Papers on the Prairie

B. Shimek

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by

B. Shimek

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HENRY FREDERICK WICKHAM, Editor

VOLUME XI NUMBER 5

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THE PERSISTENCE OF THE PRAIRIE

B. SHIMEK

The belief that the prairie flora will not return if the prairie is broken is widely prevalent. With it is linked the further belief that the prairie flora is not a climax flora, but that it represents a transition stage which would culminate in a forest with the cessation of prairie fires, were it not for the disturbance of the prairie surface by cultivation.

It is true that the prairie yields readily to cultivation. The breaking of the prairie turf is sufficient to cause most of the prairie plants to disappear from the broken surface, but there is abundant evidence to show that it requires continued cultivation to keep them out. Their return is rather slow and is preceded by a transitional mixture of species, but it is quite certain, provided man does not interfere.

Comparatively little of the native prairie remains in Iowa. A few unbroken tracts are still scattered about over the state, especially in the northwestern quarter, but even these have been disturbed more or less by pasturing and cutting. The purest remnants of the prairie are often found along the right of way of the older railways which entered the territory before the original prairie was broken, and they give the most striking illustration of the persistence of prairie where it remains undisturbed, even in such narrow strips as those here noted.

In this state the prairie flora survives in these unbroken areas, and also in neglected corners, along fence-rows, in partially pastured areas, and on more or less undisturbed open grounds generally. Much of this native flora was also formerly preserved along the public highways, but this is rapidly disappearing with the widening of the driveways on the primary roads and the enforcement of the unwise undiscriminating weed-laws of the state along secondary roads.

These various remnants of the prairie flora are widely scattered, and they are amply sufficient to re-seed all suitable areas. No native prairie species has entirely disappeared, though all have been much reduced, and in a few cases almost exterminated. Perhaps the most striking of the latter kind is that of one of the blaz-

ing stars, *Liatris squarrosa*, once abundant on the prairies of Iowa, but now very rare. The buffalo grass, *Buchloe dactyloides*, never common in Iowa, is now almost, if not entirely, extinct. Other species have become very rare, but on the whole the original prairie flora is practically preserved, and if given an opportunity it would no doubt again spread over a large part of the state. It has even advanced into many places which were formerly covered with forest, but in such cases the prairie flora persists only when the return of the forest is artificially prevented. Numerous illustrations of this fact are found where the railway right of way has been kept cleared through the groves which broke the monotony of the prairies in Iowa. In such cases the prairie usually invades the denuded areas, in which it will probably persist so long as the right-of-way is kept clear. Some years ago the writer reported[1] a similar case, where prairie took possession of the borders of a road cut through the forest north of Homestead, Iowa, and periodically cleared for many years. The borders of this road have not been cleared since, excepting as the driveway has been widened and graded, and most of the prairie flora is being crowded out by the rapidly returning forest flora.

For many years the writer has been engaged in making field-observations on the development and disappearance of prairie floras, and this paper contains an account of such changes in two widely separated areas, the result in each case being the return of the prairie flora to a disturbed surface.

The first of these areas extends along the Chicago, Rock Island and Pacific Railway between Wilton and Summit, in Muscatine County, Iowa, and illustrates both the persistence of the prairie flora on undisturbed surfaces, even when narrow, and the possibility of the return of this flora to disturbed areas.

The second is a more limited area adjoining Mason City, Iowa, and illustrates a result of the invasion of a formerly cultivated area by the prairie in apparent competition with a forest flora on the opposite side.

I. THE WILTON-SUMMIT AREA

This area embraces the right of way, averaging less than one hundred feet in total width, along the Wilton and Muscatine branch of the Chicago, Rock Island and Pacific Railway, beginning at a point nearly half a mile south of Summit and extending to the for-

[1]An artificial prairie.—This Bulletin, vol. VI, no. 4; 1913.

est border south of Wilton, a total distance of about five miles. The area is shown within the three two-mile stretches represented in Plate I.

This line was constructed in the year 1854, when most of the surrounding region was uncultivated, and strips of the original prairie still remain within the right of way. The portion of the line here considered traverses a high prairie, lying entirely within a gently undulating Illinoian drift plain (Plate II, fig. 1). In the report on Muscatine County, Udden[2] represents this area as loess-covered, but there is no loess in the part of the plain under consideration. Most of the area is covered with a fertile prairie loam, but the ridges often show some sand,—evidently small outliers of the old sand-dune area bordering the Cedar River valley to the west.

The undulating character of the surface is well shown along the railway, necessitating a succession of rather low cuts and fills, as shown in Plate I. The depressions are more or less swampy, and are covered with a hydrophytic flora, while the better drained areas are occupied by a more or less xerophytic prairie flora.

The road-bed and the ditches on either side occupy about 25 feet of the width of the right of way, but in some places there has been a further disturbance of the surface by the deeper cuts (which extend to the edge of the right of way in several places), by the heaping up of ridges of earth excavated from the cuts, or by additional grading to secure earth for the fills. Excepting for these interruptions, and those caused by the intersecting public highways at intervals of a mile, the outlying strips on both sides of the right of way form continuous belt transects of the original prairie about five miles in length and reaching a width of more than thirty feet in the widest place.

The entire right of way therefore presents three more or less distinct surface types: 1. The outlying original prairie belts on either side, with the native prairie flora well preserved. 2. The areas disturbed early in the history of the road by cuts, or ridges thrown up from the cuts, but subsequently practically undisturbed for many years, to which the prairie flora has fully returned. 3. The road-bed proper with its ballast and the bordering ditches, all of which are subjected to frequent disturbances in connection with the repair and maintenance of the railway. The flora of this section is mixed, and contains a large element of introduced weeds.

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[2]Iowa Geological Survey, vol. IX; 1899.

1. The Original Prairie

The remarkable tenacity of the prairie flora is well illustrated in these belt transects of unbroken prairie. For many years the adjoining fields have been under cultivation, and both fields and fence-rows have produced weeds abundantly. On the inner side each belt transect has been in contact with the middle roadbed belt, with its numerous weeds and other introduced plants. (See more detailed discussion of the flora of this belt under section 3, following.) Yet few introduced plants have been able to establish themselves in the belts of unbroken prairie, and most of these in very small numbers. The blue grass, *Poa pratensis*, seems to make the most successful invasions, but does not establish a sod to the exclusion of the native prairie plants, and it is probable that its success is due in large part to the frequent introduction of new seed. *Poa compressa* is less frequent, and usually occurs in areas which have been somewhat disturbed. It is possible that this was a native of the drier prairies. Two other introduced plants occasionally gain a foothold, but usually in very small numbers. They are timothy, *Phleum pratense*, which is also extensively cultivated on the farms, and asparagus, *Asparagus officinalis*, which is also commonly cultivated. In the latter case birds which feed on the berries are evidently responsible for the wide dispersal of the seeds.

Aside from these four by no means conspicuous invaders these belts contain a typical prairie flora where the surface has not been disturbed, or where it does not become very wet during the early part of the season.

Where there have been minor local disturbances of the prairie turf by gophers, groundhogs, slight excavations for earth needed for ballasting the track, etc., the disturbed surface is usually promptly invaded by a mixed group of plants consisting in part of introduced foreign weeds and in part (or originally, and sometimes even now entirely) of certain native prairie plants which now also invade cultivated grounds and pastures, and which were evidently the "weeds" of the original prairie which took possession of all disturbed surfaces. These weeds are usually soon followed by the climax flora of the prairie. They are discussed in section 2, Restored Prairie.

The continuity of the prairie belts is also interrupted by the low areas which alternate with the higher places indicated in Plate I

by railway cuts. Some of these depressions are creek-beds, but most of them are undrained. Their flora is that which usually characterizes low areas in the prairie region which are wet during at least a part of the year. There is no larger body of water in this area, and none of the depressions retain water during the average season, hence the flora is marsh rather than aquatic. The following plants of this type were noted:

Typha latifolia
Panicum dichotomiflorum
Leersia oryzoides
Agrostis alba
Calamagrostis canadensis
Glyceria nervata
Elymus virginicus
Eleocharis palustris
Scirpus fluviatilis
Scirpus atrovirens
Scirpus cyperinus
Carex vulpinoidea
Carex Sartwellii
Carex lanuginosa
Acorus calamus
Juncus interior
Iris versicolor
Habenaria leucophæa
Salix longifolia
Salix cordata
Polygonum Muhlenbergii
Rumex brittanica
Rumex mexicanus
Radicula palustris
Penthorum sedoides
Saxifraga pennsylvanica
Lythrum alatum
Ludwigia polycarpa
Œnothera pratensis
Cicuta maculata
Steironema ciliatum
Asclepias incarnata
Verbena hastata
Stachys palustris
Galium asprellum
Aster salicifolius
Silphium perfoliatum
Bidens frondosa
Bidens aristosa
Helenium autumnale

Of this list, *Agrostis alba, Habenaria leucophaea, Rumex mexicanus, Oenothera pratensis, Steironema ciliatum, Verbena hastata, Stachys palustris, Aster salicifolius* and *Silphium perfoliatum,* also sometimes appear on drier prairie, but they seem to prefer low grounds.

Where the prairie merges into these lower areas there is usually a mixture of the two floras consisting of the above-noted less hydrophytic forms of the low grounds and the less xerophytic species of the prairie. The latter includes species which are commonly found on the richer, less-exposed parts of the prairie, but also occur not infrequently in wet places. In this region the following species, listed in the table of prairie plants, are of this type:

Carex gravida
Hypoxis hirsuta
Thalictrum dasycarpum
Anemone canadensis
Spiræa salicifolia
Polygala sanguinea
Gentiana Andrewsii
Apocynum cannabinum
Gerardia auriculata
hypericifolium
Gerardia purpurea
Lobelia spicata
Liatris pycnostachya
Aster novæ-angliæ
Aster paniculatus
Ambrosia trifida
Rudbeckia subtomentosa
Helianthus grosseserratus
Helianthus tuberosus

The following species in the prairie table are restricted in the native prairie transect to the sandy areas on the outliers of old dunes:

Eragrostis pectinacea spectabilis
Cyperus filiculmis
Ambrosia psilostachya
Helianthus occidentalis

To them should be added *Lechea stricta, Viola pedata, Asclepias amplexicaulis* and *Lithospermum Gmelini*, which occur in similar situations but are less common.

The table of prairie plants contains 16 species which are not represented in the prairie transect. All of these species occur on the prairie of the general region, but they were not found within the limits of the transect. It will be observed that one-half of them are prairie "weeds" (see 2, Restored Prairie), and also include *Phleum pratense*, an introduced species which occurs sparingly on undisturbed prairie.

The entire native prairie transect presents a very characteristic prairie flora, comparable in its composition and variations to that of any larger prairie area in this part of the state.

2. Restored Prairie

The restored prairie appears upon two types of surfaces,—the larger fills and the sides of the cuts. (For location of these see map, Plate I).

The prairie flora has extended quite generally over the sides of the larger fills, but the proximity of the road-bed with its numerous weeds, and the more frequent local disturbances of the surface caused by section hands working along the road-bed, have resulted in a frequent admixture of foreign invaders.

A much purer prairie flora has taken possession of the slopes of the deeper cuts. When the road was constructed these surfaces were, of course, bare. No record of the invasion and succession of floras in these areas has been preserved, but, judging from the history of more recent exposures of the same kind, as noted by the writer in many cases, the first plants to enter were undoubtedly those enumerated herein as prairie weeds with some admixture of imported weeds. Because of the newness of the territory the latter were probably not very numerous. This flora was gradually replaced until today it is indistinguishable from that of the adjoining native prairie.

Several of these cuts are found along the railway between Wilton and Summit, and they are noted in Plate I.

Those within the first mile are located chiefly in the southern half, and do not exceed 5 feet in depth.

The second mile contains two cuts. Cut a begins about 200 yards south of the north end of the mile and extends southward for about one-half mile. It reaches a maximum depth of 11 feet, and its slopes present a fine example of restored prairie. This also extends over the ridges which were heaped up above the sides of a portion of the cut at the time the excavation was made. A portion of this cut is shown in Plate II, fig. 2.

Another cut, b, is located near the south end of the mile. This is about 100 yards long and reaches a depth of 8 feet. The ridge here cut is quite sandy and the flora of both the original prairie transect and the restored slopes show a scattering of the species listed as characteristic of sandy prairie among the ordinary species of the drier prairie.

The third mile is almost flat and shows but one small cut about 3 feet in depth.

The fourth mile contains another fine cut, c, which is more than 450 yards long and reaches a depth of 14 feet. Ridges heaped up above portions of this also show restored prairie.

The fifth mile contains several cuts. Cut d is more than 500 yards long and reaches a maximum depth of 11 feet. Cut e is about 90 yards long and 5 feet deep. A ridge on either side above the cut, about 5 feet wide and two feet high, is now covered with a prairie flora. Cut f is about 180 yards long and 8 feet deep. Its slopes are almost entirely covered with *Robinia pseudo-acacia* which had been planted nearby and has extended to this and portions of other cuts. The *Robinia* is distinctly a tree-weed and does not establish forest conditions.

The cut which is located in the south half of the sixth mile is not included in this discussion. It is located at the edge of the rough, timbered area bordering the Mississippi River, and the railway begins here to drop rapidly into the valley of Mad Creek. Its flora is mixed.

The faces of the cuts a to e, as well as the ridges above the cuts, have remained undisturbed for many years, excepting where gophers or ground-hogs have burrowed, or where limited areas were disturbed by man. They are now covered with a typical prairie flora, which is recorded in the second column of the prairie table. It will be observed that 112 species are common to these areas and the native prairie transect.

So complete is the extension of the prairie flora over the once disturbed surfaces that there is no way of determining their limits on the prairie side excepting by the upper edges of the cuts and the bases of the ridges which had been piled up on the prairie bordering the cuts.

