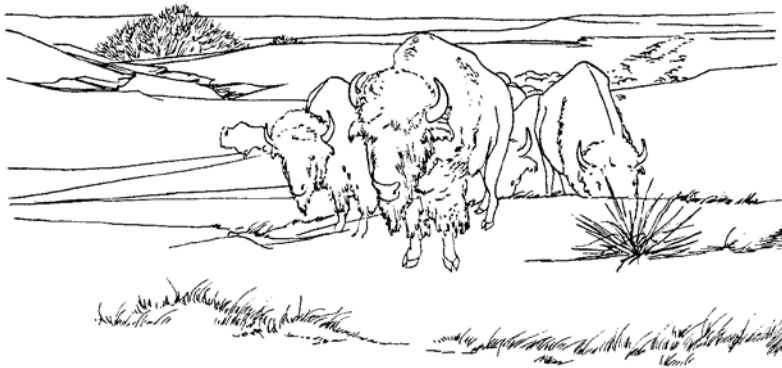


## **CHAPTER 1**



### ***The Grassland Setting***

THE STORY OF NORTH DAKOTA begins with geology. Invasions of a great salt sea laid down the strata in which oil and other mineral deposits are found, and, later, fresh-water rivers formed strata containing lignite beds. Erosion, caused by wind, water, and glacial ice sheets, shaped the surface of the land, leaving what is now North Dakota as part of two significant physiographic provinces of North America: the Central Lowlands and the Great Plains. Within the state, the Central Lowlands Province is subdivided into the Drift Prairie and the Red River Valley and is separated from the Great Plains Province by the Missouri Escarpment.

Thus divided into three distinct regions, North Dakota is a rather

large state, a rectangle some 335 miles from east to west and 210 miles north to south, with an area of 70,665 square miles. It is located at the center of the continent, roughly 1,500 miles from the Atlantic Ocean and also from the Pacific, and about the same distance from the Gulf of Mexico and the Arctic Archipelago.

## **GEOLOGY**

The Williston Basin, a saucer-like depression in the igneous granite crust of the earth's surface, had its origin half a billion years ago when the granite crust began to sink, a process which continued several million years. It now extends over some 130,000 square miles, about 50,000 square miles of which underlie North Dakota. The basin reaches from eastern North Dakota (Devils Lake and Jamestown are near its eastern edge) into Montana, and from northwestern South Dakota into Manitoba and Saskatchewan. At its center, near the Killdeer Mountains, the granite lies 15,000 feet below the surface.

For hundreds of millions of years the Williston Basin and the area surrounding it were intermittently covered by a salt sea stretching from the Gulf of Mexico to the Arctic. Sediment carried into the sea by flowing water was deposited on the bottom and slowly compacted into strata, or layers, of sedimentary rock made up of clay, shale, sandstone, and limestone. During the long periods when the sea withdrew, the exposed surface was eroded. Thus the strata are thicker in the deeper parts of the basin, covered longer by water, than they are in its shallower parts or outside it. All of the strata become thinner toward the eastern part of the state, where the basin floor slopes gently upward. In that section the granite lies only 200 to 800 feet below the surface.

Oil was formed in the deepest strata, probably from the remains of plants and animals buried in deposits at the bottom of the sea.

In some places, such as the Nesson Anticline south of Tioga, oil pools were created. North Dakota oil has been produced principally from the Mississippian Madison formation, the pay zone of the Clarence Iverson No. 1, the discovery well, but it has also been found in many strata above and below the Madison at depths of from 8,000 to 14,000 feet.

About a hundred million years ago the Dakota sandstone, a thin layer of mud and sand, was deposited under eastern North Dakota. At one time more than six thousand artesian wells brought up much water from this formation, especially in the southeastern part of the state.

Overlying the Dakota sandstone are the Niobrara strata, containing a great profusion of microscopic Globigerina whose calcareous shells have made the formations nearly pure limestone. These strata are the well-known "cement rock" which outcrops along the face of the Pembina Mountains and in the gorge of the Pembina River. For a few years, from 1897 to 1907, it was used for the manufacture of cement at Concrete in Pembina County. Above the Niobrara is a thin bed of fuller's earth clays, used in the filtration of edible fats.

