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## The Fern Flora of Nebraska\*—I

T. J. FITZPATRICK

Nebraska lies near the center of the region known as the great plains of North America and near the eastern side of the semi-arid district. The boundaries are natural or nearly so. The Missouri river forms the eastern boundary, the northern boundary lies in the valley of the Niobrara, the southern in the valley of the Republican, while the western boundary is in the foothills. The range is from the 40th to the 43rd parallel and the western border is the 104th meridian. The greatest width is 208 miles, the greatest length is 455 miles, the area is 77,530 square miles, of which 712 square miles are water. As to comparative size, Nebraska is much larger than all of New England and considerably larger than England and Wales together. The elevation varies from 785 feet to about 5390 feet. As a whole the state has the aspect of a rolling prairie, there being plateaus and foothills only in the western portion. The annual rainfall varies from 35 inches along the Missouri river in southeastern Nebraska to 14 inches in the semi-arid districts in the western portion. The mean annual temperature varies from 52° F. in the southeastern corner to 45° in the northwestern corner. The recorded evaporation data give the average annual total amount from April to September inclusive, for Lincoln, during an eleven year period, as 34.8 inches, and for a three year period at North Platte as 41.3 inches.

The physiographic regions of the state are: (1) river valleys, (2) wooded bluffs, (3) prairies, (4) sandhills, (5) plateau or foothill region, (6) pine ridge, and (7) bad lands.

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## RIVER VALLEY REGION

On the eastern side of the state is the narrow valley of the Missouri River. It is bordered by steep and wooded bluffs, broken by numerous ravines. The width varies from half a mile to as much as eight miles. The Missouri river meanders between the bordering bluffs, thus leaving a variable width of valley to the Nebraska side. Horseshoe lakes or lagoons are frequent. The soil is of alluvial origin, being of fine silt and sand. Old woods are frequent.

The Platte river with its main tributary, the North Platte, flows across the state through the central portion from west to east. The width of the North Platte on entering the state is about five hundred feet, the width of the Platte at its mouth is more than a mile. The valley of the North Platte is deep and narrow, usually less than half a mile in width, the valley of the Platte varies in width from one to eight miles. The river banks are low and usually treeless. The water is shallow and frequently divides into several streams which are separated by long sandbars or low wooded islands.

The Niobrara river flows in a narrow gorge for more than two-thirds of its course in Nebraska. The last fifty miles of its course is through a valley varying in width from half a mile to a mile. Here the banks are low and wooded, the bluffs are steep and densely covered with thickets and young trees, and occasionally the valleys are heavily wooded.

The Republican river enters the state near the southwestern corner, flows eastward through eight counties of the southern tier, then turns southward into Kansas. The valleys are rather broad and treeless, the bluffs low and bare of trees, in the ravines are willow, cottonwood, and ash trees, the river banks usually have a fringe of

willows. The river is broad and shallow with frequent sandbars.

The Big Blue river with its tributaries drains much of the southeastern portion of the state. The current is slow, the bed and banks muddy, the valleys broad, level, rich and frequently heavily wooded.

The fern species that may be found in the river valleys are *Osmunda regalis* (rarely), *Dryopteris thelypteris*, and *Onoclea sensibilis*. The fern allies are *Equisetum robustum* and *Equisetum fluviatile*.

#### WOODED BLUFFS REGION

This region consists of narrow strips of country bordering on the river valleys on one side and the uplands on the other. The line of demarcation with the river valley is rather sharp although the woods are frequently continuous. The separation of the wooded bluffs from the uplands is often not sharply drawn, there being varying degrees of divergence, yet within limits it is distinctive. The wooded bluffs extend in narrow dichotomous strips over much of the state paralleling the valleys of the main water courses. They reach their greatest development near the Missouri river which is the center of their extension westward. Upland woods are an extension from the wooded bluffs into favorable situations. The trees are of the broad leaf species except in the northwest where there is a development of the yellow pine.

In Nebraska the fern flora reaches its greatest development in this region. The principal fern species of this region are *Botrychium virginianum*, *Adiantum pedatum*, and *Filix fragilis*. In the crevices of the rock cliffs, often more or less exposed, are found *Cryptogramma acrostichoides* (rarely), *Notholaena dealbata* (rarely and locally), *Pellea atropurpurea*, *Woodsia obtusa*, and on dry rocky soil *Selaginella rupestris* (rarely).

