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Plant Relations in North Dakota

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When we think of the physical conditions of North Dakota as they are at the present time we must remember that they have not always been the same. Even before man had produced the changes which he has produced in her landscape, there had been many and great changes in the land and water forms and in the resident forms of plant and animal life. These changes had been going on regularly through hundreds of thousands of years before man appeared.

The vast region of the Great Plains was formerly a great sea. Into this sea flowed rivers from the lands on the east and the west carrying their loads of sand and silt. This deposit of silt and sand was built into the sedimentary rock of the sea bottom. By successive emergence and submergence the region was alternately land and sea.

Finally the land rose and was submerged no more. It was now a vast expanse of swampy land and of lakes. Into this region vegetation came, such as was suited to the natural conditions. So for long ages the vegetation flourished. In the great marshes the vegetation year after year fell and was covered by the water of the marsh, which prevented its decay. In this way the great lignite coal beds were formed.

But in time a strange age-long winter came over all the land. Arctic conditions prevailed; snow did not melt from year to year, but continued to accumulate. Finally a slowly moving mass of ice, a continental glacier, advanced from the north, coming as far as some distance beyond the present course of the Missouri river.

As gradually as this glaciation had come on, so gradually it receded, just as autumn, winter and spring come now each year. But the coming, the continuance, and the recession of the ice of the age-long winter occupied many thousands or hundreds of thousands of years. And there was not only one but several of these age-long winters with consequent advance and intermittent recession of the great ice-cap over the land.

Most of what is now North Dakota was thus covered in those times with a mass of ice many thousands of feet in thickness. This slowly moving mass by its great weight crushed and broke away masses of rock which were left in the form of boulders strewn over the land when the ice finally retreated for the last time.

As the great cold season drew to an end the ice cap gradually melted away along its front and so receded towards the north. After the ice thus receded vegetation began to move in and take possession of the land once more, just as we may see vegetation now taking possession of the land close up to the edges of the continental glacier in Greenland and of the mountain glaciers in the Rocky Mountains of America and the Alps of Switzerland.

In the coming in of vegetation there has been from the first a constant succession of species. Plant population has been, and is, a constant stream of life, ever changing. We may compare the movement of plant species over the lands and waters to the movements of human beings. They come and go. Certain species and associations of species are suited to primitive harsh conditions. They move in and settle in the land. By their growth throughout a period of time they bring about changes in the soil which make it suitable to the growth of various other plant species which now come in as later settlers. Thus the complex of plant associations is changed,

never suddenly, but gradually over longer or shorter periods of time.

The coming of vegetation now makes possible the subsistence of certain species of birds and mammals. These, in turn, bring about further changes in the vegetation. Thus the inweaving of the lines of floral and faunal life become ever more complex. Birds and mammals have helped in the dissemination and wide distribution of plant species. Then in time came man upon the scene, and he, both purposely and undesignedly made further changes in the plant distribution.

Examples of the purposeful activity of man in plant distribution may be cited in the case of the crops cultivated by Indian tribes from prehistoric to immediately recent times over the larger part of the arable portions of North America. These activities included portions of what is now the state of North Dakota, notably the alluvial valleys of the Missouri River and of its tributaries.

The food crops here grown by the farmers of various Indian nations in the region of the upper Missouri River, notably the Arikara and the Mandan, were corn, beans, squashes and pumpkins, and sunflowers. All these except sunflowers are of tropical origin. The wild ancestors of corn, beans, squashes and pumpkins were native in Mexico and Central America. There they were brought into cultivation by the Indian tribes of that region ages ago. The advantages attaching to the cultivation of these crops were recognized by neighboring tribes and they obtained seed of them and still further extended their cultivation. Thus they were carried from tribe to tribe, farther and farther from their place of origin, becoming gradually acclimatized during the time of many generations, until finally they were cultivated throughout all the country as far northwards as the region of the upper Missouri River and the Great Lakes and the St. Lawrence River.

This was the situation, then, in regard to cultivated crops, when white men first came to North America. Corn had been developed by the Indians throughout the long ages into five types, namely, flint corn, flour corn, sweet corn, pop corn and dent corn. Of these five types three, namely, flint corn, flour corn and sweet corn, were cultivated by the Arikaras, Mandans and Hidatsa on the upper Missouri River. And they cultivated numerous varieties of each of these types, especially of the flour corn type. They also cultivated numerous varieties of beans and of squashes.

The sunflower (*Helianthus annuus*) is native of the western plains region of North America. It is probable that they were first brought into cultivation by the tribes of the region of the Kansas and Platte Rivers. From these the cultivated sunflower was disseminated throughout all the region from its place of origin on the western plains to the Atlantic coast and to the St. Lawrence.

Among the gifts of the American Indian to the storehouse of the world we must count corn, beans, squashes and sunflowers, for none of these crops were known prior to the European discovery of America.

