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Notes on Revegetation
of a Wisconsin Sandy Oak Opening, 1948-49

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Notes on Revegetation of a Wisconsin Sandy Oak Opening

H. C. Greene

The native vegetation of Wisconsin is being preserved, or re-created in miniature, in the University of Wisconsin Arboretum on the southwest edge of the City of Madison in Dane County. This vegetation includes a number of types, among which is the sand prairie-oak opening, a type rather extensively developed in central and south-central Wisconsin. This is an interim report on studies carried on 1943-49. It is anticipated that they will not be completed for some years to come.

Sandy oak openings are characterized by soils grading from sandy loam to almost pure sand. They are often rather low and subject to spring flooding, if adjacent to sizeable streams. Frequently there are more or less extensive pockets of sandy, blackish sedge peat which are decidedly more retentive of moisture than are the drier parts of the openings. The plant cover consists of 1) more or less scattered, often scrubby, oaks, mostly belonging to the largely indeterminate red oak-black oak group, but with occasional bur oaks which may be sizeable where sufficient moisture is available, and 2) a rather heterogeneous assemblage of prairie grasses and herbs, few or none of which can be said to be characteristic exclusively of sand prairies. Curtis and Greene ('49) studied Wisconsin relic prairies by the species-presence method and found that the ten species with the greatest presence values in sand prairies (sandy oak openings are essentially sand prairies with scattered oaks superimposed) are Andropogon furcatus, Liatris aspera, Amorpha canescens, Andropogon scoparius, Euphorbia corollata, Sporobolus heterolepis, Tradescantia ohioensis, Lespedeza capitata, Solidago rigida and Coreopsis palmata (presence refers to the occurrence of a species in a series of stands of a given plant

association and may be considered as stand-frequency).

The area chosen for these revegetation studies is within the so-called Grady Tract and consists of a rather flat, sandy, presently open tract of between ~~25~~³⁰ and ~~30~~³⁵ acres, bounded on the south by the right-of-way of the Lancaster Branch of the Chicago & Northwestern R. R., and on the north by a series of sand hills covered with scrub oak, under which is a more or less characteristic sand prairie flora. According to Prof. F. T. Thwaites of the Univ. of Wis. Geology Dept., these sandy hills were deposited as moraine in water at the edge of the glacier when its margin stood just west of Lake Wingra. Thus, the northern edge of the Grady Prairie, as the study area will be referred to in the rest of this paper, is almost pure sand, because it lies at the foot of these sand hills. In contrast, the southernmost and westernmost portions of the Grady Prairie have an overlying sheet of clay (heaviest in the south), apparently washed down from adjacent elevations, and perhaps also in part deposited from waters originating in Dunn's Marsh which lies immediately southwest of the Grady Tract. Between the sand and clay extremes lies a relatively high and dry area of sandy loam, with some clay pockets, in the east central part of the prairie. The soil here is light brown in color and tends to become very dry on the surface in the latter part of the ordinary growing season. To the west of this section lies a rather extensive area of more or less wet, blackish sedge peat, made light in texture by a considerable admixture of sand. In Addition there are several ponds, usually well-filled in spring, which dry up by the middle of the summer, but which nevertheless provide a favorable habitat for a number of semi-aquatic plants.

It happens that the interior line between Sections 4 and 5 in T6N R9E is adjacent to the west edge of the Grady Prairie, while the

north exterior line of the same town intersects the section line within the Grady Tract. The records of the original land survey indicate that, previous to settlement, the area that I am now designating as the Grady Prairie was a rather brushy oak opening, with some of the oaks being of considerable size. These records also indicate that there was an understory of prairie grasses and herbs, such as "rosin weed" (probably Silphium terebinthinaceum), "red root" (probably Ceanothus americanus, or perhaps Desmodium illinoense), "indigo" (Baptisia sp., probably B. leucophaea) and others. In the course of agricultural exploitation of the region this particular area was cleared, and at present the only trees of any size on it are several bur oaks which mark the position of a former fence line. The aim of the present work is to restore the prairie understory, on the assumption that the trees will eventually take care of themselves, by seeding in from trees at the periphery of the open area, as indeed is already occurring at the north and east edges of the Grady Prairie.

The Grady Prairie when first examined by the writer, in 1942, was but a few years removed from a long succession of ill-advised, sporadic and spotty attempts at cultivation. The original survey listed this land as only second rate for agriculture, and since that time it has suffered severe depletion. Because of the ponds and low, wet areas adjacent to them and a rather deep drainage ditch which isolates the southeast corner of the prairie, there were a number of spots from which some of the prairie species had not been entirely eliminated. There thus remained a reservoir of seed plants from which, in the course of natural succession over a period of many years, the prairie might have been restocked. A further source is the adjacent railroad right-of-way which supports many prairie species and offers very convenient and satisfactory clues as to the

original herbaceous vegetation of the Grady Prairie, indicating that it was the sand-prairie-oak opening type, a conclusion further substantiated by the character of the open oak woods to the north of the study area.

The writer, in 1944, preliminary to extensive work on revegetation, undertook a rough survey by which the prairie was divided into squares 100 ft. on a side. At the periphery, because of the irregular outlines of the area, this resulted in many partial squares. A base line was established (without reference to the original land survey) and the squares staked out. A map of the area, according to this survey, is contained in the research report for 1944, in the files of the Arboretum Director. In 1944 the western boundary of the Grady Prairie was the fence line from the southwestern corner of the oak opening, south to the railroad right-of-way. The eastern boundary was, and still remains, the line fence along the Williams farm.

Following the survey, the eastern half of the prairie was examined in some detail, with a view to determining the species composition of the plant cover. No attempt was made to determine relative abundance of different species. The following description of procedure is quoted (with slight modifications) from my 1944 research report: "In all squares.....three lines were run as follows: Starting at the northeast corner of each 100 ft. square or partial square (and beginning with the square farthest north in any particular tier) the surveyor walked 8 paces (approx. 25 ft.) along the N boundary of the square. The surveyor then faced the S boundary and walked in a straight line to it, thus paralleling the E and W sides of the square. The plants on either side for a distance of approx. 6-8 ft. were noted and the names of all species seen written down. With this method, if 500 plants of Aster pilosus and only 2 plants of Pentstemon digitalis were present, the names of each would appear

only once for the line in question, so that it is not an index of abundance of species observed on that line. A second line was run by going back to the same corner (NE) and walking 16 paces to the center of the square and repeating the procedure. The third line was run (starting as before at the NE corner) by walking 24 paces toward the W side of the square, and repeating the outlined procedure. This was done throughout the E portion of the prairie area with the object of determining which species were widely distributed and of listing as many more as could be noted by the method used. For the W half of the prairie, but a single line was run through the center of each square, the abbreviated procedure being dictated by time limitations. For the entire prairie area 202 species of phanerogams were noted, plus two species of Equisetum.....2 species of mosses were also observed, Polytrichum piliferum and Ceratodon purpureus. These formed considerable ground cover in the interstices between clumps of bunch grass in the sandiest spots.....In thus thoroughly traversing an area one gains definite impressions as to which plants are most abundant as well as which are most widely distributed, but such impressions are as likely as not to be faulty. There can be little doubt that in number of individuals and actual area occupied, the various grasses, especially the blue grasses, quack grass, and red top were far ahead of all the other plants. As a matter of curiosity, 51 squares and partial squares (i.e., the more intensively surveyed portion, S of the base line only) were chosen after the survey had been made, and the lists made in them examined to determine the distribution of 20 species which were thought to be perhaps the most widely distributed, the supposition being based merely on impressions gained in the field. In the following list the number which follows the name of the plant indicates in how many of the 51 areas (the term "area" will be used

instead of "square" henceforth in this report, so that Area 51, for example, refers to the square or partial square having that numerical designation on the survey map) the plant in question was observed. The list is in decreasing order: Ambrosia artemisiifolia 51, Aster pilosus 50, Poa pratensis 49, Lactuca canadensis 47, Agropyron repens 45, Solidago nemoralis 42, Agrostis alba 39, Aster paniculatus 39, Lactuca ludoviciana 39, Cirsium discolor 35, Lobelia spicata 35, Lycopus americanus 34, Equisetum laevigatum 34, Monarda fistulosa 33, Achillea millefolium 32, Convolvulus sepium 31, Asclepias verticillata 30, Prunella vulgaris 28, Erigeron ramosus 27, Lespedeza capitata 26, Pycnanthemum virginianum 25, Panicum virgatum 24, Equisetum arvense 23, Poa compressa 23, Solidago altissima 23, Eragrostis spectabilis 21. That large numbers of individual plants tend to confuse the observer as to the wideness of their distribution is true for, upon checking over the lists, it was found that Asclepias syriaca (not among the 20 chosen) occurred in 36 of the areas, as opposed to 30 for Asclepias verticillata which certainly had present vastly greater numbers of individuals. The same holds for Phleum pratense which was observed in 28 areas, as opposed to 24 for Panicum virgatum and 23 for Poa compressa." The abundance and wide distribution of Ambrosia was probably due to the fact that the prairie was burned over in the spring of 1944. The plant survey was done in July, so that some species flowering in the spring, such as Hypoxis hirsuta which is very inconspicuous when not in flower, were overlooked in the initial survey. T

The following are among the more characteristic prairie species which were observed at this time, plus additions made in the fall of 1944 and the spring of 1945, prior to any extensive plantings:

Amorpha canescens, Andropogon furcatus, Andropogon scoparius,
Anemone canadensis, Antennaria fallax, Asclepias syriaca, Asclepias

verticillata, Aster azureus, Aster laevis, Blephilia ciliata,
Bouteloua curtipendula, Ceanothus americanus, Cirsium discolor,
Convolvulus sepium, Coreopsis palmata, Desmodium canadense,
Desmodium illinoense, Dodecatheon meadia, Equisetum laevigatum,
Eragrostis spectabilis, Euphorbia corollata, Fragaria virginiana,
Galium boreale, Helianthus occidentalis, Helianthus rigidus,
Hypoxis hirsuta, Lactuca canadensis, Lactuca ludoviciana, Lespedeza
capitata, Liatris aspera, Lobelia spicata, Lythrum alatum, Monarda
fistulosa, Panicum scribnerianum, Panicum virgatum, Potentilla
arguta, Pycnanthemum virginianum, Quercus macrocarpa, Ratibida
pinnata, Rhus glabra, Rudbeckia hirta, Silphium integrifolium,
Sisyrinchium campestre, Solidago graminifolia, Solidago juncea,
Solidago rigida, Solidago speciosa var. rigidiuscula, Stipa spartea,
Vernonia fasciculata, Veronicastrum virginicum, Vicia angustifolia,
Viola "cucullata", Viola pedata and Zizia aurea. It is apparent
that from the standpoint of species alone, a good representation
was already present on the area. However, some of these were ob-
served only as scattered individuals, and several were noted only
in the extreme southeast corner of the area, so that, in general,
they did not form a satisfactory stand.

In 1946 The west boundary of the Grady Prairie was relocated
west and north, so that the prairie now includes the large bed of
lupine adjacent to the SW corner of the oak opening, as well as
considerable land SW of this. The west boundary is now marked by a
fire lane which leaves the oak opening north of the lupine patch
and thence runs southwesterly to the south fence along the railroad
right-of-way. The eastern part of the land thus added had not been
plowed and contained many desirable prairie species. The western
part, on the other hand, was in more or less continuous cultivation
up through 1946, at which time it was premanently withdrawn. This
added area has not so far been staked out.

Intensive work on revegetation was begun in 1945 and has continued up through 1949. A limited number of mature plants were moved to the Grady Prairie in 1943 and 1944 and they are listed in the research report for 1944. In all, nearly 10,000 mature plants and greenhouse-grown seedlings have been transplanted into the area since the work began. These are from a number of sources, but most came from southern Wisconsin. By "mature plants" is meant those plants, however small, which were larger than seedlings when they were moved. In general, in moving such plants (taking the size of the plant into consideration of course) as large a sod as could be conveniently dug was taken and replanting was done as soon as possible following moving. When they were set out during the growing season, the transplants were watered in many cases. Watering has been greatly facilitated by the presence in Area 140 of an old well which usually holds water up through early August, even if there are no heavy rains. Most of the greenhouse seedlings which were set out developed from stratified seed which was germinated in flats in the greenhouse, later transplanted to small paper pots and finally set out in the field, pots and all. In a number of cases where, for one reason or another it seemed advisable, the pots were stripped off just prior to planting. Some of the later-grown seedlings, particularly those set out in 1948, were taken bare-rooted directly from the flats, and were watered when planted. This procedure, while perhaps not quite as successful as transplanting to paper pots, was much less trouble and the hardier species did not seem inconvenienced by it. The results of seeding experiments make it evident that for many species this is by far the easiest and most satisfactory way of obtaining them, even in a relatively short time. On the other hand, there would seem to be no way of getting such things as lady-slippers and gentians in a reasonable time, except through moving mature plants.

A total of 133 species have been employed in revegetation work up through 1949. By no means all these are now present on the Grady Prairie, as will appear in the alphabetically arranged accounts of the individual species which follow the list presented here. Numbers planted, in the case of seedlings and mature plants, range from two small seedlings of Coreopsis tripteris to 1824 more or less mature plants of Liatris aspera. The test of success and establishment for a species lies in its ability to seed in on a particular site. A few of the species used, including Andropogon scoparius, Cacalia tuberosa, Liatris aspera, Liatris spicata, Liatris pycnostachya, Polemonium reptans, Sorghastrum nutans, and Zizia aptera have shown themselves to be successful from this viewpoint. For some of the other species it is still too early to say whether they will be able to seed in. It is planned to pay special attention to this aspect of the revegetation studies in 1950.

Species Employed in Revegetation Work on Grady Prairie

(s) seed; (sdl) seedlings; (m) mature plants.