At the beginning of the Cenozoic Era, or Age of Mammals, some seventy million years ago, the ancient sea withdrew for the last time, and all later rock formations were laid down in fresh-water rivers and lakes or by glacial ice sheets. Large rivers ran eastward from the Rocky Mountains, carrying huge quantities of gravel, sand, and clay. They dropped much of this material on the Dakotas, turning from side to side to build an extensive alluvial plain and leaving behind scattered swamps with large conifers (cypress and sequoia) and other kinds of trees and shrubs. As the partially decomposed vegetation was buried by sand and clay, it was transformed into lignite, a soft brown coal, most of which is found in the Tongue River strata. The numerous beds of it show

that western North Dakota was occupied again and again by swamps covering hundreds and even thousands of square miles. They built up seams of lignite, varying in thickness from a few inches to forty feet, which underlie 28,000 square miles of western North Dakota, or about 40 per cent of the state. By conservative estimate, there are in workable beds some 351 billion tons of lignite, the largest supply of solid fuel in the United States.<sup>1</sup>

Although lignite-some of which contains uranium-and oil are perhaps the most valuable, North Dakota has other mineral deposits. There is clay suitable for ceramic products and lightweight concrete aggregate, and lakes in the northwest corner of the state contain more than twenty million tons of Glauber's salt.

After the final withdrawal of the sea, erosion carved high ridges and buttes, such as the Killdeer Mountains and Sentinel Butte. Running water carried away a thousand feet or more of sedimentary deposits in western North Dakota and largely created the Badlands and the present-day landscape west of the Missouri River. The process was accelerated by an uplift to the west which caused the Missouri, Little Missouri, and Yellowstone rivers to empty their muddy waters into Hudson Bay. Erosion also wore down the land surface in eastern North Dakota. A northward-flowing river cut the broad valley of the Red River of the North some nine hundred feet into Cretaceous and older rocks.

About a million years ago the climate grew colder and the Pleistocene Epoch, or Ice Age, began. Snow piled up around

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<sup>1</sup> Russell A. Brant, *Lignite Resources of North Dakota*, United States Geological Survey Circular 226 (Washington, 1953), p. I.

I have listed in the footnotes and the Bibliographical Essay the principal sources used in the preparation of this volume, avoiding, as far as was practical, duplication between the two. The most important books and articles, as well as those most likely to be interesting and available to the reader, are described in the Bibliographical Essay. Instead of using specific citations for statistical data, I have included a description of their sources in the essay. And to avoid an excessive number of footnotes, I have sometimes cited in a single note sources for a diverse variety of material.

Hudson Bay, compacted into ice, and began to flow slowly outward. A series of continental ice sheets, or glaciers, moved south, retreated, then moved south again. Two and possibly four separate ice sheets invaded North Dakota. The first covered all of the state except the southwest corner, reaching forty to sixty miles beyond the Missouri River, but it left behind only a thin layer of glacial debris consisting of boulders and gravel. The Missouri Slope, that part of North Dakota which lies west of the river, is not glacial but erosion topography-formed by running water.

The last glacier, the Wisconsin, shaped the land surface of the rest of the state. The mighty mass of ice gouged out or pried off rocks and earth, picked up boulders, gravel, sand, and clay, and carried them along. It planed off ridges, filled up valleys, and pushed up onto the Missouri Plateau, but did not reach the Missouri River. Then, as the climate became milder, the leading edge of the glacier remained stationary for a time as melting equaled its forward movement. The melting ice dropped its earth burden, leaving as an end moraine a belt of rough, hilly country, from ten to twenty miles wide, known as the Coteau du Missouri, or Hills of the Missouri. Some maps label it the Altamont Moraine, and geologists have renamed its northern portion the Max Moraine. It is dotted with lakes and potholes and is part of the great flyway for ducks from Canada to the Gulf of Mexico. Including those in the Coteau du Missouri, North Dakota has an estimated 8,659 such permanent water areas with an average size of 65 acres.<sup>2</sup>

When the Wisconsin Glacier retreated, about 25,000 years ago, it not only filled the Red River Valley with 200 feet of debris but also dropped a mantle of glacial drift in the form of ground moraines and, where it paused, smaller end moraines.

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<sup>2</sup> Roy N. Bach, "North Dakota Water Areas," [North Dakota Outdoors](#) (April 1952), p. 16.

The ground moraines buried the landscape under 200 to 300 feet of boulders, clay, sand, and gravel and contoured the land into the gently rolling prairie so characteristic of much of North Dakota. The end moraines, such as those south of Devils Lake, are picturesque hills covered with timber-ideal refuges for game. Indeed, when the first white men entered the region, they found the Devils Lake country to be a favorite haunt of the grizzly bear.