Since corn, beans, and squashes all are of tropical origin, and have become acclimatized in regions of the temperate zone only by gradual adjustment to varying conditions of soil and climate through long periods of time, it stands to reason that those varieties which local tribes have been cultivating in any given region are likely to

be more successful in that region than other varieties which we bring in from regions of different climatic conditions. Therefore it would be the part of wisdom for farmers of North Dakota to obtain seed for their own planting from the stock of seed of these crops which have been cultivated here already for many hundreds of years. Such a course would assure perfect hardiness and fullest adaptation to local conditions.

Besides these agricultural crops which were cultivated by the aboriginal tribes of this region, they also made use of many of the native plants. Among the economic uses in which they employed plants or plant products may be named food products, fibers and fabrics, perfumes, dyestuffs, articles for the requirements of religious ceremonies, for domestic utensils and instruments, and many other uses.

Most of the cultivated crops which are familiar to us, aside from the comparatively few which we have adopted from Indian culture, were reduced to cultivation in prehistoric times in the region surrounding the Mediterranean Sea from wild plants native there, which is the region where arose our form of civilization. Most of our cultivated grains and grasses, our fruits and vegetables, are derived by cultivation and selective breeding from ancestral forms which grew wild in Europe, North Africa and Asia Minor.

It would seem to be worth while to make experiments in the domestication of some of the fruits and vegetables native to our state. We do not know their possibilities. We do know that the wild ancestors of the cultivated fruits and vegetables which we have brought with us from the old world were no more promising in the beginning than many of the wild fruits and vegetables which are native to this country.

As a matter of fact Prof. N. E. Hansen, horticulturist of the State Agricultural College of South Dakota has done some good work in selective breeding and hybridising of some of our native wild fruits. He has done some notable work with the native sand cherry (*Prunus besseyi*) and with the native plums. (*Prunus americana*)

There are numerous wild fruits which might very well repay experimentation in cultivation and breeding. Besides the wild plum and the sand-cherry just mentioned there are also the native red raspberries, (*Rubus strigosus*) gooseberries, (*Ribes gracile*) red currants (*Ribes triste*) and black currants, (*Ribes americanum*) buffalo berries, (*Lepargyrea argentea*) choke cherries. (*Padus melanocarpa*) pin cherries, (*Prunus pennsylvanica*) June berries, (*Amelanchier alnifolia*) peminbas, (*Viburnum opulus*) and eye-berries (*Rubus triflorus*) There are also two species of native strawberries (*Fragaria virginiana*) and (*Fragaria americana*) which might be useful for hybridisation work in producing desirable new varieties for cultivation.

The name of one of the berries mentioned above, the peminba, is of special interest because it originated in North Dakota and is fixed upon the map of North Dakota as a geographical name, the name of a river, a mountain, a county and a town. This berry is also called "high-bush cranberry;" but it is not at all like a cranberry except that it is acidulous in taste and red in colour. And there are many other fruits, which in common with the cranberry are also red and sour, notably the buffalo berry. However, the

pembina is not in any way related to the cranberry, and botanically the two have no resemblance. The name pembina results from the white man's corruption of pronunciation of the name which this berry has in the Chippewa language, which is **nepin minan**, the word **nepin** meaning summer and the word **minan** meaning berry. So **nepin minan** has been corrupted to pembina on the white man's tongue.

The hazel-nut is the only nut native to North Dakota. There are two species of hazel-nut (*Corylus americana*) and (*Corylus rostrata*) native in North America, and both these species are found in the Pembina Mountains and in the Turtle Mountains. One species is also found in some of the ravines among the hills along the course of the Missouri River.

The filbert of commerce is a cultivated form of an Old World species of the hazel-nut. It might be well for us to cultivate selections from our native hazel-nuts.

Our native wild grape (*Vitis vulpina*) might repay experiments in selective breeding and cultivation. The Concord grape is a development by selective breeding of native wild grapes at Concord, Massachusetts. All other varieties of grapes grown in the eastern part of the United States are also from native stock. No Old World grapes are grown in the United States except in California.

There are also certain native plants having roots, tubers, or seeds useful for food, which might well repay selective breeding to add to our list of garden vegetables. One of these is tipsin. (*Psoralea esculenta*) The name which I have given this plant, tipsin, is derived by adaptation from the name of this plant in the Dakota language. Mention of it may be found in the writings of the early explorers and traders under the name by which it was called by the French, which is "pomme blanche," or "pomme de prairie." Tipsin is an approximation to the name in the Dakota language, as near as an English speaking tongue would make it. This plant belongs to the Bean Family, the botanical family which has furnished so many useful plants. The part of the tipsin plant which is used is the root. The root contains a store of food materials, starch, sugar and proteid. The plant grows in a widely extended range over all the western plains in the United States and Canada. It was a very important item to the food supply of all the prairie tribes. It is possible it would be a very useful addition to our list of garden vegetables, and might be improved by cultivation.