## THE PRAIRIE REGION

The prairies lie immediately west of the Missouri river bluffs and in general cover the eastern half of the state, extending farther westward in the southern portion and are much restricted in the north central portion. These prairies with their gently undulating surfaces are the western representatives of those characteristic of Iowa and Illinois and are made up of indiscriminately arranged series of low rounded swells or hills interspersed with broad shallow depressions or limited valleys. The soil is of glacial drift which is quite deep in many places and is more or less veneered with loess. Drainage systems are well established and ponds or lakes are infrequent or rare.

This region is not conducive to fern growth. Where a belt of upland woods occurs *Botrychium virginianum* and *Adiantum pedatum* may be found. *Onoclea sensibilis* and *Dryopteris thelypteris* occur in wet prairie bottoms. Of the fern allies there are *Equisetum arvense*, preferring dry soil, and *Equisetum laevigatum*, preferring moist soil. Both species are frequent to common and widely distributed in this region. *Equisetum variegatum* is rarely found. In ponds *Marsilea vestita* occurs infrequently or locally frequent. *Isoetes melanopoda* occurs rarely and locally.

## THE SANDHILL REGION

The sandhills lie west of the prairies and cover much of the western half of the state, being confined largely to the central and west central portions. The eastern boundary of this region is not well marked, the prairies passing gradually into the sandhills, but in general the boundary line is irregular, receding westward in the river valleys and extending eastward along the water sheds, the greatest eastern extension being in the north

central portion. The western boundary is quite distinct, although there are outlying sandhills in the foothill region. The area is about 18,000 square miles, a little more than one-fourth of the area of the state. The soil is porous and sandy. The hills are broken, abrupt or rounded, frequently pitted with blowouts or crater-like depressions, and the valleys are deep and narrow. The variable contours of the hills and blowouts are the direct result of the prevailing winds. Drainage systems are poorly established. Large ponds and small lakes occur throughout the region and lakes of considerable size occur near the heads of the water courses, particularly in Cherry, Grant and Hooker counties. Lost creeks are numerous. These streams, rising in ponds or springs, flow on the surface for a distance and then sink in the soil to pursue a subterranean course, occasionally coming to the surface for a short distance only to be lost again. The valleys along streams are broad and marshy, their limits marked by high sandhills. Buttes occur occasionally in the western part. This is the bunch-grass region of the state. Woodland vegetation is scanty.

In favorable situations, usually in moist soil, there occur: *Dryopteris cristata* (rarely), *Dryopteris spinulosa* (rarely), *Dryopteris thelypteris* (often locally abundant), *Onoclea sensibilis*, *Woodsia oregana* (rarely), *Marsilea vestita*, *Azolla caroliniana* (rarely). *Equisetum arvense* (in dry soil), *Equisetum laevigatum*, *Equisetum variegatum* (rarely), and *Selaginella rupestris* (locally) which forms mats on hillsides.

#### THE PLATEAU OR FOOTHILL REGION

The plateau region, in the western part of the state, comes rather abruptly from the sandhill region. It is an elevated district well marked by numerous isolated buttes and by deep and precipitous ravines. It is the short-grass region of Nebraska.

The fern flora of this region is scanty. The following species have been collected: *Cheilanthes feei*, in cañons; *Woodsia oregana*, on buttes; *Marsilea vestita*, in ponds; and *Selaginella rupestris*, on exposed dry situations, often forming dense mats on high hills and buttes.

#### PINE RIDGE REGION

Pine Ridge is a northerly facing escarpment extending from Wyoming into Nebraska near the northwest corner and in the middle part of Sioux county and extending eastward across Sioux, Dawes, Sheridan and Cherry counties, approximately parallel with the northern boundary of the state. The ridge varies from a mile to several miles in width and has its greatest development in Nebraska in Sioux and Dawes counties. Eastward it becomes lower and narrower. The ridge is much broken by deeply cut cañons crossing transversely to the general trend. Along this ridge upon the cañon sides is a development of the western yellow pine (*Pinus ponderosa scopulorum*). The vegetation peculiar to Pine Ridge extends farther eastward across Brown, Rock and Keya Paha counties. Pine Ridge is essentially a variation of the wooded bluffs region.

In favorable, usually moist situations are found *Botrychium virginianum*, *Athyrium filix-foemina* (rarely) *Cystopteris fragilis*, *Dryopteris spinulosa*, *Dryopteris thelypteris*, *Woodsia oregana*, and *Equisetum laevigatum*.