- Acerates floridana s, sdl
- Acerates viridiflora s, sdl
- Agoseris cuspidata sdl
- Aletris farinosa m
- Allium canadense m
- Allium cernuum sdl
- Allium stellatum m
- Amorpha canescens s, sdl
- Andropogon furcatus s, m
- Andropogon scoparius s, m
- Anemone cylindrica s, sdl
- Anemone patens var. wolfgangiana s, sdl
- Artemisia caudata m
- Asclepias amplexicaulis s
- Asclepias ovalifolia sdl
- Asclepias sullivantii s, sdl, m
- Asclepias tuberosa sdl, m
- Aster azureus m
- Aster laevis m
- Aster linariifolius m
- Aster oblongifolius m
- Aster ptarmicoides sdl, m
- Aster sericeus m
- Astragalus canadensis s, sdl

- Baptisia australis sdl
- Baptisia leucantha s, sdl, m

Baptisia leucophaea s, sdl, m
 Besseyia bullii s, m
 Blephilia ciliata s, sdl, m
 Bouteloua curtipendula s
 Bouteloua hirsuta m
 Brauneria pallida, s, sdl
 Bromus kalmii s, sdl, m

Cacalia atriplicifolia s, sdl
 Cacalia muhlenbergii sdl
 Cacalia suaveolens sdl, m
 Cacalia tuberosa sdl, m
 Calopogon pulchellus m
 Camassia esculenta m
 Castilleja coccinea (yellow & red form) s
 Castilleja sessiliflora s
 Ceanothus americanus s
 Cirsium hillii m
 Coreopsis palmata s, m
 Cypripedium candidum m
 Cypripedium parviflorum m

Dodecatheon meadia s, m
 Dryopteris thelypteris m

Elymus canadensis s
 Eryngium yuccifolium s, sdl, m

Froelichia floridana s

Gentiana andrewsii m
 Gentiana crinita s
 Gentiana puberula m
 Gentiana puberula x andrewsii s, m
 Geum triflorum s, sdl, m
 Geum triflorum f. pallidum m
 Grindelia squarrosa sdl

Habenaria ^{ell} clavata m
 Habenaria hyperborea m
 Habenaria leucophaea m
 Habenaria psycodes m
 Helianthus occidentalis s, sdl, m
 Helianthus rigidus s, sdl, m
 Heliopsis helianthoides sdl
 Heliopsis scabra s
 Hierochloa odorata m
 Houstonia carulea m
 Houstonia longifolia m
 Hypoxis hirsuta m

Koeleria cristata s, m
 Kuhnia eupatorioides s, sdl, m

Lathyrus venosus var. intonsus s
 Lespedeza capitata s
 Liatris aspera s, sdl, m
 Liatris aspera? (late-blooming) sdl, m
 Liatris cylindracea s, sdl, m
 Liatris ligulistylis s, sdl, m
 Liatris pycnostachya s, m

Liatris spicata m
Liatris squarrosa s, sdl, m
Lilium michiganense m
Lilium philadelphicum var. *andinum* sdl, m
Lithospermum canescens m
Lithospermum incisum s, m
Lobelia cardinalis sdl, m
Lobelia siphilitica sdl, m
Lupinus perennis s

Muhlenbergia cuspidata m

Onosmodium molle var. *occidentale* s
Oxalis violacea m
Oxypolis rigidior s

Parthenium integrifolium s, sdl, m
Pedicularis canadensis s, m
Pentstemon digitalis m
Pentstemon gracilis m
Pentstemon grandiflorus sdl, m
Pentstemon hirsutus sdl
Petalostemum candidum s, sdl
Petalostemum purpureum s, sdl, m
Phlox pilosa s, m
Polemonium reptans m
Polygala senega s, m
Polytaenia nuttallii s
Potentilla arguta s, sdl
Prenanthes racemosa s, sdl, m
Psoralea esculenta s, sdl, m

Ratibida pinnata s, sdl — *Rosa* sp. (prairie) s
Rudbeckia subtomentosa s, sdl

Silphium integrifolium s
Silphium laciniatum s, sdl, m
Silphium perfoliatum sdl
Silphium terebinthinaceum s, sdl, m
Silphium terebinthinaceum x *laciniatum* s
Solidago ohioensis m
Solidago riddellii s, m
Solidago rigida s, m
Solidago speciosa sdl, m
Solidago speciosa var. *rigidiuscula* m
Sorghastrum nutans s, m
Spiranthes cernua m
Spiranthes cernua var. *ochroleuca* m
Sporobolus asper m
Sporobolus heterolepis s, sdl, m
Stipa spartea s, m

Thaspium trifoliatum var. *flavum* m

Valeriana edulis s, sdl, m
Vicia americana s
Viola pedata m
Viola pedatifida m

Zigadenus chloranthus m
Zizia aptera s, sdl, m
Zizia aurea s

Notes on Species used in Revegetation Work on Grady

Prairie, 1943-49.

The locations cited in these notes both as to areas (squares) and individual stakes can be determined by reference to the area survey map filed with the 1944 research report.

Acerates floridana

1) In Oct. 1947 a considerable quantity of seed was planted in Area 43 in a low spot where the ground had been raked to break the surface. No results noted through 1949.

2) In May 1948 21 fair-sized seedlings were set out bare-rooted in Area 59, about 5 paces NE of Stake 62S. Watered when planted. No results noted through 1949.

Acerates viridiflora

1) 100 seeds scattered on roughed-up soil surface just S of Stake 52S in Oct. 1946. No results noted through 1949. In Oct. 1947 a considerable quantity of seed was planted in Area 43 in a low spot where the ground had been raked to break the surface. No results noted through 1949.

2) In May 1948 21 fair-sized seedlings were set out bare-rooted in Area 60, about 3 paces SE of Stake 62S. Watered when planted. No Results noted through 1949.

Agoseris cuspidata

In May 1948 27 fair-sized seedlings were set out on a gravelly knoll adjacent to the Grady Prairie, rather than on the flat, because it was considered that the knoll provided a more characteristic habitat. Bare-rooted and watered when planted. No results have been noted and it is thought the seedlings succumbed to drought shortly after planting.

Aletris farinosa

3 large flowering plants were obtained in July 1948 on sand barrens at Otsego, Columbia Co. Set out in NW part of Area 158 and

watered when planted. Two of these plants were observed coming into leaf in May 1949. None of the plants flowered and they could not be found later in the summer.

Allium canadense

13 mature plants were dug in deep sand along a slough near arena, Iowa Co., May 1946. Set out in a very sandy spot in S part of Area 55. These plants have come up each year since planting, but no seedlings have been noted up through 1949.

Allium cernuum

57 greenhouse-grown seedlings were set out in 3 colonies in June 1946: a) 14 in NE corner of Area 49 in a low spot with black peaty soil, b) 14 in NE corner of Area 22, soil similar but somewhat drier and sandier, and c) 29 in S part of Area 59 where soil is a sandy loam and on the dry side. The seedlings were sizeable, with 3 or 4 leaves. None of these plants were found again until July 1949 when 10 blooming plants were observed in Area 49. No trace of the other colonies could be found.

Allium stellatum

7 flowering plants dug in August 1946 near Seeley, Sawyer Co. The flower stalks were removed at time of digging and 3 days later the bulbs were planted in a compact group on the E border of Area 50. In August 1947 six blooming plants were observed. In 1949 this colony still persisted, but only two or three plants flowered, and it appears that the colony will probably die out unless replenished by seeding-in.

Amorpha canescens

1) A small quantity of seed was used in a mixture planted in Oct. 1946 in NE part of Area 71 where the ground had been raked to break the soil surface. Several small plants were noted in 1949. Also in Oct. 1946 a considerable amount of seed was broadcast in a specially prepared area at the W edge of the prairie. Some small plants were

noted in 1948 and many more in 1949. In Sept. 1949 seed was used in a mixture which was spot planted at random in the higher east and central portions of the prairie, and in Oct. a rather large amount of unmixed seed of this species was broadcast over rather open, sandy soil in the block comprising Areas 45, 46, 47, 55, 56, 57, 65, 66, 67, 77, 78, 79.

2) Two greenhouse-grown seedlings were set out in central part of Area 58 in June 1946. Although fully 2 months old, the plants were quite small, and have not been observed since.

Andropogon furcatus

1) Considerable seed was broadcast on the open, sandy soil surface in the E part of Area 45 in Oct. 1945. By Oct. 1949 half a dozen flowering plants from this seeding were noted, hardly a large take. In Oct. 1946 a great deal of seed was broadcast in the specially prepared area at the W edge of the prairie. By Sept. 1949 a considerable number of plants had flowered. Also in Oct. 1946 a limited amount of seed was used in a mixture planted on the roughed-up soil surface in the NE part of Area 71. Several plants flowered in 1949. In Sept. 1947 seed was used in a mixture broadcast on disturbed spots (produced by mole activity) in the west-central part of the prairie. In 1949 this was repeated on fresh spots of mole activity in the same general area. Also in Sept. 1949 a considerable number of spot plantings were made in an area about 50-75 yds. slightly SE of the SW corner of the Grady Tract oak opening. In Oct. 1949 a rather large amount of seed was broadcast on the sandy open soil of the block comprising Areas, 45, 46, 47, 55, 56, 57, 65, 66, 67, 77, 78, and 79.

2) 123 sods of various sizes, from medium to very large, have been set out to date (1949): 6 in 1944, 32 in 1946, 40 in 1947, 9 in 1948 and 36 in 1949. These have been spotted over a wide area in the east-central, central and west-central parts of the prairie. A small amount of seeding-in has been noted adjacent to some of the earliest plantings. Most of the plants are rather widely spaced and should ultimately seed a large area.

Andropogon scoparius

1) In Oct. 1945 the W portion of Area 45 was seeded with a broadcast grass mixture containing this species and Sorghastrum nutans. The seeding was a great success and by 1949 many large plants of both species had developed to flowering size. The open sandy soil, with little or no competition seems to provide ideal conditions for A. scoparius. In Oct. 1946 seed was used in a mixture scattered on the roughed-up soil surface. By 1949 several plants bloomed and it appeared that many more were present. Also in Oct. 1946 a very considerable quantity of seed was sowed in a specially prepared area at the W edge of the prairie. A number of plants bloomed in 1949. In 1947 this species was used in a mixture which was seeded^d onto spots disturbed by moles in the west-central area. No plants had bloomed by 1949, but it appeared that many plants of this species were present. In 1949 many mole hills were seeded with this species and it was used in a mixture which was spot planted at random over the higher parts of the prairie. Also, there were a number of spot plantings made about 50-75 yds. slightly SE of the SW corner of the oak opening.

2) 135 plants, mostly small, but some quite large, have been set out on the prairie to date: 1 in 1944, 16 in 1945, 59 in 1946, and 59 in 1949. Most of these were planted in Areas 59 and 60, plus sizeable colonies in Areas 51 and 103. This species is rather slow to recover following transplanting, but ultimately does well, provided competition is not too severe.

Anemone cylindrica

1) In Oct. 1946 a rather small amount of seed was broadcast in a specially prepared area at the W edge of the prairie. In 1948 two or three seedlings were observed, but these were not seen in 1949.

2) In May 1948 five small seedlings were set out bare-rooted 1 pace E of Stake 62S on border of Areas 59 and 60. Watered when planted. Not observed in 1949.

Anemone patens var. wolfgangiana

1) A small amount of seed was used in a mixture which was scattered on the roughed-up soil surface in the central part of Area 42 in Oct. 1947 (seed coll. in May 1946). No results noted up through 1949.

2) 10 seedlings, 5 very sizeable, were set out in Sept. 1947 in Area 58, 9 paces slightly NW of Stake 51S. Six of these were found in May 1948, but were not seen in 1949. Soil reaction is probably not favorable here and competition is rather severe.

Artemisia caudata

In Oct. 1947 16 first year rosettes were transplanted to SW part of Area 45. The colony seems well established in this very sandy situation and thriving plants were noted in both 1948 and 1949, with a number of small rosettes, indicating seeding-in.

Asclepias amplexicaulis

A moderate amount of seed was used in a mixture which was scattered on the roughed-up soil surface in the central part of Area 42 in Oct. 1947. No results noted up through 1949.

Asclepias ovalifolia

In May 1948 8 medium-sized seedlings were set out in Area 59, 2 paces NE of Stake 62S. Bare-rooted, and watered when planted. Not observed in 1949.

Asclepias sullivantii

1) Seed was planted in Oct. 1946 in Areas 31, 115 and 116. An indefinite amount was used. Slits were made in the ground, with a knife, and 2 or 3 seeds planted in each slit. In July 1949 a few small plants were found in Area 115, undoubtedly from this seeding. No results noted so far in the other areas. At the same time a considerable amount of seed was broadcast in Area 42 in a rather dry spot where the ground cover was very sparse. No results to date. In Oct.

1947 seed from the same batch used in 1946 was scattered on the roughed-up soil surface in the NE part of Area 43 (seed was used in a mixture). No results to date, but it is interesting to note that 3 plants of this species, two of them fair-sized, were observed at a spot about 100 ft. E of this seeding. It seems possible that some of the seed may have been transported by water in the spring of 1948, as both these stations are adjacent to the drainage ditch, which floods over in the spring thaw. Some seed of this species was further used in 1947 in a mixture which was sowed on some of the mole hills in the west central part of the prairie. No results noted to date.

2) In June 1947 74 sizeable seedlings were set out near the edges of the temporary ponds in Areas 30 and 41. In 1948 two small plants, little if any larger than when set out, were found. In 1949 two plants were likewise observed, but it is uncertain whether they were the same ones seen in 1948.

3) 19 small to large mature plants set out to date: 1946 - 3 small non-blooming plants were dug with as large sods as possible at Faville Prairie near Lake Mills. By July 1949, these had proliferated so that 8 leafy stalks were counted, but with no blooming as yet; 1948 - 3 plants, 2 very small and 1 medium-sized, were moved to Area 158. These were transplanted bare-rooted. One small plant was noted in 1949; also in 1948 7 large and fleshy rootstocks were dug near Juda, Green Co., and transplanted bare-rooted to Area 151. In 1949 5 sizeable leafy stalks were located, thus showing that, like Asclepias tuberosa, this species can be moved bare-rooted with good success, for in addition to being bare the roots had be cut off at a point about 10 or 12 inches below the crown, on which there is strong bud development; 1949 - 6 more plants, of varying size, dug bare-rooted from Faville Prairie. Set out in Area 142.

Asclepias tuberosa

1) 29 seedlings were set out in the NE part of Area 56 in June 1946. These were individually grown in paper pots which were stripped from the plants when they were set out. At least half a dozen of these plants survived through 1949 and in that season two of them flowered. To date, A. tuberosa is the only member of the Asclepiadaceae where any success has been attained with seedlings grown in the greenhouse and moved to the field. All the species of Acerates and Asclepias used germinated well and produced vigorous looking seedlings in the greenhouse, but evidently they are very sensitive to moving once the tap root is developed, especially when they are moved bare-rooted as was the case with all except Asclepias tuberosa.

2) In April 1946 an indefinite number of pieces of rootstocks obtained from the Toole Nursery at Baraboo were set out, one large group in Area 69 and a smaller group in the E part of Area 80. These plants have done moderately well, with considerable blooming from year to year, but up through 1949 not much seed had been set.

Aster azureus

In Oct. 1947 8 medium-sized plants, were set out, 2 in Area 58 and 6 in Area 59. These have done very poorly to date, only a couple of small plants being noted in 1948 and 1949. It seems likely they are suffering from too much grass competition, as they do well in the more open sod of the adjacent oak opening.

Aster laevis

In Oct. 1945 75 plants were moved to Areas 58 and 59. The plants were pulled up bare-rooted and the flowering tops cut off before re-planting. Despite this drastic treatment, many of the plants had fully recovered, and bloomed vigorously in 1949. (In 1947 a small amount of seed of this species was used in a mixture which was scattered on areas of mole disturbance in the west-central part of the prairie. In 1949 a small plant, probably from this source, was found).

Aster linariifolius

In Oct. 1947 3 plants were moved experimentally from the large stand in the oak opening to a sandy spot in the SW part of Area 45, about 10 paces NE of Stake 52N. In flourishing condition in 1949. In 1949 56 plants were dug from the sand barrens near Sauk City and were set out NW of the 1947 plants, mostly in Area 55. How well these will respond in 1950 is questionable, for the majority seemed to have died down completely following transplanting to this hot, dry situation. It is of interest that in 1949 a small plant of this species was found growing naturally in the sandy north-central part of the prairie.

Aster oblongifolius

In Oct. 1947 9 medium-sized plants were moved from a lime prairie in northern Green Co. to the SW part of Area 58. These plants did only moderately well in 1948 and 1949 and it seems likely that the soil reaction of the Grady Tract is not optimal.