The 39 species which were found on the native prairie (recorded in the first column) but not on the restored areas, are rare or local on the prairie of this region. Several, like *Agropyron Smithii*, *Hordeum jubatum*, *Oxybaphus nyctagineus*, *Silene antirrhina*, *Hypericum cistifolium*, *Ellisia nyctelea* and *Physalis pruinosa*, are prairie weeds which occur upon the disturbed spots within the restored prairie, but have not been observed on the older portions. Several others, like *Carex scoparia*, *Lilium philadelphicum andinum*, *Thalictrum dasycarpum*, *Anemone canadensis*, *Polygala sanguinea*, *Gentiana Andrewsii*, *Gerardia auriculata*, *G. purpurea*, *Rudbeckia subtomentosa* and *Helianthus tuberosus*, are ordinarily found only upon rather moist prairie, and these drier restored areas would not offer a congenial habitat. The remaining 22 species are quite rare even in the larger native prairie areas of this tract, and their absence in the more restricted restored areas is not surprising.

The great bulk of the flora is the same on both types of areas, and there is practically no admixture of weeds or other foreign plants in either, excepting where there have been local disturbances of the surface, as noted.

These disturbed places in either area are promptly occupied by a mixture of prairie weeds, imported weeds, and later the plants of the permanent prairie. The plants here designated as prairie weeds play an important part in this succession, as they are among the first to take possession of surfaces which have been disturbed sufficiently to break up the prairie turf. Since the invasion of our territory by a large number of foreign weeds the latter join with the prairie weeds in covering new surfaces, but on the original prairie the prairie weeds evidently formed the first transitional flora, later to be replaced gradually by the climax prairie flora. The prairie weeds also appear on native prairie, but they are usually the first to enter broken areas.

Since the breaking of the prairies these prairie weeds have entered the cultivated fields and most of them have become noxious weeds. They are also likely to invade waste places, especially if sandy or rather barren. Thirty such species were found on the

disturbed portions of the prairie under discussion. They are marked with the letter x in the prairie table.

3. The Roadbed

The middle strip includes the roadbed and the lateral drainage ditches, and is subject to frequent disturbances by the section-hands whose duty it is to keep the roadbed in repair. The ditches frequently contain marsh plants of the species already noted, and need no further attention here.

The roadbed includes the area between the rails, and a strip on either side from 3 to 5 feet in width. A portion of it is well shown in Plate II, fig. 2. Its flora is a mixture and is derived from the following sources:

From prairie.—A large part is derived from the prairie and is recorded in the third column of the prairie table. It includes the four introduced species and the thirty prairie weeds, most of the latter being rather common. Many of the remaining prairie species are represented only by scattered individuals. The low form of *Rhus Toxicodendron*, elsewhere occuring on the prairie, is also found here. This makes a total of 130 species of prairie plants observed on the roadbed.

From dry open places, etc.—The following roadbed species were evidently introduced from dry borders of thickets and open places:

Bromus purgans
Rubus villosus
Hypericum Ascyron
Apocynum androsæmifolium
Aster sagittifolius
Gnaphalium polycephalum
Erigeron annuus

From sand-ballast.—The roadbed is ballasted in part with sand brought from the Cedar River valley. The following species occurring on the roadbed were evidently introduced with the sand:

Paspalum ciliatifolium
Cenchrus carolinianus
Aristida gracilis
Sporobolus cryptandrus
Eragrostis pectinacea spectabile
Eragrostis Frankii
Festuca octoflora
Hordeum pusillum
Cyperus Schweinitzii
Carex setacea ambigua
Polygonum tenue
Frœlichia floridana
Mollugo verticillata
Draba caroliniana
Polanisia trachysperma
Crotalaria sagittalis
Tephrosia virginiana
Astragalus distortus
Strophostyles helvola
Strophostyles pauciflora
Oxalis filipes
Croton glandulosa septentrionalis
Œnothera rhombipetala
Asclepias amplexicaulis
Verbena angustifolia
Plantago aristata
Plantago Purshii
Pentstemon hirsutus
Antennaria neglecta
Xanthium commune
Helianthus petiolaris

It is also probable that most or all of the plants of *Aristida basiramea*, *Cyperus filiculmis* and *Helianthus occidentalis*, noted in the prairie table, were introduced with the sand ballast rather than from proximate sandy prairie.

From wet places.—The following species of swamp plants were represented on the roadbed chiefly by scattered individuals. They were probably derived from the adjoining ditches.

Panicum dichotomiflorum
Agrostis alba
Muhlenbergia mexicana
Spartina Michauxiana
Carex lanuginosa
Carex tetanica Meadii
Salix longifolia (juv.)
Rumex brittanica
Rumex mexicanus
Polygonum Muhlenbergii
Apios tuberosa
Rotala ramosior
Cornus stolonifera
Steironema ciliatum
Verbena hastata
Stachys palustris
Aster salicifolius
Silphium perfoliatum

From the forest.—The forest has contributed several species to the roadbed, but chiefly near the northern end where the grove along the creek probably constitutes the chief source. This grove is composed of such species as *Acer saccharinum*, *A. Negundo*, *Salix amygdaloides* and *Betula nigra* in the lower parts, and *Ulmus americana*, *Celtis occidentalis*, *Juglans nigra*, *Gleditsia triacanthos*, *Fraxinus pennsylvanica lanceolata*, *Carya cordiformis*, *Crataegus mollis*, *Prunus serotina*, *Tilia americana*, *Populus tremuloides*, *Quercus velutina*, *Q. macrocarpa*, etc., and contains the usual accompanying smaller species of our alluvial woods and banks.

The following forest species were found on the roadbed, mostly in very small numbers and not far from the grove:

Smilax herbacea
Polygonum scandens
Physocarpus opulifolius
Rubus allegheniensis
Rubus occidentalis
Prunus virginiana
Geranium maculatum
Psedera quinquefolia
Cornus paniculata
Sambucus canadensis
Erigeron annuus
Cacalia suaveolens

These species do not appear constantly, but form a fluctuating and inconspicuous element of the flora. It will be noted that most of them produce fleshy fruits, and birds are probably responsible for their appearance on the roadbed. The remaining species could easily be distributed by wind or moving trains.

The seedlings of the following trees have also been found from time to time:

Populus deltoides
Ulmus fulva
Celtis occidentalis
Quercus macrocarpa
Prunus serotina
Prunus americana
Pyrus ioensis
Robinia pseudoacacia
Gleditsia triacanthos
Acer Negundo
Acer saccharinum
Fraxinus pennsylvanica lanceolata

None of these seedlings occur in large numbers, and though they have been observed for a number of years, none seem to become established. Wind and birds are probably responsible for their recurrence.

It is possible that some of the seedlings of the species of *Populus*, *Ulmus*, *Acer* and *Fraxinus* are derived from trees cultivated near the farm-houses. It is quite certain that this is the source of the thickets of *Robinia* which occupy parts of the disturbed surfaces near Summit, and seedlings of which sometimes appear on the roadbed. This species is not a native of the region.

Introduced weeds.—Mingled with the plants of the preceding lists are numerous species of weeds which are not native to this part of the state, or have become so thoroughly established as weeds that their source cannot be determined definitely. They have been introduced chiefly by gradual diffusion or by the railway with stock and produce, though wind, birds and other agencies may have assisted. It is noticeable that the most persistent of these weeds ars usually most abundant near the railway stations, this being true of this area as well as of the state at large.

The introduced weeds may be considered in two groups: those which are native to our country, and those which are of foreign origin.

The group of American weeds includes a number of species which may be native to this part of Iowa, but they are now so generally distributed as weeds that they are included here. With one possible exception they cannot be regarded as members of the prairie flora, though most of them occasionally appear upon slightly disturbed portions of the prairie. The list follows:

Panicum capillare
Humulus lupulus
Polygonum erectum
Polygonum pennsylvanicum
Amaranthus blitoides
Lepidium virginicum
Sisymbrium canescens
Oxalis corniculata
Acalypha virginica
Euphorbia maculata
Verbena bracteosa
Teucrium canadense
Solanum carolinense
Solanum nigrum
Solanum rostratum
Physalis subglabrata
Veronica peregrina
Plantago Rugelii

Perhaps *Sisymbrium canescens* and *Plantago Rugelii* should be included in the prairie weeds list, as both are natives of the prairies of Iowa. The former, however, seems to be restricted to waste and disturbed places in this region, and the latter has become so thoroughly established as a weed that it is often much more abundant than the introduced *P. major*.

The foreign weeds of the roadbed are mostly of common and widely distributed species, of which two, *Bromus tectorum* and *Melilotus alba*, are increasing rapidly. The list follows:

Digitaria sanguinalis
Echinochloa crus-galli
Setaria viridis
Setaria glauca
Bromus tectorum
Lolium italicum
Cannabis sativa
Rumex crispus
Rumex acetosella
Polygonum aviculare
Polygonum convolvulus
Chenopodium album
Amaranthus retroflexus
Capsella bursa-pastoris
Brassica arvensis
Sisymbrium officinale
Sisymbrium altissimum
Sedum purpureum (rare)
Trifolium procumbens
Melilotus alba
Melilotus officinalis
Pastinaca sativa
Nepeta cataria
Verbascum thapsus
Anthemis cotula
Arctium minus
Taraxacum erythrospermum
Taraxacum officinale
Lactuca scariola
Lactuca scariola integrata

To this list may be added the following small group of species which have escaped from cultivation and some of which have become weeds, particularly those in the second column:

Triticum sativum
Zea mays
Raphanus sativus
Trifolium pratense
Trifolium hybridum
Medicago sativa

This interesting mixture of prairie, swamp, forest, and introduced plants represents a condition which is common where new surfaces have been created, and where competition is possible between the floras of the several types. The bars and borders of most of our streams present essentially the same combination of floras, though the percentage of each will vary with the character of the contiguous territory from which they are derived.

The struggle between these floras continues until that one which is best adapted to the region becomes dominant. In the Wilton-Summit region the prairie flora would undoubtedly dominate on the roadbed if left undisturbed, as it has done on the restored prairie surfaces; along the streams the forest would more frequently become dominant; but in either case the earlier mixed character of the flora represents a transition stage which soon yields to the flora best fitted to survive.

The presence of this belt of mixed floras on the roadbed is especially worthy of note because it shows that despite exposure to possible encroachment by the several floral elements here combined, the prairie flora has been able to re-establish itself on the adjacent strips of restored prairie and is holding its own against this varied competition.

An additional interest attaches to the list of native prairie plants in column I because it is the first definite published list of prairie plants from the Illinoian drift of Iowa. Previous lists, published by the writer[3] covered portions of the prairies on Kansan, Iowan and Wisconsin drifts.

It is sufficient here to note that the prairie flora of these several drift areas, as of other surface areas in the state whether loess or alluvium, shows no differentiation which would indicate or suggest that surface formation has anything to do with the distribution of the prairies. On the contrary, true prairie, with its characteristic flora, occurs on every type of soil or formation which comes to the surface in Iowa, excepting the muck of swamps, and even that will usually produce prairie if thoroughly drained and left undisturbed.

II. THE MASON CITY TRACT

Another area illustrating the ability of the prairie to return has been studied by the writer near Mason City for a number of years. This case is even more remarkable than that discussed in the first part of this article because of the possibility of sharper competition between forest and prairie.

This area is located between the north line of Highlands Addition to the city and Buffalo Slough, a swampy abandoned channel of Lime Creek. The Slough is bordered by limestone ledges which rise to a height of 35 or 40 feet, and have a prominent rocky forested talus at the base. The forest also enters the gulleys and ravines which cut the line of ledges. (See Plate IV, fig. 1).

The upland above the edges of the ledges rises to a height of 50 feet, or more, above the bed of the Slough. It was formerly covered partly with native prairie, and partly with scattered or interrupted groves which connected more or less with the groves and thickets of the talus and ravines. The area here considered lies on this upland west of the line extending north from the north end of Kentucky Avenue to the Slough. Along this line a strip of native prairie about 40 feet wide and nearly 500 feet long was broken and planted in corn. Along the west side of this strip lies a piece of unbroken prairie, while just east of it is a small upland grove which is a part of the bluffs forest belt.

The cultivation of this strip was soon abandoned, and for about

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[3]Report on Harrison and Monona Counties, Iowa Geological Survey, vol. XX, 1910; The Prairies, this Bulletin, vol. VI, No. 2, 1911; The Plant Geography of the Lake Okoboji Region, this Bulletin, vol. VII, No. 2, 1915.

5 years the writer gave it only passing notice, since it appeared merely as a neglected weed patch. Unfortunately no record of the plants was kept during this period, but at its close more systematic observations were begun and continued for 5 years. At the beginning of this second 5 year period the ridges marking the old corn-rows were still plainly visible, but the tract was covered late in the summer with a mass of *Aster multiflorus, A. azureus* and *Solidago rigida*, with a scattering of prairie weeds such as *Agropyron Smithii, Hordeum jubatum, Potentilla monspeliensis, Rosa pratincola, Hedeoma hispida, Erigeron ramosus, Ambrosia artemisiifolia* and *Achillea millefolium;* and of introduced weeds such as *Phleum pratense, Poa compressa, P. pratensis, Trifolium pratense, T. procumbens, Melilotus alba* and *Taraxacum erythrospermum.* The general appearance of this strip was quite different from that of the adjoining undisturbed prairie along the west side. While the two species of *Aster* and the *Solidago* dominated the restored strip, their flowers producing a distinct belt of color, the native prairie presented a much larger number of species, with none so prominent as the three noted in the restored strip, and these three, while present, were scattered and comparatively few in number.

These observations have been continued for 5 years, and in 1924 the number of prairie species had been increased, the species were more equally mixed, the introduced weeds had almost disappeared, and the striking distinction between the restored and native prairie had disappeared. The number of species is still distinctly less in the restored strip, but its flora is clearly of the prairie type and most of the species of the native prairie will no doubt return to it if it is not again disturbed.

A comparative view of the floras of the restored and contiguous native prairie may be obtained by scanning columns V and IV of the Table of Prairie Plants, and, in addition, the supplementary lists which follow.

The following prairie species should be added to both the native and restored prairie lists given in the table:

Agropyron Richardsonii
Lathyrus venosus
Galium boreale
Antennaria plantaginifolia
Brauneria pallida

The following border plants (also found in open woods) were also sparingly represented in both areas:

Bromus purgans
Apocynum androsæmifolium

The following species should be added to the native prairie list in column IV:

Vicia americana
Rhus Toxicodendron
Tænidia integerrima
Aster oblongifolius

The *Taenidia* often occurs in borders and open woods; the *Aster* is often found in rocky and barren places; and the *Rhus* is the low form characteristic of the prairies.