#### BAD LANDS REGION

The Bad Lands in Nebraska are confined largely to Sioux and Dawes counties, in the northwestern part of the state, with occasional outliers in the foothill region south of the North Platte river in Scottsbluff county. The region is a rugged, submontane one, marked with deep cañons, mostly drained by Hat creek and White river and their tributaries. The larger part of the region

is known as the Hat creek basin. The soil is largely clays and marls, absorbs little water, and readily erodes. This unstable soil receives little rain and much summer heat, hence there is little or no vegetation.

In favorable situations in the cañons are found: *Botrychium virginianum*, *Filix fragilis*, *Woodsia oregana*, *Equisetum arvense*, *Equisetum laevigatum*, and *Equisetum robustum*.

#### GENERAL DISTRIBUTION

The fern flora in Nebraska is represented by 17 genera and 26 species. Of these, *Botrychium neglectum*, *Osmunda regalis*, *Osmunda claytoniana*, *Cryptogramma acrostichoides*, *Dryopteris cristata*, *Notholaena dealbata*, and *Isoetes melanopoda* are quite rare, being known from but one locality for each. *Cheilanthes feei*, *Dryopteris spinulosa*, and *Azolla caroliniana* are known from two localities for each. *Pellaea atropurpurea* and *Athyrium filix-foemina* have been collected in three or four localities. *Adiantum pedatum*, a common eastern fern but which ranges across the continent, occurs in Nebraska only in the southeastern quarter. *Botrychium virginianum*, *Filix fragilis*, *Dryopteris thelypteris*, *Onoclea sensibilis*, *Marsilea vestita*, *Equisetum arvense*, *Equisetum laevigatum* and *Equisetum robustum* are the only species that are frequent to common and widely distributed over the state. *Pteris aquilina*, the nearly cosmopolitan species, does not occur, neither does *Polypodium vulgare* nor *Camptosorus rhizophyllus*. There are no Lycopodiums. The nearly cosmopolitan species, *Athyrium filix-foemina*, is found in Nebraska only in two or three favorable localities.

#### SUMMARY AND CONCLUSIONS

From this it is readily seen that the fern flora of Nebraska is conspicuous for its poor development. The reasons for this paucity may be due to the effects or



mutual reactions of the effects of several causes. Some of these are:

(1) The greater portion of the state is too arid for a rich development of fern growth; much of the surface is unsuitable for any ferns, the suitable areas being few and restricted, thus limiting the possible number of species.

(2) Entire absence of endemic forms; there are no species peculiar to Nebraska.

(3) Lack of development of features favorable to distributional adaptation; ferns are rather rigid in their requirements and do not readily overcome new environmental difficulties.

(4) Ferns are comparatively old from the standpoint of evolution, being far beyond their period of culmination, while the soil of Nebraska is comparatively new.

(5) The centers of migration for the ferns into this area are the Appalachian and the Rocky Mountains. The broad prairies of northern Missouri, of Iowa, and of southern Minnesota prevent migration from the east. A number of species of ferns that are absent from similar localities in eastern Nebraska are found along the eastern border of Iowa. The aridity of the western portion of the state prevents migration from the Rocky Mountains.

(6) The line of easiest migration into Nebraska is by way of the Missouri river valley, a route suitable to only a limited number of ferns.

(7) Lack of development of a mountain range within the state or near by with a humid climate, the submontane region of western Nebraska being too arid.

(8) The area of fern distribution tends to lessen, many species are now quite limited in range, and ferns as a whole have little migrating tendency.

#### ACKNOWLEDGMENT

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of Nebraska. This material was largely collected or contributed during the botanical survey of Nebraska conducted by the botanical seminar, an organization founded and promoted by Dr. C. E. Bessey and his co-workers.

## ANNOTATED LIST OF SPECIES

### OPHIOGLOSSACEAE

**BOTRYCHUM VIRGINIANUM** (L.) Swartz. Grape fern.

In rich woods, preferring bluffs and cañons, rather common in favorable locations.

DOUGLAS COUNTY: woods near Florence, July 9, 1897, *William Cleburne*.

SARPY COUNTY: Bellevue, open woods, June 3, 1887, *William Cleburne*; Bellevue, May 2, 1893, no. 3232, *Roscoe Pound & DeAlton Saunders*.