Tipsin is a low, bushy, herbaceous plant, perennial by the storage root, which is about the size of an egg. The plant is hairy, the leaves are trifoliate, the flowers are in close racemes, bluish in colour, and of the familiar bean-blossom form. The plant body is branched. Because of this characteristic the women when gathering them, and having their children with them to hunt for the plants, would say to the children, "Now, notice that they point to each other with their arms. Here is one, now notice the directions in which its arms are pointing and you will find others." So the children would look for the plants, and of course, if they followed in any direction pointed by a branch of the plant, and kept close watch, they would find another.

Another native plant of the Bean Family which was of much food value to the tribes over the most part of North America, in-

cluding North Dakota, is the ground bean. (*Falcata comosa*) It is possible this might be a very useful plant if brought into cultivation.

The native prairie sunflower has been mentioned already as the ancestor of our cultivated sunflower.

Another plant of this same genus which was of use to the tribes as a food plant, is the tuberous sunflower, (*Helianthus tuberosa*) the so-called "Jerusalem artichoke." The tubers were used for food and for this purpose it was cultivated by the eastern tribes. It is also cultivated to some extent at the present time in the east, and can be obtained in the vegetable markets of eastern cities. It grows wild in abundance in our state.

One of the most useful of native food plants is wild rice. (*Zizania aquatica*) This grows in some places in North Dakota, but still more in the lake regions of Minnesota, Wisconsin, Michigan and Ontario. It ought to be disseminated in all the fresh water lakes of our state. It will not grow in alkaline waters.

The common big milkweed, (*Asclepias syriaca*), is a useful food plant. It was commonly used by the people of all the tribes who lived in the range of this plant. The plant is useful for cooking in five stages of its growth, and is well liked, not only by Indians, but by white people who have learned its usefulness and good flavour. In springtime the young tender sprouts are cooked in manner like asparagus; later, the leaves are cooked for greens so long as they are young and tender, then the bud clusters are cooked and are as tender as the finest cauliflower. After the seedpods are formed, but before they have approached maturity, they are also cooked.

The tribes inhabiting the regions where the maple tree grows made sugar from its sap, and the tribes of the region of North Dakota obtained some sugar from them by intertribal trade. But they also made sugar themselves to some extent from the sap of the boxelder, (*Acer negundo*.) The boxelder tree was the only native source of sugar in North Dakota and all the region of the upper Missouri River.

Acorns were used for food. To rid them of the tannin which gives them a bitter taste, the acorns were cooked with lye made from wood ashes. Then they were thoroughly washed free from the lye and so made a nutritious and palatable article of food.

Several fungous plants were used for food by Indians. Morels, which grow about decaying stumps in the woods, are most delicious. The meadow mushroom also is good, and so is the elm-cap, a fungus which grows upon dead wood of elm trees and boxelders.

Corn smut, when it first appears, while white and solid, is good food, being cooked in a vegetable stew.

Indians made a hot aqueous beverage like tea from the leaves of various species of plants. The young leaves of the raspberry were so used; they also made a hot drink from the leaves of native mint. (*Mentha canadense*), and from the leaves of wild anise, (*Agastache anethiodora*.) Native mint was also used as a flavour in cooking meat, especially for the flesh of the deer.

But it is not only of the utilization of our native food plants that we should think. Man does not live by bread alone. Beauty is a form of refreshment of the soul, and we should take heed

to the conservation of the natural beauty of our state. There are many species of our native flowers of woodland and prairie which should be brought into cultivation in our gardens and parks. Many of our native shrubs and vines and also of the native grasses are very desirable for decorative planting.

All the wild fruits already mentioned are suitable for domestic planting in certain situations for decorative purposes. Besides those there are numerous other species, including three species of wild roses, the thorn-apple or haw-thorn, (*Crataegus chrysocarpa*) the lead plant, (*Amorpha canescens*) kinnikinnick, (*Cornus stolonifera*) sheep-berry, (*Viburnum lentago*) wolf-berry or badger berry (*Symphoricarpos occidentalis*) snow-berry (*Symphoricarpos racemosus*) and the honey-suckle. (*Lonicera dioica*)

Of vines we have the clematis or virgin's bower, (*Clematis ligusticifolia*) bittersweet. (*Celastrus scandens*) Virginia creeper, (*Parthenocissus quinquefolia*) wild grape, (*Vitis vulpina*) wild cucumber (*Micrampelis lobata*) and hop vine. (*Humulus lupulus*)

There are many beautiful wild flowers native on our prairies and in the woods which are readily grown in domestication. Among these may be named the wild columbine, (*Aquilegia canadensis*) which grows in some wooded ravines along the Missouri River, in the Turtle Mountains, the Pembina Mountains and about Sully's Hill. The white larkspur (*Delphinium virescens*) of the prairie is found in the eastern part of the state. The beautiful white anemone (*Anemone canadensis*) is found in moist situations widely distributed throughout the state.