The following species were sparingly represented on the restored prairie, and should be added to the list in column V of the Table:

Draba caroliniana
Trifolium stoloniferum
Symphoricarpos occidentalis
Lactuca ludoviciana

All of these additional species are found in the general region on prairie or in open places. The *Draba* usually prefers sand.

Four introduced species, which now occur quite rarely, should be added to these lists. *Trifolium pratense* is found in disturbed spots on both areas, and the following species still persist on the restored prairie:

Trifolium procumbens
Melilotus alba
Taraxacum erythrospermum

The invasion of the restored prairie strip took place almost entirely from the prairie side. There are probably two reasons for this: Most of these prairie species have their seeds distributed by wind, and the prevailing westerly and northwesterly winds of the summer and fall would bring seed mostly from the native prairie lying to the west; and the exposure of this open area to drying agencies would make it easier for the more xerophytic prairie flora to become established.

But for these circumstances the invasion might have taken place quite as readily from the contiguous forested tract on the east and north. The former lies on the upland and the latter along the bluffs,—both immediately adjacent to the restored tract.

It is interesting in this connection to note how entirely different the flora of these timbered tracts is from that of the nearby prairie. The following 24 species were found in both the upland woods and those of the banks and bluffs along Buffalo Slough in the vicinity of the restored prairie tracts:

Quercus macrocarpa
Quercus ellipsoidalis
Pyrus ioensis
Prunus serotina
Prunus virginiana
Psedera quinquefolia
Lonicera sempervirens
Botrychium virginianum
Smilax ecirrhata
Sanguinaria canadensis
Anemone virginiana
Desmodium grandiflorum
Geranium maculatum
Aralia nudicaulis
Thaspium aureum
Polemonium reptans

Carex rosea
Uvularia grandiflora
Allium tricoccum
Smilacina racemosa
Hydrophyllum virginianum
Galium triflorum
Solidago latifolia
Prenanthes alba

The following additional 30 species were found only on the uplands:

Quercus alba
Quercus rubra
Celtis occidentalis
Ribes gracile
Cratægus punctata
Zanthoxylum americanum
Celastrus scandens
Cornus paniculata
Asplenium filix-femina
Hystrix patula
Carex
Polygonatum commutatum
Cypripedium pubescens
Thalictrum dasycarpum
Agrimonia gryposepala
Geum canadense
Geum strictum
Amphicarpa monoica
Desmodium bracteosum
longifolium
Circæa lutetiana
Cryptotænia canadensis
Osmorrhiza brevistylis
Sanicula marilandica
Lappula virginiana
Monarda fistulosa
Scrophularia marilandica
Phryma leptostachya
Triosteum perfoliatum
Campanula americana
Eupatorium urticæfolium

The following additional 45 species were found only on the wooded bluffs and talus:

Juniperus virginiana
Populus tremuloides
Juglans cinerea
Juglans nigra
Carya cordiformis
Ostrya virginiana
Ulmus fulva
Menispermum canadense
Ribes cynosbati
Ribes floridum
Amelanchier oblongifolia
Amelanchier spicata
Rubus idæus aculeatissimus
Rosa blanda
Prunus pennsylvanica
Prunus americana
Staphylea trifolia
Tilia americana
Cornus alternifolia
Fraxinus pennsylvanica lanceolata
Fraxinus nigra
Lonicera Sullivantii
Lonicera dioica
Viburnum pubescens
Viburnum Lentago
Adiantum pedatum
Cystopteris bulbifera
Cystopteris fragilis
Arisæma triphyllum
Smilacina stellata
Trillium erectum
Smilax herbacea
Asarum acuminatum
Ranunculus abortivus
Ranunculus septentrionalis
Thalictrum dioicum
Aquilegia canadensis
Actæa rubra
Actæa alba
Fragaria vesca americana
Lathyrus ochroleucus
Viola sororia
Viola scabriuscula
Aralia racemosa
Phlox divaricata

It will be observed that only 7 species of woody plants (the woody plants head each list) are common to the uplands and the bluffs, and that 8 additional species are represented in the upland woods while the bluffs woods present 25 more. Of the 8 species from the upland woods, one, *Quercus alba*, is quite rare in this vicinity, and the remaining species are found on more remote por-

tions of the bluff area. It seems evident that the bluff area is the center of distribution for the more lasting woody plants, and that the upland forest has been produced by the gradual and limited advance of the forest flora under the protection of the plants of the forest border. This forest border here, as elsewhere in the state, is a fluctuating line or belt, which advances more or less during cycles of favorable seasons and retreats during the dry cycles. There is, however, no general advance or retreat.

The southern and western border of the upland woods is here formed by rather low, more or less scrubby oaks, *Q. ellipsoidalis* and *Q. macrocarpa*, and in its more open portions it frequently contains stray individuals or clumps of species which belong to the prairie of the region. The deeper woods, however, present a pure forest flora, which is also characteristic of the greater part of the sheltered bluffs belt which forms the northeastern part of this forest area, and which is itself limited by the swamp of Buffalo Slough.

Since the restored prairie is in direct contact with the forested area on the north and east sides it would not be surprising if the latter should invade it during some future cycle of moist seasons, but such advance would be a mere fluctuation such as has been noted. It is evident that in this case, with seemingly equal opportunities for the forest and prairie floras, the latter has taken possession of the restored tract to the exclusion of the former. When the prairie turf is once established it will probably hold its own against the encroachments of the forest if left undisturbed.

Conclusions

1.—It is evident that prairie areas may be restored after having been cultivated or otherwse disturbed. The prairie flora does not represent a transition state, but is a climax flora in its own right.

2.—The remnants of the prairie still persisting in the state are sufficient to furnish seed for the restoration of disturbed prairie areas, and this can be accomplished if the latter are simply left to themselves.

3.—The restoration of the prairie flora will occur gradually, the earlier transition stages representing various mixtures of floras determined by the character of the adjacent areas.

4.—An important part in this transformation is played by a certain group of native prairie plants, herein designated as prairie weeds, which quickly take possession of new surfaces. They form

the advance guard of the prairie flora, and have become weeds in cultivated areas.

5.—More recently certain introduced weeds assist the prairie weeds in this process of restoration.

6.—When the prairie is finally restored the prairie weeds may be incorporated in the renewed flora, probably usually in diminished numbers, but the introduced weeds practically disappear.

7.—It is evident that restoration of prairie tracts for incorporation with our state parks system here in Iowa is entirely feasible and can be accomplished at little additional expense.

8.—The views that prairie will disappear for all time if broken, and that with the cessation of prairie fires the forest will take possession of the prairie, are untenable in the light of the behavior of these and similar prairie tracts.

TABLE OF PRAIRIE PLANTS

The following table contains a list of all the plants found on the native prairie transects between Wilton and Summit, Iowa, and a corresponding partial record of the same (and a few additional) species for other areas indicated in the several columns by the letter x. The columns are numbered at the head as follows:

I. Represents the native prairie south of Wilton, as noted.

II. Includes the corresponding flora of the restored prairie in the same region.

III. Includes the corresponding species of the roadbed in the same area.

IV. Marks the corresponding species on the restored prairie at Mason City, Iowa.

V. Contains the corresponding species on the restored prairie at Mason City.

Supplementary lists are given in the text in connection with the discussion of each of the localities.

Plants marked with an asterisk (*) have been introduced, but are sparingly established on the prairie.

Plants marked with an x before the name belong to the group herein designated as "prairie weeds."

The nomenclature of Gray's Manual, 7th edition, is employed for native or established plants, and that of Gray's School and Field Botany for other introduced plants. Hence authors' names are omitted throughout the paper.

TABLE OF PRAIRIE PLANTS

	I	II	III	IV	V
Family *Equisetaceae*					
xEquisetum arvense	+	+	+		
Equisetum hyemale intermedium	+	+	+		
Family *Gramineae*					
Andropogon scoparius	+	+	+	+	+
Andropogon furcatus	+	+	+	+	
Sorghastrum nutans	+	+	+	+	+
Panicum virgatum	+	+	+		
Panicum huachuchæ	+	+	+		
Panicum Scribnerianum	+	+	+	+	
Stipa spartea	+	+	+	+	
Aristida basiramea		+	+		
Muhlenbergia racemosa	+	+	+	+	+
*Phleum pratense		+	+	+	+
Sporobolus heterolepis	+		+	+	
Agrostis hyemalis	+	+	+		
Agrostis alba vulgaris	+		+	+	
Sphenopholis obtusata		+			
Kœleria cristata	+	+	+	+	
Bouteloua curtipendula	+			+	+
*Poa compressa	+	+	+	+	+
*Poa pratensis	+	+	+	+	+
xAgropyron Smithii	+		+	+	+
xHordeum jubatum	+		+		+
Elymus canadensis	+	+	+	+	+
Family *Cyperaceae*					
Cyperus filiculmis	+	+	+		
Carex scoparia	+				
Carex festucacea	+	+	+	+	
Carex gravida			+		
Carex pennsylvanica	+	+			
Family *Commelinaceae*					
Tradescantia reflexa	+	+	+		
Family *Liliaceae*					
Allium canadense	+				
Lilium philadelphicum	+	+			
Lilium philadelphicum andinum	+				
*Asparagus officinalis	+	+	+		
Smilacina stellata	+		+	+	
Family *Amaryllidaceae*					
Hypoxis hirsuta	+				
Family *Iridaceae*					
Sisyrinchium campestre	+	+	+	+	
Family *Orchidaceae*					
Spiranthes gracilis	+			+	
Family *Salicaceae*					
Salix humilis	+	+	+	+	+
Family *Betulaceae*					
Corylus americana	+	+	+	+	
Family *Santalaceae*					
Comandra umbellata	+	+		+	
Family *Polygonaceae*					
Rumex altissimus	+	+	+		
Polygonum ramosissimum			+		
Family *Chenopodiaceae*					
Chenopodium leptophyllum		+			

	I	II	III	IV	V
Family *Nyctaginaceae*					
xOxybaphus nyctagineus	+		+		
Family *Caryophyllaceae*					
xSilene antirrhina	+		+	+	
Silene stellata	+			+	
Family *Ranunculaceae*					
Ranunculus fascicularis	+			+	+
Thalictrum dasycarpum	+			+	
Anemone cylindrica	+	+	+	+	+
Anemone canadensis	+		+		
Family *Cruciferae*					
xLepidium apetalum	+	+	+	+	
Family *Saxifragaceae*					
Heuchera hispida	+	+	+	+	
Family *Rosaceae*					
Spiræa salicifolia	+	+	+		
Fragaria virginiana	+	+	+	+	+
Potentilla arguta	+	+	+	+	
xPotentilla monspeliensis			+	+	+
Potentilla canadensis	+	+	+		
Rosa pratincola	+	+	+	+	+
Family *Leguminosae*					
xCassia chamæcrista	+	+	+		
Baptisia bracteata	+			+	
Baptisia leucantha	+				
Amorpha canescens	+	+	+	+	+
Petalostemum purpureum	+	+	+	+	+
Petalostemum candidum	+	+	+	+	+
Astragalus canadensis	+	+	+		
Desmodium illinoense	+	+	+		
Desmodium canadense	+	+	+	+	+
Lespedeza capitata	+	+	+	+	+
Amphicarpa Pitcheri	+	+		+	
xTrifolium repens		+	+	+	
Family *Linaceae*					
Linum sulcatum	+	+		+	+
Family *Oxalidaceae*					
Oxalis violacea	+		+	+	
xOxalis stricta		+	+		
Family *Polygalaceae*					
Polygala sanguinea	+		+		
Polygala Senega	+		+	+	
Polygala verticillata	+				
Family *Euphorbiaceae*					
xEuphorbia Preslii			+		
Euphorbia corollata	+	+	+		
Family *Anacardiaceae*					
Rhus glabra	+	+	+	+	
Family *Rhamnaceae*					
Ceanothus americanus	+	+	+	+	+
Family *Vitaceae*					
Vitis vulpina	+	+	+	+	
Family *Hypericaceae*					
xHypericum cistifolium	+		+		
Family *Cistaceae*					
Helianthemum majus	+		+		
Helianthemum canadense	+	+			
Family *Violaceae*					
xViola cucullata		+	+		

	I	II	III	IV	V
Viola fimbriatula	+	+	+		
Viola pedatifida	+	+	+	+	+
Family *Onagraceae*					
xŒnothera biennis	+	+	+	+	
Gaura biennis		+	+	+	
Family *Umbelliferae*					
Eryngium yuccifolium	+	+	+	+	
Zizia aurea	+	+		+	
Family *Primulaceae*					
Dodecatheon Meadia	+				
Family *Gentianaceae*					
Gentiana puberula	+	+		+	
Gentiana Andrewsii	+				
Gentiana flavida	+	+		+	+
Family *Apocynaceae*					
xApocynum cannabinum	+	+	+		
Apocynum cannabinum hypericifolium	+				
Family *Asclepiadaceae*					
Asclepias tuberosa	+	+	+	+	+
xAsclepias syriaca	+	+	+		
Asclepias verticillata	+	+	+		
Acerates floridana	+		+		
Acerates viridiflora	+	+	+		
Acerates viridiflora lanceolata	+	+		+	
Family *Convolvulaceae*					
xConvolvulus sepium	+	+	+		
Family *Polemoniaceae*					
Phlox pilosa	+	+	+	+	+
Family *Hydrophyllaceae*					
xEllisia nyctelea	+		+		
Family *Boraginaceae*					
Lithospermum canescens	+	+	+	+	
Family *Verbenaceae*					
xVerbena stricta	+	+	+		
Family *Labiatae*					
Scutellaria parvula		+	+		
Monarda mollis	+	+	+	+	+
xHedeoma hispida		+	+	+	+
Pycnanthemum flexuosum	+	+	+		
Pycnanthemum pilosum	+	+			
Family *Solanaceae*					
xPhysalis pruinosa	+		+	+	
Physalis virginiana	+	+	+	+	
Family *Scrophulariaceae*					
Scrophularia leporella	+		+	+	
Veronica virginica	+	+	+		
Gerardia auriculata	+				
Gerardia aspera	+				
Gerardia purpurea	+				
Gerardia Skinneriana	+				
Pedicularis canadensis	+	+		+	
Family *Acanthaceae*					
Ruellia ciliosa			+		
Family *Campanulaceae*					
xSpecularia perfoliata		+	+		
Family *Lobeliaceae*					
Lobelia spicata	+	+	+	+	+