CASS COUNTY: Weeping Water, June, 1889, *Tom A. Williams*.

LANCASTER COUNTY: Lincoln, June 30, 1886, no. 6102, woods west of Saltillo, *H. J. Webber*.

THOMAS COUNTY: in woods near Plummer ford, Dismal river, July 3, 1893, no. 1467, *P. A. Rydberg*; Halsey, June 18, 1912, *Raymond J. Pool & Donald Folsom*.

DAWES COUNTY: Belmont, wooded bluffs, July 18, 1889, no. 6103, *H. J. Webber*.

SIoux COUNTY: Squaw cañon, August, 1892, no. 444, *Albert F. Woods*; Monroe cañon, north of Harrison, June 21, 1911, *Raymond J. Pool & C. V. Williams*.

**BOTRYCHUM NEGLECTUM** Wood. (*Botrychium ramosum* (Roth) Aschers.).

FRANKLIN COUNTY: one specimen in the herbarium, collected by E. M. Hussong, in August, 1895, copses and meadows on Mr. Ewing's farm, one mile northeast of Franklin, not abundant, no. 4689. It is labeled *Botrychium ternatum australe*.

OPHIOGLOSSUM VULGATUM L. Adder's-tongue.

Rev. J. M. Batès, in *The Fern Bulletin*, vol. 20, p. 67, July, 1912, reports finding a colony of this species in Cherry county, along Snake creek, Kennedy township, forty miles southwest of Valentine, the county seat. No specimens are at hand.

#### OSMUNDACEAE

OSMUNDA REGALIS L. Royal fern. Flowering fern.

FRANKLIN COUNTY: in original prairie in Republican river valley, near Franklin, May 5, 1896, no. 6776; also one and one-half miles southwest of Franklin, near Ashby mill and on low ground near the river, June, 1896, no. 4693, both specimens collected by E. M. Hussong.

OSMUNDA CLAYTONIANA L.

One specimen, no. 7516, without definite locality, and doubtfully referred to Nebraska.

#### POLYPODIACEAE

ADIANTUM PEDATUM L. Maidenhair.

This species is frequent to common in rich woods, especially in the southeastern quarter of Nebraska, the region of the state having the greatest rainfall.

DOUGLAS COUNTY: June 29, 1875, *Samuel Aughey*: woods, south of Omaha, June 25, 1873, *William Cleburne*; Florence, October 3, 1908, *N. F. Petersen*.

SARPY COUNTY: Bellevue, September 2, 1893, no. 3146, *Roscoe Pound & D. A. Saunders*; south of Albright, September 1, 1908, *F. G. Ernst*.

CASS COUNTY: Plattsmouth, woods of the Missouri river bluffs, May 15, 1886, no. 6127, *H. J. Webber*.

NEMEHA COUNTY: Nemeha, July 5, 1910, no. 5145, *Rev. J. M. Bates*; also reported from the vicinity of Peru by *Bessey & Webber*.

RICHARDSON COUNTY: wooded bluffs of the Missouri river, common, August 26, 1889, no. 6129, *H. J. Webber*.

PAWNEE COUNTY: Table Rock, May, 1896, *J. E. Shue*.

LANCASTER COUNTY: Lincoln, June 3, 1890, no. 6128, *H. J. Webber*, from Lucena Hardin; Lincoln, May, 1895, rich, moist woods, *E. B. Robinson*; another specimen by Fred C. Cooley without further data.

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(*To be continued*)

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## The Soil Reactions of Certain Rock Ferns—I

EDGAR T. WHERRY

Judging from the literature, the ferns which grow on rocks would appear to be, on the whole, markedly sensitive to the chemical features of their soils. Their distribution is of course controlled to some extent by physical factors, such as climate, porosity of soil, availability of moisture, etc.; yet in many instances a given species has been observed to grow in soils of widely varying physical character, but consistently associated with a particular type of rock, and accordingly more or less uniform in chemical composition. Again, soils of like physical properties but dissimilar chemical nature often occur in such proximity that spores of the various ferns can not fail to have fallen into both kinds, yet flourishing plants have developed in but one of them.

It is commonly recognized that certain species of rock ferns grow by preference upon limestone and similar rocks, and are accordingly to be classed as calcareous soil plants. Other species, however, appear to avoid calcareous rocks quite definitely, and are presumably to be classed as acid soil plants. In the course of geological field trips and vacation outings for several years past the writer has been collecting information upon these