The pasque flower (*Pulsatilla patens*) abounds throughout the state on dry prairies. It is the earliest flower to bloom in spring-time, often appearing before all snow is gone. Its bluish-purple flowers gladden the bare brown hillsides with great profusion of bloom, an earnest of returning life. For this reason it has a strong hold upon the affections of the people of all the native tribes throughout all its extended range. This plant is closely related to the anemone, which is sometimes called the wind flower. The people of the Dakota nation have a pretty little folk story concerning the pasque flower. The story is that in the long ago, whenever any of the people happened to pass by one of these flowers it tried to show the friendliness which it felt for human beings by nodding its head in the chilly wind, smiling and saying, "Good morning! good morning!" But the people passed it by unheeding. It became abashed at this treatment, so nowadays, when people are going by it turns its head to one side as it nods its head and calls its kindly greeting in its sweet low voice.

There are several species of native violets in woodland, meadow and dry upland prairie. The pink oxalis (*Oxalis violacea*) delights in sandy soil, and is delicately beautiful. On the dry prairies the beautiful heavenly blue wild flax (*Linum perenne*) abounds. This plant blossoms profusely and thrives wonderfully when cultivated.

There are three species of gentian native in the northeastern part of the state. There are four native species of pentstemon, all showy and well suited to garden planting. The meadow phlox (*Phlox pilosa*) is a showy and profuse bloomer. The ground phlox (*Phlox hoodii*) and (*Phlox douglasii*) is pure white and suited for growing in low borders. The native meadow strawberries are beautiful as

flowering plants and the fruit is also beautiful and fragrant and very delicious in flavour.

Blue lupines (*Lupinus pusillus*) and purple-flowered buffalo peas (*Geoprumnon crassicaupum*) may well be cultivated. There are several species of the evening primrose family, and all are suitable for cultivation.

Two species of cactus on the dry prairies have beautiful flowers, one, the prickly pear, (*Opuntia polycantha*) has large yellow flowers of delicate satiny texture; the other, the ball cactus, (*Coryphantha vivipara*) has flowers of rosy colour.

In autumn we have several species of goldenrod and of asters. There is also the native golden-glow. (*Rudbeckia laciniata*)

One of our common native prairie flowers, gaillardia, (*Gaillardia aristata*) has been brought into cultivation and has responded by greatly increased size and variation of colouring.

A very beautiful flower is the spiderwort, (*Tradescantia bracteata*) and (*Tradescantia occidentalis*) deep blue in colour, delicate and graceful in habit of growth. It thrives wonderfully in cultivation. It likes sandy soil and is widely distributed in the prairies, wherever there is a sandy loam. The western prairies have no more enchantingly beautiful flower than this one when it is sparkling with dewdrops in the beams of the rising sun. There is about it a suggestion of purity, freshness and daintiness.

There is a pretty conceit in the folklore of the Dakota nation concerning this flower. When a young man of the Dakota nation is in love, and walking alone on the prairie finds the spiderwort blooming, he stops and sings to it a song in which he personifies it with the qualities of his sweetheart's character as they are called to his mind by the aspect of the flower. Its gracefulness of form, its daintiness and shyness and fresh beauty suggesting her personal grace and her mental charm. In his mind the beauties of the flower and of the girl are mutually transmuted, and flow together into one image.

The words of his song, translated from the Dakota language into the English, are something like this:

"Tiny, gladsome flower,
So cheerful and modest,
Thou are dear and sweet,
And for love of thee I'd die."

In moist places in valleys and in depressions of the prairie the brilliant flame lily abounds over almost all of North Dakota. One of the early botanical explorers a hundred years ago tells of the abundance of flame lilies (*Lilium umbellatum*) in the valley of a small tributary of the Knife River. He said that the little valley, as seen from a hilltop, appeared like a scarlet ribbon winding between the hills.

The yucca, (*Yucca glauca*) or Spanish bayonet, is a stately and beautiful flower which abounds on the Missouri River bluffs and on the hills of the western part of the state. The Mariposa lily (*Calochortus nuttallii*) is found on buttes and plateaus of the Badlands.

The dainty little golden star-like flowers of hypoxis, (*Hypoxis hirsuta*) or Star-of-Bethlehem, may be found among the grass in moist places, as also the pretty little starry blue flowers of the so-called "blue-eyed grass," (*Sisyrinchium mucronatum*) and (*Sisyrhin-*

chium campestre) which is not a grass but a plant belonging to the Iris family.

The cypripedium, also called lady's slipper, (*Cypripedium reginae*) or moccasin flower, is found in damp woods in the Turtle Mountains and in the Pembina Mountains. Lady's-slippers will not succeed in cultivation unless great care is taken to provide conditions of shade, soil moisture and richness of leaf mold like the natural conditions where they are found growing wild.