	I	II	III	IV	V
Family *Compositae*					
Kuhnia eupatoroides corymbulosa	+	+	+	+	
Liatris cylindracea	+				
Liatris scariosa	+	+	+	+	+
Liatris pycnostachya	+	+	+		
Solidago speciosa angustata	+	+	+	+	+
Solidago missouriensis	+	+	+		
Solidago nemoralis	+	+	+	+	+
Solidago canadensis	+	+	+	+	+
xSolidago rigida	+	+	+	+	+
Solidago graminifolia	+	+	+		
Aster novæ-angliæ	+	+	+	+	
Aster sericeus	+	+		+	
Aster azureus	+	+	+	+	+
Aster lævis	+	+		+	+
Aster multiflorus	+	+	+	+	+
Aster paniculatus	+	+	+		+
xErigeron ramosus	+	+	+	+	
xErigeron canadensis	+	+	+	+	
Antennaria neglecta	+	+	+	+	
Silphium laciniatum	+	+	+		
Silphium integrifolium	+	+	+		
Parthenium integrifolium	+	+	+		
xAmbrosia trifida	+	+	+		
xAmbrosia artemisiifolia		+	+	+	
xAmbrosia psilostachya	+	+	+	+	
Heliopsis scabra	+	+	+	+	+
Rudbeckia subtomentosa	+				
Rudbeckia hirta	+	+	+	+	+
Brauneria pallida	+	+	+		
Lepachys pinnata	+	+	+	+	+
Helianthus scaberrimus	+	+	+	+	+
Helianthus occidentalis	+	+	+	+	
xHelianthus grosseserratus	+	+	+	+	
Helianthus tuberosus	+		+		
Coreopis palmata	+	+	+	+	+
Coreopis tripteris	+	+	+		
xAchillea millefolium	+	+	+	+	+
Artemisia caudata	+	+		+	+
Artemisia serrata	+				
Artemisia ludoviciana	+	+	+	+	+
Cacalia tuberosa	+				
Senecio plattensis	+		+	+	+
Cirsium discolor	+	+	+	+	+
Cirsium iowense	+				
Cirsium Hillii	+	+		+	
Krigia amplexicaulis	+				
Lactuca canadensis	+	+	+	+	
Prenanthes racemosa	+	+	+		

Wilton-Summit tract
(For explanation see next page)

PLATE I

EXPLANATION OF PLAT OF WILTON-SUMMIT TRACT

Each of the three sections represents 2 miles.
Miles are numbered from north to south with Roman numerals.
The horizontal dotted lines mark quarter miles.
The section lines are marked with heavy broken lines.
The railway runs on section lines to near Summit.
Its right of way and the intersecting roads are marked with full lines. Both are exaggerated in width.
The cross-lines mark the fills, the largest about 9 feet high.
The dotted areas are low and wet.
The black areas represent cuts. They are distributed as follows:

Mile I.—Three cuts 3 to 5 feet deep.
Mile II.—Cut a is about one-half mile long and reaches 11 feet in depth.
Cut b is about 100 yards long and 8 feet deep.
Mile III.—One cut 3 feet deep.
Mile IV.—Cut c, more than 450 yards long and reaching 14 feet in depth.
Mile V.—Cut d, nearly 500 yards long and 14 feet deep.
Cut e, less than 200 yards long and 5 feet deep.
Cut f, about 180 yards long and 8 feet deep.
Mile VI.—The large cut is just outside of our area.

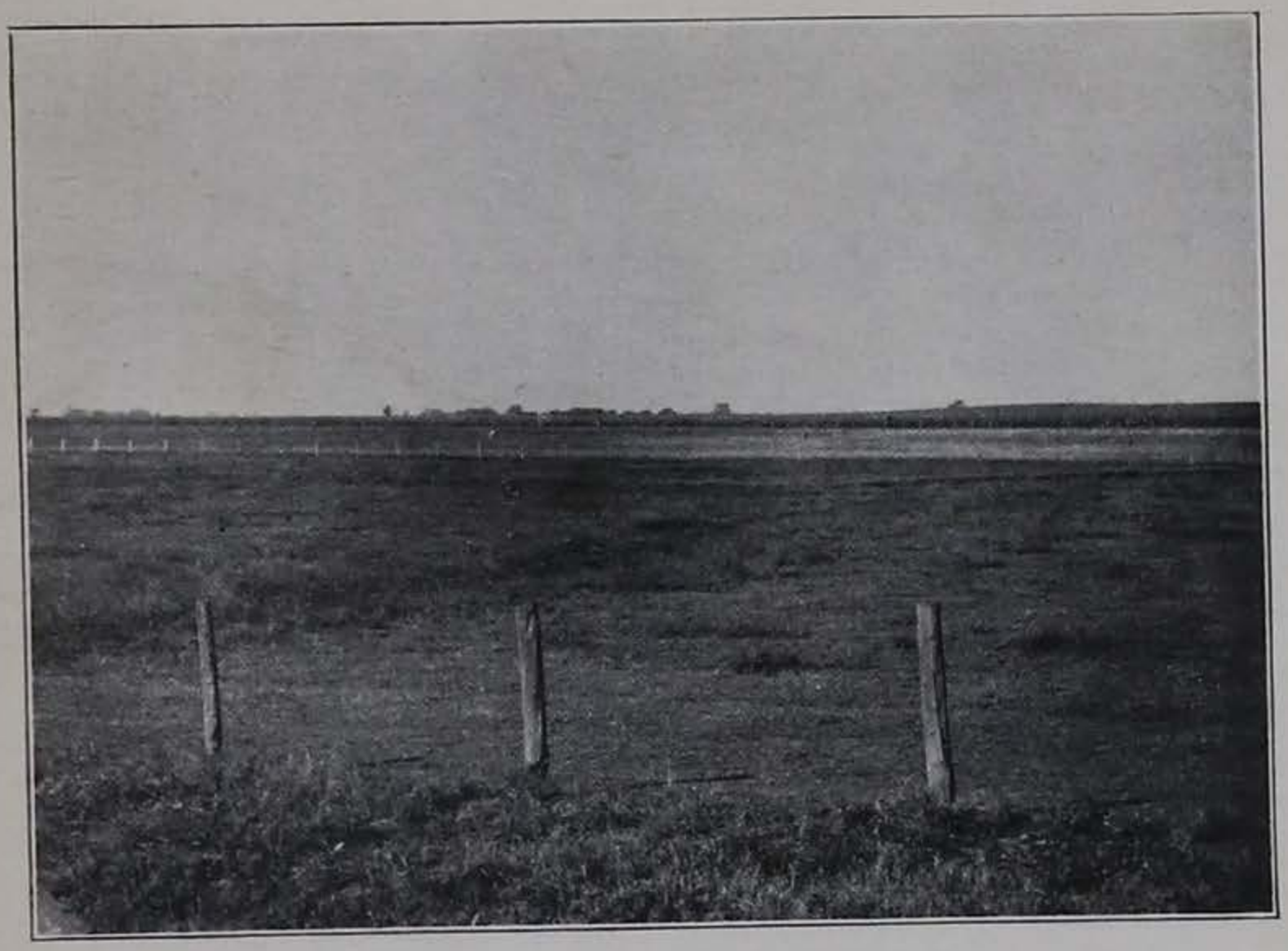

Fig. 1. Illinoian drift prairie south of Wilton.

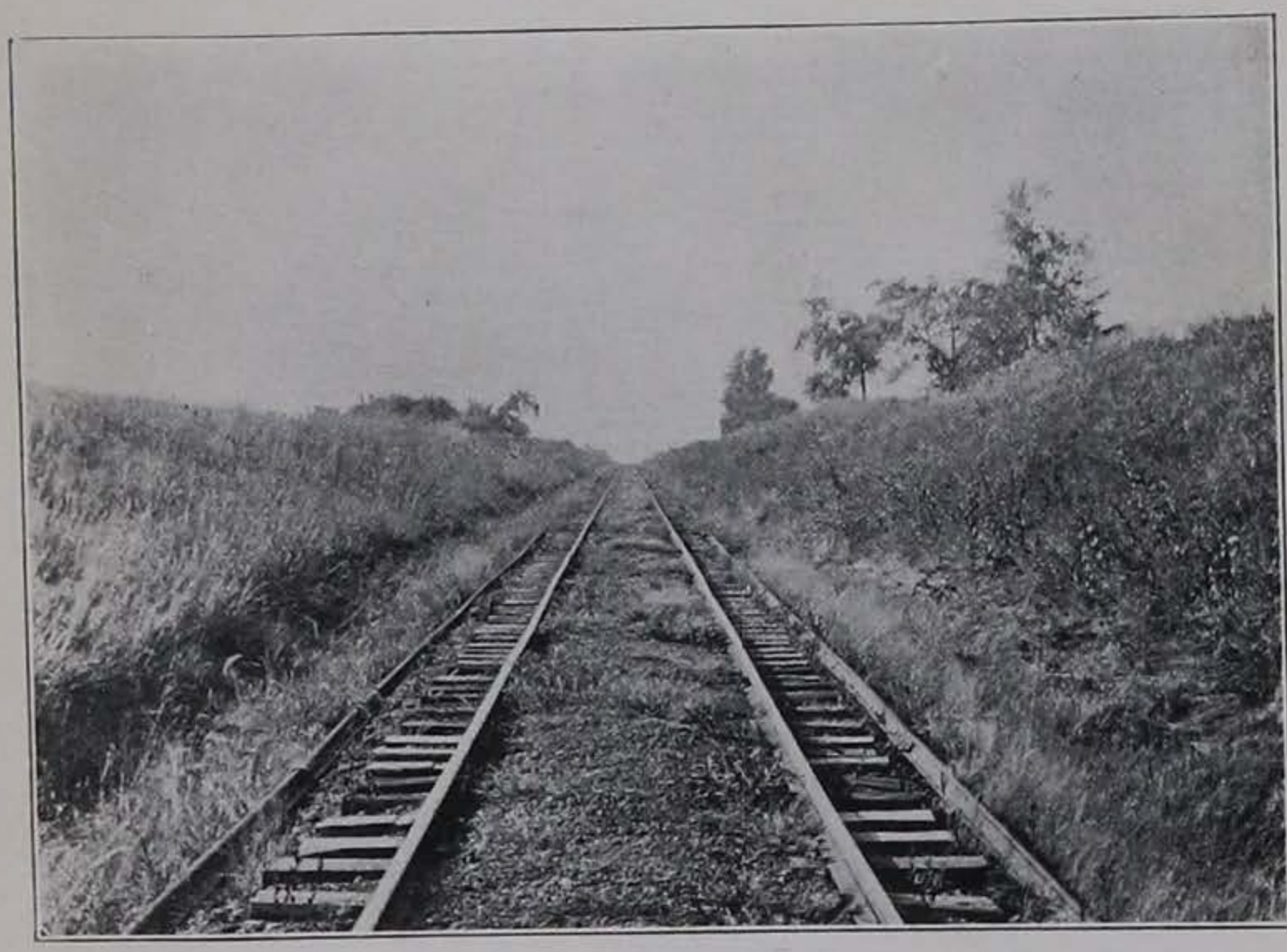

Fig. 2. Cut a, looking south. Shows restored prairie. South of Wilton.

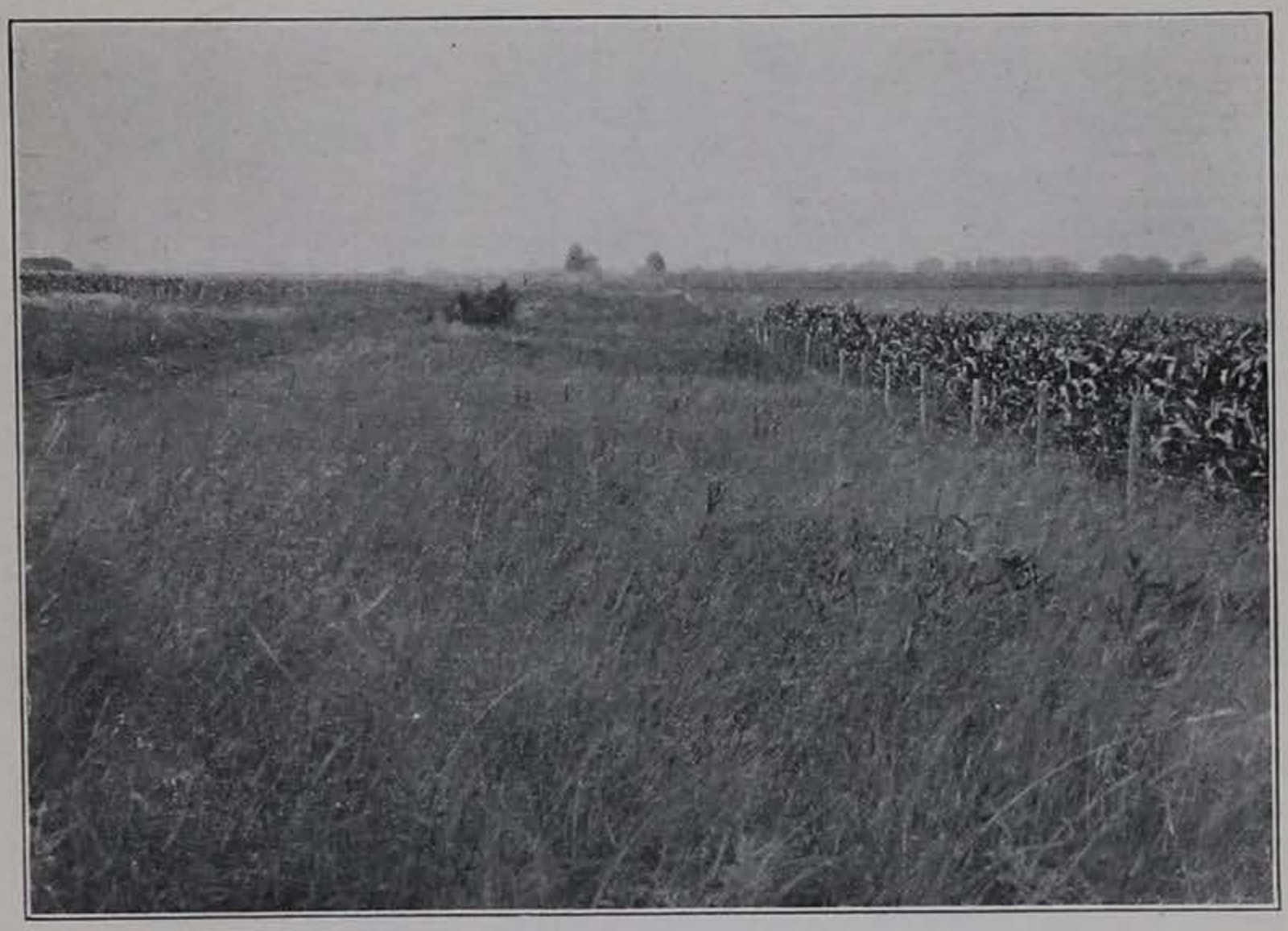

Fig. 1. Native prairie along railway. Looking north from cut b. Partly low. South of Wilton.