Aster ptarmicoides

1) In May 1948 15 sizeable seedlings were set out on a gravelly knoll adjacent to the Grady Prairie. Planted bare-rooted and watered. It appears that drought killed the seedlings following planting. (In 1947 seed of this species was scattered on areas disturbed by moles. No results have been noted to date)

2) In Sept. 1946 12 plants were obtained from a goat prairie near Sauk City. This was on a ridge capped with limestone. The plants are not thriving in the sandy soil and increased competition of the Grady Prairie. Of the 12 plants set out at random in Area 58, no more than 4 blooming plants have been seen in any year, and in 1949 they did even more poorly.

Aster sericeus

In Sept. 1946 18 plants were moved from a limey goat prairie and set out at random in Area 58. A few days later 16 more plants dug on

the sand flats near Sauk City were transplanted in a colony to the NE part of Area 58. In Oct. 1947 21 plants, some quite large, were dug from a roadside in southern Dane Co. and set out in the S part of Area 58. Aster sericeus^{which} seems not to be so particular in its requirements as A. ptarmicoides usually does well by the second year after moving.

Astragalus canadensis

1) Non-scarified seed which had been overwintered in the cold was scattered in April 1946 on the roughed-up soil surface adjacent to a large imbedded boulder, 10 paces NE of Stake 61S in the SW part of Area 58. No results noted up through 1949.

2) In May 1945 1 seedling (greenhouse-grown in a paper pot) was set out in the NW part of Area 29 near Stake 32S. This plant made very good vegetative growth in 1945 and 1946 and bloomed well in 1947. By 1948 it was in evident decline and it did not come up in 1949. In June 1946 75 large seedlings were set out as follows: 10 at random in Area 58; 15 at random in Area 68; 16 at random in Area 69; in central part of Area 40; 33 in a compact colony in Area 70 13 paces slightly SW of Stake 62S. In 1946 and 1947 most of these plants did well and bloomed. By 1948 they were in uniformly poor condition, and by 1949 only a single plant, in Area 58, was noted and it did not bloom. Evidently a very short-lived perennial depending for its continued presence on regular seeding-in. These areas will be watched for the next few years to check for any new seedlings, since presumably the small, hard-coated seeds might lie dormant for a long time. In this connection, two colonies which were on the old prairie have likewise disappeared.

Baptisia australis

Seed, collected in Aug. 1943, was, in the winter of 1945-6, placed in loamy soil in a tin can tightly closed and held out of doors until

the latter part of April, at which time the seed was found to be germinating. The seed was promptly sowed and covered over in a rather sandy spot in Area 79. Four or five plants have resulted from this seeding but, while they still appear healthy, their growth in size to 1949 has been disappointing. This species, with a range primarily more ^{south} westerly, does well in cultivation in the Madison area. It may be that its location in the Grady Prairie is on a soil too light for its best development.

Baptisia leucantha

1) In Oct. 1945 a small amount of seed was scattered on the open sandy soil of Areas 45 and 46. By 1949, four or five plants, one of which had reached large flowering size, had developed. Also in Oct. 1945 a considerable amount of seed was sowed in a prepared bed on the old prairie. A good many seedlings appeared the following summer and in Sept. 1946 23 small plants were moved to a colony in Area 69. (Despite their small size these plants, like other prairie species, had quickly developed a very deep tap root, up to 12 inches, which was more or less damaged in the digging). Nevertheless, the crowns of the fleshy tap roots had one or two well-developed, purplish buds and at least a dozen of these plants grew and survived through 1949. It seems probable that they would have done better had the seed been sown on the spot. In the fall of 1947 seed of B. leucantha was used in a mixture sowed on spots disturbed by moles, and in 1949 a group of small plants from this seeding was observed in the N part of Area 142. In 1949 seed of this species was used in a mixture which was spot planted at random throughout the higher parts of the prairie.

2) Seedlings of this species develop best where seed is both scarified and stratified. In May 1945 a total of 47 seedlings, grown and planted in paper pots, were set out at various stations. Of all these only 5 are known to have survived and grown, 2 in Area 29, 1 in Area 31 and 2 in Area 86 (the latter moved to Area 69 in 1947)

The plant in Area 31 was large and vigorous in 1949 and should be flowering size in 1950. In July 1945 four flower pots, each containing several seedlings, were buried flush with the soil in a low, moist spot in the south part of the prairie and left over the next winter. This was done after it had been observed that single, transplanted first-year seedlings did not do well. In the spring of 1946 a dozen or so of these small plants were developing thriftily. In June, 4 clumps, one from each pot, a total of 10 plants, were set out, with as little disturbance as possible in the central part of Area 42. By 1949, two or three of these plants, at two points, still survived, but had not shown notable development.

3) In Oct. 1945 two large taproots with crowns were planted in the SW part of Area 68. Both roots were severed in the digging, but had well-developed buds on the crown. The plants came up and grew somewhat in 1946 and 1947, but neither had flowered or was much larger by 1949. In September 1946 29 rootstocks of mature plants were transplanted at random in Area 48. 10 or 12 of these plants survived up through 1949 and there has been some blooming, but they are very late in coming up and are not especially thrifty. The conclusion seems inescapable that only seed sown in the field will produce consistently healthy, normal plants of this species.

Baptisia leucophaea

1) In Oct. 1947 seed was used in a mixture scattered on the roughed-up soil surface in Area 42 (E part). No results noted through 1949. In Sept. 1949 seed was used in a mixture which was spot planted at random in the central higher part of the prairie.

2) In May 1945 a single seedling, grown and planted in a paper pot, was set out in Area 31. The grass competition here was heavy and this plant has not been seen since. In May 1948 14 seedlings were set out in a group in the central part of Area 40, adjacent to a medium-sized mature plant. Bare-rooted and watered when planted. In 1949 5 of these were noted to have survived.

3) In July 1945 a single medium-sized plant was dug along a roadside near Cross Plains, Dane Co., and set out in the central part of Area 40. This plant survived up through 1949 and seems to be gradually increasing in size. It flowered moderately in 1948 and 1949. In Oct. 1945 a very large plant was dug from the shoulder of the Seminole Highway and set out in Area 58. Much of the extensive root system was lost. In May 1946 one shoot with flower buds was noted, but the plant has not been seen since. In Sept. 1949 a large stand of this species was found on a prairie remnant near New Clarus, Green Co. The bushy tops, long since blackened and dead were still in place. The crown, just below the soil surface, had several very large buds. The root of one of the plants was severed just below the crown, and the crown portion set out in the east-central part of Area 49. The plant will be searched for in 1950. Like B. leucantha, experience with this species indicates that probably the best way to obtain healthy plants is from seed sowed in the field.

Besseyia bullii

1) In Oct. 1947 seed was used in a mixture sowed on the roughed-up soil surface of a plot in Area 43. No results noted through 1949.

2) In May 1949 5 mature plants, with large sods, were dug from a sandy prairie remnant near Albany, Green Co. All were large flowering specimens. 2 of these were set out in rather sandy soil in the NW part of Area 58, 2 in sandy soil in Area 31, and 1 in a clay soil in Area 42. (In July 1944 9 small plants, 2 of blooming size, were dug on a morainal hillside near Eagle, Waukesha Co. These were set out in the Grady Tract oak opening and, after various growth fluctuations, produced four blooming plants, plus one non-blooming, in 1949. No more could be found. Thus, this species can be moved. Furthermore the Eagle specimens were taken from a spot where the soil was very thin and were almost bare-rooted when transplanted).

Blephilia ciliata

1) In Oct. 1946 a considerable quantity of seed was scattered on the roughed-up soil surface in Area 105, south of a seed bed of *S. laciniatum* in that Area. No results noted through 1949.

2) 3 seedlings set out in June 1947 at the SW edge of the large *Liatris spicata* colony in Area 116. Not seen since. In Nov. 1947 a large but indefinite number of plants, grown in flats since spring 1947, was obtained from J. H. Zimmerman and set out in small clumps on the border of Areas 40 and 50 about 5 or 6 paces S of Stake 42S. No further development noted.

3) In July 1944 six plants were obtained on the Scuppernong Prairie near Eagle, Wis., and set out in Area 23. In 1945 several plants were seen in flower, but they seem since to have died out completely. In Aug. 1945 10 more plants from the same source were set out in Area 134, 10-15 paces SW of Stake B12. Some flowering plants were noted here in 1947, but they appear to have since died out. In June 1946 19 flowering plants, some with numerous small rosettes clustered about their bases, were obtained from the Scuppernong Prairie. Five of these were placed in Area 40 near the edge of the temporary pond in that area, while the rest, including most of those with rosettes, were set out in Area 115. In 1949 there were still plants of this species in bloom in Area 115, but those in Area 40 have not been seen since transplanting. A certain number of plants of this species have been observed growing naturally on the Grady Prairie. On Wisconsin prairies *B. ciliata* evidently develops as a biennial or a very short-lived perennial. Most taxonomic manuals state that this is a species of dry, open places, but in Wisconsin I have seen it only in low, moist, prairie habitats.

Bouteloua curtipendula

Seed of this species was used in a mixture which was spot planted at random in the higher central part of the prairie, in Sept. 1949. Also, some spot plantings of this species alone were made in the sandy soil of Areas 55, 56, 65, and 66.

Bouteloua hirsuta

In July 1949 11 mature plants were set out in the SW part of Area 45. Two of these came from a lime prairie in NW Green Co., while ^{the other 9} came from sand plains near Sauk City.

Brauneria pallida

1) Seed obtained near Belleville, Aug. 1947, was used in a mixture which was sowed on roughed-up soil in Area 42. No results noted through 1949. Was also used in a mixture that was sowed ^{on} areas disturbed by moles in fall 1947. No results noted so far. In Sept. 1948 a large quantity of seed was obtained from the same source and was scattered at random in Areas 48, 58, and 68, as well as in the E part of Area 31 and the W part of Area 42. No results noted through 1949. In 1949 some more seed was obtained from the same source and scattered in the same general area.

2) In June 1945 66 seedlings were planted in paper pots in the E part of Area 42. A majority of these plants survived and in 1948 one bloomed. In 1949 only 3 bloomed, not including that at of 1948, but many were large and looked as though they should flower in 1950. This is an exceedingly drought-resistant species and does not wilt even under conditions extremely adverse for most prairie species.

Bromus kalmii

1) In Oct. 1946 a moderate amount of seed was scattered on the roughed-up soil surface in Area 105, south of the Silphium laciniatum seedbed in that Area. No results noted through 1949.

2) In June 1947 90 seedlings were set out in the NE part of Area

49. This was done in the rain, and it was thought the seedlings would have a good chance for survival, but they have not since been observed.

3) In July 1946 11 fruiting plants were obtained on the Scuppernong Prairie near Eagle, Wis. Set out in Area 126, about 8 paces SE of Stake B12. Not seen since.

Cacalia atriplicifolia

1) In April 1946 seed was scattered on the roughed-up soil surface adjacent to an imbedded boulder 9 paces N of Stake 61S on the border of Areas 58 and 68. In 1949 three or four small plants were noted at this point, coming up in stiff grass competition.

2) In June 1946 98 vigorous seedlings, grown and planted in paper pots, were set out in 4 colonies as follows: 17 in NW corner of Area 14; 25 on tongue of land on N side of drainage ditch close to the E line fence of the Grady Tract and about on border of Areas 8 and 9; 25 in Area 32 at W end of drainage ditch, between 2nd and 3rd clump of willows at that end; 26 at SW edge of Area 62. By 1948 a number of plants in the colonies in Areas 8 and 32 had reached blooming, and in 1949 blooming plants were present in all colonies.

Cacalia muhlenbergii (reniformis)

In June 1947 64 seedlings, large and appearing very thrifty, were set out near the east line fence north of the drainage ditch. A few small struggling plants were seen in 1948, but none found in 1949.

Cacalia suaveolens

1) In June 1946 65 large and thrifty seedlings, most with as many as 6 leaves and grown individually in paper pots, were set out in Area 166. By 1948 a number had reached blooming size, although the situation is probably not wet enough to be optimal.

2) One large plant obtained Sept. 1944 along edge of Black Earth Creek near Cross Plains and set out on bank of drainage ditch in S part of Area 16. This plant grew strongly in 1945, but did not flower. In 1946 it flowered and has done so in the three seasons since. In Sept.

1945 54 rootstocks of this species were dug from a sandy roadside bank on Highway 78 near Sauk City. These were pulled up bare-rooted and most of the tap root lost, but there was a well-developed crown and many laterals. Set out in Area 166. Most survived and many have since flowered, although they have not attained the large size they had at the original site where the roots were able to reach standing water in the marsh through which the highway is built.

Cacalia tuberosa

1) In June 1946 141 seedlings, grown in paper pots, were set out in 5 colonies: Area 115, 33 plants 20 paces slightly SE of Stake B11; 24 plants 10 paces E of first colony; and 33 plants 12 paces NE of first colony; Area 127, 29 plants 20 paces slightly SE of Stake 121S; and 22 plants directly SE of Stake 121S. These have nearly all done well and in 1949 two of those in Area 115 bloomed, with the prospect of many more doing so in 1950.

2) A total of 47 mature plants were set out from 1943 through 1946, as follows: 1943 - 4 plants in Area 23; 1944 - 5 in Area 40, 7 in Area 126; 1945 - 5 in center of Area 125, 3 near SE corner of same area, and 3 in SW part of Area 114, and 6 in Area 40; 1946 - 14 in N part of Area 134. All these plants were obtained near Cross Plains, Dane Co. This species seems admirably adapted to the black, peaty soils in the lower parts of the Grady Prairie, and is conspicuously successful, with much seeding-in, even in tightly closed sod.

Calopogon pulchellus

In July 1948 colonies containing indefinite, but considerable numbers of plants were set out in Area 115 (NW part); Area 141 (NE part and N center; Area 150 (W center part); Area 158 (center). In 1949 some of the plants in Area 141 flowered and non-flowering plants were noted in the other colonies. In June 1949 17 more plants, 15 of them flowering, were set out widely spaced at random in the W part of

the prairie. All plants of this species were obtained from a marsh near Sauk City, Wis.

Camassia esculenta

In June 1946 20 plants, 15 large and 5 small, were dug on a low prairie near Red Rock, Lafayette Co. These were set out in two colonies of 10 plants each, in the SW part of Area 40, and in the SW part of Area 104. In general, these have bloomed well and set seed regularly. No seedlings have yet been noted, but they would probably be difficult to find because of the grass-like character of the young leaves.

Castilleja coccinea (yellow and red form)

In June 1946 seed was collected at Devils Lake and scattered several paces S of Stake 121S. In 1948 orange-red blooming plants were observed here. In June 1947 seed was obtained near Sauk City and sowed in a mixture of spots which had been disturbed by moles, in the W-central part of the prairie. Many blooming plants from this seeding were observed in 1949. In 1948 a very considerable quantity of seed was obtained from Devils Lake and Sauk City and sowed at random in the general vicinity of Stakes B11 and B12. If this seeding is successful, blooming plants from it should appear in 1950, since the species is evidently biennial. Most of the plants so far seen are red or orange-red, but a few bright yellow individuals have appeared.

Ceanothus americanus

Seed of this species was used in a mixture which was spot planted at random ^{1948 in} the higher central part of the prairie.

Cirsium hillii

In June 1949 8 basal rosettes from small to medium size were dug on a low sandy prairie remnant N of Belleville. They were easily dug and there did not seem to be the deep tap root, so characteristic of the mature plants. Two colonies of 4 plants each, one a few paces SW of Stake 52N, the other to the SE of the same stake. The soil here is very sandy. The plants seemed to thrive, following transplanting.