The copious quantities of water produced by the melting ice also helped to shape the terrain. Since the land sloped downward toward the north, the leading edge of the glacier became a gigantic dam which altered the course of the Missouri and its tributaries so that, instead of pouring into Hudson Bay as before, they turned south. Rushing water sorted the debris released by the ice sheet and created scattered veins and lenses at its base and throughout the glacial drift. These became gravel pits and the most prolific source of well water in the state.

Backed-up water from the rivers and melting ice formed many glacial lakes, the largest of which were in the valleys of the Mouse, James, and Red rivers: Lake Souris, Lake Dakota, and Lake Agassiz. Lake Souris covered much of Bottineau and McHenry counties, while eastern Dickey and northwestern Ransom counties were submerged by Lake Dakota. Lake Agassiz, named for the Swiss glacial geologist, spread out over some 110,000 square miles on both sides of the Red River of the North, mostly in Canada. At first, Lake Agassiz found an outlet to the south through the glacial River Warren, which cut the broad Minnesota River Valley on its way to the Mississippi, but as the ice sheet retreated, the outlet became Lake Superior. Later the waters ran north to Hudson Bay. Lakes Winnipeg and Manitoba are remnants of Lake Agassiz.

Water from melting ice carried much silt into the glacial

lakes, whose water spread it evenly to make flat plains of their bottoms. Some rivers formed deltas where their heavily burdened waters rushed into Lake Agassiz: the Sheyenne delta (800 square miles, with many sand dunes, in Richland and Ransom counties), the Elk River Valley Delta (stretching for 50 miles from Fordville to Portland), and the Pembina Delta (known locally as the First Mountain and seen in the sandy country east of Walhalla). As it drained, Lake Agassiz marked succeeding water levels with sand and gravel beaches. Rising from ten to twenty feet above the land surface on the lake side, these have made good farmsteads with adequate wellsites. They have also been frequently used as gravel pits, supplying material for road construction.<sup>3</sup>

## **TOPOGRAPHY**

North Dakota is part of two physiographic provinces, the Central Lowlands and the Great Plains, each of which occupies about half the state. The Central Lowlands Province, stretching westward from the Allegheny Plateau, confronts the Great Plains, extending to the east from the Rocky Mountains, along an escarpment which runs from Saskatchewan to Texas. In North Dakota this dividing line, a marked rise of from 300 to 400 feet, is called the Missouri Escarpment and forms an arc from the Canadian boundary in eastern Divide County to South Dakota in western Dickey County. That portion of the Great Plains lying within the state is known as the Missouri Plateau, while the Central Lowlands Province consists of two regions, the Red River Valley and the Drift Prairie. The land rises from east to west in three broad steps: the Red River Valley, the Drift Prairie, and the Missouri Plateau. These are the

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<sup>3</sup> Wilson M. Laird, *Guide for Geologic Field Trip in Northeastern North Dakota*, North Dakota Geological Survey Bulletin 30 (Grand Forks, 1956), pp. 8-16.

fundamental divisions of the state: They differ in origin, climate, surface features, soil, and native vegetation and roughly mark off economic and even political and ethnic differences.

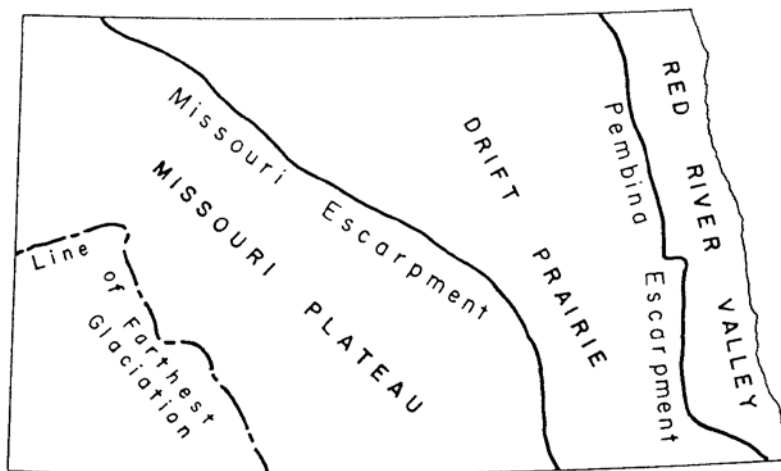
The Red River Valley reaches westward for thirty or forty miles from the Red River of the North to make up about 10 per cent of the state's area. Once the bottom of Lake Agassiz, it is a flat land lying 800 to 1,000 feet above sea level and sloping down toward the north; Pembina, the lowest point in North Dakota, is 792 feet above sea level. The rivers in this region drain into Hudson Bay, for the valley rises to the west, where the Pembina Escarpment separates it from the Drift Prairie. In the north the escarpment is the Pembina Mountains, a range of wooded bluffs which rise abruptly from 300 to 500 feet above the valley floor. They disappear in Walsh County, and the escarpment becomes almost unnoticeable. Near the South Dakota line, however, it is again striking in the Coteau des Prairies, a hilly country beginning in southeastern Sargent County.

