE I.

SOIL MOISTURE CONTENT AND WILTING COEFFICIFNT AT ELEVEN STATIONS.

Station	June 9	June 15	June 28	July 7	July 15	July 22	July 28	August 4	August 13	August 24	September 16	October 5	October 19	Wilting Coefficient
3	32.2	22.5	22.4	23.6	24	19.7	18.7	16.6	21.4	22.4	.....	31	31.6	21.2
24	31.3	20.8	23.1	25	22.7	19	16.8	14.2	14.8	13.6	19.6	31.2	29.8	19.5
34	26	19.5	18.7	17.3	20	13	12.6	10	16.9	12.8	17.4	26.1	24.8	16.3
60	....	30.5	25.2	23.5	27.1	18.6	17	16.7	19	18.7	16.3	32.6	29.3	16.7
51	36.6	34.5	27.8	25.4	24.3	21.3	21.1	17.7	21.1	20.2	16.2	31.6	31	20.9
54	....	33.4	28.6	23.6	27.3	20.4	17.7	18.5	20.3	18.9	.....	27.7	31.6	21.4
55	45.6	37.8	31.5	28.8	25.9	23.8	21.8	21.2	21.4	20	21.3	35.2	40.8	20.5
56	....	37.9	32.5	27.9	30	24.8	20.8	23.8	22.2	17.3	22.6	43.9	41.1	23.9
64	....	....	31	24.8	23.5	22.5	19.2	14.4	21.9	19.7	.....	37.6	36.3	24.6
61	....	....	....	....	.....	.....	.....	.....	23.4	20.9	.....	29	36.8	23.1
63	....	....	....	....	.....	.....	.....	20.9	25.8	21.5	.....	34.7	39	18.3

efficient at least once, indicating a general xeric state for this prairie during the summer.

This is practically the conclusion reached by Harvey (14) in the study of soil from a 7.5 cm. depth, on an Illinois prairie during the summer of 1911. He found that the soil water content was below the wilting coefficient during most of the period from the first of July to the last of September.

An extensive study of soil moisture content and the wilting coefficient has been carried out by various workers in Nebraska. The work of Weaver and Thiel (41) and Pool, Weaver, and Jean (17), in 1912 showed that there were fluctuations in water content for each depth from "0-60 inches" and for each station. Their results show a generally lower wilting coefficient and through June and July a lower soil moisture content than is found at the xeric stations of this prairie at approximately the same soil depth. They found that during the latter part of July and early August the soil moisture even at a depth of twenty-four inches dropped below the wilting coefficient. However, in depths of "0-6 inches" the wilting coefficient was reached sooner. These investigators state their results "abundantly prove the importance of soil moisture as a factor in plant succession between prairies on one hand and forest on the other".

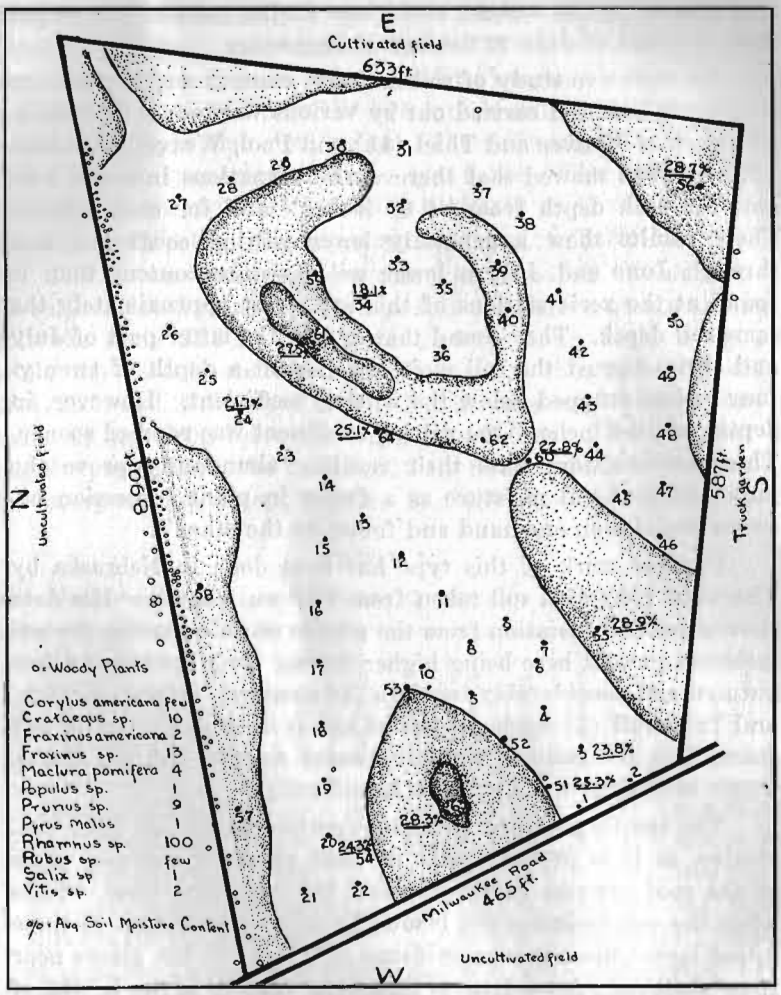
Further work of this type has been done in Nebraska by Thornber (35) with soil taken from 6-10 cm. depths. His data show a greater deviation from the results on this prairie, the soil moisture content here being higher during early spring and late autumn and considerably lower in the summer. Alway, McDole, and Trumbull (2) made studies of soil as deep as 12-21 feet and found that the ratio between the water content and the hygroscopic coefficient was higher in humid soils.