Coreopsis palmata

1) Seed was scattered on the roughed-up soil surface in the NE part of Area 71 in Oct. 1946. A number of small plants were noted in 1948 and 1949. Also in Oct. 1946 a considerable amount of seed was broadcast in a specially prepared area at the W edge of the prairie, and blooming plants were noted as early as 1948, with many seen in 1949. In Sept. 1949 seed of this species was used in a mixture which was spot planted at random in the higher central part of the prairie.

2) In Oct. 1947 25 plants were dug bare-rooted and set out in the N part of Area 59. These were not observed again, probably because of failure to obtain the proliferated rhizomatous parts necessary to the next year's growth.

Coreopsis tripteris

In June 1946 2 seedlings were set out in the NW corner of Area 14. These plants have not been seen since.

Cypridium candidum

In June 1947 12 clumps (in some instances a single plant, up to one instance of a dozen or more) were set out slightly S of the temporary pool which is, in turn, just S of the SW corner of the Grady Tract oak opening. About half these plants were observed in 1948 and 1949, but they are suffering from competition with grass and it may be desirable to move them, particularly if the area is not burned. In June 1948 15 clumps ranging from single plants to 8 or more were obtained near Lake Mills. These were set out in a colony on the border of Areas 150 and 158. These plants came up strongly in 1949 and three bloomed. In June 1949 an indefinite number of clumps, over 30 and some very large were obtained in a marsh near Sauk City and planted approx. in Areas 142 and 143 (some perhaps in adjacent Areas). Also, one large clump with a dozen or more plants, plus a single plant, were set out in Area 134.

Cypripedium parviflorum

In June 1947 17 "clumps", containing in most instances 1 or 2 stems, were set out slightly S of the 1947 plantings of Cypripedium candidum (see p. 29). In both 1948 and 1949 several plants came up and bloomed, but in general this does not seem a favorable site. In June 1949 several plants were obtained near Sauk City and set out in the W part of Area 142. It is possible that some non-blooming plants dug at this time, and considered to be C. candidum, may instead turn out to be C. parviflorum.

Dodecatheon meadia

1) Seed of this species was scattered on the roughed-up soil surface in the NE part of Area 71, Oct. 1946. No results noted up through 1949. Seed also used in the specially prepared area at W edge of prairie in Oct. 1946, but no results noted through 1949.

2) In Sept. 1944 30 plants were set out in Area 15. Blue grass competition was too severe and all the plants had disappeared by 1946. In May 1949 5 flowering plants with large sods were set out in Area 31. These wilted badly after transplanting.

Dryopteris thelypteris

In June 1949 9 large turfs were obtained near Lake Mills in a very peaty soil. Set out in the S part of Area 142.

Elymus canadensis

In Oct. 1946 seed of a glaucous blue strain of this species was broadcast in the seeded area at the W edge of the prairie (specially prepared by discing). In 1949 a number of flowering plants were noted. In Sept. 1949 seed of this same strain was used in a mixture spot planted at random throughout the higher central part of the prairie.

Eryngium yuccifolium

1) In Oct. 1946 seed was scattered on the roughed-up soil surface in the NE part of Area 71. A number of plants have since developed. In Oct. 1946 seed, in very considerable quantity was broadcast in the

specially prepared area at the W edge of the prairie. The "take" in this case was very large, and more plants than desirable are now present.

2) In May 1945 28 seedlings, grown and planted in paper pots, were set out as follows: 11 in Area 31, 13 in Area 58, and 4 in Area 87. Most of these survived and had reached blooming size by 1948, some even in 1947. The 2 survivors in Area 87 were moved to other locations in 1948 (see below). In May 1947 7 large seedlings (grown in greenhouse for 6 mos.) were set out in Area 40.

3) A total of 64 more or less mature plants of various sizes were moved from 1944 to 1948 onto the Grady Prairie: 1944 - 21 small to medium-sized plants set out in Area 40; 1945 - 8 medium-sized plants set out in Area 22, and 3 plants to N part of Area 87 (these latter transplanted again in 1947 into Liatris spicata colony in Area 116), also 3 medium-sized plants moved to Area 31, 25 small to large plants moved to W part of Area 58 and 1 to Area 59; 1948 - 2 medium-sized plants (from seedlings set out in Area 87 in 1945) moved to Area 105 and interplanted with Silphium laciniatum colony in that Area, and 1 large plant was set out in S part of Area 57. It is not planned to plant any more of this species, as experience on the old prairie indicates that, given a chance, it seeds in strongly and spreads.

Froelichia floridana

In Oct. 1945 seed was collected on the sand plains near Arena, Iowa Co., and scattered in the sandy NE corner of the Grady Prairie. A few small plants have been noted each year since, up through 1949. Whether they are all from the original seed, or whether the species has seeded in in a limited way is unknown.

Gentiana andrewsii

In Sept. 1949 8 blooming plants were dug in the East Marsh and moved to a spot about on the border of Areas 149 and 157. Because the soil was a soft fluffy peat it could not be held on the roots, so the

plants had to be set out bare-rooted. There was a large bud on the crown of each plant. Flower stalks were removed. In Oct. 1949 4 large plants were dug at New Glarus, Green Co., and moved to a spot 10-15 yds. S of Stake B11 on the borders of Areas 115 and 126. Very sizeable sods were obtained with these plants.

Gentiana crinita

In Oct. 1949 seed coll. at New Glarus, Green Co., was scattered on a number of more or less bare, damp spots, about on the borders of Areas 135 and 142, and in a few instances seed was sowed on spots where grass and sedges had been clipped close. Sowing was rather heavy on the assumption that much of the light seed would probably be displaced by washing or other means.

Gentiana puberula

In Oct. 1946 a single plant was set out in the SE corner of Area 59. This was lost track of in 1947, but bloomed in 1948. In Oct. 1948 16 plants were obtained near Belleville, and transplanted at random to Areas 58 and 59. Half a dozen of these bloomed in 1949. In Sept. 1949 7 plants were interplanted in the Brauneria pallida colony in Area 42, 1 was set out in the SE corner of Area 70, and 1 more in Area 59.

Gentiana puberula x andrewsii

1) Seed was sowed in a rather small disturbed place along S edge of Area 103, just S of colony of large Andropogon furcatus.

2) In Oct. 1947 one large plant with 5 or 6 stems was dug from a prairie remnant S of Belleville. This plant flowered in both 1948 and 1949, doing much better in the latter year, although the flower stalks remained much shorter than those the specimen had at the time of transplanting. In Oct. 1949 6 plants, 2 very large, were moved with big sods to a spot about on the borders of Areas 115 and 126 S of Stake B11. These plants were obtained near Exeter, Green Co., as was the seed mentioned above.

Geum triflorum

1) In Oct. 1946 a small amount of seed was scattered on the roughed-up soil surface in Area 105, just S of the bed of Silphium laciniatum in that area. No results noted through 1949.

2) In May 1945 54 seedlings, grown and planted in paper pots, were set out as follows: 20 in two approx. equal groups in a very sandy spot in Area 45 near Stake 52N (one of these finally bloomed in 1949), 9 in Area 22, not seen again, and 25 in a compact colony, of which about 17 survived by 1949. Some bloomed in both 1948 and 1949.

3) In July 1944 18 plants were obtained on the Scuppernong Prairie near Eagle, Wis. Divided into two colonies, one of 10 plants in Area 25 and one of 8 in Area 23. The colony in Area 25 has done moderately well, but that in Area 23 has almost, if not entirely disappeared. In Sept. 1944 28 plants were obtained from a bluff near Sauk City and moved to the S part of Area 15 on island in drainage ditch. There is a heavy Kentucky blue grass sod here, but most of the plants have survived and seem to be holding their own. In May 1945 13 clumps of large plants were set out in the W part of Area 29 where the soil is fairly sandy. These still survive and seem to be holding their own, but no real evidence of spreading has been noted. In May 1946 18 clumps, including a number of large plants, were dug from sand $1\frac{1}{2}$ mi. NW of Prairie du Sac, and moved to a similarly sandy location in Area 46. These seem to be doing well, but as yet no evidence of spread has been noted.

Geum triflorum f. pallidum

In June 1946 13 plants were dug on the Scuppernong Prairie near Eagle, Wis., and were set out in the SE part of Area 48. In 1947 only 7 plants could be found, none particularly thrifty and none blooming. In 1948 two plants flowered, but no others were found. Seed gathered from these plants was stratified in the cold over winter, but none germinated when brought into the greenhouse. Although a careful search was made no plants were found in 1949.

Grindelia squarrosa

In June 1946 5 sizeable seedlings were set out in Area 55. In July 1947 3 flowering plants were observed. These seem not to have seeded in as no plants were observed in 1948 or 1949 and the species is evidently a biennial, as it developed here.

Habenaria clavellata

One plant obtained in July 1946 near Lake Lulu, Walworth Co. Set out in Area 126 and no seen since.

Habenaria hyperborea

In June 1946 10 small plants were obtained near Hartland, Waukesha Co. Set out in Area 141 in low, wet spot. Not seen since.

Habenaria leucophaea

In July 1945 one plant obtained near Hartland, Waukesha Co. Set out in Area 126 and not seen since. In Aug. 1947 another plant was obtained near Belleville, in Green Co., and set out in Area 116, adjacent to Liatris spicata colony. Not seen since, although Andropogon scoparius dug with it in the sod has since developed strongly.

Habenaria psycodes

In Aug. 1946 4 sizeable specimens, just past blooming, were dug from a low, shaded marshy spot at Baxter's Hollow, Sauk Co. and were set out along W edge of the original prairie area. Two plants bloomed in 1947, but in 1948 only one plant was seen and it did not bloom. By 1949 these plants had disappeared.

Helianthus occidentalis

1) In Oct. 1946 seed was used in a mixture scattered on the roughed up soil surface in the NE part of Area 71. Several blooming plants had developed by 1949. Also, in Oct. 1946 seed was broadcast in a specially prepared area at the W edge of the prairie. Blooming plants from this seeding were noted as soon as 1948.

2) In May 1945 25 seedlings, grown and planted in paper pots, were

set out as follows: 2 colonies of 4 and 6 plants resp. in Area 29 near Stake 32S; 4 colonies of 3, 3, 4 and 5 plants resp. in Area 58. So far as known all these plants survived and have since flowered and proliferated.

3) In Oct. 1945 approx. 130 plants were set out in Area 59. These have developed strongly. Due to the pronounced proliferation and spread of this species, it seems inadvisable to plant any more on the Grady Prairie. In all probability, in another decade a large stand will have developed from those plants now present.

Helianthus rigidus

1) In Oct. 1946 seed was used in a mixture scattered on the roughed-up soil surface in the NE part of Area 71. Blooming plants from this seeding were noted in 1949. Also in Oct. 1946 seed was broadcast in the specially prepared area at the W edge of the prairie. Blooming plants from this seeding developed as early as 1948. In Sept. 1949 seed was used in a mixture which was spot planted at random in the higher central part of the prairie.

2) In May 1945 19 seedlings were set out at random in Area 49, and 2 plants were put in Area 58. Grown and planted in paper pots. ~~These plants~~ These plants were slow to develop, but by 1949 one esp. sizeable and flourishing group had been proliferated in Area 49 and four or five smaller groups noted.

3) In Oct. 1945 78 bare-rooted plants were set out in Area 59. No more was seen of these, and it seems likely that the necessary lateral portions for further growth were not obtained.

Heliopsis helianthoides

Seedlings, from seed said to be of this species, were grown individually in paper pots. In June 1946 13 plants were set out in a rather widely spaced colony in Area 70 near Stake 63S. Some of these plants bloomed as early as 1947, at which time 12 survivors were counted. By 1949 there were 4 large plants, the others much smaller.

Heliopsis scabra

Seed of this species was used in a mixture which was spot planted at random through the higher central part of the prairie in Sept 1949.

Hierochloa odorata

In May 1945 10 small sods were obtained from a prairie remnant near Cross Plains, Dane Co. and set out in SE part of Area 31. Not seen since.

Houstonia caerulea

In July 1947 two sods containing plants of this species were set out in Area 105, just to the E of the Silphium laciniatum colony in that Area. Blooming plants noted in both 1948 and 1949.

Houstonia longifolia

In June 1946 three small sods obtained near Broadhead, Green Co. Set out in Area 59, but not seen since.

Hypoxis hirsuta

In May 1946 10 plants were moved to Area 40 and 16 to Areas 115 and 126. In May 1949 a considerable number (more than 50) of plants were set out at random in the W part of the prairie. Many plants of this species have been moved in with sods which were dug primarily, because of other prairie species contained in them.

Koeleria cristata

1) In July 1949 a considerable quantity of seed was broadcast in the tne sandy Areas 55, 56, 65, 66.

2) In Oct. 1947 3 sizeable plants obtained from the Grady Tract oak opening were set out in the SE part of Area 68. Not seen since. In June and July 1949 a total of 43 plant^s~~s~~ were obtained from sand plains near Sauk City and set out in Area 55.

Kuhnia eupatorioides

1) In Oct. 1946 seed was used in a mixture scattered on the roughed up soil surface in the NE part of Area 71. No results noted through 1949.

Also in Oct. 1946 seed was broadcast in the specially prepared area at W edge of prairie. Small plants were observed in 1948 and a blooming specimen was noted in 1949. In 1947 seed of this species was used in a mixture which was broadcast on areas disturbed by moles in the west-central part of prairie. No results noted through 1949.

2) In late April 1945 seedlings were set out (grown and planted in paper pots) as follows: 24 in Areas 16 and 17 and 30 in Area 27. These were all killed by frost. In the latter part of May, 9 seedlings were set out in Area 29. Two of these have developed into plants of blooming size, one of which flowered as early as 1947. In July 1946 7 very sizeable seedlings, with quite woody stems, were set out in Area 80. One of these was seen in Oct. 1947, but did not appear thrifty. Not since seen.

3) In July 1944 a single attempt was made to move a mature plant of this species. The large, deep tap root was cut, and the plant did not come up the following year.

Lathyrus venosus var. intonsus

Four seedlings of this species have so far been tried, with a uniform lack of success, so far as observed: 1) in Area 43, 2) in Area 71, 3) in specially prepared area at W edge of the prairie 4) on areas disturbed by moles, in west-central part of prairie.

Lespedeza capitata

In Oct. 1946 seed of this species was scattered on roughed-up soil in the NE part of Area 71 (seed used in a mixture). Some small plants were noted in 1949. Also in Oct. 1946 seed was broadcast in the specially prepared area at W edge of prairie. A few small plants noted in 1948 and a few flowering ones in 1949, a very small "take" considering the amount of seed used. It is possible that this hard legume seed may lie dormant for years in some instances, so more plants still may come from the original seeding.

Liatris aspera

1) In Oct. 1945 seed was broadcast on sandy soil in Area 45. No certain results noted through 1949. In Oct. 1946 seed was used in a mixture scattered on roughed-up soil surface in the NE part of Area 71. Small plants noted in 1948 and 1949. Also in Oct. 1946 seed was broadcast in the specially prepared area at W edge of the prairie. By 1949 a number of blooming plants had developed.

2) In June 1946 20 seedlings, some with corms very large for such otherwise small plants, were set out in the SE part of Area 82, 10 paces NW of Stake 73S. In July 1949, 10 plants, 4 of them blooming, were present.