West of the Red River Valley lies the Drift Prairie. More than two hundred miles wide along the Canadian boundary, it narrows to seventy miles along the South Dakota line and occupies some 40 per cent of North Dakota. The altitude of the Drift Prairie varies from 1,300 to 1,650 feet above sea level, and the landscape is youthful, having been changed little by erosion. There are few rivers; some counties have none, but an abundance of lakes, ponds, and sloughs reveal the drainage system. In this region, along the Canadian border in Bottineau and Rolette counties, are the Turtle Mountains. Rising to 800 feet, they are a heavily wooded island of timber, sprinkled with lakes, in the treeless prairie.

To the west of the Drift Prairie stands the Missouri Plateau, a rugged, open country stretching away to the Rocky Mountains. It makes up half the area of North Dakota. East of the Missouri, the plateau is from 1,800 to 2,000 feet above sea level; west of the river,



it ranges from 2,000 to 2,500 feet. Rhame, the state's highest town, stands at 3,184 feet, while White Butte, in Slope County, is the highest geographical point at 3,506 feet. The portion of the plateau west of the river is called the Missouri Slope, or simply the Slope. It has many high, flat-topped buttes, such as Camels Hump, Bullion Butte, Sentinel Butte, and the Killdeer Mountains.



*TOPOGRAPHY OF NORTH DAKOTA*

The landscape of the Slope contrasts with that east of the Missouri. East of the river the Missouri Plateau has a youthful, rolling topography formed by glacial drift, but the Slope was carved by running water working on the soft, poorly cemented sands and clays of the exposed rocks. The Slope's scanty vegetation has done little to check this erosive work, whose most spectacular results are seen in the Badlands along the Little Missouri River. There streams have cut the land into innumerable canyons, gorges, and ravines and have produced an incredible waste of bluffs and pinnacles, often colored in shades of red from masses of scoria, the clinker of clays fused by burning lignite beds.

## **CLIMATE**

Semiaridity makes North Dakota a borderland between the humid East and the arid West. As such, it exhibits, two climatic provinces. The western half of the state, part of the Great Plains, is a grazing and wheat land with light rainfall, short grasses, and dark-brown Chestnut soils. The eastern half, east of the Missouri Escarpment, is the semiarid extension of a cold, humid continental zone running from Maine to Manitoba. In North Dakota the zone is a tall-grass country with black Chernozem soils. The soil line, the grass line, and the climate line- really transition zones rather than lines-all follow the Missouri Escarpment.

North Dakota has a continental climate. There are cold winters and hot summers, warm days and cool nights, light rainfall, low humidity, and much sunshine. It is a climate of extremes. The coldest temperature on record is 60 degrees below zero (Parshall, February 15, 1936); the hottest, 121 above (Steele, July 6, 1936). January, the coldest month, has an average temperature of 7° F., and July, the warmest, averages 68° F. The mean temperature is 40° F., the lowest of any state until the admission of Alaska. North Dakota's mean annual rainfall is a scanty 17.16 inches. The relative humidity is low, averaging 68 per cent. Long days and an abundance of sunshine compensate for a short growing season. The wind blows much of the time.

The North Dakota climate is a result of the state's location at the center of the continent. Winds move freely over the great central plain of North America, influencing both temperature and rainfall. Warm winds sweeping up from the Gulf of Mexico bring rain, but because North Dakota is nearly 1,500 miles from the Gulf, it receives little precipitation from that source, certainly much less than the Great Plains states farther south. Within North Dakota, the northern and western counties, farther

from the Gulf, get the least rain.