The results obtained in these experiments are not fully conclusive, as it is probable that in most plants the deeper parts of the root systems extended below the collecting level. Thus when the soil moisture fell below the wilting coefficient in these upper layers there was no evidence of wilting in the plants near these stations. According to Sampson (21) it is the height of the water table and not the chemistry of the soil that is the limiting factor determining the order of associations. This may be the explanation for the peculiar localization of a number of species of the hydro-xeric associations which will be discussed later.

Morphology of Associations.

Methods:

The quadrat method was used for determining the distribution and the frequency index (F. I.) of species. Count was made of the actual number of each species of the coarse herbs



TEXT FIGURE 1—Location of Quadrats (1-64). Average Soil Moisture content at eleven stations (percentage underlined); Wet areas stippled.

in the quadrats and the distribution and abundance was plotted on charts of the area. The association of which each was most characteristic was thus determined and the accompanying Table II compiled. Sixty-four quadrats, each one meter square, were

plotted, most of which were located on the dry ridges or in border zones between the meso-xeric and xeric areas. Since much of the rest of the land was exceedingly wet in the spring when the plotting was done, and showed little vegetation other than grasses and sedges, it was thought impracticable to attempt to place quadrats upon it. Later in the season a number of quadrats were added in these regions. In most cases quadrats were placed fifty feet apart along the ridges.

Specimens of all species were preserved in the herbarium at Northwestern University. The nomenclature used is that given in the 7th Edition of Gray's Manual with the exception of *Petalostemum tenuifolium,* Britton and Brown; therefore, authority names have been omitted.

Floristic Content:

With the exception of an unidentified moss which was a frequent mesic plant in the spring, and *Equisetum* sp., the plants on the prairie were Angiosperms.

Table II gives a list of the species and the associations in which they were found. The following abbreviations are used: *ch* = characteristic, *G* = general, *a* = abundant, *f* = frequent, *i* = infrequent, *L* = local, 1-2-3 etc. = number of localities, *N. E.-S. W.* = points of the compass, *R* = ruderal, *F. I.* = frequency index. The + signs opposite the three species of Liatris indicate a greater F. I. of undetermined amounts as in early blossom many were cut by a local florist.

TABLE II.

Floristic Content.

Coarse Herbs.	Hydro-xeric.	F. I.	Meso-xeric.	F. I.	Xeric.	F. I.	Total F. I.
Achillea millefolium					2Lf	13.5	9.4
Allium canadense	1Ll	25	Gf	82	Ga	69.5	68.8
Allium cernuum	2Lf	50	Lf	45.5	Gf	65.3	61.1
Ambrosia artemisiifolia					LiR	2.2	1.6
Amorpha canescens					Gi ch	14.3—22.5	10.9—17.2
Anemone cylindrica					3Li	2.2— 6.1	1.6— 4.7
Antennaria neodioica ..			Lf	36.3	Ga	94.0	78.2
Apocynum cannabinum .			2Lf	18.4			1.6— 3.1
Asclepias Sullivantii			1Lf	9.1	2L f	4.1	1.6
Asparagus officinalis ...					1LiR	—2.2— 8.2	—1.6— 6.3
Aster azureus					4Li	10.2	7.8
Aster commutatus			LNWi	9.1	GSi	2.2—12.5	3.1—10.9
Aster ericoides var platyphyllus					1Li	2.2— 8.2	1.6— 6.7
Aster laevis					Gf ch	32.6—73.5	25.0—56.3
Aster multiflorus			4Li	9.1—45.5	Gf ch	8.2—34.6	7.8—34.4
Aster novae-angliae.....					2Li	—4.1	—3.1
Aster oblongifolius			2Li	—18.2			—3.1
Aster ptarmicoides					1Ll	—2.2	—1.6
Aster spp. (white).....			1La	—9.1			—1.6
Baptisia bracteata					3Lf	10.2	7.8
Baptisia leucantha					3Li	—2.2— 4.1	—1.6— 3.2
Bidens frondosa	1Lf	25	1Ll	—9.1			1.6— 3.1
Cacalla tuberosa					EGi	15.7	3.2—11.9
Chrysanthemum							
Leucanthemum					1LaR	—2.2	—1.6

TABLE II.

FLORISTIC CONTENT—*Continued.*

Coarse Herbs.	Hydro-xeric.	F. I.	Meso-xeric.	F. I.	Xeric.	F. I.	Total F. I.
Cicuta maculata			4Li	9.1—36.4			1.6— 6.3
Cirsium arvense					1LiR	—4.1	—3.1
Cirsium Hillii					Gf	40.1	31.3
Comandra umbellata ...					Ga	69.5	53.1
Coreopsis palmata					N.W. S.E. a	24.5	18.8
Dodecatheon Meadia.....					1Li	2.2— 4.1	1.6— 3.1
Erigeron ramosus					2Li	6.1—14.6	4.7—10.9
Eryngium yuccifolium .					WGf ch	24.5	18.7
Fragaria virginiana			Gf	81.8	Gf	30.6	37.2
Galium tinctorium			1Li	—18.2		16.3	—3.1
Gentiana affinis (?).....					Gf	42.9	12.5—32.9
Gerardia aspera			2Li	—18.2			—3.1
Geum triflorum			1Lf	—18.2	1Lf	2.2	1.6— 6.3
Helianthus grosseserratus			1La	—18.2			—1.6
Helianthus scaberrimus.			2La	—4.1	2La	—4.1	—4.7
Heuchera hispida			2Lf	18.2—36.4			3.1— 6.3
Hypoxis hirsuta	1Li	25	Gf	82	Ga	96	87.5
Krigia amplexicaulis ..			3Lf	45.5	Ef	34.7	34.2
Kuhnia eupatorioides var. corymbulosa			3Li	—36.4			1.6— 4.7
Lactuca campestris					Gf	4.1— 6.1	3.1— 4.7
Lactuca canadensis					Gf	20.2	15.6
Lactuca hirsuta					3Li	2.2— 4.1	1.6— 3.1
Lepachys pinnata					Gf ch	14.3—40.1	10.9—36.2

TABLE II.