3) A total of 1824 corms, ranging in size from very small to very large, mostly medium-sized, have so far been set out, the great majority in Areas 58 and 59. Most were planted in 1946, but some planting has been done in every year except 1949. Development has generally been satisfactory with considerable seeding-in. Flowering has not been as profuse as it was hoped it would be, but this should change as the naturally seeded plants come to blooming size.

Liatris aspera? (late-blooming)

1) In June 1946 113 seedlings ~~set~~ (grown individually in paper pots) were set out in the SE part of Area 70. By 1948 it was apparent that there was a good survival, and it is believed that some of the plants which bloomed in 1949 were from these seedlings.

2) In Oct. 1946 3 mature plants, obtained from stand on old prairie, were set out adjacent to the seedlings planted in June, and in Oct. 1947 three more mature plants were added to the colony. It now appears that seedlings of this evidently very vigorous form have come up naturally, from seed dropped from the mature plants moved in 1946 or 1947. Grass competition is strong here, but these plants seem able to overcome it with ease, as they do on the old prairie.

Liatris cylindracea

1) In Oct. 1946 seed was broadcast in the specially prepared area at the W edge of the prairie. No results noted through 1949. In 1947 seed of this species was used in a mixture broadcast on areas disturbed by moles in the west-central part of the prairie. No results noted through 1949. In Sept. 1949 seed was used in a mixture spot planted at random in the higher central part of prairie.

2) In May 1948 39 seedlings were set out on a gravelly knoll adjacent to the Grady Prairie. These evidently succumbed to drought.

3) In Aug. 1946 69 plants in full bloom were dug from a bluff near Sauk City. The flowering stems were cut off and the corms set out along the W edge of Areas 48 and 49. Blooming occurred until 1949 and it was first thought all the plants had died. In 1949 half a dozen bloomed and it seems reasonable to think that more may be present, for it is ^{sometimes} very difficult to distinguish small plants of this species from the grass in which they may be growing, if no flower stalk has been produced. In Sept. 1946 two plants were set out in the SE part of Area 58. In Aug. 1947 three large plants were dug in Green Co. and set out in SE corner of Area 59. In Oct. 1947 four medium-sized plants were obtained from the Primrose Prairie in SW Dane Co. and set out in Area 59 3 paces SW of Stake 51S. All plants, except those moved in Aug. 1946 have developed very well. In Sept. 1949 77 plants, mostly from a densely seeded-in stand in nursery on the old prairie, were set out along E border of Areas 58 and 59.

Liatris ligulistylis

1) In Oct. 1946 a small amount of seed was scattered on the roughed-up soil surface in the E part of Area 31 in the vicinity of mature plants set out in June 1946. Results of seeding uncertain.

2) In May 1947 40 seedlings were set out in E part of Area 31. A number of these were found again in 1948.

3) In June 1943 28 plants were obtained from Scuppernon Prairie near Eggle, Waukesha Co. These were set out about on the borders of Areas 15 and 23. These plants have done moderately well, with some seeding-in, but it has been found necessary to move a considerable number of them because of the encroachment of Panicum virgatum which forms a heavy and growing stand in this part of the prairie. In July 1944 13 more plants were obtained from the same source, as indeed have all the plants of this species. 5 of these were added to plants on island in drainage ditch (border of Area 15) and 8 were set out in a new colony in Area 25. In June 1946 13 more plants were set out along E border of Area 31. In July 1947 18 more plants were set out in two colonies: 10 plants in Area 22 interplanted with the Erumpium yuccifolium in that Area, and 8 plants on the N border of Areas 39 and 40 (As noted above, in Sept. 1948 a number of the original 1943 transplants and seedlings from them were moved, 25 to SW part of Area 31, and 7 were interplanted with the 1947 colony in Area 22.)

Liatris pycnostachya

1) A considerable quantity of seed was broadcast in the wetter part of the specially prepared area at W edge of prairie in Oct. 1946. Plants from this seeding have developed well and two blooming specimens were observed in 1949.

2) A total of 1079 corms, ranging in size from very small to very large, and from various sources, have been set out in colonies in low spots at a number of points throughout the prairie, in every year, except 1947, 1944 through 1949. Most of these have grown and flowered very well, but seeding-in was not noted to any extent until 1949, when it was observed adjacent to early-established colonies, esp. in Area 40, and also in Area 141.

Liatris pycnostachya (white-flowered)

In July 1947 a single medium-sized plant was obtained from the

Scuppernong Prairie near Eagle, Waukesha Co. This was set out at the edge of the temporary pond in Area 40, associated with plants of normal color. The continued growing well enough up through 1949, but did not bloom. Like other albinos, this plant exhibits more delicate structures than the normal. For example, the leaves and flower stalks are more slender and the plant, in general, seems less vigorous than the normal for this species.

Liatris spicata

Approx. 1000 corms, mostly medium size, were obtained in May 1946 from a nursery in Pennsylvania. These were set out in a single large, irregular colony in the W part of Area 116 and the E part of Area 127. The colony has done well and there has been extensive seeding-in within and adjacent to the colony. Some of the seedlings should approach or reach blooming size in 1950.

Liatris squarrosa

1) A small quantity of seed was scattered on the roughed-up soil surface, close to Stake 528 in Oct. 1946. Results uncertain.

2) In June 1947 18 seedlings were set out in Area 49, slightly NE of Stake 528. In July 1949 six or seven of these plants bloomed.

3) In Oct. 1946 3 mature plants (from old prairie) were set out adjacent to and slightly south of Stake 528. These plants have all done well and developed strongly.

Lilium michiganense

In July 1944 nine small plants were moved into a low, wet spot in Area 40. They were still present in 1949, and there was rather poor blooming in 1947 and 1949, but seemingly the plants were permanently retarded by moving.

Lilium philadelphicum var. andinum

1) In June 1946 77 seedlings, grown individually in paper pots, were set out in 4 colonies: 25 along S border of Area 49; 27 in SE

part of Area 29; 10 plants in SW corner of Area 30; 15 plants in west-center part of Area 41. There was little leaf development, but a sizeable bulb on each plant. No results noted through 1949. It seems likely that the plants were destroyed by rodents.

-----Lithospermum canescens

In May 1949 5 mature plants with large sods were set out in Area 31. Later in the same month 2 more set out, one in Area 46 in a very sandy spot (this plant had been growing on a sand prairie), the other in the central part of Area 58.

Lithospermum incisum

1) In Sept. 1949 seed of this species was used in a mixture spot planted at random in the higher central part of the prairie.

2) In June 1949 one plant was set out in central part of Area 58. In July 1949 two plants were set out on W edge of Area 31, adjacent to Brauneria pallida colony.

Lobelia cardinalis

1) In Aug. 1945 27 seedlings were set out in peaty soil in the bottom of a shallow ditch at the W edge of Area 167. Some of these have bloomed in subsequent years.

2) Sept. 1945, 5 mature plants set out in Area 40. These all died out the following year. At the same time 7 were set out in Area 143 and a couple of these bloomed in 1946. In Sept. 1946 134 medium-sized plants (6 mos. old) were set out in a colony in Area 143. Many of these bloomed in 1947, but since then, in the relatively dry seasons of 1948 and 1949, they appear to have almost, if not completely, died out since, except in a wet year this site is probably too dry.

Lobelia siphilitica

1) In June 1946 50 seedlings, grown individually in paper pots, were set out in a compact colony in a low peaty spot in the SE part of Area 158. Four small blooming plants were found here the following year but none have been seen since.

2) In July 1946 two good-sized clumps were set out adjacent to the seedlings mentioned in 1). Not seen since. A little later in the same month 11 clumps were set out in a low area (very wet in spring) in Area 41. Not seen since.

Lupinus perennis

Every year since 1944 seed has been scattered in the sandy parts of the Grady Prairie (Areas 35, 44, 45, 54, 55, 64, 65) and a number of thriving patches have thus been started. The seed source is the large lupine bed at the NW corner of the Grady Prairie.

Muhlenbergia cuspidata

In Oct. 1947 two small sods were obtained from a lime prairie in the Town of Primrose, Dane Co., and were set out in the central part of Area 58. Not observed in 1948, but found again in 1949, at which time they did not appear thriving.

Onosmodium molle var. occidentale

In Sept. 1949 222 well-matured seeds, coll. in Town of York, Green Co., were carefully planted individually in the east-central part of prairie, mainly in Areas 50, 60, 51, 61 and 42. Also in Sept. 1949 seed from the same source, but coll. earlier in the season and of doubtful maturity, was used in a mixture spot planted at random in the higher central parts of the prairie.

Oxalis violacea

In May 1949, 20 plants dug from a sandy slope, were set out in 2 colonies: 8 plants to a moderately low, sandy site in Area 31, and 12 plants to a low, peaty spot in Area 31.

Oxypolis rigidior

In 1947 seed of this species was used in a mixture broadcast in spots disturbed by moles in the west-central part of the prairie. No results noted up through 1949. In 1949 seed of this species alone was broadcast on mole hills in the same general area.

Parthenium integrifolium

1) In Oct. 1946 seed of this species was used in a mixture scattered on the roughed up soil surface in the NE part of Area 71. Plants were noted in 1948 and 1949. Also in Oct. 1946 a considerable quantity of seed was broadcast in the specially prepared area at the W edge of the prairie. A good many plants have since been found here.

2) In May 1945 74 seedlings, grown and planted in paper pots, were set out as follows: 21 close to line fence in Areas 10 and 17 in SE corner of prairie; 8 in Area 31; 8 in Area 40, 8 in Area 48; 29 in Areas 86 and 87 (in 1946 most of the latter group were moved to Area 58 - in 1947 two plants overlooked in 1946 were moved to Area 105 where they were interplanted with the Silphium laciniatum in that Area). All these plants appear to have survived, except for some of those in Area 31 where they suffered from heavy blue grass competition. One plant in Area 40 bloomed in 1948 and most of the others did so in 1949.

3) In Sept. 1944 a single large plant was obtained near Cross Plains and moved to Area 40. This plant has grown very well every year since and in 1949 a seedling was found alongside it. In Sept. 1945 a single very large plant obtained near Madison was moved to the central part of Area 58. It did only moderately well in 1946, but has since thrived and seems well established. In Sept. 1946 8 mature non-flowering plants were dug up bare-rooted along the C. & N. W. right-of-way and set out at random in Area 31. The plants made a good recovery in 1947 and are established. Oct. 1947, 1 small plant was set out in the SE corner of Area 58.

Pedicularis canadensis

1) In Oct. 1946 a small amount of seed was scattered on the roughed up soil surface in Area 105, S of Silphium laciniatum colony in that Area. In 1948 several small plants were observed and in 1949 two bloomed. In 1947 seed of this species was used in a mixture which was sowed on spots disturbed by moles. No results noted through 1949.

2) In Sept. 1946 12 sandy sods, some with more than one plant of this

species, were set out in the SE part of Area 59. Two or three plants were seen in 1947, but none since. The plants were dug in quite loose sand and undoubtedly the root systems were considerably disturbed; in addition the plants were moved to a site where competition was severe. This species can be moved successfully if the sod is sufficiently deep and large, as attested by the thriving survival of plants moved incidentally in sods that were dug for Polygala senega.

Pentstemon digitalis

In Sept. 1945 37 plants were set out as follows: 27, varying in size from small to large, set out at random in Areas 47 and 48; 10 set out near baseline in Area 114. These plants have done fairly well since transplanting, but so far no seedlings have been noted. The plants were obtained from the upper Grady Tract in a spot now on the Belt Line Highway.

Pentstemon gracilis

In June 1948, 8 plants, 2 or 3 quite small, were dug in very sandy soil near Lyndon Station, Juneau Co. One was set out in sandy N part of Area 45, and 7 in sand in Area 148. Not seen since.

Pentstemon grandiflorus

1) In June 1947 51 seedlings were set out in sandy soil in Area 46. Grown individually in paper pots. In 1949 it appeared that perhaps between a third and a fourth of these plants had survived. One bloomed in 1949.

2) In June 1948 20 plants, from small rosettes to large flowering specimens, were dug near Lyndon Station, Juneau Co. and set out as follows: 4 on sandy slope on borders of Areas 11 and 19; 6 in sand in N part of Area 45; 8 in sand in Area 148. Half the plants were blooming and following transplantation set apparently normal seed which was collected and scattered in the vicinity of the plantings. The same procedure was repeated in 1949. All plants developed strongly in the spring

of 1949, but later it was noted that those which showed the best ultimate growth were in Area 148. The species appears to be a short-lived perennial, perpetuated in part by the development of lateral rosettes at the base.

Pentstemon hirsutus

In June 1946 41 seedlings, grown individually in paper pots, were set out as follows: 15 plants in NW part of Area 44; 11 in NE part of Area 57; 15 in E-central part of Area 59. Fair survival in all colonies, esp. in Area 44, where a dozen plants are still present. In Area 44, where competition was slight, blooming occurred in 1947. In Area 57 blooming was not observed until 1948, and in Area 59 until 1949, altho in the latter it was evident from an old flower stalk that at least one plant had flowered in 1948.

Petalostemum candidum

In Oct. 1945 seed was sowed heavily in a prepared bed in a nursery on the old prairie. In Oct. 1946 2 seedlings from this bed were placed in Area 68 and 22 more in the NE part of Area 48. Survival appears to have been poor, with only a couple of seedlings being subsequently noted. In Oct. 1946 seed was used in a mixture scattered on the roughed-up soil surface in the NE part of Area 71. Small plants from this sowing were identified in 1949. Also in Oct. 1946 seed was broadcast in the specially prepared area at the W edge of the prairie, and in 1949 some small plants were noted. In Sept 1949 seed was used in a mixture which was spot planted at random throughout the higher east-central part of the prairie.

Petalostemum purpureum

1) In Oct. 1946 seed was used in a mixture scattered on the roughed-up soil surface in the NE part of Area 71. No results noted to date. Also in Oct. 1946 seed was broadcast in the specially prepared area at the W edge of the prairie. No recognizable plants noted to date. It is believed likely that in its juvenile state this species is not always

distinguishable from Petalostemum candidum. In 1947 seed of Pet. purpureum was used in a mixture sowed on spots disturbed by moles. No results noted to date. In Sept. 1949 seed was used in a mixture which was spot planted at random throughout the higher east-central part of the prairie.

2) In May 1945 13 seedlings, grown and planted in paper pots, were set out in 2 colonies: 6 in NE part of Area 29 and 7 on borders of Areas 86 and 87. In July 1947 four plants bloomed in the latter group, the others not found. Later one of these was transplanted to the NE part of Area 69, while the others were lost track of. In 1949 two plants were finally noted in Area 29 and it is assumed they are from the 1945 seedlings.

3) In Sept. 1944 three plants were moved to island in drainage ditch in Area 15. These survived for two or three years, but it is believed they have now succumbed to blue grass competition. In late April 1945, plants which had been dug bare-rooted in March and potted and brought into leaf in the greenhouse, were set out as follows: 8 in Area 22, 9 in Area 13, 6 in SE part of Area 18 and 3 in Area 15 on island in drainage ditch. Survival does not appear to have been good. In 1949 two plants still survived in Area 22 and 2 or 3 in Area 13. None of the others were located. In Oct. 1945 138 roots of varying size were set out as follows: 18 plants to peaty soil in Area 31; 60 plants to sandy soil in Area 39; and 60 plants to sandy loam in Area 48. The plants in Area 31 did well for one year, but have since died out. The other two colonies show fair survival, esp. that in Area 39 where the competition is less severe. No seeding-in has been noted and so far P. purpureum is not very successful on the Grady Prairie, although it occurs in a profuse stand on a sandy-gravelly knoll adjacent to the prairie.