There is a significant difference in the amount of rainfall received in the three parts of the state. The Red River Valley gets the most, the Missouri Plateau the least, and the Drift Prairie stands between the two: the farther west, the less rain. Fargo, in the southern part of the Red River Valley, has an average annual precipitation of 21.5 inches. Valley City, on the Drift Prairie, averages 19.6 inches. Dickinson, on the Missouri Plateau, receives 15.8 inches. The eastern third of the state averages 19.4 inches, the middle third 16.6 inches, the western third 15.4 inches. The four-inch advantage the east enjoys over the west is enhanced by temperature differences: the west has higher temperatures and so higher rates of evaporation. Moreover, the lighter Chestnut soils of the west do not hold the moisture as well as the Chernozem soils of the east. Fortunately, 77 per cent of North Dakota's precipitation comes in the growing season.

Winds account for rapid changes in temperature. Cold air from the subarctic McKenzie Valley brings rapid drops and sometimes blizzards.

Warm air from the Gulf creates summer heat waves and milder temperatures in winter. Chinooks (warm, dry winds from across the Rockies), which can raise the winter temperature in the southwestern part of the state as much as seventy-five degrees in twenty-four hours, make winters milder in the west. Dickinson has an average January temperature of 10.6° F., compared with 1.8° F. at Devils Lake. In summer, differences in temperature between east and west are small. With two-thirds of the state averaging less than seventeen inches of precipitation annually, semiaridity was and is the most important aspect of the North Dakota environment. Semiaridity explains much about the state: the character of the soil, the native vegetation, the importance of wheat and cattle in the

economy, the increasing size of farms, the scattered population, the steady out-migration of young people, and the high cost of schools, roads, and other social services.

If the rain had always come when it was needed, North Dakota would have enjoyed continuous prosperity, but frequent droughts have brought poor crops and instability of income. There is no exact statistical measure of drought, for both timeliness and annual amount of precipitation are important to growing crops, but it is likely that when the annual precipitation falls below fourteen inches, drought seriously reduces yields for most farmers. The western third of the state has had less than fourteen inches in 36 per cent of the years from 1889 to 1962, the middle third less than fourteen inches in 16 per cent of the years, and the eastern third less than fourteen inches in 8 per cent of the years. Put in another way, the western third had twenty-seven years with less than fourteen inches' annual precipitation in the seventy-four years from 1889 to 1962, the middle third had twelve such years, and the eastern third had only six. Thus drought has been a much greater hazard in the west than in the east.

But there have been many years of plentiful rainfall. From 1889 to 1962 the western third of the state had eighteen years with more than 17 inches, the middle third thirty-five such years, and the eastern third sixty-one years. Precipitation in the western third ranged from 6.6 inches in 1934 to 22.2 inches in 1941. As one pioneer exclaimed, "Dakota is a great land for extremes, either too hot or too cold, too wet or too dry."<sup>4</sup> The threat of drought has made all North Dakotans weather conscious, however, and a current of anxiety always runs beneath the surface.

Drought has been a long-standing experience. George F. Will's

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<sup>4</sup>Mary Dodge Woodward, *The Checkered Years* (Caldwell, Idaho: The Caxton Printers, Ltd., 1937), pp. 38-39.

studies of tree-ring growth show that periodic drought has been the rule in the region around Bismarck since 1406. The worst droughts since white settlement came in 1934 (9.5 inches of precipitation) and 1936 (8.8 inches). In the latter year no prairie grass grew outside the Red River Valley; farmers shipped out their livestock for lack of feed and water; dust storms obscured the sun. In the bitter years from 1935 to 1940; some 86,000 persons fled the state.

In terms of agriculture and economics, rainfall, or the lack of it, has marked off four regions in North Dakota: a range-livestock region along the Little Missouri Valley; a wheat and range-livestock region west of the Missouri; a wheat region from the Missouri to the Red River Valley; and a wheat and general-farming region in the Red River Valley and the southeast corner of the state. These divisions roughly parallel the three broad steps of North Dakota's topography; although they merge into one another, each of the latter has its own characteristic agricultural-economic base.<sup>5</sup>

For the most part, however, North Dakota is a small-grain country where wheat is king, so much so that pioneers liked to call it "the land of the No.1 hard." Wheat needs only a 100-day growing season (the average in North Dakota is 130 days) and does best on less than thirty inches of rainfall per year (more rain increases losses from disease, the lodging of grain, and the leaching of nitrates in the soil). Dry regions produce a hard, flinty, high-protein grain that is ideal for making bread,<sup>6</sup> and North Dakota lies in the heart of just such an area, a hard-spring-wheat belt extending from Minnesota and South Dakota to the

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<sup>5</sup>A map of farming areas is in Baldur H. Kristjanson and C.J. Heltemes, *Handbook of Facts about North Dakota Agriculture*, North Dakota Agricultural Experiment Station Bulletin. 357 (Fargo, 1950), p. 18.