Warning should be given by all who love natural beauty, against the danger of extermination which menaces our native wild flowers. It will be observed that already none or very few of our native flowers, especially the most beautiful and most prized species, are to be found anywhere in walking distance of any town. And now the automobile has greatly extended the ravages of those who seem bent on the utter destruction and desolation of all our native flowers. They seem determined to let none escape alive, to perpetuate their kind, but seek and snatch all they can find. To see such persons gathering the quantities which they do one might suppose they were gathering them not as flowers but as fodder for cows.

We should remember that, while such flowers as roses, golden-rod and asters may be gathered with no danger of killing the plant, yet that with many species the plucking of the flower involves the destruction of the plant, certainly so when the roots are disturbed by pulling up the flower. And bulbous plants, such as the flame lily are inevitably destroyed if the flower is plucked. So if we wish to conserve the wealth we have in our native flowers we must have consideration and not waste them.

We must know that the complex of life forms, both plant and animal, in any given period of time and area of terrestrial space results from the action of many causes and forces, physical and biological, which converge at the given time and place. Some of these causes lie in climatological and topographic conditions of the given region, and in the biological complexes of neighboring regions.

In the long passage of time occupied by the successive geological ages since the final emergence from the sea of the land forming the Great Plains, of which North Dakota is a part, there have been many and great changes of physical conditions with consequent great changes of the flora.

At the present time the Great Plains present from south to north a succession of floral regions through mild temperate, temperate, boreal to arctic. In Tertiary geological time a mild climate was enjoyed over nearly all of North America, so that a subtropical flora existed over all the Great Plains and to all the regions east and west of Hudson Bay. At that time the temperate, boreal and arctic floral zones were restricted between the limit just indicated and the north polar ice cap.

Then came the climatic changes incident to the gradual southward extension of the polar ice cap, which we call the glacial age and the continental glaciation which pushed arctic conditions southward in the Great Plains to a line roughly fifty to sixty miles to the south of the Missouri River. As arctic conditions moved southward, naturally the arctic, boreal, temperate and subtropical floral vegetations retreated southward before the advancing ice fields. While this wholesale compulsory movement of the vegetation population

produced very slight effect if any changes upon species as such, it did produce a tremendous reassortment of species with a consequently greatly extended area of many species.

As the successive waves of vegetation, temperate, boreal and arctic, were driven southward by the slow, agelong but resistless and relentless southward march of the continental ice field they spread themselves over the lands to the southward. Then, when the ice field had made its farthest advance and halted, piling up the great terminal moraine, which in North Dakota forms the Plateau du Coteaux du Missouri and at last began its retreat, it left a great denuded area where its field of ice had been, and where, consequent to the melting of that ice there had resulted a turmoil of wild rushing waters, violent streams and great lakes. Finally the great volume of waters subsided. Small streams were left where great streams had flowed; and the lakes diminished in extent, leaving marshes where they had been.

After the great icefield had begun its final northward retreat the zones of vegetation again returned northward across North Dakota, marching up to recover the ground from which they had been driven by the advancing ice thousands of years before. The arctic vegetational zone had doubtless covered the southwest part of our state, beyond the farthest advance of the glacier, and now it first followed after the retreat of the ice across the Missouri River, its plateau, and through the Turtle Mountains and the Pembina Mountains. As the ice still retreated the arctic vegetation followed after and the boreal vegetation closed in after it, followed by the more hardy species of the temperate vegetation zone. The advancing armies of the temperate vegetation zone routed the boreal species from almost all of North Dakota except throughout the northern part, as they had already driven before them the arctic species. At every slight elevation the boreal species were able to maintain themselves for a time, but were finally driven from all but some of the more considerable elevations, where a few boreal species have established themselves. Notably the Killdeer Mountains, Turtle Mountains and Pembina Mountains are such strongholds from which outposts of boreal species have not yet been dispossessed. Some of these boreal species remaining behind in situations whose altitude and climatic conditions permit them to maintain themselves are the trembling aspen, the balsam poplar, the silver berry, the paper birch, the beaked hazel-nut, the bear berry, the silver berry and the eye-berry.

In the onrush of the host of species of the temperate vegetational zone which crowded out most of the boreal species, the pasque flower, which is boreal in habitat, has been able to maintain itself upon the hills of the elevated prairies of the Great Plains throughout all the extent of North Dakota, and even in South Dakota, which state has chosen it for its state flower.

There are two sets of factors concerned in the distribution of vegetation. One set of factors lies in the forms of plants, especially in the forms of the parts by which dissemination is accomplished, the other set of factors lies in the topographic and climatic conditions. It is by the interaction of these two sets of factors that the vegetational complex of any region is determined. Physiographical factors may be by nature either obstructive or conductive in their

effect, or obstructive to certain vegetation forms and conductive to other forms. The lines of direction of movement in plant migration may be called lines of stress. Barriers to plant migration, such as high mountain ranges, regions of aridity, or very wide rivers lying athwart the lines of stress constitute obstructive physiographic factors; while rivers flowing parallel with the line of stress constitute conductive factors.