FLORISTIC CONTENT—*Continued.*

Coarse Herbs.	Hydro-xeric.	F. I.	Meso-xeric.	F. I.	Xeric.	F. I.	Total F. I.
Liatris graminifolia					2Li	4.1+	3.1+
Liatris scariosa					Gf	9.8+	7.7—26.3+
Liatris spicata					Gf	34.7	9.4+
Lilium canadense.....			2Li	—27.3		12.2+	—4.7
Lilium philadelphicum .			3Li	9.1—27.3	1Li	2.2— 6.1	3.1—10.9
Lithospermum canescen					Gf	42.8	32.9
Lobelia spicata			5Lf	63.5	Gf	55.1	53.2
Ludvigia polycarpa	1La	25					1.6
Lycopus americana	2Lf	50	Gf	45.6			7.7
Lythrum alatum	1Li	25	4La	4.1—10.2			4.7— 9.4
Medicago sativa					N.W. 1LR	—2.2	—1.6
Melilotus alba					W. N.E. fR	10.2	7.3
Oenothera muricata					2Li	—10.2	—4.7
Oxalis cymosa					NiR	—2.2	—1.6
Oxalis violacea.....					Gf	53	40.7
Oxypolis rigidior			3Li	—36.4			—6.3
Parthenium integrifoliu					3Li	10.2	7.8
Pedicularis canadensis .					1Lf N.E.	2.2— 6.1	1.6— 4.7
Penthorum sedoides ...	2Lia	25–50					3.1
Petalostemum candidum					2LG if ch	4.1— 8.2	3.1— 6.2
Petalostemum purpur-eum					Gf ch	16.3—34.7	12.6—26.3
Petalostemum tenuifoli-um B. and B.....					2LGlf	10.2—20.1	7.8—14.1

TABLE II.

FLORISTIC CONTENT—*Continued.*

Coarse Herbs.	Hydro-xeric.	F. I.	Meso-xeric.	F. I.	Xeric.	F. I.	Total F. I.
Phlox glaberrima.....	1 La	—25	1La	—9.1			—1.6
Phlox pilosa					Gf ch	44.8	34.2
Plantago Rugelii	1L	25	1L	—9.1	3LR	—2.2	—1.6
Polygala Senega					Gf	40.7	31.1
Polygonum amphibium	1La	25	1Lf	9.1			3.1
Potentilla arguta					1Li	4.1	3.1
Potentilla canadensis ..			6Lf	54.6	Gfa	24.5	26.7
Prenanthes aspera			Gf	9.1—72.7	1Li	—2.2	—1.6
Prenanthes racemosa ..					Li	—6.1	1.6—12.5
Prunella vulgaris					4LiP	4.1	3.2
Psoralea tenuiflora					2Li	4.1	3.2
Pycnanthemum pilosum			5Lfa	18.4—45.5			3.2—7.8
Rosa humilis					Ga ch	59	45.3
Rosa Woodsii			2Lf	—27.3			—4.7
Rudbeckia hirta			4Li	36.4	Ga ch	71.5	60.9
Rumex crispus					1LiR	—2.2	—1.6
Senecio plattensis	2Lf	50	Ga	63.5			20.2
Silphium integrifolium .					S.E. N.W. Ga	14.3—24.4	10.9—18.8
Silphium laciniatum			3Li	27.3	Gf	8.2—16.3	12.5—18.8
Silphium terebinthina-ceum					Gf	20.2—28.6	15.6—21.8
Sisyrinchium campestre			Gf	54.5	Ga	92	79.7
Smilacina stellata			2Li	18.2	S N.W. Ga	47	39.1
Solidago canadense					3Li	—6.1	—4.7
Solidago graminifolia ..					1Li	—2.2	—1.6
Solidago nemoralis			1Lf	9.1	2Li	—2.2	1.6— 3.1
Solidago Riddelii			Ga ch	36.3—72.7			6.3—20.2

TABLE II.

FLORISTIC CONTENT—*Continued.*

Coarse Herbs	Hydro-xeric	F. I.	Meso-xeric	F. I.	Xeric	F. I.	Total F. I.
Solidago rigida			3Li	18.2—36.4	Gf ch	6.1—38.8	6.3—42.2
Spiranthes cernua			2Li	—18.2			—3.1
Stachys palustris			1La				1.6
Steironema ciliatum ...			1Lf	—9.1			—1.6
Steironema quadriflorum	2La	50	3Lf	—27.3			4.7
Taraxacum officinale ...					3LiR	8.2	6.2
Tradescantia reflexa ...					S.E. Gi	24.5	18.7
Tragopogon pratensis ..					3LiR	2.2— 4.1	16—3.1
Trifolium hybridum					GifR	12.2	9.4
Trifolium pratense					N.W. GR	24.5	18.7
Typha latifolia	1Li	—25				—2.2	—1.6
Verbena hastata			1Li	—9.1	1Li	—2.2	—1.6
Veronica virginica			3La			—6.1	—4.7
Vicia americana			3Lf	18.2—27.3	1Lf	8.2	7.8
Viola sp.					Gf	20.2	15.6
Viola cucullata	ILa	25	2Lf	9.1—18.2	Ga	47	39.1
Viola pedatifida	1Li	—25					
Xanthium commune ..	2Li	25	2Li	9.1	Ga ch	53	40.7
Zizia aurea					Gf	47	4.7 35.9
Woody Plants							
Crataegus sp.					2L		
Salix sp.....			1Li 1 plant		? plants		
Populus sp.							
Equisetum			Lf	[illegible]	[illegible]	[illegible]	[illegible]

TABLE II.