Fig. 2. Native prairie at cut a. Looking south.

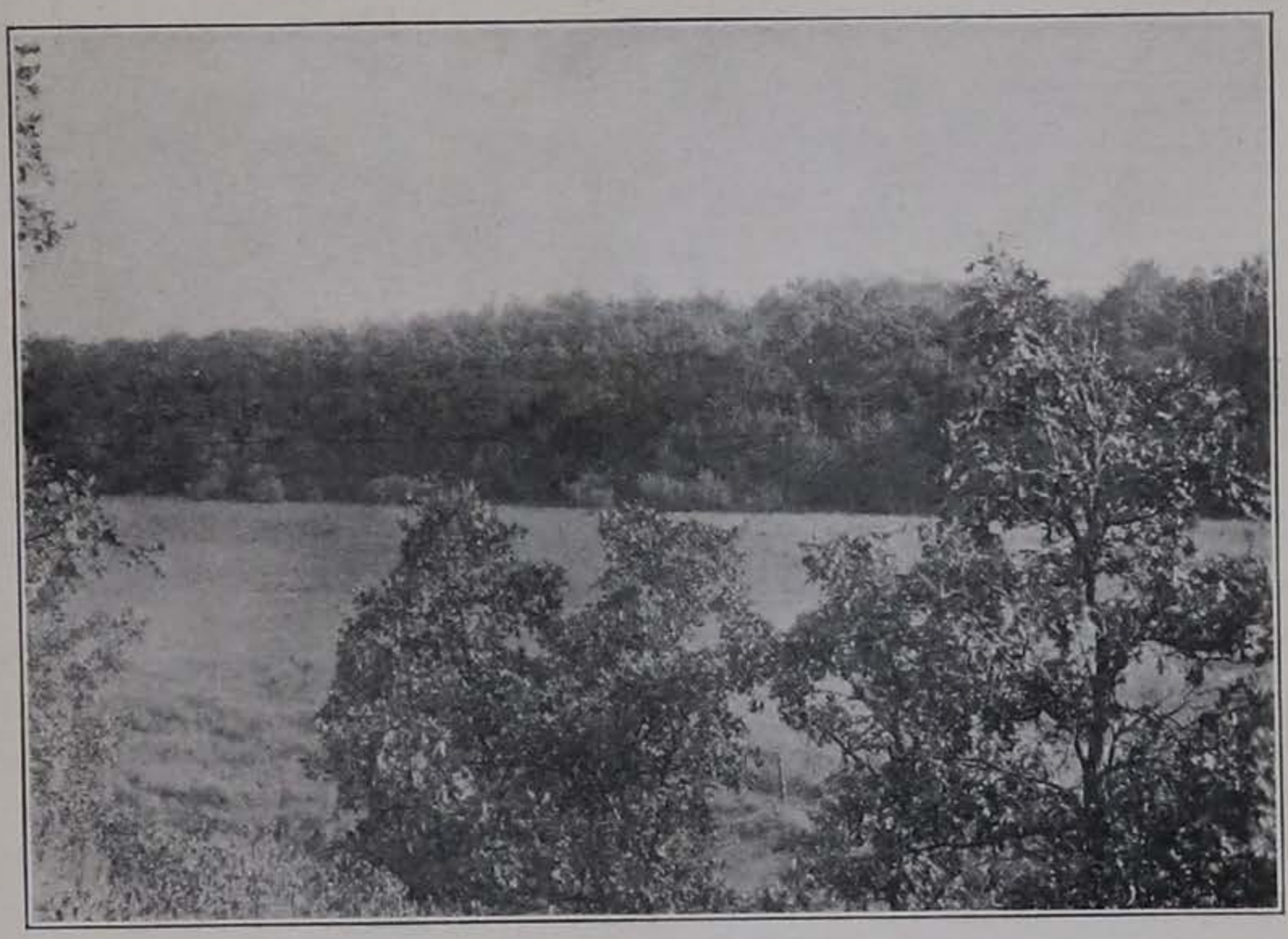

Fig. 1. Looking nearly south across Buffalo Slough towards the wooded bluffs just east of restored prairie. Mason City.

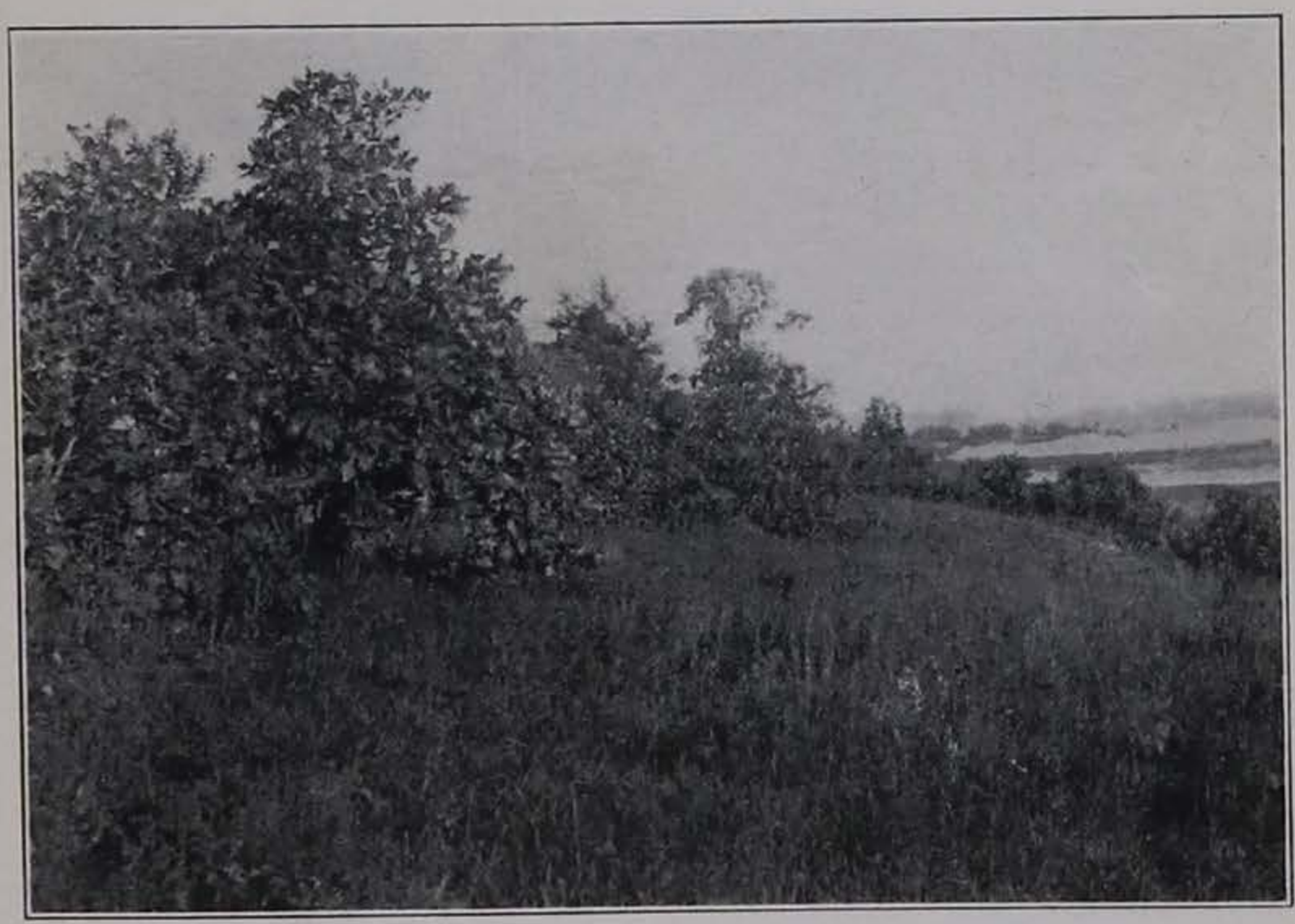

Fig. 2. A bit of native prairie with forest border. Near restored prairie at Mason City.

THE PRAIRIE FLORA OF MANITOBA

B. SHIMEK

The prairies originally occupied a large part of the Mississippi Valley and the region to the north. They extended southward to Oklahoma and Texas; eastward through Illinois, Indiana and Ohio, including also the barrens of Kentucky and Tennessee; and westward and northwestward, including seven-eighths of the area of Iowa, the southern and western parts of Minnesota, eastern Kansas, Nebraska and the Dakotas, and thence into the southern portions of the provinces of Canada east of the Rocky Mountains.

They extended over almost every type of topography and soil found within that area, and there is nothing in either which definitely marks or determines the character of the prairie. There is substantial agreement in but one character,—the flora. The prairies are treeless, or practically so, and the greater part of the flora consists of perennial herbs of a distinctly xerophytic type, the Gramineæ being most numerous in individuals though exceeded by the Compositæ in number of species, with the Leguminosæ following as third in order.

The prairies were continuous over large areas, or were interrupted by groves, swamps and sand-dune areas, or were limited to small areas hemmed in by forest or swamp. Whatever their extent, however, they agreed in the character of their original flora, now reduced over most of the area to mere remnants. The typical prairie flora, as represented in Iowa, extended over the entire area, but at its western margins it blended more or less with the still more xerophytic flora of the great plains.

The present paper presents a brief discussion of this flora as it appears in a portion of southern Manitoba, still well within the prairie area, but near its northern border. The vicinity of Carberry, about 100 miles west of Winnipeg, was chosen for study because an earlier list of the flora of the region had been published by Christy.[1] This list was prepared on the basis of observations made in 1883 and 1884, when the region was just being settled and

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[1]Christy, R. Miller, Notes on the Botany of Manitoba. Journal of Botany, vol. XXV, 1887.

presented much of the prairie in its primitive condition. In 1920 the writer found the prairie of the region mostly under cultivation, but few tracts remaining unbroken. The best illustrations of the prairie flora were preserved in the unbroken strips along the railway right of way, and on limited tracts west and northwest of Carberry. For an illustration of the latter see Plate VI, fig. 1.

The Canadian Pacific Railway was constructed when the region was still practically unsettled, and its right of way has preserved a transect of the native prairie along both sides of the roadbed for about three miles on either side of Carberry. A portion of it is illustrated in Plate VI, fig. 2. The Canadian Northern Railway has little prairie on its right of way north and south of the station as it was built after most of the surface was broken. Some attention was also given to the strips of prairie along the Canadian Pacific right of way both east and west of MacGregor,—about thirty miles east of Carberry.

Carberry lies in a lobe of the prairie plain which is bounded by the northern margin of the great sand-dune area which extends along the Assiniboine River for about 150 miles. The location of the lobe is shown in the map, Plate V. Its surface is quite level, being somewhat broken only by a few very shallow kettleholes (now mostly dry), and near the margins by low outliers of the dune area. Its marginal portions and irregular areas scattered over its surface are quite sandy, but most of it is fertile and was originally covered with a prairie flora, which was interrupted only by the kettleholes. The latter were bordered by a marsh flora, of which little remains, in some cases, and by thickets consisting largely of *Populus tremuloides*, some of which still persist.

The sand-dune area, which extends for many miles along the southern border of the prairie of which the Carberry lobe is a part, was studied only in the region including the lobe. Much of its border is quite abrupt, but occasionally it shades off gradually into sandy prairie, as at Brandon Junction. Its surface presents a variety of features. Much of it is of the usual dune type (see Plate VIII, fig. 2), but there are large gently sloping or flat areas, which, though very sandy, are largely covered with a prairie flora. Such areas are shown in Plate VII, fig. 2, and Plate VIII, fig. 1.

One of the finest areas of this type is known as Spruce Plain. It is located southwest of Carberry, and a little of the eastern mar-

gin is shown on the map, Plate V. It lies in the heart of the dune area, but its surface is flat, or but gently rolling. A portion of it is shown in Plate VII, fig. 2. While a large part of it is treeless, thickets and clumps of white spruce, *Picea canadensis*, are scattered over its surface, giving it its name. The treeless surfaces are covered with an almost pure prairie flora.

The rougher portions of the dune area are more or less covered with thickets, particularly in the depressions and around the ponds or bogs which occupy them. The largest of these swamps lies a little to the west of the area mapped, and is an extensive tamarack muskeg which surrounds a small lake.

The dune area crosses the Canadian Pacific about four miles west of Carberry, and a narrow lobe extends northward about three miles to the east, as shown on the map. Another lobe crosses the line of the railway near Sidney, east of the area mapped; but beyond that, eastward, the border of the sandhills sweeps well to the south.

The MacGregor area is typical, nearly level fertile prairie, and practically all excepting the right of way is under cultivation. The latter shows good transects of native prairie, varied occasionally by slight depressions which contain a marsh flora. Some of the depressions in this region are also bordered by thickets.