In North Dakota the principal drainage systems are two; one to the northward into Hudson Bay by way of the Red River of the North, and the other to the southward by way of the Missouri River to the Gulf of Mexico. Besides these two open systems there is the closed drainage system into Devils Lake. This large body of water, Devils Lake, being without outlet is salt.

The main tributaries of both the Red River of the North and the Missouri River flow into the master streams from the west. Thus the drainage systems of the state are mainly parallel with the line of stress of migration of the vegetation zones before mentioned, namely, the arctic, boreal and the temperate. The tributary streams of the two main drainage systems, flowing as they do from west to east, constitute secondary lines of plant migration in a west-east and an east-west direction. Reference will be made to the significance of this factor farther on. The line of the Missouri River deviates from the north-south line by being from northwest to southeast.

Some of the agents in the dissemination of plants are wind, water, animals and man. Of course the first two agents have been active for the longest time, while man's agency in plant migration has been effective for but a comparatively short period of recent time in vegetation history. But man's agency has been tremendous and far-reaching, and in some aspects ominous. This point will be discussed in another place.

Plants are fitted for migration by various organs of dissemination. For our present purpose we may consider mainly the means of distribution by fruits and seeds. Some plants have winged seeds by which they are carried down the wind, as the elm, ash, birch and boxelder, pasque flowers, thistles, asters, etc. Others, such as the tumble-weeds, are suited to bodily transportation by the wind, the entire plant body breaking loose from the root when ripe, and, driven by the wind shakes out its seeds all along its course. Other plants have hooked or spiny fruits, as the burs, which attach themselves to feathers of birds, wool, hair and fur of animals and clothing of men and so are transported to new localities.

Nuts and various kinds of fruits and seeds are sought for food by animals and so are carried away, some escaping destruction and, happening to find places suitable for germination, perpetuate their species in new situations.

The course of migration of plants from the original home is to some extent in all directions, but in large part will depend upon the agent of dissemination. If this agent be the wind the direction of migration may be definitely in one direction, the direction of seasonal winds at the season of seed maturing. If the disseminating agency be the movements of animals which carry the fruits or seeds the direction will be determined by their movements. Naturally animals are limited in their movements by the presence or absence of

water, hence they, and the plant species depending upon them for transportation, will move more freely along the course of streams. Thus the natural drainage systems of North Dakota have determined the lines of stress in plant migration.

The main physiographic regions of North Dakota are three; these are in order from east to west and increasing altitude from low to high, the valley of the Red River of the North, the Drift Prairie, and the High Plains.

The Red River valley is a plain resulting from the draining out of the waters of the glacial Lake Agassiz after the recession of the ice field to the north. The boundary between the Red River valley and the Drift Prairie on the west is a slope rising from three hundred to five hundred feet above the level of the valley. This difference in levels is greater at the north, for of course the valley is deeper at the north, the river flowing in that direction. The boundary between the Drift Prairie and the High Plains is another slope trending diagonally across the state from southeast to northwest. This is the Plateau du Coteaux du Missouri. These three plains lie at three general levels, the first at less than one thousand feet, the second at fifteen hundred to eighteen hundred and the third at eighteen hundred to twenty-seven hundred feet above sea level.

These differences of altitude, together with differences of soil owing to different causes in the formation of the soils, and differences in amount of rainfall have brought about characteristic differences in vegetation formations in these three areas.

Mainly because of more generous rainfall in the eastern and northeastern part of the state that region has more timbered areas than any other parts, though even there the timber is mainly restricted to the stream valleys, lake shores and to the gorges of the Pembina Mountains and the immediate vicinity of these gorges and the mountain sides. The area of the Turtle Mountains is forested throughout. In the Drift Prairie region the timber is strictly confined to lake shores and stream beds. In the High Plains region timber growth is still more restricted and more stunted in growth where it does occur. In this region many streams are without timber except in the protection of cutbanks. In the Bad Lands and upon many of the most exposed buttes a species of juniper, the creeping juniper, (*Juniperus horizontalis*) is found. This is a species of juniper tree which is reduced in habit, correlated with its very arid situation, to creeping closely recumbent upon the surface, forming close, firm mats upon the rocks and arid soil.

In the Bad Lands cottonwoods, (*Populus sargentii*) willows, and boxelder (*Acer negundo*) are commonly found along streams near to the water. On the hills the bull pine, (*Pinus scopulorum*) red cedar, (*Juniperus scopulorum*) scrub cedar (*Juniperus communis*) and ground cedar or ground juniper (*Juniperus horizontalis*) are dominant. In some valleys of the Bad Lands sage brush of three species is the dominant growth.

The prairies of North Dakota may be classified as of two kinds. In the more moist eastern portion of the state the dominant native grasses are the big blue-stem or blue-joint (*Andropogon furcatus*) and the tall coarse cordgrass or slough glass (*Spartina michauxiana*) the latter grass being dominant in all the swales. In some of the drier situations the little blue-stem grass (*Andropogon*

scoparius) abounds. This grass is sometimes called broom blue-stem and sometimes bunch grass because of its habit of growth.