Phlox pilosa

1) Seed was used in a mixture scattered, Oct. 1947, on the roughed up soil surface in the NW part of Area 43. 2 small plants noted in 1949.

2) A total of 831 plants, from various sources, have been set out at a number of stations throughout the Grady Prairie. To date success has not been as great as had been hoped for, but it now appears that a number of plants have become well established and it is thought likely that they will ultimately seed in. There is a wide range in flowering time for different plants, perhaps owing to place of origin,

Polemonium reptans

In May 1945 7 plants were set out in the N part of Area 41. By 1949 five plants still survived and flowered and seedlings were observed adjacent to them. In June 1945 8 plants were set out in Area 22. Some of these may still survive, but they are in a spot where blue grass competition is severe.

Polygala senega

1) A medium amount of seed was scattered on the roughed-up soil surface in Area 105 S of the Silphium laciniatum colony in that Area. In 1949 two small plants were observed. In June 1949 a considerable quantity of seed was sowed at various point in the central-west part of the prairie, esp. near Stake B11 where mole disturbance was great.

2) In July 1946 five sods with plants of this species were obtained near Eagle, Waukesha Co. and transplanted to Area 115. At least two plants survived and developed strongly in 1948 and 1949. In June 1949 two rather small plants were dug on a prairie remnant near Belleville and set out in a low on the E edge of Area 49.

Polytaenia nuttallii

In Oct. 1946 seed was scattered, as part of a mixture, on the roughed-up soil surface in the NE part of Area 71. Small plants noted in 1948 and 1949. Also in Oct. 1946 seed was broadcast in the specially prepared area at the W edge of the prairie. In 1948 a number of small plants were observed and in 1949 they continued their development, although slowly. In Oct. 1947 seed was scattered on the roughed-up soil surface in Area 42. No results noted through 1949.

Potentilla arguta

1) Seed was used in a mixture which was scattered on the roughed up soil surface in the SE part of Area 43 in Oct. 1947. In 1949 several small plants were found.

2) In May 1948 12 seedlings were set out 3 paces E of Stake 628 on borders of Areas 59 and 60. Bare-rooted and watered when planted. 3 survivors found in 1949.

Potentilla fruticosa

Six seedlings set out in June 1946 on edge of ditch in Area 167. One of these plants survived up through 1949, but it is not much larger than when set out, so the site is plainly not favorable.

Prenanthes racemosa

1) In 1947 seed was used in a mixture which was broadcast on areas disturbed by moles. No results noted through 1949.

2) In May 1948 50 seedlings, with thick well-developed roots, were interplanted with the large colony of *Liatris spicata* in Area 116. Set out bare-rooted and watered when planted. In 1949 a fair number of thriving small plants (but many less than 50) were observed early in the season.

3) In Aug. 1945 three medium-sized plants were set out in the N part of Area 125. In Oct. 1945 two more plants were set out in Area 40. The latter have not since been seen, but two of the plants in Area 125 flowered in 1947, but evidently have since died out. In June 1949 three non-flowering plants were set out in the N part of Area 142, and in Aug. 1949, three plants, 2 of them flowering, were planted in the SE corner of Area 140.

Psoralea esculenta

1) In Oct. 1947 20 seeds, coll. in Iowa Co., and scarified were individually planted on an exposed gravelly knoll adjacent to the Grady Prairie. At the same time 50 non-scarified seeds were planted in another

Adjacent to the first. In May 1949 three seedlings were observed, evidently originating from non-scarified seed. In dry weather later in the summer they died down. To be searched for again in 1950.

2) In May 1948 15 barerooted seedlings were planted on the knoll. Watered when planted, but later killed by severe drought.

3) In June 1947 five plants, 3 seedlings and 2 mature, were set out on the knoll. Obtained in Town of Monroe, Green Co. The mature plants still survived in 1949, but had shown no notable development and had not flowered. It seems possible that they have been carried along on the reserve food in the fleshy tap root, and it is feared they will not become established. The soil of the Grady Tract is probably too acid.

Ratibida (Lepachys) pinnata

1) In Oct. 1946 seed was used in a mixture scattered on the roughed up soil surface in the NE part of Area 71. Plants from the seeding noted in 1948 and 1949. Also in Oct. 1946 considerable seed was broadcast in the specially prepared area at the W edge of the prairie. Many plants from this noted in 1948 and 1949

2) In May 1947 a group (indef. no.) of seedlings was set out in Area 40. Probably persisting, but not certainly identified. There is much Ratibida on the Grady Prairie, so that it is sometimes difficult to differentiate planted specimens from those occurring naturally.

Rosa sp. (prairie form)

1) In the fall of 1947 seed of this rose (R. carolina?) was used in a mixture which was scattered on spots disturbed by moles, in the west central part of the prairie. No results noted through 1949.

Rudbeckia subtomentosa

1) In Oct. 1947 seed, obtained near Juda, Green Co., was used in a mixture scattered on the roughed-up soil surface in the NW part of Area 43. No results noted through 1949, but another search to be made in 1950.

2) In May 1948 nine sizeable seedlings set out in SW part of Area 116, adj. to L. spicata. Several plants bloomed in 1949.

Silphium integrifolium

In Oct. 1946 seed was used in a mixture which was scattered on the roughed-up soil surface in the NE part of Area 71. Plants were noted in 1948 and 1949. Also in Oct. 1946 a considerable quantity of seed was broadcast in the specially prepared area at the W edge of the prairie. Many plants have developed from this seeding and a considerable number flowered in 1949.

Silphium laciniatum

1) A great many seeds of this species have been individually planted at random over the prairie, particularly in 1946 and 1949. Localized plantings were also made in 1944 in Area 31 and in 1945 in Area 105. In Oct. 1946 a large quantity of seed was broadcast in the specially prepared disced area at the W edge of the prairie. In 1947 seed was used in a mixture scattered on spots disturbed by moles in the west-central part of prairie, and in 1949 it was used in a mixture which was spot planted at random in the higher east central part of the prairie. Very sizeable plants had developed from the 1944 seeding in Area 31, but none had flowered up through 1949. A fairly good take has resulted from the seeds individually planted in 1946, although it really represents a rather small percentage of the thousands planted. Plants of good size have developed from the 1945 planting in Area 105. These were set out in a compact colony to test the practicality of planting individual seeds. The colony has since been interplanted with a number of other prairie species to produce a more natural effect. An extremely, and in fact undesirably, large take resulted in the disced area at the W edge of the prairie. These plants resulting from seed which was broadcast on an area which was first disced and then dragged after seeding have developed with considerably more rapidity than those coming from seed individually planted in slits ~~intog~~ made by inserting the tip of a knife into the soil, dropping the seed in edgewise, and then closing the slit with the fingers.

2) A total of 95 seedlings, grown and planted in paper pots, were set out in late April 1945, as follows: 8 in Area 40. Development only moderately good to date; 19 in Area 31. Development fairly advanced; 22 in Area 42. Development quite good on this heavier soil; 18 in Area 22. Survival low, but fair growth of remaining plants; 18 in Areas 24 and 25. Survival also low, but fair development of remaining plants; 8 in Area 48. Development only fair. A month later 2 more seedlings set out in Area 40. Survival count to be attempted in 1950, since all these plants are now quite large (none have flowered so far). This may not be feasible in Area 31, since some of the plants thought to come from seed planted in 1944 are as large or larger than the 1945 seedlings. It was thought in 1945 that the 1944 planting was a failure, so seedlings were set out in the same area as occupied by seed planted in 1944. In May 1947 5 more seedlings set out in Area 40.

3) Four plants, 2 perhaps seedlings, the others quite small, were dug and set out in Area 157. Still surviving as far as known.

Silphium perfoliatum

In June 1946 80 seedlings were set out, as follows: 16 in Area 53 adjacent to fence, survival poor; 64 in Area 166, survival quite good, and survival count to be made in 1950. One plant bloomed as early as 1947 in Area 166 and many bloomed in 1948 and 1949.

Silphium terebinthinaceum

1) In Oct. 1946 seed was used in a mixture scattered on the roughed up soil surface in the NE part of Area 71. A number of plants noted in 1948 and more in 1949. Also in Oct. 1946 a very considerable quantity of seed was broadcast in the specially prepared disced area at the W edge of the prairie. Many plants came from this and many were quite sizeable by 1949. In Sept. 1949 many seeds were planted individually at random in the central and west parts of the prairie.

2) In late April 1945 a total of 90 seedlings, grown and planted

in paper pots, were set out as follows: 22 in Areas 48 and 49. Some these have done well and bloomed in 1949; 24 in Area 13. Some of these have also done well and bloomed, as have 20 which were set out in Area 40. In 1948 one plant in Area 40 bloomed, while in 1949 a total of 8 or 9 plants, as indicated above, bloomed. 24 seedlings which were placed in Area 87 where the soil is very sandy have done poorly and are small and stunted, with no blooming. In 1950 an attempt will be made to move the survivors to a more suitable location. In May 1945 2 additional seedlings were set out in Area 40 and in May 1947 two more in the same location. Survival count to be attempted in 1950.

3) In July 1944 five small plants were moved with sods to Area 42. They seemed to be severely retarded by transplantation, but two plants finally bloomed in 1949. It seems probable that if seed had been planted in 1944 as good results, with considerably less effort, could have been obtained.

Silphium terebinthinaceum X laciniatum

28 seeds were obtained from a hybrid on the old prairie (which had developed from seed collected on the Faville Prairie near Lake Mills, Jefferson Co.) and were individually planted slightly SW of the SW corner of the Grady Tract oak opening, and about due W of small pond and willow, in Sept. 1949.

Solidago ohioensis

Three small plants dug in June 1949 in Jefferson Co. were set out in SW part of Area 142, about 200 ft. S of well.

Solidago riddellii

1) In 1947 seed was used in a mixture scattered on spots which had been disturbed by moles. No results noted through 1949.

2) In July 1949 six plants were moved to the border of Areas 115 and 126. In Sept. 1949 nine blooming plants were set out in Areas 150 and 158.

Solidago rigida

1) In Oct. 1946 seed of this species was used in a mixture which was scattered on the roughed-up soil surface in the NE part of Area 71. Small plants were first noted in 1949. Also in Oct. 1946 seed was broadcast in the specially prepared disced area at the W edge of the prairie. In this area many plants reached blooming size as early as 1948.

2) Although attempts to germinate stratified seed in the greenhouse failed, numerous seedlings were obtained in 1946 from seed sowed in a prepared bed in the field. In Sept. 1946 about 60 of these, some of them in clumps, were set out in Area 68, adjacent to Liatris aspera colony in NW corner of the Area close to Stake B7. Most of these plants have developed satisfactorily since.

3) In Sept. 1945 one large blooming plant with many stems was moved to Area 58. This plant did well every season until 1949 when few flowering stems were produced and it seemed to be dying out. In Oct. 1945 18 small plants were set out at random in Area 59. A number of these have bloomed in subsequent years. In Oct. 1946 one large plant was moved to the SE part of Area 59 and another to the S part of Area 57. Also in Oct. 1946, 8 plants, one very large, the others small to medium size, were set out: the large plant in the NW corner of Area 58, the 7 others in the W part of Area 68. Even large plants of this species are readily moved, and they develop normally the year following moving.

Solidago speciosa

1) In June 1946 28 seedlings were set out in Area 58. Probably half of these survived and are still growing strongly, with several stems per plant noted in 1949.

2) In Oct. 1944 two plants were dug from a very sandy site and moved to Area 59. These were much set back by transplanting and full recovery has not been attained. In Oct. 1945 four plants with small

sods were set out in Area 58. These have not been seen since. In July 1946 11 small plants were moved to Area 69. Several of these have survived, but it is plain that S. speciosa is not a good subject for transplanting.

Solidago speciosa var. rigidiuscula (angustata)

In Sept. 1944 one plant was moved to Area 23. Not seen again. In Sept. 1945 two plants were moved to Area 58. One is believed to have survived.

Sorghastrum nutans

1) In Oct. 1945 seed was broadcast on the very sandy soil surface in the W part of Area 45. This seeding was notably successful and many plants now of flowering size have developed from it. In Oct. 1945 six small nursery seed plots of this species were established in Area 79. Despite crowding, by 1949 many of these plants had reached blooming size, and in both 1948 and 1949 many sods were transplanted from these plots to other parts of the prairie. In Oct. 1946 seed was used in a mixture which was scattered on the roughed-up soil surface in the NE part of Area 72. Blooming plants were first noted here in 1949. Also in 1946 much seed of this species was broadcast in the specially prepared disced area at the W edge of the prairie. By 1949 there were many blooming plants. In Oct. 1948 a rather large amount of seed was broadcast in the sandy Areas 55, 56, 58 and 59. No definite results noted as yet. In Oct. 1949 a considerable amount of seed was broadcast in the sandy block comprised of Areas 45, 46, 47, 55, 56, 57, 65, 66, 67, 77, 78, and 79.

2) In Sept. 1944 seven sods were moved to Areas 48 and 49. These all grew well and by 1949 there was considerable seeding-in. In Oct. 1946 25 sods were set out in Areas 59 and 60. In Oct. 1948 200 sods were moved from the nursery plots, mentioned above, and set out at random in the central part of the prairie and in 1949 155 more sods from the same source were set out at random in the central and west-central part

of the prairie. The Grady Prairie is well suited to the requirements of this species, and it should not be necessary to do any more seeding or transplanting of mature plants.

Spiranthes cernua

In July 1946 two plants were dug near Lake Lulu, Walworth Co., and set out in Area 126. Not seen since.

Spiranthes cernua var. ochroleuca

In Sept. 1946 16 blooming plants were dug near Lake Mills and moved to the W edge of Area 142. In Sept. 1947 two plants seen in bloom, and no others found. The same in 1948, but 12 plants bloomed in 1949. It is thought that some of the latter may have developed from seed dropped in 1946. In Oct. 1947, 31 more plants obtained from the same source, were set out in two colonies, 11 in Area 48 and 20 in Area 49. None observed in 1948, but in 1949 10 plants bloomed, 1 in Area 48 and 9 in Area 49. The blooming phase of this ^{variety} ~~species~~ seems to be manifested only following fall rains.

Sporobolus asper

In Oct. 1949 eight large sods, obtained from a sandy vacant lot in Nakoma, were set out SW of the SW corner of the Grady Tract oak opening, just below the large lupine patch.

Sporobolus heterolepis

1) In Oct. 1946 seed was used in a mixture scattered on the roughed-up soil surface in the NE part of Area 71. Small, non-flowering plants were tentatively identified as this species in 1949. Also in Oct. 1946 considerable seed was broadcast in the specially prepared disced area at the W edge of the prairie. No flowering plants had developed by 1949, but it is fairly certain that a considerable number of plants are present. In Sept. 1949 a considerable quantity of seed was used in a mixture spot planted at random in the higher east-central part of the prairie. Besides this numerous spot plantings of this species alone were made, some in the central-west part of the prairie, and

others in the sandy north-central part, as well as in Areas 48, 49, 59, and 68.

2) In May 1946 four tufts, from greenhouse-grown seedlings, each tuft consisting of many individual plants, were set out in the W part of Area 59. These all survived and by 1949 had made fair-sized plants although still evidently a considerable way from blooming size.