<sup>6</sup>S. C. Salmon, "Climate and Small Grains," *Climate and Man: Yearbook of Agriculture, 1941* (Washington : Government Printing Office, 1941), pp. 32-33, 321-342.

Peace River district northwest of Edmonton, Alberta. As a result, North Dakota ranks first among the states in the production of durum and spring wheat and is second only to Kansas (a winter-wheat state) in total wheat production. In fact, wheat is the chief source of income, accounting for 35 to 45 per cent of the gross annual farm income. North Dakota also raises more barley, flax, and rye than any other state, and in the 1950's, small grain made up 60 to 65 per cent of the gross farm income.

Such heavy dependence on small grains has put North Dakota at the mercy of the uncertain rainfall. Over the years, crop yields and farm income have fluctuated widely throughout the state, with the Missouri Plateau suffering most. From 1916 to 1920, for example, North Dakota did not have a single good wheat crop. Yet in spite of it all, North Dakotans feel that their state has been slandered when it is pictured as a land of drought, blizzards, and severe cold.

There is a measure of justification in this defensive loyalty, for North Dakota's continental climate, with its sunshine, variations of temperature, and low humidity, is healthful and stimulating. Promoters have often boasted of it; in 1887 an official publication designed to attract settlers noted that the air was "dry, pure and full of invigoration." Perhaps this accounts for the state's low death rate. From 1924 to 1940, with the exception of 1935, North Dakota had the lowest death rate in the nation, and in the 1950's it was still below both the national average and that of neighboring states.

Many people have testified to the energy-giving qualities of the North Dakota climate. Meriwether Lewis and William Clark, wintering near Stanton in 1804-1805, were surprised at the Mandan Indians' resistance to the cold. In 1884, Theodore Roosevelt wrote to his sister from the Badlands: "I have never been in better health than on this trip. Bill Sewall, his Maine guide, observed that "it is a dirty country and very dirty people

on an average, but I think it is healthy." Also in the 1880's, Mary Dodge Woodward, keeping a diary on a bonanza farm near Fargo, commented that North Dakota farmers were "more energetic" than those back home in 'Wisconsin. "They rush things here," she said.

One word best describes the result of plant adaptation to the environment in North Dakota: grassland. Light rainfall, autumn drought, and prairie fires discouraged trees, so grass, a drought-enduring flora, became the dominant vegetation. Before settlement, 95 per cent of North Dakota was covered by three large grass communities, each of which developed its own type of soil.

Originally the Red River Valley was a "true prairie" of tall and medium grasses in which tall grasses, growing from four to six feet in height, were dominant. By far the most outstanding type was big bluestem, a tall grass from which the bluestem sod, the grass community of the valley, takes its name. But there were also a number of medium (one and one-half to three feet) and short (one-half to one and one-half feet) grasses. Some of the important medium grasses were feather bunch grass, slender wheat grass, and western wheat grass; prairie June grass was a short grass. Together they formed the black Chernozem soils of the Red River Valley. Most of these soils are of the Fargo-Bearden variety of Chernozem, that is, soils which were developed from materials filling old lake basins and which are noted for their production of small grains.<sup>7</sup>

A somewhat different grass community occupied the Drift Prairie. As rainfall decreased to the west, the tall grasses gradually dropped out, except in the wetter places, and the medium grasses became

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<sup>7</sup>United States Department of Agriculture, *Soils and Man: Yearbook of Agriculture, 1938* (Washington: Government Printing Office, 1938), pp. [970-971](#), [1077](#); Philip V. Wells, "Scarp Woodlands, Transported Grassland Soils, and Concept of Grassland Climate in the Great Plains Region," *Science*, CXLVIII (April 9, 1965), 246-249.

shorter. Drought dwarfed the plants. Medium and short grasses became more important than they were in the Red River Valley, the dominant species in most places on the Drift Prairie being needle and thread, western wheat grass, slender wheat grass, prairie June grass, and blue grama. The grasses of the Drift Prairie composed a transitional community between the "true prairie" of the Red River Valley and the "mixed prairie" of the drier Missouri Plateau.<sup>8</sup> The soil they built is Chernozem, generally of the Barnes-Parnell type, formed on uplands of calcareous drift laid down by the Wisconsin Glacier. Barnes-Parnell Chernozem is the darkest upland soil in the United States, and the finest spring-wheat country in the nation has been developed on it.