FLORISTIC CONTENT—*Concluded.*

Species	Hydro-xeric	Meso-xeric	Xeric
Gramineae			
Agrostis alba			GfR
Agrostis hyemalis		La	Li
Andropogon furcatus			G
Bromus Kalmii			GiR
Calamagrostis canadensis	f		
Elymus canadensis			Gi
Festuca elatior			iR
Glyceria nervata	Lf	Lf	
Hordeum jubatum			LiR
Koeleria cristata			i
Panicum huachucae	Li		
Panicum virgatum			Gf
Phleum pratense			1LfR
Poa compressa		LaGiR	
Poa pratense			GfR
Sorghastrum Nutans			N.Gf
Spartina Michauxiana	Gf		GLa
Stipa spartea	G		
Cyperaceae			
Carex Baubaumii	1 Li		
Carex Crawei		1Li	
Carex vulpinoidea	Li	i	
Eleocharis palustris	Gf	Ga	
Scirpus lineatus	Li		
Juncaceae			
Juncus balticus var. littoralis	1La		
J. Dudleyi	1Lf		
J. Torreyi	1Li		

Distribution:

The distribution of the plants on this prairie seems in the main to be related to physiographic conditions of the area. As a rule, the occurrence of characteristic species in each of the hydro-xeric, meso-xeric, and xeric regions, was general. However, some very interesting cases of localization were noted.

Many plants, while otherwise general, were absent from the N .E. section around quadrats 27 and 28, and frequently near 29 and 30. Similarly certain species were often lacking in the N. W. corner between quadrats 18 and 22. Some examples of the former are: Lithospermum, Lobelia, Oxalis Violacea, the three species of Petalostemum, *Phlox pilosa, Potentilla canadensis, Rosa humilis,* Rudbeckia, the three species of Silphium, all of the species of Solidago except *S. rigida,* both species of Trifolium, *Viola cucullata, Aster multiflorus,* Fragaria and the two species of Alliums. Polygala and Comandra were present in all these quadrats, while Pedicularis was only found there.

Plants which were likewise noticeably absent from the N. W.

corner are Lithospermum, the three species of Petalostemum, *Phlox pilosa, Potentilla canadensis,* Krigia, the three species of Lactuca, and also Liatris. Only two or three plants of the three species of Silphium were scattered in this area and only one Zizia plant was found. Smilacina was here abundant while Verbena, Medicago, and Psoarlea, were observed only in this section of the field. Both of the areas discussed above were of xeric nature and between wet spots.

Apocynum cannadinum and *Asclepias Sullivantii* were abundant near 56. Apocynum occurred again in the region of 59, while Asclepias spread out onto the nearby dry ridge.

Cacalia tuberosa, another typical prairie plant was found rather sparsely scattered in only the Eastern half of the field. A few plants of *Cicuta maculata* occurred in the meso-xeric regions of 51, 53, 40 and 60.

A few plants of *Dodecatheon Meadia* were observed in the vicinity of quadrat 41, and a single plant in quadrat 21. None of these plants produced blossoms. *Erigeron racemosus* which is usually reported to be common on prairie soil was rare, showing only a few plants in scattered localities. A small patch of *Galium tinctorium* occurred at the edge of the moist region north of 43. Two *Gerardia aspera* plants were located, one under shrubbery and Helianthus plants near the north fence, and the other at 64. Also, only two *Spiranthes cernua* plants were observed. These were considerable distance apart near quadrats 47 and 59. *Geum triflorum* found here near quadrats 28, 37, and 41, but infrequently found on prairies, is reported by Pepoon (16) in his Flora of the Chicago Region as "the most localized of our plants, only two stations near our area being recorded, one at Ashburn and another at West Chicago, more than 30 miles distant." He finds that it is always associated with *Heucheria hispida* as it is in this case. Heucheria, however, is not found near 28, but is fairly abundant around 19 and 54.

Several plants of *Baptisia leucantha* were noted near quadrats 10, 32, and 41, which however, were not very vigorous.

Both *Helianthus grosseserratus* and *H. scaberrimus* were limited to the ridge along the north fence, the latter extending for more than half its length. *H. Grosseserratus* was more localized, occurring in clumps in the more moist regions around quadrat 58. These plants were abundant in this general region but did not extend far out onto the dry ridge. *Kuhnia eupator-*

ioides var. *corymbulosa* was very localized, being represented by few scattered individuals about 21, 39, 40 and 60.

The Liliums were few in number, *L. canadense* especially, as there was only a total of fifteen plants found between 51 and 54. According to Pepoon (16), *L. canadense* does not appear in the Chicago Region, and reports of this species are due to mistaken identity. According to him, this species would be *L. superbum*. *L. philadelphicum* was slightly more numerous and also

TABLE III.

SHOWING THE OCCURRENCE OF SPECIES ABSENT FROM IOWA AND OTHER ILLINOIS REPORTS.