3) In Sept. 1946 one small plant was set out near the SE corner of Area 58, and 9 sizeable plants in the SE part of Area 59. The latter have survived and several flowered in 1949. In Oct. 1947, two plants, one very large, were set out, the larger in the SW part of Area 48, the smaller in the SE part of Area 58, and an additional plant was also set out in Area 58 close to the smaller plant just mentioned. None of these plants have done well, and by 1949 had died out in the center and were growing only at a few points about the periphery. In Sept. and Oct. 1949 twelve plants were set out as follows: 2 interplanted in Liatris spicata colony in Area 116 and two more to the SW in Area 127; 2 to Area 42 slightly W of Brauneria pallida colony in same Area; 4 plants in Area 56 in proximity to Liatris aspera colony in that Area; 1 plant in the N part of Area 52 adjacent to colony of Stipa spartea est. in 1949; 6 plants in S part of Area 31. Most of the 1949 plants are portions of larger plants which were subdivided for convenience in moving. In March 1945 a number of corms of Liatris aspera were dug at a station where there was considerable S. heterolepis also present. Very small sods were moved with the corms, but one of them evidently contained a small tuft of Sporobolus for by 1949 a blooming plant, medium-sized, of the grass had developed in the Liatris colony. On the assumption that spring may be the most favorable time for moving this species, it is hoped that in the spring of 1950 a number of such tufts can be obtained for transplanting to the prairie.

Stipa spartea

1) In Oct. 1946 100 seeds were scattered on the roughed-up soil

surface close to Stake 52S. No results noted through 1949. In June 1949 considerable seed was broadcast in Areas 45, 55, and 65 and planted individually at random in the east-central part of the prairie. Planting was done by inserting the sharp seeds, point down, into the moist soil. In July several thousand seeds were thus individually planted, in four main areas: 1) in Area 31; 2) in Areas 48, 49, 50, 58, 59, 60, 68, 69; 3) in Areas 45, 46, 55, 56; and 4) in Areas 140, 148.

2) In Sept. 1947 four plants were set out in Area 60. At least two ~~of~~ these have survived. In Oct. 1947 two plants were set out in Area 58. Both have survived. In Oct. 1948 38 medium-sized plants were moved to E part of Area 42 and W part of Area 31. Many, if not all, survived in 1949. In July 1949 five medium-sized plants were set out in E-center part of Area 31. In Oct. 1949 27 small to medium-sized plants were set out in a compact colony in the N part of Area 52.

Thaspium trifoliatum var. flavum (T. aureum)

In June 1946 six plants were set out in a group in the SW part of Area 58. These plants have languished since 1947, and by 1949 but a single stunted survivor remained.

Valeriana edulis

1) In June 1949 seed was scattered on some of the spots caused by mole activity in the vicinity of Stake B11.

2) In June 1947 49 seedlings, grown in paper pots, were set out ~~and~~ among and adjacent to the Liatris spicata colony in Areas 116 and 127. Several plants have survived through 1949. For reasons not apparent there is considerable size difference between the Valerian plants, all set out at the same time, and deriving from equal sized seedlings.

3) In Sept. 1945 six plants were moved to Area 125. Much of the root system was lost and only one plant survived through 1949.

Vicia americana

In 1947 seed of this species was used in a mixture which was scattered on spots disturbed by moles, in west-central part of prairie.

Viola pedata

In Oct. 1946 23 plants were moved to the W part of Area 68. The plants have thrived and increased greatly in size. In May 1949 25 plants were set out at random in Areas 58 and 59.

Viola pedatifida

In June 1949 two plants were set out on W edge of Area 23.

Zigadenus chloranthus

In July 1944 three plants were dug on the Scuppernong Prairie near Eagle, Waukesha Co., and set out in E part of Area 25. The plants survived but did not do well in this location, and in July 1949 two were moved to a lower, wetter site in Area 23. In June 1946 21 more plants from the same source were set out in NE part of Area 126. Probably 8 or 9 survived through 1949 and in that year 5 bloomed. There is a strong development of Andropogon scoparius in connection with some of these plants, and it appears that they may be crowded out if left alone.

Zizia aptera (cordata)

1) In Oct. 1946 seed of this species was scattered on the roughed up soil surface in the S part of Area 105. Numerous small plants have since developed from this seeding. In Sept. 1949 seed was used in a mixture which was sown planted at random throughout the higher east-central part of the prairie.

2) In June 1947 54 seedlings were set out barerooted in the rain at random in Area 58. Many of these survived and at least two bloomed in 1949.

3) In July 1944 seven sizeable plants were dug on the Scuppernong Prairie near Eagle, Waukesha Co., the source of all Grady Prairie transplants. Set out in Area 23; in August 1945 15 plants were set out in a scattered pattern in the general vicinity of Stake B11, both N and S of it. In June 1946 17 small plants were set out in Area 115, plus one in Area 40. In 1949 a few small seedlings were dug up in Area 23 and moved

to the S part of Area 31. Zizia anthera is one of the most successful species tried on the Grady Prairie and has seeded in abundantly and seems firmly established.

Zizia aurea

In July 1949 seed of this species (of doubtful maturity) was scattered in the W part of the prairie on bare soil spaces, esp. in the vicinity of Stake B11 where mole disturbance had been great.

Frequently in moving specimens of prairie plants with sizeable sods, other species growing close to them will be moved in at the same time. Moved into the Grady Prairie in this way are the five outstanding prairie grasses of the region, Andropogon furcatus, A. scoparius, Sorghastrum nutans, Sporobolus heterolepis, and Stipa spartea, as well as the following incomplete list of forbs: Castilleja coccinea (yellow form), Coreopsis palmata, Galium boreale, Gentiana andrewsii, Helianthus occidentalis, H. rigidus, Hypoxis hirsuta, Krigia biflora, Lathyrus palustris var. linearifolius, Liatris pycnostachya, Lithospermum canescens, Pedicularis canadensis, Solidago riddellii, and Spiranthes cernua.

Seeding Technic where Soil Surface is Disturbed but Sod Remains Unbroken.

In Oct. 1946 six areas of variable size (about 35 sq. ft. for the smallest to 100 sq. ft. for the largest) in the NE part of Area 71 were vigorously raked in such a way as to break the soil surface without at the same time removing the grass cover which consisted almost entirely of Poa compressa (Canada blue grass), with a small admixture of Panicum and red top. These plots were then seeded down fairly heavily with the following mixture (seed coll. 1946), following which the roughed-up soil surface was lightly tamped down by walking over it:

Mixture Grasses -- Andropogon furcatus, A. scoparius, Sorghastrum nutans,
Sporobolus heterolepis.

Forbs. -- Amorpha canescens, Coreopsis palmata, Dodecatheon meadia, Eryngium yuccifolium, Helianthus occidentalis,

H. rigidus, *Kuhnia eupatorioides*, *Lathyrus venosus* var. *intonsus*, *Lespedeza capitata*, *Liatris aspera*, *Parthenium integrifolium*, *Petalostemum candidum*, *P. purpureum*, *Polytaenia nuttallii*, *Ratibida pinnata*, *Silphium integrifolium*, *S. terebinthinaceum*, and *Solidago rigida*.

Until the season of 1949 it was thought that this seeding was not very successful. At that time, however, a heavy stand of the prairie grasses showed so strongly in each of the seeded areas that they could be distinguished at a considerable distance by color alone. Only four of the species used had not been noted by the end of the 1949 season. These were *Dodecatheon meadia*, *Lathyrus venosus* var. *intonsus*, *Kuhnia eupatorioides*, and *Petalostemum purpureum*. The most striking thing was the great diminution in numbers of stems of *Poa compressa*, and the taking over of the plots by the prairie grasses. The plants in these areas were not so far advanced as those in the disced area at the W edge of the prairie which was seeded down at the same time, but it would seem reasonable to ascribe the lag to the relatively greater competition in the spots where the grass cover was not turned under.

Establishment of a Prairie Vegetation by a Seeding Process.

It is not feasible to plant a sizeable area with prairie species using mature plants, with a view to gaining an immediate solid stand. Seeding-in to the point where interspersed non-prairie forms are largely eliminated will require a decade or more, even under very favorable conditions. Thus, at the cost of great labor, many thousands of large specimen plants were moved into the old prairie in the Arboretum 15 or more years ago but, since up to now there has not been a consistent policy of burning, the very heavy Kentucky blue grass sod which covers a large part of the area has prevented the extensive spread of the prairie species in that sod. In general, conditions are more favorable for seeding-inⁱⁿ the Grady Prairie, because there is much more Canada than Kentucky blue grass and the disturbed sandy soil is much more open. In 1946 the limits of the Grady Prairie were extended to a point several

hundred (400-500) feet west, at the farthest point, of the west line of the Grady Tract oak opening (this line marked the former west limit of the prairie). The most westerly part of this extension had been in cultivation for a number of years up through 1946 and following the removal of a hay crop was covered with weeds and the usual agricultural stragglers, such as quack grass, timothy, ragweed, red clover, alsike, smooth brome, and others. The soil here is a yellowish-brown sandy clay in the higher spots, grading into a darker peaty soil in the low spots. In September and October of 1946 a large amount of seed of prairie species was gathered and, on the 29th of October, was used to seed in an area of more than an acre at the southwest edge of the prairie. The west edge of this seeded area is now delimited by a fire lane. A total of 28 prairie species was employed, including six grasses and twenty-two forbs, as follows: Grasses - Andropogon furcatus, Andropogon scoparius, Elymus canadensis, Sorghastrum nutans, Sporobolus heterolepis, and Stipa spartea; Forbs - Amorpha canescens, Anemone cylindrica, Coreopsis palmata, Dodecatheon meadia, Eryngium yuccifolium, Helianthus occidentalis, Helianthus rigidus, Kunzia eupatorioides, Lathyrus venosus var. intonsus, Lespedeza capitata, Liatris aspera, Liatris cylindracea, Liatris pycnostachya, Parthenium integrifolium, Petalostemum candidum, Petalostemum purpureum, Polytaenia nuttallii, Ratibida pinnata, Silphium integrifolium, Silphium laciniatum, Silphium terebinthinaceum, and Solidago rigida.

The area was thoroughly disced, blanketed as completely as possible with mixtures of the grass seed, and sowed at random with the forbs, except that Liatris pycnostachya was seeded only on the low spots, while in general plants considered to be more characteristic of higher ground were not seeded on the lower spots. Following seeding, the area was dragged to cover the broadcast seed.

The following highly incomplete results have been noted up through 1949:

In May 1947 many Silphium seedlings were observed, but nothing else that could be certainly identified. In July several thrifty seedlings of Solidago rigida were noted, while in October seedlings of Helianthus rigidus, Ratibida pinnata, and Eryngium yuccifolium were identified. Grasses, assumed on the basis of color to be prairie species, were likewise noted at this time.

On traversing the seeded area in May 1948, the following plants were recognized: Coreopsis palmata, Eryngium yuccifolium (many), Helianthus occidentalis, Helianthus rigidus, Liatris aspera, Polytaenia nuttallii, Ratibida pinnata, Silphium integrifolium, Silphium laciniatum, Silphium terebinthinaceum, and Solidago rigida. Later, in June 1948 small plants of Parthenium integrifolium, Anemone cylindrica, and many sizeable Liatris pycnostachya were observed. In July and August seedlings of Lespedeza capitata and small plants of Kuhnia eupatorioides were noted, and some plants of Helianthus occidentalis, Helianthus rigidus, and Solidago rigida were in bloom. In September small plants of Amorpha canescens were found and non-flowering Sporobolus heterolepis was tentatively identified. In October, judging from the autumnal coloration, it was evident that there was a large stand of prairie grasses, although their distribution seemed spotty.

In 1949 the following additional species flowered: Andropogon furcatus, Andropogon scoparius, Elymus canadensis, Eryngium yuccifolium, Kuhnia eupatorioides, Liatris aspera, Liatris pycnostachya, Lespedeza capitata, and Sorghastrum nutans. The development and flowering of the prairie grasses was exceptionally notable in 1949. The season was especially favorable for prairie grasses throughout southern Wisconsin, and this condition was reflected in the seeded area. Sorghastrum was particularly prominent with very many plants in flower, Stipa spartea has not been recognized and it is thought that broadcasting is probably not the proper method for planting this species which is normally forced point down into the ground by the twisting movement of the awns. The

stand of quack grass is still quite heavy in parts of the area, but has been replaced by the prairie grasses in others and it is hoped that this will be an accelerating process, so as to prevent any large-scale growth of Kentucky blue grass. Some of the forbs, especially Eryngium yuccifolium and the Silphiums were sowed too heavily in spots for a naturaleffect. The "take" was unexpectedly heavy, but it is thought that the crowding will eventually be adjusted through competition. It is hoped that this area, along with the rest of the Grady Prairie, can be burned in the spring of 1950 as it is thought that this would give a great impetus to the prairie species. No manipulation, other than burning, is planned for this area, now or in the future.

It should be noted that the results set forth on pp. 60-64 for the specially seeded areas will also be found in brief in the notes on the individual species concerned, in the main body of the paper.

In some cases in the discussions of the individual species, e.g., Phlox pilosa, where small plantings were made at many points over the prairie, full details as to locations are not given in this paper. The locations are in my files, however.

It is planned to continue transplantation work and seeding work for at least several years. It would be desirable, for example, to have a good stand of Dodecatheon meadia on the prairie, as there is almost none at present. So far, complete failure has attended efforts to get it from seed, so it is planned to obtain as many small plants as possible in the spring of 1950 and transplant them to the prairie. More Phlox and gentians are also desired. It is felt, however, that a very substantial start has been made and that in another decade, even if no further plantings were made, the Grady Prairie should show the essential characteristics of a Wisconsin sand prairie, on its way to becoming a sandy oak opening, i. e., a restoration to its original condition.

Seed broadcast, or planted on Grady Prairie - 1945-49 incl.