The grass community of the Missouri Plateau is a "mixed prairie." It differs from that of the Drift Prairie, although the grasses are largely the same. With less rainfall, some of the medium grasses drop out or become smaller, and more of the short ones become dominant. The principal varieties are blue grama, niggerwool (a dry-land sedge rather than a grass), needle and thread, and western wheat grass. The first two are short, the second two of medium height. Blue grama and needle and thread are bunch grasses; the other two tend to form a continuous sod cover. Blue grama is the best range grass in North Dakota. All four, however, are drought resistant and make good forage. They grow throughout the state but are most abundant in the drier central and western sections. It is significant that big bluestem, before settlement the dominant grass of the Red River Valley, is found in moist places, even in the western part of the state, and that the drier ridges in eastern North Dakota have grasses characteristic of the western end. The medium and short grasses

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<sup>8</sup>A. L. Shantz and Raphael Zon, *Natural Vegetation: Atlas of American Agriculture* (Washington: Government Printing Office, 1924), p. 14.



of the Missouri Plateau have formed dark-brown Chestnut soils. Because the grass cover is thinner than on the Drift Prairie, the soils are also thinner and lighter than the Chernozem soils of the Drift Prairie and the Red River Valley.

North Dakota's grasses, especially the medium and short varieties, have made productive use of the limited moisture in adapting to their environment. They are long-lived perennials, begin to grow early in the spring, produce seed quickly, and go into a dormant stage during summer and fall drought. They are hardy enough to withstand extremes of heat and cold, flood and drought. They are not only palatable to livestock but quite nutritious as well. Cured on the stem, they supply forage both summer and winter and can re-establish themselves after injury from overgrazing. They protect the soil from wind and water erosion and provide shelter and food for wildlife. In sum, the grasses are, next to the soil, the great natural resource of the state. As hay and forage for livestock, they were producing much more wealth in the late 1950's than either oil or lignite.

Other plants adapted themselves to the nature of the land in North Dakota. Some kinds grew throughout the state, others only in certain parts. Several species of trees from the broad-leaved eastern forest—such as bur oak, green ash, elm, box elder, and cottonwood, which could best adapt to the semiarid climate—came into the state, but these retreated to the riverbanks. They grew only along streams in most of the state until settlers began to plant windbreaks, becoming scarcer in the western and northern areas. Aspen and balsam poplar, trees of a cold forest, entered the Pembina Hills and Turtle Mountains from Canada. A trace of the Rocky Mountain forest (western yellow pine, red cedar, and dwarf juniper) invaded the warmer and drier southwestern section of North Dakota, especially the Badlands. The Ranger Grove of western yellow pine in Slope County was a

northeastern outpost of the species. Where trees could not survive, a great variety of shrubs (wolf berry, buffalo berry, dwarf sage, and creeping cedar) grew.

## **ANIMAL LIFE**

In bird and animal life, North Dakota was a meeting place for species from north and south, from east and west. The Red River Valley seems to have been the dividing line between some eastern and western species, and the only North Dakota breeding grounds of the sage grouse lay west of the Badlands.<sup>9</sup> Birds of the forest, such as thrushes and warblers, clung to the wooded stream banks. Other birds, such as the western meadowlark (the state bird), Franklin's gull, and the far-flying longspur, lived on the open grassland. The snowy owl came into the colder sections of the state from Canada, the burrowing owl into the warmer parts from the south. More ducks nested in North Dakota every summer than in any other state, their heaviest concentration being on the Drift Prairie and the Coteau du Missouri. North Dakota was a transition zone for amphibians and reptiles; some species were eastern, others western. The rattlesnake was apparently found only on the Missouri Plateau.