Milwaukee Road Prairie	Other Illinois Reports	Iowa Reports
Aster commutatus	0	0
Aster ericoides var. platyphyllus	0	0
Asparagus officinalis R.	0	+
Chrysanthemum Leucanthemum R.	0	+
Cirsium arvense R.	0	+
Dodecatheon Meadia	0	+
Gentiana affinis (?)	0	0
Gerardia aspera	0	+
Geum triflorum	+	0
Lactuca campestris	0	+
Lactuca hirsuta	0	0
Liatris graminifolia	0	0
Liatris spicata	+	0
Lycopus americana	+	0
Medicago sativa	0	+
Oenothera muricata	0	0
Oxalis cymosa R.	0	0
Oxypolis rigidior	+	0
Petalostemum tenuifolium	+	0
Phlox glaberrima	+	0
Polygonum amphibium	+	0
Psoralea tenuiflora	(Rep. from Neb.)	0
Rosa Woodsii	0	+
Silphium terebinthinaceum	+	0
Smilacina stellata	0	+
Solidago Riddelii	+	0
Steironema quadriflorum	+	0
Tragopogon pratensis R.	0	+
Trifolium hybridum	0	+
Xanthium commune	0	+
Carex Buxbaumii	0	0
C. Craweii	(Rep. from Neb.)	0
Juncus Dudleyi	0	0
Scirpus lineatus	+	0
S. validus	0	+
Spartina Michauxiana	+	0

a little more widespread. It was found associated with *L. canadense*, but also extended out onto the xeric ridge near 10 and again was fairly numerous between 12 and 62.

A number of the species characteristic of the hydro-xeric habitants were restricted to one or two of the areas. *Ludvigia polycarpa* and *Polygonum amphibium* are abundant only in the area about 63. *Penthorum sedoides* is found in two regions at 61 and 63. Localization was observed also in the following spe-

cies: *Steironema quadriflorum* in 40, 51, 53, 55 and 56; *S. ciliatum* in the vicinity of 56 only; *Phlox glaberrima* abundant in the meso-xeric zone about 55; *Stachys palustris* near 64 only; *Veronica virginiana* in three locations considerable distance apart at 57, 39, and 56; *Rosa woodsii* was abundant between 40 and 60.

As nearly as can be determined from the study thus far, the cause or causes for such localization as described above are chiefly to be attributed to available soil moisture.

Most of the species listed herein are contained in reports by other investigators (see literature cited), the majority of the reports being from Illinois or Iowa prairies. The plants recorded in floristic lists of these two states and also Nebraska are very similar, at least as to the characteristic species. Table III is a list of plants identified with this prairie that are not reported either from Iowa or Illionis. The plus sign in this table indicate presence.

Seasonal Aspects

Throughout the season the prairie was very colorful. In early spring the predominating colors were the blues of Sisyrinchium and Phlox, the yellows of Hypoxis and Pucoon, the darker hues of the violets, and the less bright colors or whites of *Baptisia bracteata,* Comandra, *Allium canadense* and Polygala; a little later after the early flowers were represented only by a few colorful forms such as Senecio and Krigia, the blue Lobelia mingled with the prairie rose, *Rosa humulis,* covered the field. Then Rudbeckia began to bloom. For a week or so following these plants, the prairie was dull and lacked showy blossoms. After this short interval the nodding onion, *Allium cernuum,* dominated the field. Soon the *Amorpha canescens* lent its bright purple to the yellow *Lepacys pinnata* and *Coreopsis palmata* which bloomed everywhere. In the meso-xeric zones, the bright *Lythrum alata* dominated, and one area around 56 was brilliant with *Phlox glabberima.* The prairie clovers were everywhere in the xeric ridges, and a few orange-red lilies added color. In the autumn the dominating plants were composites, chiefly blue and white asters, and the yellow goldenrods, lettuces, and rosin weeds. Later still, the field was blue with the many gentians. A more complete list of species blooming in the various seasons is given in Table IV.

TABLE IV.

PHENOLOGY OF PRAIRIE PLANTS.

Prevernal May-June 15	Vernal June 15-July 1	Aestival July	Autumnal Aug. 1-Oct. 1
Allium canadense	Achillea millefolium	Allum cernuum	Aster azureus
Antennaria neodioica	Anemone cylindrica	Amorpha canescens	A. commutatus
Baptisia bracteata	Lobelia spicata	Apocynum cannabinum	A. ericoides var. platyphyllus
Comandra umbellata	Polygonum amphibium	Asclepias Sullivantii	A. laevis
Dodecatheon Meadia	Rosa humilis	Baptisia leucantha	A. multiflorus
Fragaria virginiana	Rudbeckia hirta	Cacalia tuberosa	A. novae-angliae
Geum triflorum	Vicia americana	Cicuta maculata	A. oblongifolius
Heucheria hispida		Cirsium Hillii	A. ptarmicoides
Hypoxis hirsuta		Coreopsis palmata	A. spp.
Krigia amplexicaulis		Erigeron ramosus	Gentiana aspera
Lithospermum canescens		Eryngium yuccifolium	Helianthus grosseserratus
Oxalis violacea		Lepacys pinnata	H. scaberrimus
Pedicularis canadensis		Lilium canadense	Kuhnia eupatorioides var. corymbulosa
Phlox pilosa		L. philadelphicum	Lactuca campestris
Polygala Senega		Ludvigia polycarpa	L. canadensis
Potentilla canadensis		Lycopus americana	L. hirsuta
Senecio plattensis		Lythrum alata	Liatris graminifolia
Sisyrinchium campestre		Petalostemum candidum	L. scariosa
Smilacina stellata		P. purpureum	L. spicata
Viola cucullata		Phlox glaberrima	Oxypolis rigidior
Viola pedatifida		Psoralea tenuiflora	Parthenium integrifolium
Zizia aurea		Pycanthemum pilosum	Petalostemum tenuifolium
		Silphium integrifolium	P. racemosa
		Stachys palustris	Silphium laciniatum
		Steironema quadriflorum	Silphium terebinthinaceum
		S. ciliatum	Solidago canadensis
		Veronica virginica	S. graminifolia
			S. nemoralis
			S. Riddelii
			S. rigida
			Spiranthes cernua

Woody Plants.