- | | |
|---|---|
| × Acerates floridana | × Polyteania nuttallii |
| × Acerates viridiflora | × Potentilla arguta |
| × Amorpha canescens | Psoralea esculenta |
| Andropogon furcatus | × Ratibida pinnata |
| Andropogon scoparius | × Rudbeckia subtomentosa |
| × Anemone cylindrica | × Silphium integrifolium |
| × Anemone patens var.
wolfgangiana | Silphium laciniatum |
| × Asclepias amplexicaulis | Silphium terebinthinaceum |
| Asclepias sullivantii | × Silphium laciniatum x
terebinthinaceum |
| × Astragalus canadensis | Solidago rigida |
| Baptisia leucantha | Sorghastrum nutans |
| Baptisia leucophaea | Sporobolus heterolepis |
| Besseyia bullii | Stipa spartea |
| Blephilia ciliata | Valeriana edulis |
| × Bouteloua curtipendula | Zizia aptera |
| × Brauneria pallida | × Zizia aurea |
| Bromus kalmii | |
| × Cacalia atriplicifolia | |
| × Castilleja coccinea
(Yellow & red forms) | |
| × Castilleja sessiliflora | |
| × Ceanothus americanus | |
| Coreopsis palmata | |
| Dodecatheon meadia | |
| × Elymus canadensis | |
| Eryngium yuccifolium | |
| × Froelichia floridana | |
| Gentiana andrewsii x
puberula | |
| × Gentiana crinita | |
| Geum triflorum | |
| × Helianthus occidentalis | |
| Helianthus rigidus | |
| × Heliopsis scabra | |
| Koeleria cristata | |
| Kuhnia eupatorioides | |
| × Lathyrus venosus var.
intonsus | |
| × Lespedeza capitata | |
| Liatris aspera | |
| Liatris cylindracea | |
| Liatris ligulistylis | |
| × Liatris pycnostachya | |
| Liatris squarrosa | |
| Lithospermum incisum | |
| × Lupinus perennis | |
| × Onosmodium molle var.
occidentale | |
| × Oxypolis rigidior | |
| Parthenium integrifolium | |
| Pedicularis canadensis | |
| × Petalostemum candidum | |
| Petalostemum purpureum | |
| × Phlox pilosa | |
| Polygala senega | |

67 total

Mature Plants (incl. small to large plants, but not seedlings)

- | | |
|---|---|
| Aletris farinosa | Lilium philadelphicum |
| Allium canadense | var. andinum |
| Allium stellatum | Lithospermum canescens |
| Andropogon furcatus | Lithospermum incisum |
| Andropogon scoparius | Lobelia cardinalis |
| Artemisia caudata | ✓ Lobelia siphilitica |
| Asclepias sullivantii | Muhlenbergia cuspidata |
| Asclepias tuberosa | Oxalis violacea |
| Aster azureus | Parthenium integrifolium |
| ✓ Aster laevis | Pedicularis canadensis |
| Aster linariifolius | Pentstemon digitalis |
| Aster oblongifolius | Pentstemon gracilis |
| Aster ptarmicoides | Pentstemon grandiflorus |
| Aster sericeus | Petalostemum purpureum |
| Baptisia leucantha | Phlox pilosa |
| Baptisia leucophaea | ✓ Polemonium reptans |
| Besseyia bullii | Polygala senega |
| Blephilia ciliata | Prenanthes racemosa — <i>Psoralea esculenta</i> |
| Bouteloua hirsuta | Silphium laciniatum |
| ✓ Bromus kalmii | Silphium terébinthinaceum |
| Cacalia suaveolens | Solidago ohioensis |
| Cacalia tuberosa | Solidago riddellii |
| Calopogon pulchellus | Solidago rigida |
| Camassia esculenta | Solidago speciosa |
| Cirsium hillii | Solidago speciosa var. |
| Coreopsis palmata | rigidiuscula |
| Cypripedium candidum | ✓ Sorghastrum nutans |
| Cypripedium parviflorum | Spiranthes cernua |
| Dodecatheon meadia | Spiranthes cernua var. |
| ✓ Dryopteris thelypteris | ochroleuca — <i>Sporobolus agrostoides</i> |
| Eryngium yuccifolium | Sporobolus heterolepis |
| Gentiana andrewsii | Stipa spartea |
| Gentiana puberula | Thaspium aureum |
| Gentiana puberula x | Valeriana edulis |
| andrewsii | Viola pedata |
| Geum triflorum | Zigadenus chloranthus |
| Geum triflorum | Zizia aptera |
| f. pallidum | |
| Habenaria clavellata | |
| Habenaria hyperborea | |
| Habenaria leucophaea | |
| ✓ Habenaria psycodes | |
| Helianthus occidentalis | |
| Helianthus rigidus | |
| Hierochloë odorata | |
| Houstonia caerulea | |
| Houstonia longifolia | |
| Hypoxis hirsuta | |
| Koeleria cristata | |
| Kuhnia eupatorioides | |
| Liatris aspera — <i>Liatris aspera?</i> | |
| ✓ Liatris cylindracea (late blooming) | |
| Liatris ligulastylis | |
| Liatris pycnostachya | |
| Liatris spicata | |
| Liatris squarrosa | |
| Lilium michiganense | |

101 total

30

10

Seedlings (raised in greenhouse and transplanted)

Acerates floridana
Acerates viridiflora
X Agoseris cuspidata
X Allium cernuum
Amorpha canescens
Anemone cylindrica
Anemone patens var.
 wolfgangiana
X Asclepias ovalifolia
Asclepias sullivantii
Asclepias tuberosa
Aster ptarmicoides
Astragalus canadensis
X Baptisia australis
Baptisia leucantha
Baptisia leucoophaea
Blephilia ciliata
Bromus kalmii
Cacalia atriplicifolia
X Cacalia muhlenbergii
Cacalia suaveolens
Cacalia tuberosa
X Coreopsis tripteris
Echinacea pallida
Eryngium yuccifolium
Geum triflorum
X Grindelia squarrosa
Helianthus occidentalis
Helianthus rigidus
X Heliopsis helianthoides
Kuhnia eupatorioides
Liatris cylindracea
Liatris ligulistylis
Liatris aspera
Liatris aspera ?
 (late-blooming)
Liatris squarrosa
Lilium philadelphicum
 var. andinum
Lobelia cardinalis
Lobelia siphilitica
Parthenium integrifolium
Pentstemon grandiflorus
X Pentstemon hirsutus
Petalostemum purpureum
Petalostemum candidum
Potentilla arguta
Prenanthes racemosa
Psoralea esculenta ← Ratidia pinnata
Rudbeckia subtomentosa ^
Silphium laciniatum
Silphium terebinthinaceum
X Silphium perfoliatum
Solidago speciosa
Sporobolus heterolepis
Valeriana edulis
Zizia aptera

55 total

F. T. THWAITES
GEOLOGIST
41 ROBY ROAD
MADISON, WISCONSIN

5

Jan. 9, 1946

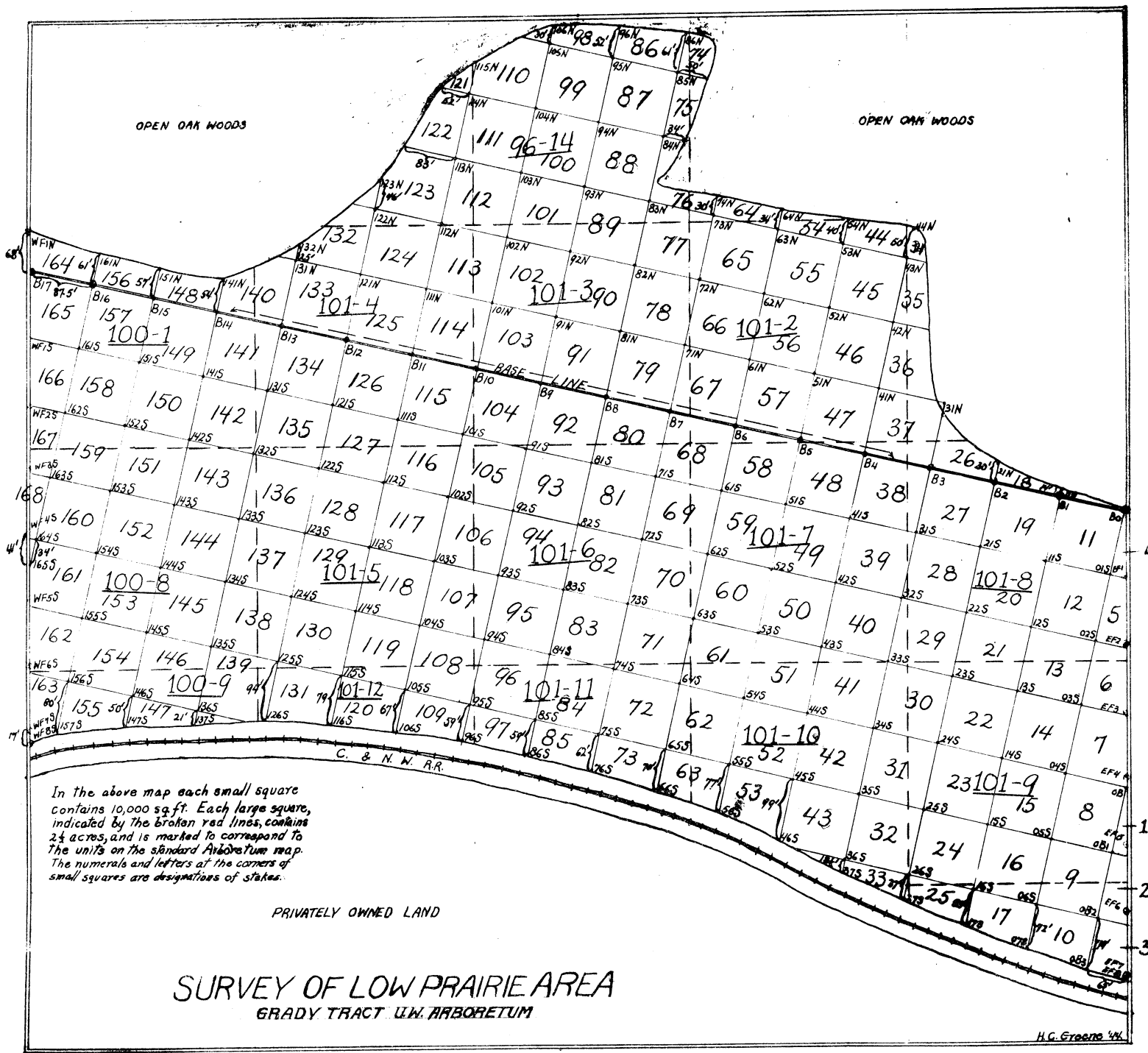
Dr. H. C. Greene,
Department of Botany,
Biology Building

Dear Dr. Greene:

In reply to yours of the 8th the sandy hills in the south part of the Arboretum are moraine deposited in water at the edge of the glacier when its margin stood just west of Lake Wingra. I think that they are similar to the ridge between Lake Wingra and Lake Monona and at College Hills. However, I have not seen any cuts in the Arboretum hills. The east end of the hills rest against the preglacial limestone hill at the old Williams lime quarry. I have not studied the question of whether or not there was a marginal lake south of the hills. The other hills were all deposited in the margins of such a lake.

Sincerely,

F. T. Thwaites



OPEN OAK WOODS

OPEN OAK WOODS

C. & N. W. R.R.

In the above map each small square contains 10,000 sq. ft. Each large square, indicated by the broken red lines, contains 2 1/2 acres, and is marked to correspond to the units on the standard Arboretum map. The numerals and letters at the corners of small squares are designations of stakes.

PRIVATELY OWNED LAND

SURVEY OF LOW PRAIRIE AREA
GRADY TRACT U.W. ARBORETUM

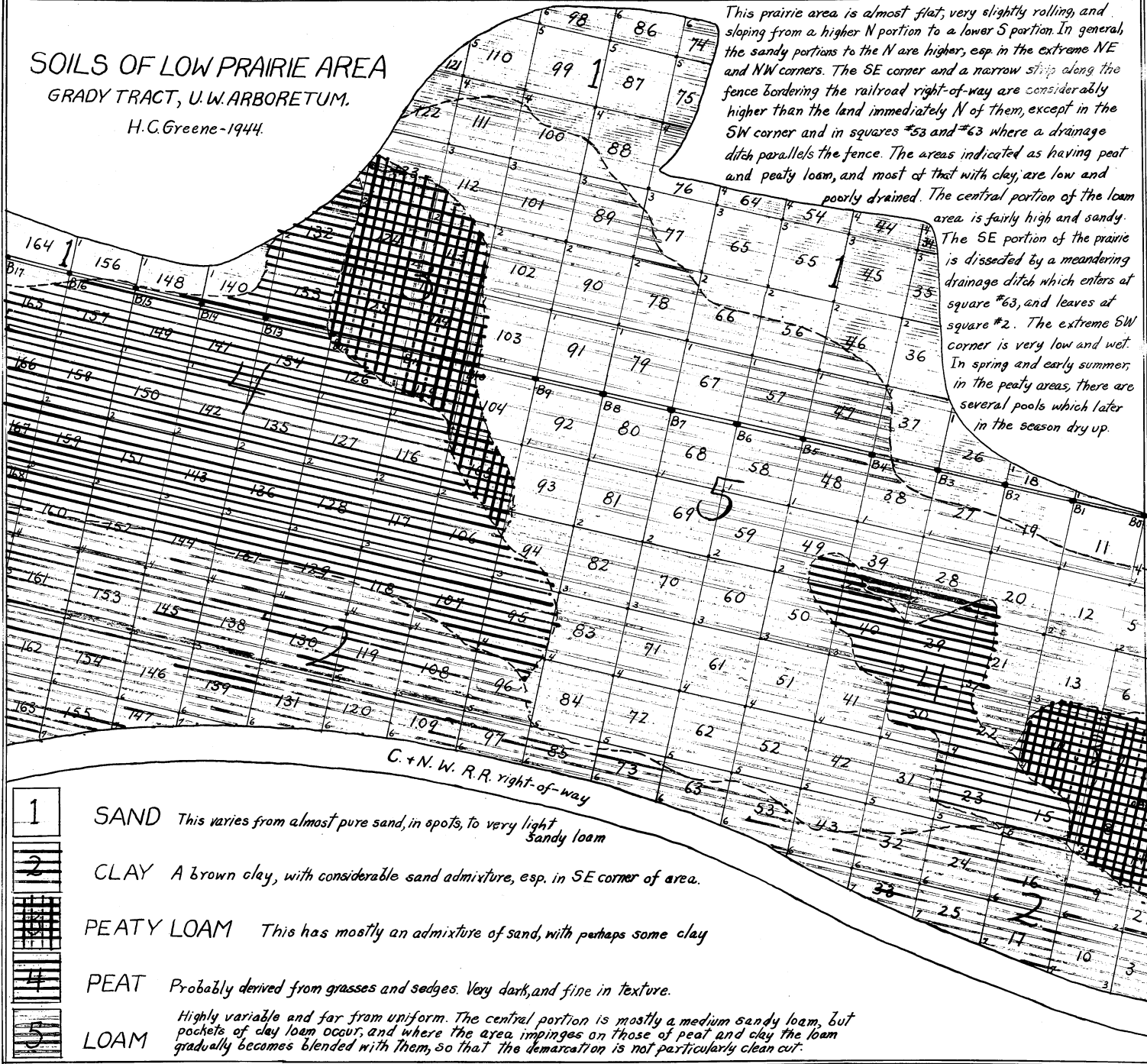
H.C. Greene '94

SOILS OF LOW PRAIRIE AREA

GRADY TRACT, U.W. ARBORETUM.

H.C. Greene - 1944.

This prairie area is almost flat, very slightly rolling, and sloping from a higher N portion to a lower S portion. In general, the sandy portions to the N are higher, esp. in the extreme NE and NW corners. The SE corner and a narrow strip along the fence bordering the railroad right-of-way are considerably higher than the land immediately N of them, except in the SW corner and in squares #53 and #63 where a drainage ditch parallels the fence. The areas indicated as having peat and peaty loam, and most of that with clay, are low and poorly drained. The central portion of the loam area is fairly high and sandy. The SE portion of the prairie is dissected by a meandering drainage ditch which enters at square #63, and leaves at square #2. The extreme SW corner is very low and wet. In spring and early summer, in the peaty areas, there are several pools which later in the season dry up.



C. + N. W. R.R. right-of-way

- 1
- 2
- 3
- 4
- 5

1 SAND This varies from almost pure sand, in spots, to very light sandy loam

2 CLAY A brown clay, with considerable sand admixture, esp. in SE corner of area.

3 PEATY LOAM This has mostly an admixture of sand, with perhaps some clay

4 PEAT Probably derived from grasses and sedges. Very dark, and fine in texture.

5 LOAM Highly variable and far from uniform. The central portion is mostly a medium sandy loam, but pockets of clay loam occur, and where the area impinges on those of peat and clay the loam gradually becomes blended with them, so that the demarcation is not particularly clean cut.