THE FLORA

No detailed study of the flora of the swamp areas and thickets was attempted, but incidental observations were made in connection with the closer study of the xerophytic flora of the prairies and the dunes. Some notes on these observations will be of interest because they reveal the floral types which occupy modified portions of these xerophytic areas.

The Swamp Flora.—The finest display of this flora was presented by the great muskeg in the Spruce Plain region. The following list of plants will suggest the general floral character of the area, the tamarack being dominant over its greater part:

Larix laricina
Equisetum fluviatile
Triglochin maritima
Calamagrostis canadensis
Eriophorum angustifolium majus
Carex hystricina
Tofieldia glutinosa
Smilacina trifolia
Habenaria hyperborea
Salix candida
Salix petiolaris
Sarracenia purpurea
Parnassia palustris
Menyanthes trifoliata
Galium Claytoni
Lobelia Kalmii
Aster junceus

In the smaller more or less marshy tracts on the prairie and dune areas the following additional species were observed:

Equisetum hyemale robustum
Typha latifolia
Alisma plantago-aquatica
Phalaris arundinacea
*Agrostis alba
Calamovilfa longifolia
Spartina Michauxiana
Spartina gracilis
Phragmites communis
Eragrostis Frankii
Poa triflora
Elymus virginicus
Scirpus validus
Eriophorum angustifolium majus
Carex filiformis
Carex Sartwellii
Carex Bebbii
Spirodela polyrhiza
Juncus bufonius
Juncus balticus littoralis
Lilium canadense
Cypripedium parviflorum
Salix longifolia
Salix discolor
*Salix rostrata
Betula pumila glandulifera
Urtica gracilis
Rumex mexicanus
*Anemone canadensis
Caltha palustris
Ribes floridum
*Spiræa salicifolia
Potentilla fruticosa
Rubus triflorus
Lathyrus palustris
Lathyrus palustris myrtifolius
*Epilobium angustifolium
Hippuris vulgaris
Cicuta maculata
Sium cicutæfolium
Cornus stolonifera
Steironema ciliatum
Apocynum cannabinum hypericifolium
Gentiana Andrewsii
Asclepias incarnata
*Stachys palustris
Mentha arvensis canadensis
Castilleja pallida septentrionalis
Pedicularis lanceolata
Plantago eriopoda
Campanula aparinoides
Aster umbellatus
Erigeron philadephicus
Artemisia biennis
Petasites sagittatus
Cirsium muticum

Several of the species in this list also appear in the prairie list. They are marked with an asterisk. These species usually grow in moist places, but sometimes they extend to drier prairies. *Ribes floridum* also appears in moist woods.

The Forest Flora.—Two groups of forest plants are more or less distinguishable in this region,—those of the more xerophytic dunes, and those of the sheltered ravines and borders of swamps or ponds.

The following list includes the species observed on the dry dunes, —often in thickets:

Picea canadensis
Bromus ciliatus
*Bromus purgans
Smilax herbacea pulverulenta
Populus tremuloides
*Quercus macrocarpa
Thalictrum dioicum
Actæa rubra
Arabis canadensis
Amelanchier spicata
Cratægus, sp.
Agrimonia striata
Prunus virginiana
Prunus pennsylvanica
*Rhus Toxicodendron
*Elæagnus argentea
Monarda fistulosa
Lonicera glaucescens

The species marked with an asterisk are also found in the prairie list.

The following species are usually found near the borders of thickets, and may extend out on the prairie:

Bromus ciliatus
Smilax herbacea pulverulenta
*Corylus americana
Polygonum scandens
Erysimum cheiranthoides
Prunus virginianus
Rubus idæus
Rubus occidentalis
Sanicula marilandica

The *Corylus* is also frequent on the prairie, and the species of *Prunus* and *Rubus* have probably been carried out upon the prairie by birds, as they are usually found along fences or telegraph wires, which serve as perches for birds.

The following species were found in the more moist and better sheltered thicket:

Equisetum pratense
Equisetum sylvaticum
Agrostis perennans
Populus balsamifera
Populus acuminata
Betula alba
Alnus incana
Anemone virginiana
Actæa alba
Ribes floridum
Rubus triflorus
Rosa blanda
Acer Negundo
*Epilobium angustifolium
Aralia nudicaulis
Thaspium aureum
Cornus canadensis
Pyrola elliptica
Pyrola americana
*Steironema ciliatum
Castilleja miniata
Viburnum opulus americanum
Eupatorium purpureum
Solidago ulmifolia
*Solidago serotina
Rudbeckia laciniata
Cacalia suaveolens
Lactuca spicata
Prenanthes alba

The species marked with an asterisk also appear upon richer prairie.

A few prairie plants may also be found in the more open portions of the groves. The following were noted:

Equisetum hyemale intermedium
Elymus canadensis
Thalictrum dasycarpum
Heuchera hispida
Fragaria virginiana
Convolvulus sepium
Agastache Fœniculum
Galium boreale
Symphoricarpos occidentalis
Rudbeckia hirta

The Dune Flora.—The Manitoba prairie list shows 96 species of prairie plants which are also found upon the dunes bordering the Carberry prairie lobe. They were collected east, west and south of Carberry. In addition to these prairie species the dunes and sandy areas yielded the following distinctively sand species:

Selaginella rupestris
Juniperus horizontalis
Cyperus Schweinitzii
Chamærhodos erecta
Androsace occidentalis
Opuntia polyacantha
Arctostaphylos Uva-ursi

Geum triflorum and *Asclepias tuberosa* were also found here only on the dunes, but both occur on ordinary prairie elsewhere. *Arabis*

Drummondii, which is given in the prairie list, was also found here only upon sandy areas. It is scarcely a characteristic prairie plant, but occurs on dry areas of various types. *Panicum Scribnerianum* is likewise found on ordinary prairie elsewhere.

The Prairie Flora.—The prairie flora may be considered in two rather illy-defined groups. The one includes the plants of the sandy prairie collected within the Carberry lobe, and the other the flora of the more fertile prairie.

The former is listed in column II, of the Manitoba prairie list, and its 125 species differ from those of the richer prairie only in that the less xerophytic forms are wanting, and that two species of sand plants are included, namely *Androsace occidentalis* and *Arctostaphylos Uva-ursi. Polygala Senega* and *Acerates viridiflora* were collected only upon the sandy prairie, but they occur on ordinary prairie almost everywhere.

The flora of the more fertile prairie in the vicinity of Carberry is listed in column I, and that from the prairie at MacGregor in column IV. It will be observed that the more fertile prairie of MacGregor yielded several species, belonging to the genera *Sorghastrum, Panicum, Sporobolus, Sisyrinchium, Amorpha, Asclepias, Helianthus* and *Prenanthes,* which are characteristic of the richer prairies in Iowa, and elsewhere, but which are lacking on the Carberry prairie. The latter, however, yielded 130 species, as against 110 from MacGregor. The additional species from Carberry are mostly more xerophytic types. The locality was more thoroughly worked than that at MacGregor, and that may account in part for the difference.

The 15 species marked with an asterisk in the Manitoba prairie list, are not known on the prairies of Iowa. Several are far western and northwestern species, and a few like the species of *Lychnis* and *Erysimum,* are scarcely characteristic prairie plants, but may occur in almost any dry situation. The great bulk of this prairie flora is identical with that of Iowa.

Column V contains the species reported by Christy,—in some cases under other names than those here employed. He does not report *Anemone cylindrica,* but evidently included it with *A. virginiana,* both being very common. Two evident errors occur in the report of *Quercus alba* and *Juniperus virginiana* from the sandhills. The former is undoubtedly *Q. macrocarpa,* which is very common, and the latter is *Juniperus horizontalis.*

Several of the species in his list were not found by the writer, but among them only the following are prairie or sand species:

Helianthemum canadense
Geranium carolinianum
Astragalus caryocarpus
Astragalus monticola
Aster vimineus
Castilleja coccinea

Christy's explanation of the cause of the treelessness of the prairies (fire) will be discussed by the writer elsewhere.

The Weed Flora.—It is interesting to compare Christy's list of weeds with those collected by the writer thirty-six years later. The country was comparatively new when his observations were made, and the list is short; it may be incomplete even for that date. The entrance of railways into this territory, however, and the general settlement and cultivation of the country, no doubt greatly increased the number of introduced weeds. Some of the native prairie plants given in the Manitoba list have also become weeds. They are discussed as "prairie weeds" in the preceding article.

The following species of introduced weeds were found chiefly along the roadbeds of the railways at Carberry and MacGregor. With them were associated various native prairie plants but mostly in small numbers. Few enter the prairie transect in the right of way, excepting where the surface has been disturbed. The list follows:

Setaria viridis
Phleum pratense
Avena fatua
Bromus secalinus
Lolium multiflorum
Polygonum aviculare
Polygonum convolvulus
*Chenopodium album
*Chenopodium Bonus-Henricus
Salsola Kali
tenuifolia
Amaranthus retroflexus
Silene noctiflora
*Saponaria Vaccaria
Portulaca oleracea
Thlaspi arvense
Lepidium virginicum
Brassica arvensis
Conringia orientalis
Sisymbrium altissimum
Capsella bursa-pastoris
Trifolium pratense
Trifolium hybridum
Melilotus alba
Melilotus officinalis
Lathyrus pratensis
Linum usitatissimum
Lappula echinata
Plantago major
Plantago lanceolata
Helianthus annuus
Tanacetum vulgare
Artemisia Absinthium
Cirsium arvense
Taraxacum officinale
Taraxacum erythrospermum
Sonchus arvensis
Crepis tectorum

Those marked with an asterisk were reported also by Christy. He added *Lychnis githago*, which the writer did not find.

While these weeds have freely invaded the roadbed and the cultivated fields on either side, they are excluded by the unbroken prairie turf here as elsewhere. Associated with these weeds on the

roadbed were the following species which were evidently introduced from some other part of the country, or from the United States:

Poa pratensis
Polanisia trachysperma
Potentilla Anserina

They also fail to enter the unbroken prairie.

The prairie flora of Manitoba is very similar to that of Iowa in identity of species, and it is quite as persistent.

TABLE OF THE PRAIRIE FLORA

The following list includes the Manitoba prairie plants which were found by the writer, and those which occur on the sandy areas are also noted.

Column I includes those from fertile prairie in or near Carberry.
Column II includes those from sandy prairie near Carberry.
Column III includes those from the treeless dune areas around the Carberry lobe.
Column IV includes those from the fertile prairie near MacGregor.
Column V includes the prairie species also reported by Christy.

Those marked with an asterisk (*) are not known from the prairies of Iowa.

The nomenclature of Gray's Manual is used in this paper excepting in the case of the few species not included in that work. In such cases Britton's Manual is followed.

	I	II	III	IV	V
Family *Equisetaceae*					
Equisetum arvense	+	+		+	
Equisetum hyemale intermedium	+	+	+	+	
Family *Gramineae*					
Andropogon scoparius	+	+	+	+	
Andropogon furcatus	+	+	+	+	+
Sorghastrum nutans				+	
Panicum Scribnerianum		+	+		
Panicum virgatum				+	
*Stipa viridula	+	+	+		
Stipa comata	+				+
Stipa spartea	+	+	+	+	+
Aristida basiramea		+	+	+	
Muhlenbergia racemosa	+	+	+	+	
Sporobolus cryptandrus	+	+	+	+	
Sporobolus heterolepis				+	
Sporobolus brevifolius		+		+	
Agrostis alba	+				
Agrostis hyemalis	+	+	+	+	
Kœleria cristata	+	+	+	+	
Bouteloua oligostachya	+	+	+		
Bouteloua hirsuta		+			
Bouteloua curtipendula		+	+		
Poa compressa	+	+		+	