Other than the semi-woody *Amorpha canescens* only three woody species were represented on the prairie proper. These were one small *Crataegus* sp. near 37, a *Populus* sp. about a foot high near quadrat 20, and a *Salix* sp. of about the same size at 51. Outside the South fence near the East corner were three small specimens of Rhamnus sp.; many trees and vines formed a hedge along the North fence, occurring both inside and out but not beyond the ditch on the side toward the prairie proper. The majority were small trees from two to four inches in diameter, and these were mostly buckthorns, *Rhamnus* sp. Some of the ashes reached a size of twelve to fourteen inches, but a number of these were dead trees. Other smaller trees were the *osage orange*, (*Maclura pomifera*), wild cherry, (*Prunus* sp.), one cultivated apple, (*Pyrus malus*), and an under-shrubbery of hazel brush, (*Corylus americana*), raspberry, (*Rubus* sp.) and two vines of grape, (*Vitis* sp.). For the distribution see Text Fig. 1.

Ruderals.

There is some difference of opinion among investigators as to which plants should be regarded as invaders of virgin prairie soil, or the so-called rederals. The author has listed seven grasses and fourteen species of coarse herbs which are usually recorded as weeds. The majority of these intruders were near fences especially to the West. Of the grasses so listed *Agrostis alba* was the most frequent, being scattered throughout the xeric regions but not abundant. *Poa compressa* and *P. pratense* were not common. *Phleum pratense* was fairly common in one locality near the road at 1, 2 and 3. *Bromus Kalmii* was scattered and infrequent, while *Festuca elatior* was rare. Wild rye, *Hordeum jubatum* was found only near the road in small numbers. Of the fourteen coarse herbs it will be noted that six did not occur in any quadrat. These are a few plants of *Asparagus officinalis* along the north fence; one clump of *Chrysanthemum Leucanthemum* near the road around quadrat 2; *Cirsium arvense* near the road west of 22; *Medicago sativa* between 19 and 20; *Oxalis cymosa* near the north fence; and a plant or two of *Rumex crispus* near 58. Three species: *Ambrosia artemisiifolia, Plantago Rugelii,* and *Tragopogon pratensis,* were present in only one quadrat. Others, with their F. I., are: *Melilotus*

alba 7.3; *Prunella vulgaris* 3.2, *Taraxacum officinale* 6.2, *Trifolium hybridum* 9.4, *T. pratense* 18.7.

Equisetum sp. is considered a weed by Sampson (21) and occurs frequently on this prairie, having an F. I. of 32.8. Sampson also considers *Tradescantia reflexa* (18.7), *Juncus balticus* var. *littoralis, Oxypolis rigidior* (-6.3), *Aster ptarmicoides* (-1.6), *Vicia americana* (7.8), *Solidago canadensis* (-4.7), as ruderals, but they are not so reported by other writers. Vestal (40) records *Oxypolis rigidior* as being characteristic of hydric localities.

Pounds and Clements (18) list *Lepachys pinnata* as a weed on Nebraska prairies, while in Illinois and Iowa it is considered characteristic.

Shimek (29) lists the following plants as weeds on original prairie: *Achillea millefolium, Ambrosia artemisiifolia, Erigeron ramosus, Plantago Rugelii, Solidago rigida,* and *Poa compressa.* In another paper (31) he places in this category also *Apocynum cannabinum* and *Hordeum jubatum.* Shimek (26) states that invasion of species not properly prairie may take place from prairie bogs and he classifies the following plants, which are found on this prairie, as of such an origin: *Cicuta maculata, Galium tinctorium, Lilium canadense, Lythrum alata, Prenanthes racemosa, Spiranthes cernua,* and *Stachys palustris.*

Thornber (35) considers *Lactuca canadensis* a ruderal. Inasmuch as the abundance of ruderals is often used as an indication of degree of disturbances of native prairie sod, it is significant to note that there is a relatively low F. I. for practically all ruderals on this prairie, a number not being represented in even one quadrat. Further consideration of this question follows in the discussion.

Discussion.

The evidence is not conclusive as to whether or not this land is virgin prairie. The floristic list comprises the characteristic species which are most frequently reported by various investigators. In this and other respects it seems to compare favorably with the other tracts which have been called native or slightly modified prairies. Elements of disturbance on a prairie are chiefly: grazing or pasturing, plowing, burrowing by animals such as gophers, and erosion by water. No data can be obtained concerning the grazing of this land by wild herds, but it seems

improbable that any such grassland would have escaped buffalo grazing. Mr. Long stated positively that this tract had not been used for pasturing at least in the past fifty years. Other old settlers confirm his statement that the soil has never been broken. A considerable number of crayfish holes were found especially in the meso-xeric zones, but these were small and seemingly caused little disturbance. There is no evidence of erosion either past or present as this prairie lies in a flat upland plain. Fires are not considered to be a disturbing element as prairie fires were frequent and undoubtedly general. Fire, however, occurring in a dry spring, and burning several inches into the ground, certainly should be recognized as having a very definite temporary effect, at least, upon plant distribution.