On the High Plains the dominant grasses are grama grass (*Bouteloua oligostachya*) on the high levels and little blue-stem on the hillsides. Big blue-stem is found in the High Plains region only on the Missouri River flood plain and in the moister ravines.

To one who travels from the middle prairie states or from the eastern part of this state westward to and across the High Plains region the most striking characteristic of the landscape will be the change in the appearance of the vegetation, especially with respect to color. As he comes upon the High Plains he will note that the dominant color effect of the vegetation is no longer vividly green, but becomes more and more grayish, so that now in the height of the growing season here the sum of color tones from the native vegetation amounts to an effect of gray-green. This color effect results from the ecological correlation of the native plants to the physical conditions of their environment. The controlling conditions of the region are a low degree of humidity of the air; small amount of precipitation of moisture, together with prolonged sunshine and prevalent high winds. To this set of conditions the native plants have responded by morphological adaptation. The plant structures of the native species have been modified in ways conducive to conservation of moisture. One modification to this end has been the thickening of the epidermis; another has been by producing a growth of hairs or down over all the respiratory parts of the plant. Both these devices tend to mask the green matter in the plant body, hence their whitish or grayish appearance. All plants of the semi-arid and arid regions of the High Plains manifest this characteristic, especially such species as the sage brush (*Artemisia cana*) and wild sage, (*Artemisia gnaphalodes*) and (*Artemisia frigida*) tipsin, (*Psoralea esculenta*) gaillardia, the psoralea which is sometimes called prairie clover, (*Psoralea lanceolata*) the false red malow, (*Malvastrum coccineum*) and numerous other species. Even the grasses of this habitat are hairy and hence grayish in appearance. It is for this reason that one who has been accustomed to a region of more generous rainfall and of moisture content in the air, feels a sort of homesickness, after some time on the High Plains seeing day after day its comparatively dull prospect of grayness, for the bright-colored prairie flowers and the emerald green of the grasses of the big blue-stem prairies.

Very many species of plants have migrated into the region of North Dakota from the east, moving northward and westward along the courses of streams, flowing down tributary streams rising on the Allegheny side of the Mississippi River drainage basin, and then following up tributaries rising in the Great Plains. Thus they have found their way into North Dakota and have migrated westward along the courses of tributaries of the Missouri River which come from the west. These same western tributaries of the Missouri have been also the routes of migration of other species of plants which had their origin in the western border of the Great Plains, in the region touching the Rocky Mountains.

An example of one such species is the buffalo berry. This shrub has followed down the courses of all the eastward-flowing rivers from its original area in the foothills of the Rocky Mountains.

The agency of man in plant migration is obvious in a number of ways, both in designed and undesigned effects. Migration of plants by man's design has been mentioned already in the case of the introduction of plants native to the tropics as crops grown by the aboriginal tribes of this region, namely, corn, beans, squashes and pumpkins and tobacco.

Certain other species of plants were probably introduced by design and others probably undesignedly were widely distributed by the aboriginal tribes. Calamus, or sweet flag, (*Acorus calamus*) is very common in the eastern states but rare in the Great Plains region, though it is found in some places, these places being few and far apart. The plant is highly valued by Indians of all tribes. Each place where it is found in the Great Plains is well known to all the tribes far around. There is a marshy place in the Mouse River valley west of Towner, North Dakota, in which there is a considerable tract of calamus growing. This tract is well known to surrounding tribes. It appears probable that long ago Indian priests and doctors purposely introduced and set the plant in the localities in the Great Plains where it is now found so far from its range.

As was said before, the buffalo berry appears to be indigenous in the region of the foothills along the east slope of the Rock Mountains, and has migrated eastward along the courses of the tributaries of the Missouri River as far as to the master stream. The broad region of the Coteaux du Plateau du Missouri is a natural barrier to this shrub, and it is not found upon or beyond the Plateau except in a few places. These places are the locations of old camping sites of the tribes east of the Plateau on their way going to and returning from excursions for hunting and trading in the region of the Missouri River and beyond, where the buffalo berry abounds. It is quite conceivable that parties returning brought with them supplies of this much prized fruit, and that it became disseminated at their camping places. The isolated places where it is thus found far outside of its range are on the south side of Devils Lake, at places in the Pembina Mountains, and on the Sheyenne River near Valley City. All these places are in the vicinity of old time camping sites along aboriginal routes of travel.

Since the coming of white men many species of plants native in the Old World have been brought and planted in North Dakota by immigrants. All our field and garden crops except those heretofore mentioned as having been derived from Indian cultivators, have been brought from the Old World. And almost all our troublesome weeds are also from the Old World, and are examples of the agency of man in the migration of plants even when not by his design.