The distribution of early North Dakota wildlife demonstrated practical adaptation to variations in environment. Short-legged Nebraska cottontail rabbits favored brushy cover along streams in eastern North Dakota and as far west as the Missouri and Mouse rivers, while the long-legged Wyoming cottontails took to the open country of the Badlands. Jack rabbits ranged all of the state except the forested areas. Tree squirrels and woodchucks lived along the Red River and those streams which carried lines of timber into the

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<sup>9</sup>Norman A. Wood, *A Preliminary Survey of the Bird Life of North Dakota*, University of Michigan Museum of Zoology: Miscellaneous Publication 10 (Ann Arbor, 1923), pp. 6-10.

prairie. Ground squirrels replaced them in the open grassland, and prairie dogs lived in the Badlands. The Hudson Bay drainage in the wetter eastern and northern sections of the state was occupied by the large, dark Canada beaver, the drier Missouri drainage by a smaller, light-brown species. White-tailed deer and black bears liked the cover of brush and woods along the streams; elk were equally at home in timber and on the grassland; buffalo, antelope, and mule deer lived only in the open country.

In one way or another, all living things had to adapt to conditions on the vast, open plain, with its drought and bitter winter cold. Some became sparing in the use of water; others became strong runners or fliers; many developed a flocking habit or took on a pallid coloration; a few went underground to escape from their enemies or from the cold. Outside the valleys, plants became small and used large root systems to protect themselves from drought. Several kinds developed a greenish-gray outer coat to check drying out. Some animals used little water: the prairie hen drank only dew, the antelope could endure long periods with no water, and the pocket gopher lived without drinking.

The level, treeless plain encouraged migration and flocking. Birds of the plain flocked together and, because they had to span long distances between watering places, became strong fliers. Building their nests on or even in the ground, many birds were good runners, and their pallid coloration helped them to hide. Buffalo and antelope traveled far and wide in large herds. Fleet-footed wolves, coyotes, and jack rabbits could quickly cover extensive areas in search of food, travel far for water, and even migrate to avoid summer drought or winter frost. Most of the animals, of course, were herbivores, depending on the grasses for food, but since the carnivores ate the herbivores, one can say that all subsisted on the grasses.

Such adaptation to the nature of the country allowed some

species not only to survive but to flourish. 'When Alexander Henry, the first man to record the appearance of the Red River Valley, rode south from Pembina in the fall of 1800, he was astonished at the many herds of elk and buffalo. The buffalo "were so numerous," he wrote in his diary, that they "only turned to stare at us." He saw two small lakes "covered with swans, geese and ducks of various kinds" and observed elk and black bears continually crossing the Red River. The buffalo had made many paths to the river and in one place had packed down the bank like a pavement. At his trading post on Park River, Henry was awakened at daybreak on January 14, 1801, by bellowing buffalo: "I dressed and climbed my oak for a better view. I had seen almost incredible numbers of buffalo in the fall, but nothing in comparison to what I now beheld. The ground was covered at every point of the compass, as far as the eye could reach, and every animal was in motion." He often saw wolves following the buffalo and heard them keep up "a terrible howling" about the fort at night. Henry also watched black bears tear up the plum trees and oaks in search of fruit and acorns.<sup>10</sup>

The Missouri Valley, too, had an abundance of game. when the Lewis and Clark Expedition entered what is now North Dakota in the fall of 1804, they saw large herds of buffalo, elk, and antelope, as well as many grizzly bears, along the Missouri River: A wounded grizzly once chased Lewis seventy paces; the grizzly was, the expedition journal noted, "very remarkable for the wounds it will bear without dying." One day the men "counted 52 Gangues of Buffalow & 3 of Elk at one View."<sup>11</sup>

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<sup>10</sup>Elliott Coues (ed.), *New Light on the Early History of the Greater Northwest: The Manuscript Journals of Alexander Henry . . . and of David Thompson . . . 1799-1814* (3 vols.; New York: Francis P. Harper, 1897), I, 83, 84, 88, 167.

<sup>11</sup>Russell Reid (ed.), "Lewis and Clark in North Dakota," *North Dakota History*, XIV (January 1947), 29.

Lewis and Clark sometimes observed buffalo swimming across the Missouri, and in the spring they saw large numbers of drowned ones floating down the river or lying stranded along the shore. In 1811, Henry M. Brackenridge, another early visitor to the Upper Missouri, saw "armies of buffalo all in motion as far as the eye could distinguish in every direction." Thirty-two years later, in the fall of 1843, John James Audubon heard buffalo bulls "roaring like the long continued roll of a hundred drums" for miles along the Missouri. And in the 1860's, steamboats sometimes had to tie up to the riverbank for hours while a migrating herd swam the river. The buffalo's days were numbered, however, for in 1871, white settlement of the region that was to become the state of North Dakota would begin in earnest.