Sampson (21) states the effect of grazing upon the natural prairie flora is as follows: "Practically every one of the dominant species occurring under natural conditions is replaced by some other species. *Scirpus fluviatilis* is replaced by *Typha latifolia; Spartina Michauxiana* and *Calamagrostis canadensis,* partly by Carex and Juncus, but mostly by *Agrostis alba; Panicum virgatum,* partly by *Agrostis alba and* partly by *Poa pratensis;* and *Andropogon furcatus,* entirely by *Poa pratensis.*"

It will be noted that on this prairie *Scirpus fluviatilis* is absent, but *S lineatus* is present and that only a very few plants of *Typha latifolia* were found. *Spartina Michauxiana* ranges from generally frequent to locally abundant. Three species of Carex are also present which are locally infrequent and three species of Juncus which vary from locally infrequent to abundant. *Agrostis alba* is common and quite generally distributed although never abundant. *Panicum virgatum* is frequent and *Andropogon furcatus* is generally distributed. The presence of the blue grasses, *Poa pratensis* and *Poa compressa,* which were introduced into the United States from Europe and which are of course not native to prairie, indicate a condition which can not be considered entirely natural. They are, however, reported as present in practically all prairie sod which has been studied. According to Shimek (31) *Poa pratensis* is the most successful invader of prairie soil, but it does not establish a sod to the exclusion of native plants. He further states that *P. compressa* is less frequent and usually occurs in areas that have been somewhat disturbed. *Koeleria crispus,* he says (24), is quite common on unbroken prairie, a grass which, on this tract, was found only infrequently.

The lack of dominance by *Andropogon furcatus* on this prairie is not an indication that it is being crowded out, but rather that this area is similar to the so-called Chicago prairie which Sampson (21) considers for the most part, under natural conditions, too wet for Andropogon. Low prairie, he finds, was dominated mainly by *Spartina Michauxiana, Calamagrostias canadensis,* and *Panicum virgatum.*

Sampson further states that there is an increase in the number of coarse herbs following a disturbance of natural conditions. In listing such species named by him, the F. I. of each is given for those which are present on this prairie: *Silphium lacinatum,* 12.5 to 18.8; *Calcalia tuberosa,* 3.2 to 11.9; *Liatris spicata,* 9.4, *Apocynum cannabinum* var. *hypericifolium Silphium terebinthaceum* 15.6 to 21.5, *Eryngium yuccifolium,* 18.7.

From these figures it can be seen that none of the species named could be considered abundant or dominant as in no case does the F. I. reach 25.

Concerning the presence of coarse herbs on the prairie, Sampson states, "The old writers speak of these prairies as 'a sea of grasses', and it is probable that coarse herbs did not occupy very large areas, as their presence would certainly have called forth exclamation from the men of those days." Search of the literature on prairies shows many articles from 1818 to recent dates, dealing with the origin of the prairies. Lengthy discussions are entered into, advocating one or more theories as to causes of origin and treelessness, such as fire, lakes and drainage, as well as climatic, or edaphic conditions. Little mention is made of any native plants of these areas and the first record found containing a floral list was in an article by Short (33) in 1845, followed by similar reports by Gray (12) in 1857, Allen (1) 1870, and Broadhead (5) 1875. These men list over forty characteristic species of coarse herbs which are common to this prairie, while only three grasses are mentioned, and these by Short.

Pepoon considers (16) the presence of *Baptisia bracteata* and *Polygala Senega* to be a sure evidence of virgin conditions. Squires (34) writes that Lady's tresses, Spiranthes, are found only where native sod has not been disturbed.

Gray (12) says that Compositae are the characteristic herbs of the prairie, while Allen (1) states that Compositae and Leguminosae are the prevailing families of the flora of prairies.

Short (23) writes that "Comparatively speaking there are but few plants except grasses (that are gregarious everywhere) which may be considered as indigenes of the prairie region generally." Among these he names over thirty coarse herbs that are characteristic of prairies, including three species of *Silphium,* six of *Aster,* four of *Solidago,* and several of *Liatris.*

Summary.

1. The presence of wet spots in the spring and the fall of the year, as well as the frequence of semi-marsh plants indicates that this prairie is of swamp origin.

2. Three divisions of the area have been recognized, namely: xeric, meso-xeric, and hydro-xeric. These are substantiated by soil moisture studies and by the distribution of characteristic species.

3. The amount of soil moisture in the upper twelve inches of earth, compared with the wilting coefficient, as well as the absence of true marsh plants, is evidence of the general xeric condition of this prairie.

4. Characteristic prairie plants were usually found to be generally distributed although particular instances of localization were noted, which were apparently influenced by physiographic conditions.

5. Eleven species of plants found on this prairie have not been reported from prairies in Iowa or elsewhere in Illinois, with this exception the prairie under study seems very similar in floristic content and also in physical features to those described by other investigators.

6. There were few woody plants associated with this prairie and they were chiefly limited to a narrow zone along one fence. Only three small tree species were present on the prairie proper.

7. Ruderals were present in comparatively small numbers and were of the usual type of prairie invaders.

8. The presence of certain introduced weeds determines that this prairie is not in an absolute virgin or natural state. However, the lack of dominance of ruderals and the presence of the characteristic species reported as such in all prairie floral lists, indicate that it is of a type generally regarded as native prairie. Therefore, a study of the floristic content should be of value in contributing to information concerning the fast disappearing prairie.

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Literature Cited.