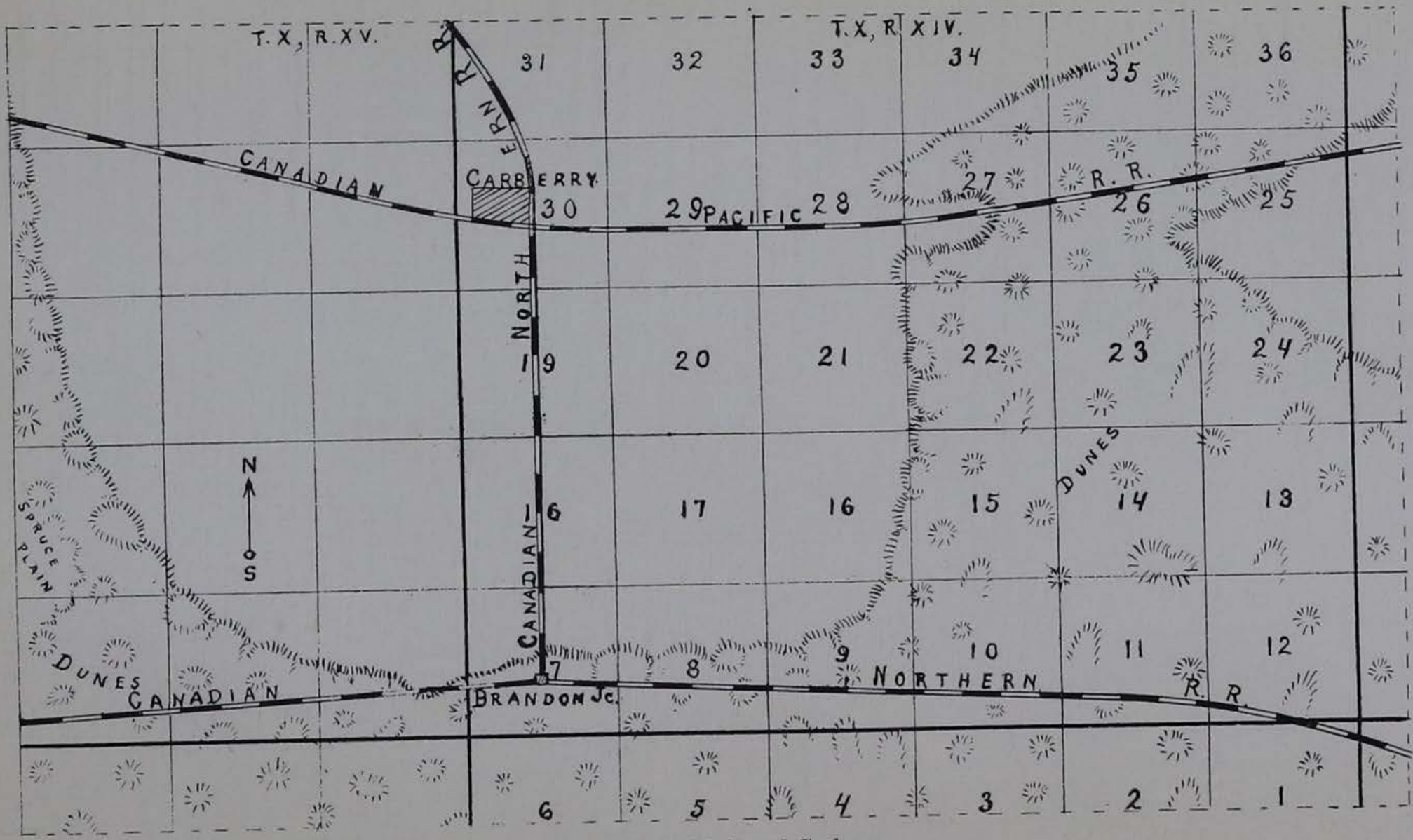
	I	II	III	IV	V
Festuca octoflora	+		+		
Bromus purgans	+	+	+		
Agropyron Smithii	+	+		+	
Agropyron tenerum	+				
Agropyron caninum	+				
Agropyron Richardsonii	+	+	+	+	
Hordeum jubatum	+	+			
Elymus canadensis	+	+	+	+	
Family *Cyperaceae*					
Carex straminea	+				
Family *Liliaceae*					
Zygadenus chloranthus	+	+		+	+
Allium stellatum	+	+	+	+	+
Lilium philadelphicum			+	+	+
Smilacina stellata		+	+	+	
Family *Iridaceae*					
Sisyrinchium campestre				+	+
Family *Salicaceae*					
Salix humilis	+	+	+		
Salix rostrata	+	+		+	
Family *Fagaceae*					
Corylus americana	+	+	+		
Quercus macrocarpa	+	+	+		
Family *Santalaceae*					
Comandra umbellata	+		+		
Comandra pallida	+	+	+		
Family *Amaranthaceae*					
Amaranthus blitoides	+	+			
Family *Nyctaginaceae*					
Oxybaphus hirsutus	+	+	+	+	
Family *Caryophyllaceae*					
Arenaria stricta	+	+			
Cerastium arvense	+	+	+	+	
*Lychnis Drummondii	+				
Family *Ranunculaceae*					
*Thalictrum confine	+	+	+	+	
Thalictrum dasycarpum		+		+	
Anemone patens Wolfgangiana	+	+	+	+	
Anemone cylindrica	+	+	+	+	
Anemone canadensis	+	+		+	
Family *Cruciferae*					
Lepidium apetalum	+	+	+	+	
Sisymbrium canescens	+			+	
Sisymbrium canescens brachycarpon	+	+	+	+	
Arabis Drummondii		+	+		
Arabis lyrata		+	+	+	
Arabis glabra		+			
*Erysimum parviflorum		+		+	
*Erysimum asperum	+	+	+		
Family *Capparidaceae*					
Cleome serrulata	+			+	
Family *Saxifragaceae*					
Heuchera hispida	+	+	+	+	+
Family *Rosaceae*					
Spiræa salicifolia	+	+	+	+	+
Fragaria virginiana	+	+	+	+	
Potentilla arguta	+	+	+	+	
Potentilla monspeliensis	+	+		+	+

	I	II	III	IV	V
Potentilla pennsylvanica	+	+	+		
*Potentilla Hippeana	+	+	+		
Rosa acicularis	+	+	+	+	+
Rosa pratincola	+	+	+	+	
Prunus pumila	+	+	+		
*Prunus Besseyi	+				
Family *Leguminosae*					
Trifolium repens	+				
Psoralea argophylla	+	+		+	+
Psoralea esculenta	+		+		+
Amorpha canescens				+	
Petalostemum purpureum	+	+	+	+	+
Petalostemum candidum	+	+	+	+	+
Astragalus canadensis	+	+		+	+
*Astragalus adsurgens	+	+	+	+	+
Oxytropis Lamberti	+		+		+
*Oxytropis splendens				+	
Glycyrrhiza lepidota	+	+		+	+
Vicia americana	+	+		+	+
Vicia americana linearis	+	+		+	+
Lathyrus venosus	+	+	+	+	+
Family *Linaceae*					
Linum rigidum	+				
Linum sulcatum	+		+		+
Family *Polygalaceae*					
Polygala Senega		+			+
Family *Euphorbiaceae*					
Euphorbia serpyllifolia	+	+		+	
Family *Anacardiaceae*					
Rhus Toxicodendron	+	+	+	+	
Family *Violaceae*					
Viola pedatifida	+	+	+		
Family *Elaeagnaceae*					
*Elæagnus argentea	+	+	+	+	+
Family *Onagraceae*					
Epilobium angustifolium	+	+			
Œnothera muricata	+	+			
Œnothera biennis	+	+	+	+	+
*Œnothera pallida	+	+	+		
Œnothera serrulata	+	+			+
Gaura coccinea	+	+			
Family *Umbelliferae*					
Zizia aurea	+	+	+	+	
Zizia cordata	+	+	+	+	
Family *Apocynaceae*					
Apocynum cannabinum			+	+	
Family *Asclepiadaceae*					
Asclepias speciosa				+	
Asclepias ovalifolia	+				
Acerates viridiflora		+			
Family *Convolvulaceae*					
Convolvulus sepium	+			+	
Family *Boraginaceae*					
Lappula Redowskii occidentalis	+	+		+	
Lithospermum canescens	+	+	+	+	+
Lithospermum angustifolium		+	+		
Family *Labiatae*					
Teucrium canadense				+	

	I	II	III	IV	V
Agastache Fœniculum	+	+	+	+	+
Dracocephalum parviflorum	+	+			
Stachys palustris		+		+	
Monarda mollis	+	+	+	+	+
Family *Solanaceae*					
Physalis virginiana	+	+	+	+	
Family *Scrophulariaceae*					
Pentstemon gracilis	+	+	+	+	
*Orthocarpus luteus	+	+		+	+
Pedicularis canadensis				+	+
Family *Rubiaceae*					
Galium boreale	+	+	+	+	+
Houstonia longifolia	+	+			
Family *Caprifoliaceae*					
Symphoricarpos occidentalis	+	+		+	+
Symphoricarpos racemosus parviflorus	+				
Family *Campanulaceae*					
Campanula rotundifolia	+	+	+	+	+
Family *Lobeliaceae*					
Lobelia spicata		+		+	
Family *Compositae*					
Liatris punctata	+	+	+		+
Liatris scariosa	+	+	+	+	+
Chrysopsis villosa	+	+	+	+	+
Solidago missouriensis	+	+	+	+	
Solidago nemoralis	+	+	+	+	
Solidago canadensis gilvocanescens	+	+		+	
Solidago serotina		+		+	
Solidago rigida	+	+	+	+	+
Solidago graminifolia	+	+		+	
Aster novæ-angliæ		+	+	+	+
Aster lævis	+	+	+	+	+
Aster multiflorus	+	+	+	+	
Aster ptarmicoides	+	+	+	+	+
*Erigeron glabellus	+	+	+	+	+
Erigeron ramosus		+	+	+	
Erigeron canadensis	+	+	+	+	
Antennaria neodioica			+	+	
Antennaria neglecta			+		
Iva xanthifolia	+				
Ambrosia psilostachya		+		+	
Heliopsis scabra	+	+		+	+
Rudbeckia hirta	+	+		+	+
Brauneria angustifolia	+				+
Lepachys columnaris				+	
Helianthus scaberrimus	+	+	+	+	+
Helianthus grosseserratus				+	
Helianthus giganteus	+	+			
Helianthus Maximiliani	+			+	
*Gaillardia aristata	+	+	+		+
Achillea millefolium	+	+	+	+	+
Artemisia caudata	+	+	+	+	
Artemisia dracunculoides	+	+			
Artemisia glauca	+	+			
Artemisia ludoviciana	+	+	+	+	+
Artemisia frigida	+	+	+	+	+
Cirsium undulatum	+	+	+	+	+
Lactuca canadensis	+		+		+

	I	II	III	IV	V
Lactuca pulchella	+	+	+	+	+
Lygodesmia juncea	+	+	+		+
Agoseris cuspidata	+		+		
*Agoseris glauca	+		+	+	
Crepis runcinata			+	+	
Prenanthes racemosa				+	+
Hieracium canadense	+	+	+	+	+

PLATE V



Map of the vicinity of Carberry.

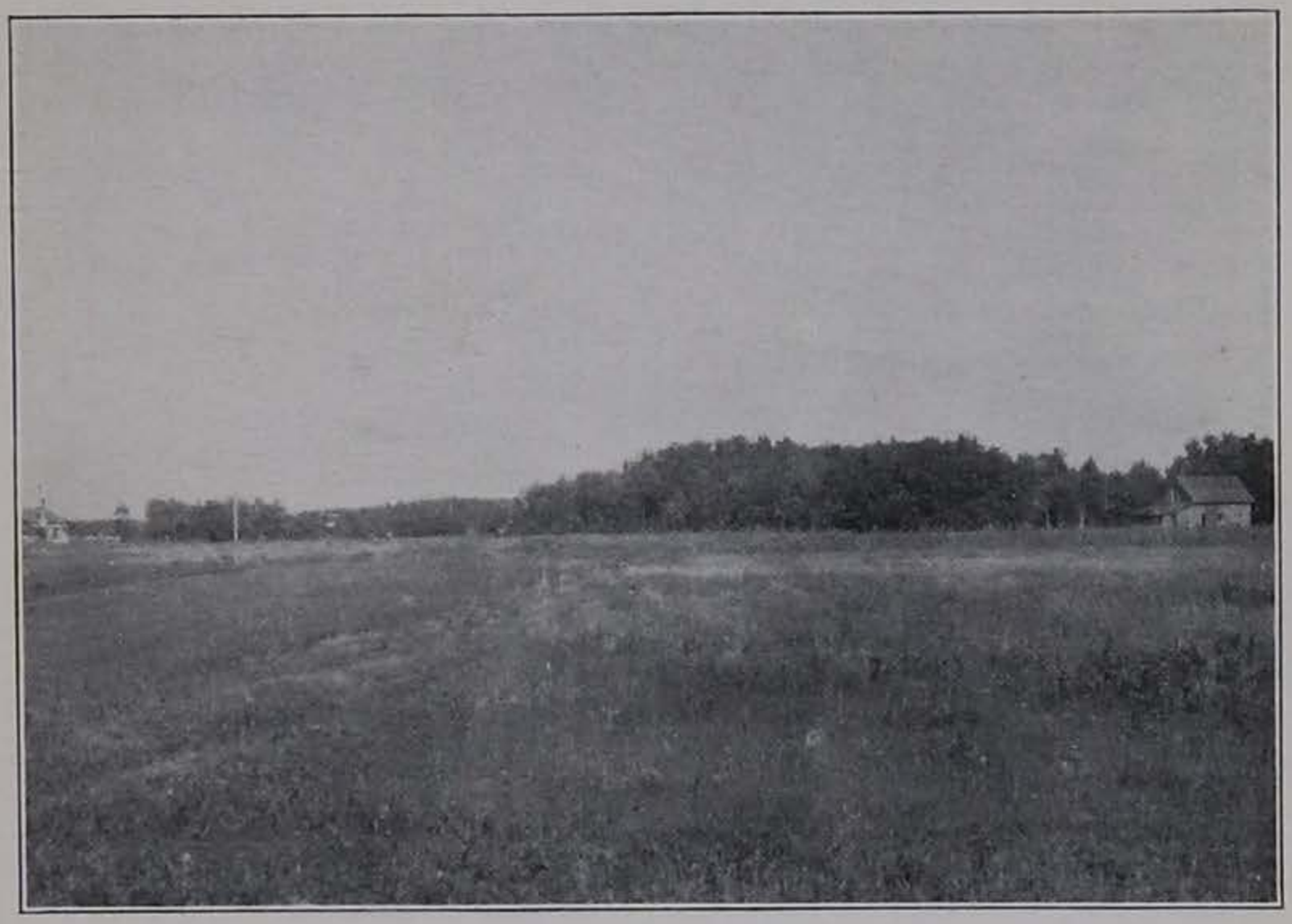


Fig. 1. A bit of native prairie on the west side of Carberry.