The so-called Russian thistle (*Salsola kali*) which by the way is not at all related to thistles, and not at all like thistles, is one such weed, the time and place of whose first appearance in America is well known. In 1887, at Scotland, Bonhomme County, South Dakota, this weed first appeared in a crop of flax, the seed of which came from Russia. Since that time the weed has spread far and wide in all the arid and semi-arid regions.

Other well known weeds which have accompanied the white man, and have settled with him in his new home in America and

in our own state, are the dandelion, (*Leontodon taraxacum*) pigeon grass or foxtail grass, (*Chaetochloa viridis*) purslane, (*Portulaca oleracea*) catnip, (*Nepeta cataria*) curled dock, (*Rumex crispus*) lamb's quarter, (*Chenopodium alba*) barnyard grass, (*Echinochloa crus-galli*) mallow, (*Malva rotundifolia*) pigweed, (*Amaranthus* sp.) chickweed, (*Alsine* sp.) Mayweed, (*Authemis cotula*) black mustard, (*Brassica nigra*) shepherd's purse, (*Bursa bursa-pastoris*) corn cockle (*Agrostemma githago*) corn flower, (*Centaurea cyanus*) burdock, (*Arctium minus*) mullein, (*Verbascum thapsus*) butter-and-eggs, (*Linaria linaria*) sweet clover, (*Melilotus alba*) and (*Melilotus officinalis*) hop clover or shamrock, (*Medicago lupulina*) hedge mustard, (*Sisymbrium officinale*) tumbling mustard, (*Sisymbrium altissimum*) French weed, (*Thlaspi arvense*) sow-thistle, (*Sonchus arvensis*) and many others.

These introduced weeds have come by seed in grain and grass seed and in the seed of other forage, field and garden crops, and in hay, and have traveled along the railways and other common routes of travel. After becoming established in any place they increase because of indifferent and slovenly methods of farming.

It will be observed that the vegetation which Nature required thousands of years to establish may in a short time be changed or ruined by the acts of man, and Nature would require the lifetime measure of hundreds of generations of mankind to restore what one man by stupidity or carelessness or avariciousness may spoil in a little time. Thus by overgrazing a tract of good grazing land the grasses may be depleted and in their stead the land become infested with weeds. And especially harmful is the overgrazing of stream valleys with strips of trees and shrubs along the stream. In such case the cattle trample and destroy the growth of the trees and shrubs and it becomes merely a breeding place of foul weeds which are a menace to all the surrounding farming land.

It should be the purpose of us all to refrain from overthrowing the balance of nature, and to do all we can to maintain that balance, which is so delicately adjusted that when destroyed we never can tell what unforeseen evils may follow in train.

NORTH DAKOTA VEGETATION Of Statewide Distribution

Trees:

Willows, various species, cottonwoods, boxelder, ash, elm, bur oak.

Shrubs:

Wild red raspberry, prairie wild rose, saskatoon or June-berry, haw-thorn or thorn-apple, wild plum, chokecherry or Rocky Mountain cherry, wild black currant, wild gooseberry, kinnikinnick, sheep-berry, wolf-berry or buck-brush, honey suckle.

Vines:

Clematis or virgin's bower, moonseed, bittersweet, hop, wild grape. Virginia creeper.

Herbaceous Flowering Plants:

Anemone, pasque flower, violets, several species. Monarda, strawberry, buffalo pea, ground bean, prairie clover, gaura,

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bluebell, blazing star, boltonia, aster, several species. Black-eyed Susan, wild golden-glow, purple cone-flower, goldenrod, several species. Common sunflower, Maximilian's sunflower, prairie thistle, spiderwort, fire lily or flame lily.

Grasses:

Big blue-stem, little blue-stem, sweet grass, grama grass.

Only or Mainly in Valley of the Red River of the North, Pembina Mountains, Turtle Mountains, and Region of Devils Lake.

Trees:

Linden or basswood, balsam poplar, trembling aspen, ironwood, paper birch.

Shrubs:

Bear berry, eye berry, wood wild rose, pin cherry, wild red currant, silver berry, smooth sumac, hazelnut, speckled alder, pembina berry.

Herbaceous Flowering Plants:

Wild columbine, shooting star, gentian, yellow star-flower, or star-of-Bethlehem, lady's slipper or moccasin flower.

Only or Mainly in Missouri River Valley.

Shrubs:

Buffalo berry.

Note: Many trees, shrubs, vines and flowering plants of other regions are here also found.

Region of the High Plain.

Herbaceous Flowering Plants:

False red mallow, bee balm, wild blue flax, pentstemon, several species. Mertensia, puccoon, lupines, ball cactus, prickly pear, wild sage, yucca.

Only or Mainly in Bad Lands.

Trees:

Bull pine, red cedar.

Shrubs:

Buffalo berry, aromatic sumac.

Herbaceous Flowering Plants:

Yucca, ball cactus, prickly pear.

Above is the list of the principal trees, shrubs, flowering plants and grasses, in their several regions of distribution.