1. Allen, J. A., 1870, The Flora of the Prairies, Am. Nat. 4:577.
2. Alway, F. J., G. R. McDole and P. S. Trumbull, 1919, Relation of Minimum Moisture Content of Subsoil of Prairies to Hygroscopic Coefficient, Bot. Gaz. 67:185-205.
3. Bonser ....., 1903, Ecological Study of Big Spring Prairie, Wyandot Co., Ohio, Ohio Acad. Sci. Special paper 7.
4. Brendel, F., 1887, Flora Peoriana, The Vegetation in the Climate of Middle Illinois, Peoria.
5. Broadhead, G. C., 1875, Geological Survey of Illinois, 6:477 ff.
6. Cowles, H. C., 1900, Physiographic Ecology of Chicago and Vicinity, Bot. Gaz. 31:73-108, 145-182.
7. Gates, F. C., 1912, Vegetation of Beach Area in Northeastern Illinois, Bull. Ill. State Lab. Nat. Hist. 9:255-372.
8. ....., 1926, Pines in the Prairie, Ecology 7 (1):96-98.
9. Gleason, H. A., 1909, Some Unsolved Problems of the Prairies, Bull. Torrey Bot. Club 36:265-271.
10. ....., 1910, The Vegetation of the Inland Sand Deposits of Illinois, Bull. Ill. State Lab. Nat. Hist. 9:23-174.
11. ....., 1912, An Isolated Prairie Grove and its Phytogeographical Significance, Bot. Gaz. 53:38-49.
12. Gray, Asa, 1857, Statistics of the Flora of the Northern United States, Am. Journ. of Science and Arts, 2nd series, 23:397.
13. Harvey, E. M., 1908, Floral Successions in the Prairie Grass Formation of Southeastern South Dakota, Bot. Gaz. 46:81-108, 277-298.
14. ....., 1913, Evaporation and Soil Moisture on the Prairies of Illinois, Ill. Acad. of Science 6:92-99.
15. Hayden, Ada, 1919, The Ecological Foliar Anatomy of some Plants of a Prairie Province in Central Iowa, Am. Journ. Bot. 6:69-85.
16. Pepoon, H. S., 1927, *Flora of the Chicago Region*, Chicago, Illinois, Copyright Chicago Acad. of Sci., Lakeside Press.

17. Pool, R. J., J. E. Weaver and F. C. Jean, 1918, Further Studies on the Ecotone between Prairies and Woodland, Univ. of Neb. Studies 18:7-47.

18. Pound, Roscoe, and F. E. Clements, 1898, The Vegetation Regions of the Prairie Province, Bot. Gaz. 25:381-394.

19. Pound, Roscoe, and F. E. Clements, 1900, *Phytogeography of Nebraska*, Lincoln, Nebraska, 2nd Ed.

20. Ramaley, Francis, 1916, Quadrat Studies in Mountain Grassland, Bot. Gaz. 62:70.

21. Sampson, Homer C., 1921, An Ecological Survey of the Prairie Vegetation of Illinois, Bull. Ill. Nat. Hist. Surv. 13:523-577.

22. Schaffner, John H., 1913, The Characteristic Plants of a Typical Prairie, Ohio Naturalist 13:65-69.

23. Shimek, B., 1897-8, The Flora of the Sioux Quartzite in Iowa, Proc. of the Iowa Acad. of Sci., Part I, 4:72-81, 1897; Part II, 5:28-31, 1898.

24. ....., 1900, The Flora of Lyon County (Iowa), Iowa Geological Survey 10:157-184.

25. ....., 1910, Prairie Openings in the Forest, Iowa Acad. of Sci. Proc. 17:16-19.

26. ....., 1911, The Prairie, Bul. from the Laboratories of Nat. Hist. of the State Univ. of Iowa 6:169-240.

27....., 1911, Botanical Report (on Harrison and Monona Counties, Iowa), Iowa Geological Survey 20:426-474.

28. ....., 1913, An Artificial Prairie, Univ. of Iowa Studies in Nat. Hist. 6:4.

29. ....., 1924, The Prairie of the Mississippi River Bluffs, Iowa Acad. of Sci. Proc. 31:205-211.

30. ....., 1925, The Prairie Flora of Manitoba, Univ. of Iowa Studies in Nat. Hist. 11:25-36.

31. ....., 1926, The Persistence of the Prairie, Univ. of Iowa Studies in Nat. Hist. 11:3-24.

32. Shimek, Ella, 1914, The Ecological Histology of Prairie Plants, Proc. Iowa Acad. Sci. 22:121.

33. Short, C. W., 1845, Observations on the Botany of Illinois, More Especially in Reference to the Autumnal Flora of the Prairies, Western Jour. of Medicine and Surgery, New Series, 3:185-198.

34. Squires, W. A., 1906, The Passing of the Prairie Flora, Plant World 9:162-164.

35. Thornber, John J., 1901, The Prairie-grass Formation in Region I, Univ. of Nebr. Botanical Studies of Nebraska, pp. 29-143.

36. Upham, Warren, 1880, Preliminary Report of the Geology of Central and Western Minnesota, Minn. Geol. Survey Ann. Rpt. 8:70-125.

37. Veatch, J. O., 1927, The Dry Prairies of Michigan, Papers of the Mich. Acad. of Sci., Arts and Letters, 8:269.

38. Vestal, Arthur G., 1913, An Associational Study of the Illinois Sand Prairies, Bul. Ill. State Lab. Nat. Hist. 10:1-96.

39. ....., 1914, Prairie Vegetation of a Mountainfront area in Colorado, Bot. Gaz. 58:377-40.

40. ....., 1914, A Black-soil Prairie Station in Northeastern Illinois, Bull, Torrey Bot. Club, 41:351.

41. Weaver, J. E., and A. F. Thiel, 1917, Ecological Studies in the Tension Zone between Prairie and Woodland, Bot. Surv. Neb. N. S. No. 1.