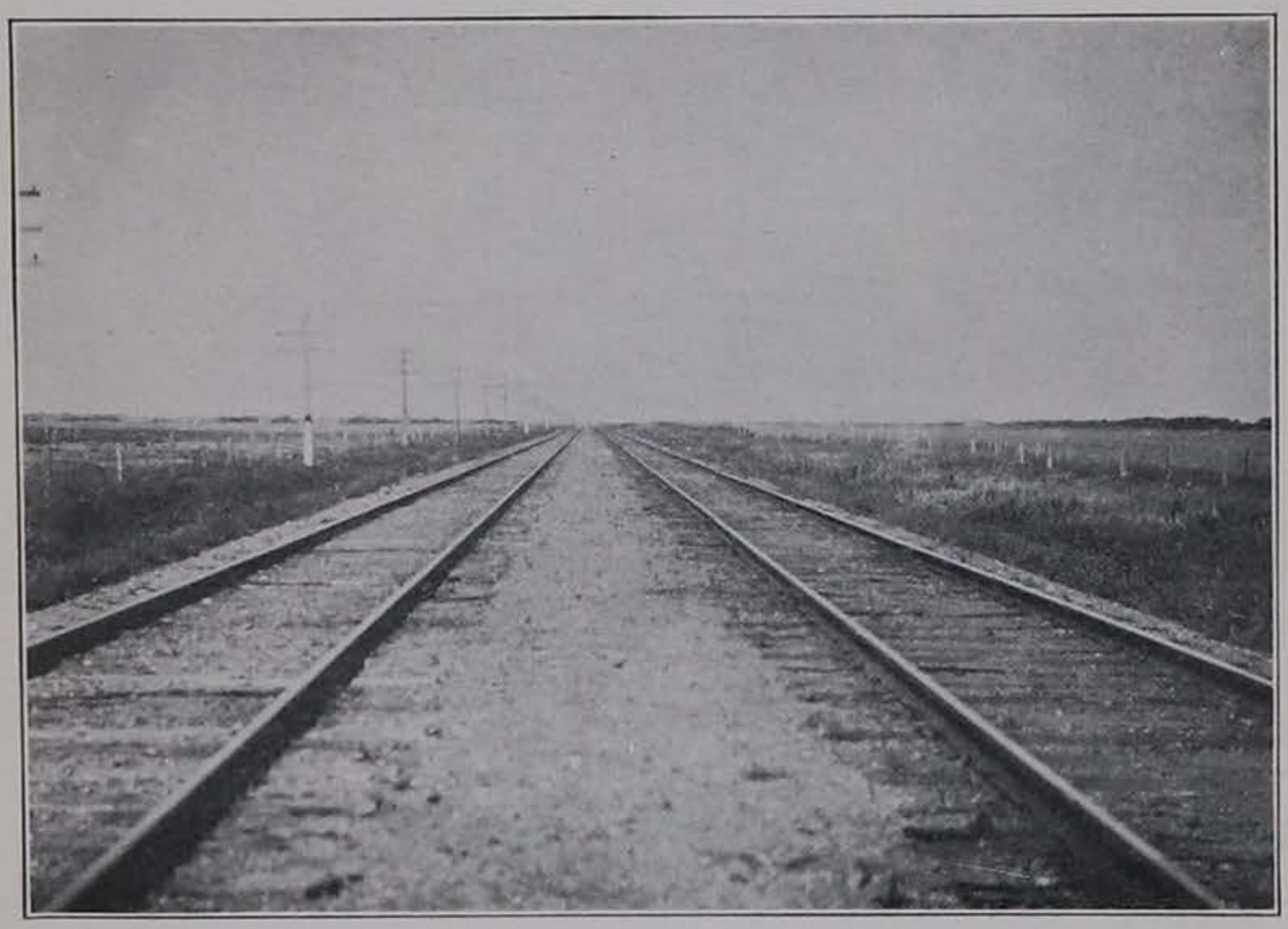


Fig. 2. Prairie along the Canadian Pacific Railway west of Carberry, looking west.

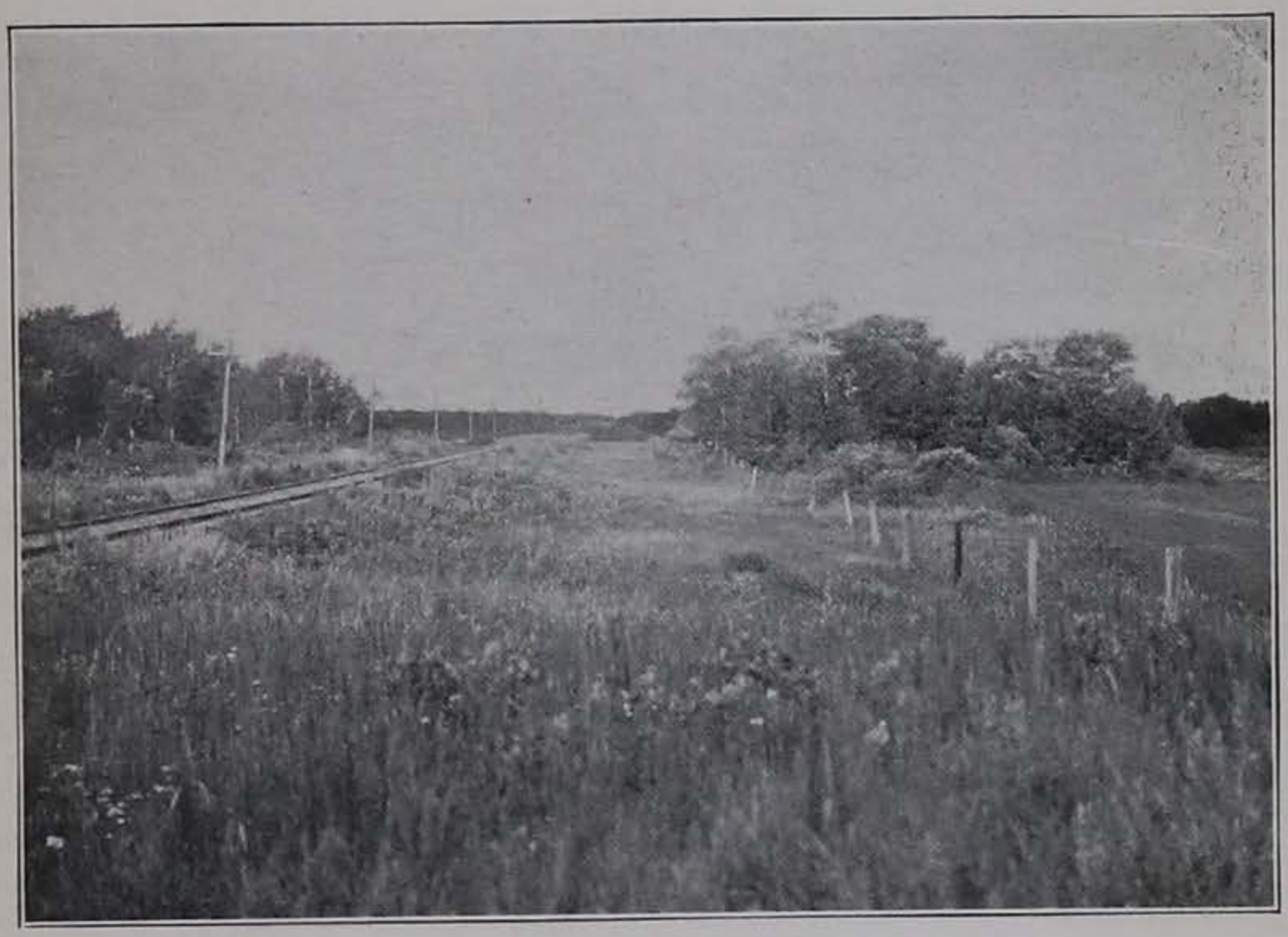


Fig. 1. Sandy prairie at Brandon Junction.

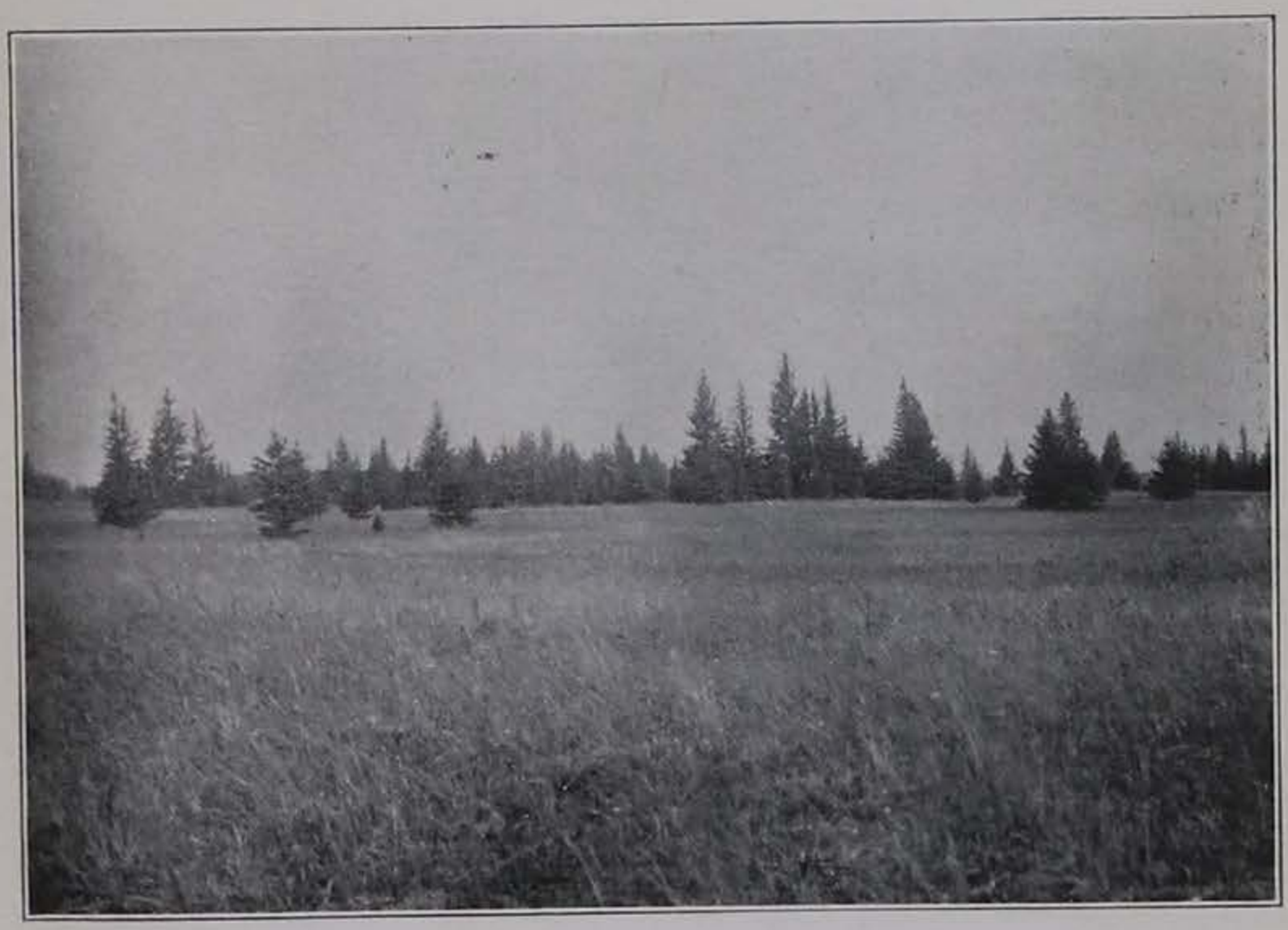


Fig. 2. Spruce Plain, with sandy plain and white spruce.

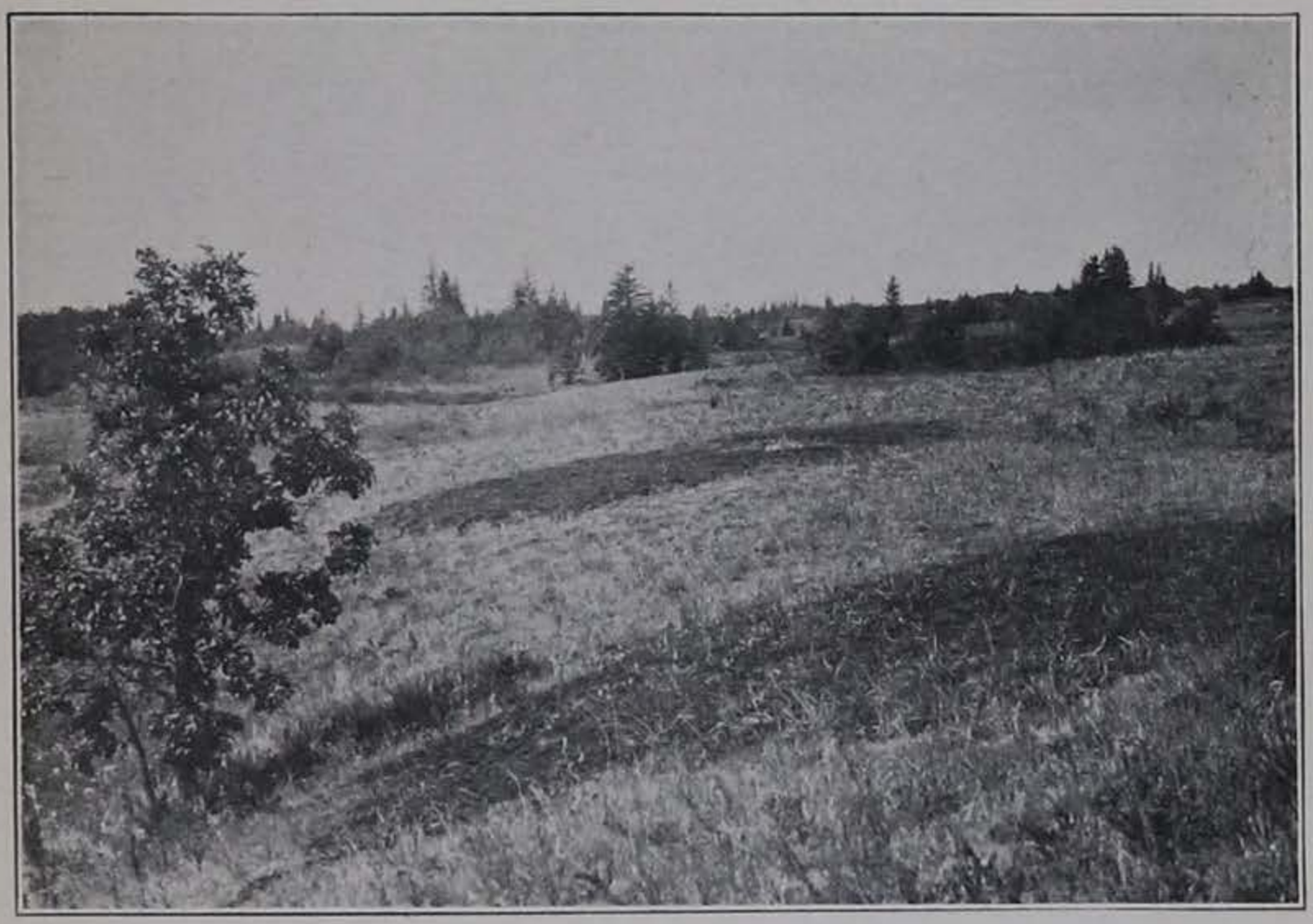


Fig. 1. Dunes east of Carberry. The two shadow-like areas are plants of *Juniperus horizontalis*. Bur-oak at left in foreground.

Fig. 2. Dunes east of Carberry, showing sandy prairie and white spruce.

Obtainable from the University
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